Print ISSN 2230 – 9047
Online ISSN 2231 – 6736
Vol. 2 (Seminar Special Issue) May 26-28, 2022

Journal of Community Mobilization and Sustainable Development

Society for Community Mobilization for Sustainable Development
New Delhi - 110 012

Peer Reviewed Journal

Journal of Community Mobilization and Sustainable Development

Registration No.: 268Ag. 33221; Print ISSN : 2230 - 9047; Online ISSN : 2231-6736

Biannual Journal of Society for Community Mobilization for Sustainable Development, New Delhi -110012

MEMBERSHIP

Life Membership	:	**₹ 5,000**	**Institutional Membership**	:	**₹ 5,000**
Annual Membership	:	**₹ 1,500**	**Foreign Membership**	:	**USD 500**
Online Indian Subscription :			Individual/Institutional	:	**₹ 600**
Online and Print Indian Subscription :			Individual/Institutional	:	**₹ 900**
Online for Foreign Subscription :			Individual/Institutional	:	**USD 60**
Online and Print for Foreign Subscription :			Individual/Institutional	:	**USD 90**

Corporate Membership : ₹ 50,000

All correspondence may be made at the following address:

Chief Editor

Journal of Community Mobilization and Sustainable Development

Office of Joint Director (Extension), Indian Agricultural Research Institute, New Delhi-12 (India)

E-mail: journalmobilization@yahoo.com
Website: www.mobilization.co.in
Available online: www.indianjournals.com

(Indexed in : Indian Science Abstract, EBSCO Discovery, Agricola and Google Scholar)

Volume - 2

Seminar Special Issue
of
Agriculture and More:
Beyond 4.0

ABOUT THE SOCIETY

MOBILIZATION Society was established in 2003 as a non-profit professional society aimed at sensitizing and mobilizing development partners and community for sustainable development. The Society, during these ensuing years has successfully mobilized researchers, academicians, planners, grass root mobilizers and student and created conducive intellectual atmosphere for introspective deliberations and conducted National seminars/ workshop to address the emerging problems experienced by the agrarian mass. Presently the Society has more than 1400 Life Members. The recognition of the Society in the efforts for strengthening the forum for scientific communication is growing among the related professionals and concerned agricultural stakeholders rapidly. The Society works on following objectives-

1. To document the on-farm and adaptive research experiences in multi- disciplinary agri-bio sciences and extension education.
2. To offer a platform for sharing the empirical experiences of development professionals, community mobilizers, academicians, multi-sectoral researchers, students etc. for the benefit of ultimate users.
3. To facilitate close and reciprocal linkage among the institutions for sustainable rural development.
4. Promoting potential and practicing entrepreneurs.
5. To disseminate the documented knowledge to the global partners through approach abstracting and indexing.

ABOUT THE JOURNAL

Journal of Community Mobilization and Sustainable Development (print ISSN 2230 – 9047; online ISSN 2231 – 6736) is published by Society for Community Mobilization for Sustainable Development twice a year. The Journal of Community Mobilization and Sustainable Development has NAAS rating 5.67 and Journal ID J158. The Journal of Community Mobilization and Sustainable Development, is also available on our website www.mobilization.co.in and it has been registered with www.indianjournal.com for national and global abstracting and indexing. MOBILIZATION envisages reorienting the young professionals and researches for imbibing the values of community participation in research, training and extension efforts.

The aim and scope of the journal are:

1. Sharing the relevant experiences and issues related to agriculture and allied fields at the grass root level and global forum to create the necessary academic and development climate.
2. Sensitizing the different stakeholders about the knowledge and innovation management system in pluralistic agri-rural environment.
3. Developing network among the related partners for convergence of their efforts for sustainable academic development of extension education discipline.

Editorial

The current era is witnessing tech-based revolutions in all sectors. Historically, the agriculture sector has been versatile in incorporating technological advancements into its applications to propel production baskets sustainably. Agriculture underwent four revolutions from the neolithic period to the current technocratic period. The nomadic hunter-gatherers gave way to agrarian settlements, and then the very first agricultural revolution, known as Agriculture 1.0, occurred. The flickering of the industrial revolution's outcome in technological innovation (tractors, seed drillers, irrigation systems, harvesting equipment) when transformed agriculture into a mechanized sector, second revolution (Agriculture 2.0) happened. The third revolution in agriculture (Agriculture 3.0) is marked by the achievement of food sufficiency by most of the developing nations through the adoption of green revolution technologies like high yielding crop varieties, quality planting materials, chemical and synthetic fertilizers, plant protection measures coupled with regular and scientific monitoring of the field. Agriculture is now in the midst of its fourth revolution, known as Agriculture 4.0. It includes a wide range of prospective futures in agriculture developed with digital farming, vertical and soil-less framing, bioeconomics, and other factors. Nanotechnology, the internet of things (IoT), robotics, sensors, 3D food printing, blockchain, artificial intelligence (AI) and machine learning, gene editing, etc., are just a few of the game-changing technologies that have the potential to drastically alter how food is produced, managed, harvested, processed, traded, and consumed. Being a multidisciplinary professional society, the Society for Community Mobilization for Sustainable Development (MOBILIZATION Society) always provides platforms to the ignited minds to share and sharpen the new ideas and innovations capable of contributing to sustainable developmental initiatives at the research, policy, and field level. The 10th National Seminar on "Agriculture and More: Beyond 4.0," announced by the MOBILIZATION Society in partnership with SKUAST-Kashmir and SKUAST-Jammu, held during 26th -28th May 2022, is one such leap. In this regard, society is highly fortunate to publish two Seminar-special issues (Vol-I and Vol-II) of the Journal of Community Mobilization and Sustainable Development, each containing a handful of quality articles submitted by professionals.

The volume-II (Vol-II) of the seminar-special issue of the journal covers a range of topics. Studies on the evaluation of extension contact of rice growers, formal and informal seed supply chain, green manuring, climate-smart agriculture, utilization pattern of ICT tools, urban farming practices, social media-led information delivery, genotype x environment interaction analysis for yield and yield attributes in *urd bean*, productivity and economics of fodder, Paramparagat Krishi Vikas Yojana (PKVY), heavy metal contamination, economics analysis of hybrid marigold production, nutrition – sensitive agriculture, rural industry and entrepreneurship (ASPIRE), adoption status of various rice residue management practices, varietal assessment of different crops and socio-economic impact of agri-entrepreneurial innovations on livelihood security are some among them. I am confident that this special issue will give you a flavour of the intellectual experience and strategic concepts that are presented at the conference.

The commitment shown by the dedicated editorial team deserves my deepest thanks and appreciation. I sincerely thank all the active readers, critics and authors whose contributions make our journal skilful enough to improve its structure and content. I am thankful to the authors who offered an overwhelmed enthusiasm and interest to respond to the conference-special call.

J.P. Sharma
Chief Editor

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 295-300

Urban Farming Practices Among the Urbanites of Hyderabad, Telangana

Veenita Kumari* and Junuthula Shirisha
Centre for Gender in Agriculture, Nutritional Security and Urban Agriculture Management, Hyderabad

ABSTRACT

An exploratory study was conducted to know the urban farming practices followed by the urbanites from different areas of Hyderabad city. Hundred active urban farming practitioners were selected as the study sample and by using semi-structured interview schedule, responses were collected. The data was decoded and statistically analyzed followed by logical interpretation. The results showed that majority of the respondents (43.0%) were growing 2 to 4 food types, eg. fruits vegetables, mushroom and fish. Out of which 45.0 per cent of them grew at least 1 to 5 types of vegetables and fruits. Majority of them (35.0%) utilized 500 to 1000 sqft for vegetable cultivation and less than 500 sqft. for fruits cultivation (75.0%). Major reasons for practicing urban farming as reported by the respondents were 'own interest' (81.0%). Different sources of motivation that inspired them to take urban farming practices expressed by the respondents were 'own interest', followed by information from 'newspapers' and from their relatives and friends respectively. Only 13.0 per cent of them had attended training programs on urban farming. In urban farming, popularly adopted model is terrace garden and majority of the respondents (67.0%) were practicing urban farming since 1 to 3 years. They are growing vegetables and fruits in mud pots, followed by grow bags as containers growing vegetables and fruits. The major challenges faced by the respondents were problems caused by insects, birds and monkeys, followed by accessibility of quality seeds in their nearby places, availability of water, especially during the summer season, spare time for gardening from their regular routine activities, inappropriate sunlight and lack of space for gardening. Based on the findings of this study, it is suggested that the urban farming practitioners may be provided training on scientific methods & practices to grow their own food, including measures to control insects, birds and pests, making vermi compost from kitchen waste etc., to increase urban farming produce.

Keywords: Challenges in urban farming, Urban agriculture, Urban agriculture practitioners, Urban farming, Urban farming practices

INTRODUCTION

Urbanization is taking place at a faster pace in India. The population dwelling in urban areas was 11.4 per cent according to 1901 census. This count has increased to 28.53 per cent according to 2001 census, even crossing 30 per cent as per 2011 census, standing at 31.16 per cent. It is also expected that by 2030, 40.76 per cent of the country's population will be residing in urban areas (Awasthi, 2013).

The growing population in urban areas and low land availability are the two major constraints to crop production in and around urban areas. Many people around the world do not get enough food and proper nourishment. Urban agriculture has been defined as the growing of plants and the raising of animals within and around cities. The most common feature which differentiates between rural agriculture and urban agriculture is integrated into the urban economic and ecological system. Urban Agriculture plays an important role for making a city more resilient and safer not only in terms of food and economy but also in improving standard of living of urban poor by increasing means of livelihood. Urban horticulture can be seen as a

*Corresponding author email id: veenita.k@manage.gov.in

solution for prevention of hunger and malnutrition. Due to the temperature rise and climate change, urbanites are facing challenges in sustaining production, resulting in poor yield and crop losses. Therefore, urban horticulture growers may need to employ new techniques and tools to improve their practices (Nwosisi and Nandwani, 2018). However, these development needs capital, information sources, knowledge and resources to improve their skills on production, processing and marketing of their produce. This paper examines the recent practices adopted by the urban residents in urban farming, the types of urban farming practices and models practiced by them. The constraints, challenges and benefits of urban farming were also explored.

MATERIALS AND METHODS

The present study focused on urban farming practices of active urban practitioners from the city of Hyderabad, Telangana State. The survey was carried out during January to August, 2019. A total of 100 respondents who were practicing urban farming were selected as the sample and data was collected through the developed semi-structured interview schedule. Data on types and number of foods grown, area utilized for urban farming, reasons and sources of motivation to practice urban farming, models adopted, duration of urban farming practice, types of containers used and the constraints faced by them was collected during the survey. The data was statistically analyzed using descriptive statistics i.e. mean, Percentage and standard deviation (SD), and presented logically in detail under results and discussion section.

RESULTS AND DISCUSSION

The major urban farming practices followed by the respondents include types of foods grown, total number of fruits and vegetables grown, area of cultivation, reasons and source of motivation for urban farming, training programmes attended, models & containers used and duration of practice.

The respondents were growing different types of foods as indicated in Table 1, like vegetables, fruits, mushroom, fish etc. Accordingly they were categorized into different categories based on the no. of different types of foods grown by them. Respondents were categorized into 3 groups as per the number of foods grown i.e. upto 2, 3 to 4 and more than 4 food groups. Majority of them (43.0%) were growing 3 to 4 food groups consisting of fruits and vegetables, followed by 41.0 per cent of them who grew upto 2 food groups i.e. vegetables, fruits, mushroom etc. and only 4.0 per cent of them were growing more than 4 types of food groups.

Table 1: Types of food grown by the respondents through urban farming

Type of foods grown	Number of respondents (f)	Percentage (%)
Upto 2	41	41.0
3-4	43	43.0
>4	4	4.0
Total	100	100.0

From the above results, it was noticed that majority of the respondents were growing 3 to 4 varieties of food groups such as fruits, green leafy vegetables, other vegetables and medicinal plants but a very less Percentage of the respondents were growing diverse types of food. Hence more training programmes on diversified urban farming or home gardening should be conducted, in order to give hands-on-experience.

The respondents were also surveyed regarding no. of fruits and vegetables grown by them through urban farming, such as brinjal, tomato, ladies finger, chilies, ridge gourd, bitter gourd and so on. Among the fruits group papaya, lemon, sweet lime, plums etc. were grown in their home garden. The data on number of fruits and vegetables grown by the respondents is given in Table 2. The results showed that majority of the respondents (45.0%) were growing at least 1 to 5 types of fruits and vegetables in their home garden, followed by 40.0 per cent of them who were growing 5 to 10 types of fruits and vegetables and 15.0 per cent of them with more than 10 varieties of fruits and vegetable in their home garden.

Table 2: Total number of fruits and vegetables grown by the respondents through urban farming

No. of foods grown	Number of respondents (f)	Percentage (%)
1-5	45	45.0
5-10	40	40.0
Above 10	15	15.0
Total	100	100.0

Major advantage of urban farming noted was that it improved access to fresh and green vegetables, as observed by a study of Vincent *et al.* (2019).

The area utilized for urban farming by the respondents is given in Table 3. Majority of the respondents (35.0%) utilized 500 to 1000 sqft, followed by 34.0 per cent who used more than 1000 sqft and 31.0 per cent who grow vegetables in an area of less than 500 sqft. The utilization of the area for fruits cultivation by majority of them (75.0%) was less than 500sqft, followed by 21.4 per cent who used 500 to 1000 sqft and the rest (3.6%) of them used more than 1000 sqft of area.

The data on area utilization showed that majority of the respondents used 500 to 1000 sqft for vegetable cultivation whereas for fruits cultivation, the area was less than 500 sqft. The area under vegetables cultivation was high compared to fruits cultivation, in terms of area and number of respondents growing vegetables. Cent per cent of the respondents were growing vegetables whereas only 28.0 per cent of them were growing fruits. The reasons could be that growing vegetables is easy in terms of watering, maintenance, knowledge and skill and can be carried out in pots/containers of any size or material as compared to fruit cultivation. The other reason could also be that there is more demand for vegetables than fruits.

Data of Table 4 highlights the reasons for urban farming practice by the respondents. The major reason expressed by majority (81.0%) of them was 'own interest'. The other reasons reported by them were their nativity of being from an agriculture family that created interest to practice urban farming, passion, healthy and safe foods by organic farming, to get government subsidy, inspired by other fellow members who were practicing, to reinstate biodiversity, through newspaper articles and found the information as useful, to inspire and educate in varying Percentages ranging from 8 to 1.

Table 3: Area utilization under urban farming practice by the respondents

Area (sqft)	Vegetables (n=100)		Fruits (n=28)	
	N	%	N	%
< 500	31	31.0	21	75.0
500-1000	35	35.0	6	21.4
>1000	34	34.0	1	3.6
Total	100	100.0	28	100.0

Table 4: Reasons for taking up urban farming practice by the respondents

Reasons	Number of respondents	Percen-tage
Passion	4	4.0
Interest/Hobby	81	81.0
Being from agriculture family	8	8.0
Health & Nutritious supply of foods	1	1.0
Interest and Govt. subsidy	1	1.0
Inspired by others	1	1.0
To preserve and safe foods by organic farming	4	4.0
To reinstate biodiversity	1	1.0
Newspaper article	1	1.0
To inspire and educate	1	1.0

**Note:* The total Percentage cannot be 100 as the reasons stated by the respondents can be more than one for each respondent. So the data represents pooled Percentage for each reason presented in Table 4.

It can be seen that as majority of the respondents (81.0%) were doing urban farming out of their own interest, therefore, to do any activity or task it is important to have self-interest which is the pre-requisite of any action/initiative. Interest is the internal drive to continue with the desired activity or task. Different sources of motivation to do urban farming was collected from the respondents and presented in Table 5. It is evident from the above result that majority of the respondents (88.0%) cited their source of motivation as 'own interest', followed by 9.0 per cent for whom the source of motivation was information from newspapers, for 7.0 per cent of the respondents,

Table 5: Source of motivation for urban farming

Source	Number of respondents (f)	Percentage (%)
Training	0	0
Neighbors	0	0
Friends	3	3.0
Relatives	7	7.0
Newspaper	9	9.0
Own interest	88	88.0

it was their relatives and the remaining 3.0 per cent from their friends.

Data on training programmes attended by the respondents before taking up urban farming practices is presented in Table 6. Majority of the respondents (87.0%) did not attend/receive any training on urban farming, whereas only 13.0 per cent of them had attended/received trainings on urban farming before taking up urban agriculture practices. Hence there is a need and scope for organizing more training programs on urban farming to enhance technical skills and knowledge of the practicing urbanites, so that they get motivated and start practicing urban farming with more enthusiasm and confidence. Those who are already into urban farming will get further advanced scientific know-how about urban farming.

The urban farming models adopted by the respondents is shown in Table 7. Majority of the respondents (88.0%) practiced urban gardening on terrace, followed by 37.0 per cent who practiced front yard gardening. Another 13.0 per cent each practiced in balcony and back yard. Yet another 12.0 per cent as rooftop garden, 2.0 per cent of them were practicing on hanging model, 1.0 per cent practiced window/slit garden and vertical garden each. None of the respondents practiced stack model as urban farming practice.

Table 6: Trainings attended on urban farming by the respondents (n=100)

Yes	Percentage	No	Percentage
13	13.0	87	87.0

Table 7: Urban farming model practiced by the respondents

Urban farming model	N (%)
Terrace garden	88.0
Roof top garden	12.0
Vertical garden	1.0
Balcony garden	13.0
Back yard garden	13.0
Front yard garden	37.0
Hanging model	2.0
Window/slit garden	1.0
Stack model	0.0

Note: Percentage and number are same.

From the above data on urban farming models practiced, by the respondents it can be inferred that the most popularly adopted model is terrace garden, since it is easily available in most of the independent houses, easy to maintain with ample amount of sun light and without much constraints of space. Another model adopted by the respondents was front yard gardening which will add beauty to their home, can be supervised easily and provide coolness during sunny days and evenings.

The urban farming practice duration, in number of years, was collected from the respondents to know the time duration since they started urban agriculture practices and is presented in Table 8. Majority of the respondents (67.0%) were practicing urban farming since 1 to 3 years, while 13.0 per cent of them were continuing this practice since more than 5 years, 12.0 per cent of them were practicing for less than 1 year and the remaining 8.0 per cent were practicing since 3 to 5 years.

From this result it can be seen that majority of them were practicing since 1-3 years, which clearly suggests the growing popularity of urban farming among the people living in urban areas and the motivation to grow safe and nutritious foods. Similar results was found in a study conducted in Hyderabad city by Rani *et al.* (2016). Majority of them (56.0%) practiced gardening since less than 3 years whereas, 30.0 per cent of them practiced for 3-5 years and only 14.0 per cent of them had experience of more than 5 years.

The data regarding type of containers used for urban agriculture by the respondents is presented in Table 9. Majority (91.0%) of the respondents used mud pots, followed by 84.0 per cent who used grow bags, 29.0 per cent does farming on ground, 23.0 per cent

Table 8: Duration of urban farming practiced by the respondents

Duration (Years)	Number of respondents (f)	Percentage (%)
<1	12	12.0
1-3	67	67.0
3-5	8	8.0
>5	13	13.0
Total	100	100.0

Table 9: Type of containers used for urban farming by the respondents

Containers Used	N (%)
Mud pot	91.0
Plastic drums	23.0
Tyres	9.0
Grow bags	84.0
Pipes	9.0
On ground	29.0
Water bottles	14.0
Paint bucket	14.0
Plastic bucket	16.0
Coconut shell	2.0
Thermocol box	3.0

Note: Percentage and number are same.

used plastic drums, 16.0 per cent waste plastic buckets at home, 14.0 per cent each grew plants in water bottles and paint buckets, while another 9.0 per cent each used old tyres and broken pipes, while 3.0 per cent used thermocol boxes and the remaining 2.0 per cent grew small plants in coconut shells that were used in the kitchen and temples. From the results it was inferred that majority of the respondents were using mud pots and grow bags which was easily available in nurseries and as a part of the subsidy kits. Most of the respondents were using containers unutilized/ waste container at home or from their vehicles (tyres) and with their creative ideas they recycled and broken things into re-usable grow containers and added aesthetic element to beautify their garden in a cost-effective manner.

The constraints faced by the urban respondents is presented in Table 10. Problems caused by insects, birds and monkeys were felt by majority of the respondents (26.0%), followed by accessibility of quality seeds in their nearby places as reported by 17.0 per cent of the respondents, another 13.0 per cent of them felt that unavailability of water, especially during the summer season is a great problem to continue home farming activities, 4.0 per cent of them found it difficult to spare/manage time for gardening from their regular routine activities, 2.0 per cent of them felt that due to insufficient sunlight productivity is low and the least Percentage (1.0%) expressed that lack of space for gardening is a major concern. The above result shows

Table 10: Constraints faced by the respondents in urban farming

Constraints	Number of respondents (f)	Percentage (%)
Getting good quality seeds	17	17.0
Water availability	13	13.0
Improper sunlight	2	2.0
Insects, birds and monkeys menace	26	26.0
Space	1	1.0
Time	4	4.0

that insects/birds/animals menace is one of the biggest problems faced by urban farming practitioners. Management of insects/birds/animals menace can be one of the significant component of urban farming practices. Also easy availability of inputs for urban farming can be promoted by linking these urban farming practitioners with the agripreneurs.

CONCLUSION

Urban farming can address food security and nutritional security of the urban and peri-urban dwellers. This practice address malnutrition by ensuring healthy, nutritious, and fresh foods without any pesticides, chemicals etc. Even though many urbanites are active urban farming practitioners there seems to be technical knowledge gap which impacts productivity will promote urban farming practices among many more urban and peri-urban dwellers and update knowledge and skill of existing urban farming practitioners. By organizing awareness programs and trainings on urban farming, it will promote urban farming. In a larger picture, urban farming can be a way to address food and nutritional security of the urban and peri urban dwellers, particularly in crisis time like the current pandemic situation. Hence urban farming should be encouraged in all urban and peri-urban areas with high population density, to overcome food insecurity.

Recommendations/Suggestions for effective urban farming:

Based on the results concerning constraints faced in urban farming by the respondents, the following recommendations/ suggestions are proposed to improve urban farming practices:

Getting good quality seeds- The active urban practitioners can form social network to exchange information among themselves and get information about quality inputs suppliers for urban farming activities.

Water availability- Now-a-days, many urban farming practitioners are doing rain water harvesting. They are constructing structures that conserve rain water, to be used at a later stage. They can also divert kitchen waste water into the urban garden. Alternatively, they can also look at advanced technologies like aquaponics as an alternative, where the water will be recycled between plant and fish ecosystem, hence less consumption of water.

Hydroponics- Now-a-days, technologies like hydroponics etc. at household level are also gaining importance, where water availability is a concern.

Insects, birds and monkeys menace- To protect vegetable and fruit plants from the attack of insects, birds and monkeys, net fencing can be done in balconies or protected structures like greenhouse structure/net on the roof top/front/back yard.

Space- Urban farming is gaining significance in cities and towns because it makes judicious use of the available space. Hence, where space is a concern innovative models like vertical garden, stack model, stair-case models, hanging models etc. can be effective in growing more plants per sqft.

REFERENCES

Awasthi, P. 2013. Urban agriculture in India and its challenges. *International Journal of Environmental Science: Development and Monitoring (IJESDM)*, 4(2): 48-51.

Nwosisi, S. and D. Nandwani. 2018. Urban horticulture: overview of recent developments. In *Urban Horticulture* (pp. 3-29). Springer, Cham.

Rani, K.U.; T.N. Reddy and S. Shah. 2016. Urban Agriculture: Experiences of Practitioners of Rooftop Gardening. *Journal of Agricultural Extension*, 17(1): 1-11.

Vincent, A.; S. Raj and B. Suchiradipta. 2019. Urban farming: Knowledge Management and Impact–Lessons from twin cities of Hyderabad and Secunderabad. *Journal of Agricultural Extension Management*, pp 75-97.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 301-311

Sustainable Development in Indian Agriculture

Rumisa Ashraf* and Mahreena Farooq
[1]Division of Entomology, [2]Division of Plant Pathology SKUAST-K, J&K

ABSTRACT

Sustainable agriculture does not represent a return to pre-industrial revolution methods; rather it combines traditional conservation minded farming techniques with modern technologies. Sustainable systems use modern equipment, certified seed, soil and water conservation practices and the latest innovations in feeding and handling livestock. India has achieved green revolution due to the increased use of high yielding variety seeds. But intensive use of land without taking enough care to maintain its productive capacity leads to loss of top soil layer due to erosion, loss of organic matter, loss of porous soil structure and water logging and build up of toxic salts and chemicals. Over use of pesticides caused localized health hazards. Indiscriminate use of modem technology may endanger ecological security and imbalance the environment. Emphasis is placed on rotating crops, building up soil, diversifying crops and livestock and controlling pests naturally. Whenever possible, external resources- such as commercially purchased chemicals and fuels-are replaced by resources found on or near the farm. These internal resources include solar or wind energy, biological pest controls and biologically fixed nitrogen and other nutrients released from organic matter or from soil reserves. In some cases external resources may be essential for reaching sustainability. As a result, such farming systems can differ considerably from one another because each tailors its practices to meet specific environmental and economic needs.

Keywords: Sustainable development, Technological development, Indian agriculture, Traditional conservation-minded methods

INTRODUCTION

The role of agricultural sector in Indian economy can be seen through its contribution to GDP (Gross domestic Product) and employment. This sector also contributes significantly to sustainable economic development of the country. The sustainable agriculture development of any country depends upon the judicious mix of their available natural resources. In fact agriculture determine the fate of a country like India where about two-thirds of the population still lives in rural India with agriculture as its livelihood, in spite of the increasing urbanization that has been taking place since many decades. Therefore if agriculture goes wrong, it will be really bad for the economy as the falling of agricultural growth not only affects employment but GDP too (thus increasing poverty). The larger objective for the improvement of agriculture sector can be realized through rapid growth of agriculture, which depends upon increasing the area of cultivation, cropping intensity, and productivity. But for a country like India, increasing productivity is more important than the rest of the two. This is simply because of increasing urbanization, industrialization and the limited land size of the country The productivity can be increased by two ways. First, increasing output by efficient utilization of available resources. Second, increasing output by variation of input. The first method is better with respect to productivity and sustainability. But due to increasing population, this method cannot provide a permanent solution. Thus, we can go for the second method, which may potentially cause environmental degradation in the economy and affect its sustainability. Therefore there is need to tackle the issues related to sustainable agriculture development Sustainable development

*Corresponding author email id: rumaisaashraf015@gmail.com

means, development at present meets the needs of the present generation without compromising the ability of future generation to meet their own demand (Singh and Parihar, 2015). Sustainability in agriculture means the land and resources that use for agriculture today should be handed over to the future generations in a sustainable form so that they can continue to practice agriculture and have food security. This means that we have to use lands, water resources, etc. in such a manner that the future generations are also will be able to have sustainable development. Sustainable agriculture is the system of raising crops for greater human utility through utilization of resources with better efficiency without disturbing imbalancing or polluting the environment. Sustainable agriculture is ecologically sound, economically viable, socially just and human (Selvam, 2015).

The paper highlights the sustainability in Indian agriculture through the judicious mix of Traditional conservation methods combined with modern technology that can reduce farmers' dependence on possibly dangerous chemicals. and in turn the rewards will be both environmental and financial.

SUSTAINABLE AGRICULTURE DEVELOPMENT IN INDIA

The issues of sustainable development can be discussed under three broad types of farming systems viz. traditional production system, modern agriculture system and sustainable agriculture system. Further, we can compare them across three dimensions, ecological, economic, and social sustainability.

Ecological sustainability: Most of the traditional and conventional farm practices are not ecologically sustainable. They misuse natural resources, reducing soil fertility causing soil erosion and contributing to global climatic change. But sustainable agriculture has some major advantages over traditional practices:

Soil degradation challenges for sustainable agriculture in India: Sustainable development that preserves soil, water, plant and animal genetic resources, is environmentally safe, economically feasible and socially acceptable, and also ensures the achievement and satisfaction of human needs for the existing and coming generations. So to attain long-term development in agriculture, the optimal usage of human resources, as well as natural, economic and technological resources is necessary (Singhand Parihar, 2015). The lithospheric part of the earth, which is comprised of solid rock material is known as land. On the other hand, soil is the surface covering of land (almost top 30 cm) and acts as a medium for plant growth. Land degradation is one of the prominent problems of mankind which not only reduces the production capacity of an area, but also affects the overall ecosystem (Alam, 2014). Various types of physical, chemical and biological land degradation result in degradation of soil quality (Figure 1). In addition, chemical fertilizers coupled with inappropriate irrigation management also result in worsening of groundwater quality in the country. The impact of chemicals on groundwater quality is much higher in shallow and unconfined aquifers. Majority of the Indian rural population uses water for domestic purpose from shallow private boreholes which are contaminated by nitrate (NO–3) pollution (Singh, and Singh, 2002). Rapid human-induced secondary salinity in the last few decades has rendered vast tracts of land in dryland and irrigated regions of the world uncultivable (Munns, 2005). Annually, 0.25–0.5 m ha agricultural lands is lost due to secondary salinization (Wicke *et al.,* 2011).

Expected land scarcity and a drastic reduction in crop yields and productivity of food crops under the scenario of climate change are foreseen by 2050. Changing temperature and rainfall patterns and intensity due to increased extreme events of climate change, soil degradation as well as pest and disease infestation impose serious threats on traditional agricultural systems (Singh *et al.,* 2019). The main causes of low productivity are excessive pressure of population on land, social environment, land degradation, uneconomic land holdings, uncertain monsoons and inadequate irrigation facilities, incidence of pests and diseases, etc. (Sreekanth *et al.,* 2017).

Technologies and mitigation strategies: There are several panaceas for the issues and processes of soil degradation. Table 1 provides an overview of the response level of different technologies with respect to financial, technological, political and other capacities for appropriate selection of land restoration techniques.

Contour bunding, terracing and other engineering structures: Contour bunding is an earthen

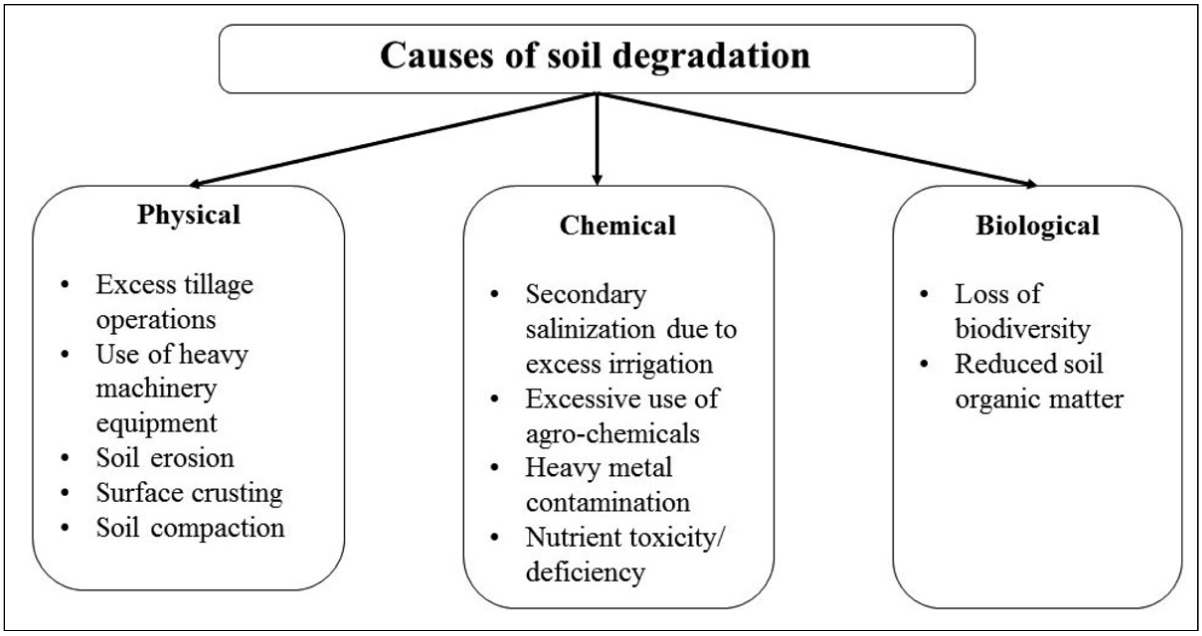


Figure 1: Different types of soil degradation

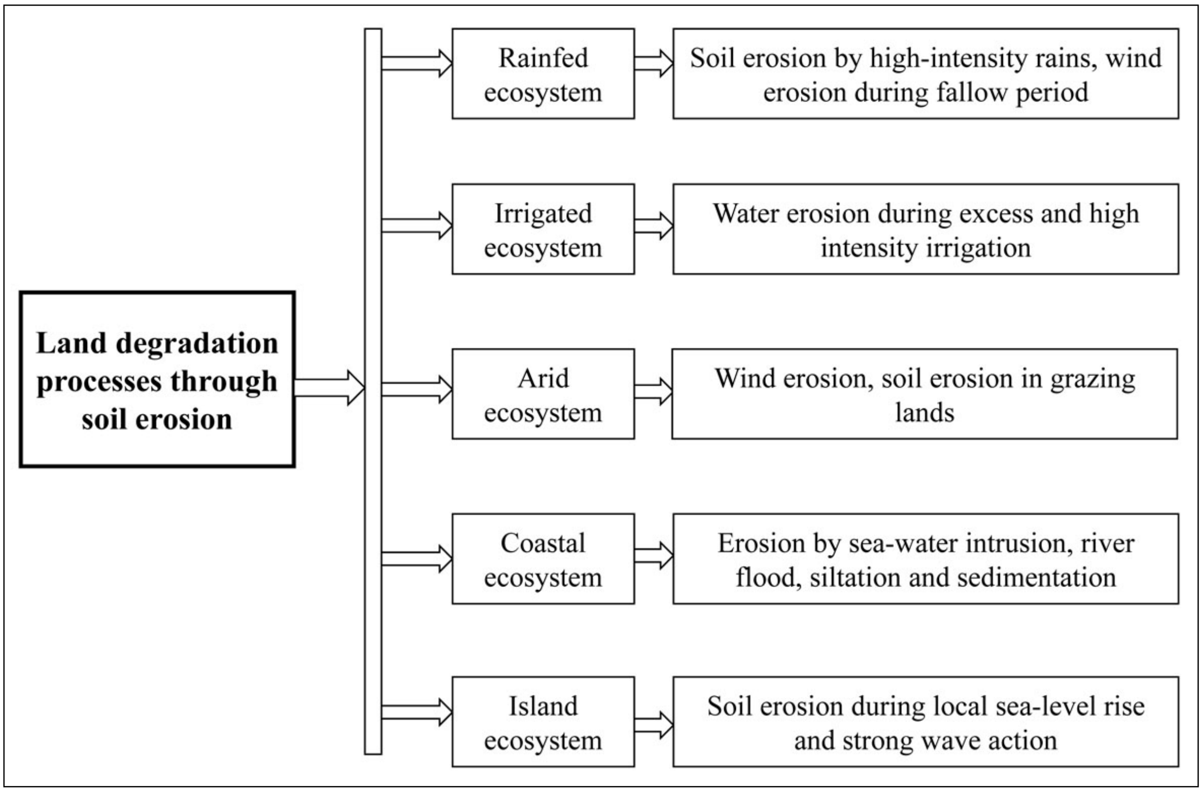


Figure 2: Soil erosion-led land degradation processes in different ecosystems of India

embankment across land slopes that divides the area into strips and restricts water flow by reducing the amount and velocity of the run-off. Such bunds protect soils from a variety of erosions to the extent of 25–162 tonnes/ha/year and are suitable for slope of about 6 per cent. Graded bunds are suitable in areas where rainfall is >80 cm/year, irrespective of soil texture. It consists of a wide–low embankment constructed on the lower edge of a channel. These bunds are used at about 2–10 per cent land slope. Bench terracing is one of the most popular soil conservation practices adopted on sloping and undulating lands having slope between 16% and 33 per cent. Original slope is converted into level fields; all the manure and fertilizers applied are retained in the field, thus helping in proper water management. Contour trenches are suitable for high-rainfall hilly areas having a slope of steeper than 33 per cent with badly eroded soil. Length is 3–3.65 m and the inter-space between trenches is 2.4 and 3 m. Due to construction of contour bunds in maize crop cultivation, around 21 per cent of the crop land was saved, with 10 per cent increase in yield (Subudhi and Subudhi, 2018).

Intercropping, crop rotation and contour farming: Intercropping system involves the cultivation of two or more crops simultaneously in the same piece of land with distinct row arrangement for efficient utilization of available natural resources that enhance the overall crop productivity. It is suitable for landholding farmers who have limited land resources and low productive soils. In an intercropping system, maize–cowpea/ladies finger, maize is sown at a wider row spacing (60–90 cm) that provides enough space for soil erosion, and cultivating cowpea14 and ladies finger (Fawusi, 1985) in between the maize crop protects the soil from erosion. Introduction of legumes in maize (Singh *et al.,* 2015) aids in the provision of atmospheric nitrogen (N_2), mitigation of the drought effects by acting as a live mulch and reduction of soil erosion and evaporation (Khola *et al.,* 1999). Especially, in sandy loam textured soils, soil erosion may be reduced by a good canopy cover during early stages. Pulse crops like pigeon pea, mung bean, cowpea, chickpea, soybean, etc. have higher root biomass, biological nitrogen–fixation capacity, and can enrich the soil with organic carbon, enhance soil fertility by redistributing the soil profile nutrients (Kamanga *et al.,* 2014). After long-term continuous cropping, the pulse inclusive crop rotations (Figure 3) brought significant changes in soil organic carbon (SOC) compared to the cereal–cereal cropping system (Venkatesh *et al.,* 2017). Contour farming is an effective practice of tillage, planting and other farming operations carried on the contour of the field slope in order to control soil erosion and increase crop productivity; it is suitable for moderate slopes. Contour ridging results in rainwater ponding, reduces velocity of run-off and soil erosion, and increases infiltration ((Liu *et al.,* 2014). Soil nutrients in the run-off are retained better in contour ridge tillages. Cultivation and planting along contour lines reduced soil and water loss to the tune of 49.5 and 32 per cent respectively.

Integrated nutrient management and organic amendments: Practice of integrated nutrient management (INM) by combining organic amendments with appropriate management options is considered as a viable strategy to combat climate change and improve carbon stocks (Srinivasarao *et al.,* 2011, 2020). Combined application of 50% NPK and farmyard manure (FYM) @ 10 tonne ha^{-1} in groundnut crop increased yield and exerted a significant effect on the mineralization of SOC (Karad *et al.,* 2016). Cereal crop residues retained on the field also aid in the provision of plant nutrient sources (Srinivasarao *et al.,* 2017). Application of azolla compost along with recommended doses of NPK helped effectively build-up soil carbon (27.43%) followed by NPK + cow dung (22.76%) over NPK alone (Bharali *et al.,* 2017). Azolla application also improved the soil carbon storage (2.88 mg ha^{-1}) capacity with grain yield of 6.55 mg ha^{-1} compared to other treatments (Table 1). Generally, in the slope areas (0.5–2.0%) run-off and soil loss are higher. In such areas, INM practice efficiently protect the soil from losses. Application of recommended rate

Table 1: Response level of different technologies for soil degradation

Technology	Environmental desirability	Technical feasibility	Political acceptability	Cultural acceptability	Social acceptability	Economic feasibility
Contour bunding, terracing and other engineering structures	H	M-H	M	M-H	M-H	M
Intercropping	M-H	L-M	L	M	M	H
Contour farming	H	M-H	L	M	M	H
Integrated nutrient management	H	M-H	M	M-H	M-H	M
Sub-soiling	M-H	M-H	M	M-H	M-H	H

Note: H, High; M–H, Moderate to high; M, Moderate; V, Variable; L–M, Low to moderate; L, Low.

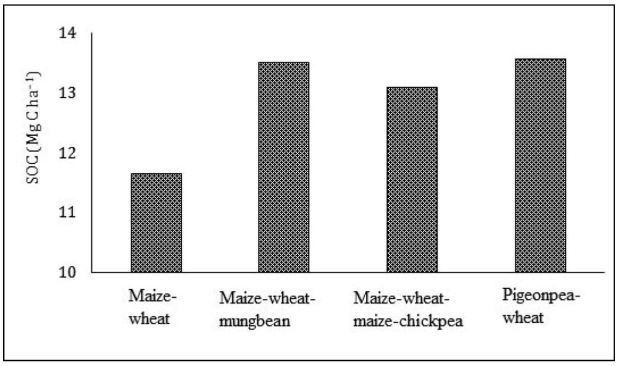


Figure 3: Soil organic carbon (SOC) as influenced by long-term crop rotation (Venkatesh, *et al.* **2017)**

of fertilizer along with FYM, minimizes soil run-off and losses (CSWCR&TI, Annual Report, 2012). Adoption of INM in the dry lands under groundnut based cropping system registered higher C accumulation rates (0.45–tonne ha^{-1} $year^{-1}$) compared to the other systems over farmer's practice (Table 1) (Srinivasarao *et al.*, 2009). Each tonne of SOC increment has a yield benefit of about 0.02– 0.16 t ha^{-1} among several rain fed crops (Srinivasarao *et al.*, 2014). The INM practice, specifically in rain fed regions of India, takes complete advantage of locally available organic resources and external fertilizers towards achieving sustainability of rain fed systems (Srinivasarao *et al.*, 2020).

Subsoiling: Soils may become deeply compacted due to heavy machinery operation during cultivation. Such compacted soils restrict the movement of water, air and roots that hampers plant growth. Soil compaction is one of the severe forms of soil degradation that affects around 11 per cent of the land area (Ahmad *et al.,* 2007). Especially, in black soils (Vertisols) such issues further increase the problems of crop cultivation. Subsoiling is an effective technique in both cropping and pastoral agriculture to alleviate soil compaction and to improve its physical condition. Sub soiling in sugarcane significantly influenced the yield and quality; it also reduced the soil bulk density and increased infiltration rate (Singh *et al.,* 2012).

Smart irrigation system for sustainable agriculture: Smart-irrigation systems provide attractive instruments and methodologies for saving water and improving soil conservation in view of mitigating the impacts of climate change as well as increasing agricultural production. They can avoid over-watering, excessive runoff_ and soil erosion by scheduling the amount of irrigation according to soil characteristics, crop types, weather conditions and field geometries.

New devices based on open-source and low-cost technologies and apps allow the management of irrigation at field and farm scales through a sustainable water supply system based on actual crop water requirements and accounting for the local variability of soil properties. Tailored irrigation water management approaches oriented towards agro-hydrological models and decision support systems at the farm and district irrigation scales can also maintain reliable and flexible water allocation during dry seasons, preserving water for environmental requirements and decreasing conflicts between water users. Likewise, the use of marginal water resources such as saline or treated wastewater, both from industrial and domestic origin, becomes a source of irrigation in semi-arid and arid regions, where the future of irrigated agriculture is threatened by existing or expected shortages of fresh water, raising concerns of potential hazards to the environment and/or humans. Therefore, smart-irrigation systems that aim to adopt single or combined automation and Information Communication Technologies at the farm/district scale, as well as customized and integrated model approaches at larger scales, would appear to be a farsighted way to promote future resilient irrigation management.

REMOTE SENSING-BASED ESTIMATES OF CROP EVAPOTRANSPIRATION

Aiming at contributing to the e_cient use and management of irrigation water, Gavilán *et al.* (2019) tackle the di_cult and important task of estimating evapo-transpiration in agricultural irrigated areas. The work explores the feasibility of using satellite-based data to carry out updated seasonal water balances over large areas—an approach that would overcome difficulties in using local measurements of surface energy balance components to extrapolate the conditions over large agricultural areas. Limitations include the heterogeneity, large space-time variability and complexity of the soil–vegetation–atmosphere interactions in agricultural environments. Results of this work are encouraging in relation to the role that the proposed approach might have in improving water management both at plot and water distribution system scales. The authors propose a method based on the integration and harmonization of the Normalized Difference Vegetation Index (NDVI) obtained from Landsat-8 and Sentinel-2 sensors in order to obtain a single NDVI time series as a means to estimate evapotranspiration through specific adjustment equations for each type of crop, which allows one to continuously characterize the demand for water during an irrigation season. The approach aims to take advantage of the characteristics of both products (Landsat-8 and Sentinel-2), and leads to an effective increase in spatial and temporal coverage, improving data availability.

INFORMATION AND COMMUNICATION TECHNOLOGIES FOR SMART-IRRIGATION

In this category, two works were published. Bhatti *et al.* (2019) describe the experience of installing flow meters in the Indus Basin Irrigation System (IBIS) and their connection in a telemetry system to allow the real-time control of water distribution in the irrigation canals and a continuous recording of water deliveries. Despite this study being focused on the IBIS context, it represents a clear message of how irrigation is still managed in a large part of the world. Unlike agricultural mechanization, which has made huge steps forward in terms of automatic, remote-controlled machineries based on artificial intelligence (e.g., variable rate applications in fertilization, in sowing and in harvesting), irrigation has remained anchored in ancient practices both in terms of methods and management. Through a six-step method based on the definition, assessment, analysis, control, implementation, and improvement of flow measurements in irrigation canals, Bhatti *et al.* (2019) found the possibility to improve, guide and address water policies in the IBIS district with positive impacts on water distribution efficiencies and managements. Automatic notifications, mobile controls, integration of irrigation systems at farm and district levels with weather forecast alerts, soil moisture sensors and crop water requirement model tools are the current technologies that farmers perceive as utilities for improving irrigation efficiency. This is discussed in the work of Zhang and Khachatryan (2019). They found that educating farmers may help to overcome the potential barriers to the adoption of smart-irrigation technologies. All the players in the production chain could, moreover, promote and encourage the use of smart-irrigation technologies through a product certification system which attests to the application of water conservation practices.

PRECISION IRRIGATION MODELS AND CONTROLS

In this Special Issue, there are five papers published in this category. Mayer *et a*l. (2019) developed an agro-hydrological modeling framework based on three sub-models (one for the agricultural areas, one for the groundwater zone, and one for the channel network) to investigate the water use efficiency in rice areas of northern Italy at the irrigation district scale. Once calibrated for a district of 1000 ha using meteorological, hydrological and land-use data of a four-year period, the model was used to assess four different irrigation management scenarios: (1) wet seeding and continuous flooding until few weeks before harvest (WFL), (2) dry seeding and delayed flooding (DFL), (3) alternate wetting and drying (WDA), and (4) WFL followed by post-harvest winter flooding (WFL-W). Their results suggest that DFL and WDA would lead to a reduction in summer irrigation needs compared to WFL, but also to a postponement of the peak irrigation month to June, which is already characterized by a strong water demand from other crops. Finally, summer irrigation consumption for WFL-W would correspond to WFL, suggesting that the considered winter flooding period ended too early to influence summer crop water needs.

Ortuani *et al.* (2019) analyzed the performance of a simple drip variable-rate irrigation (VRI) system, designed according to the soil variability in a vineyard of 1 ha located in the Morainic Hills region south of the Garda Lake (Lombardy, Italy), in reducing irrigation water use while maintaining product yield and quality. The mapping of the soil electrical conductivity (EC) was used to identify different management zones and design a drip VRI system. The drip VRI system was characterized by three sectors: two sectors supplied water to different management zones (MZs), while the third sector was used to illustrate the "reference irrigation management" used by the irrigator. Irrigation in the first two sectors was managed firstly according to the different crop irrigation requirements estimated considering the site-specific soil hydraulic properties and successively on the basis of data acquired by soil moisture probes installed in each sector. The results showed a reduction of water use by 18% compared to the "reference" sector without losses in yield and product quality, and a grape's maturation was more homogeneous in time. Therefore, it can be concluded that a relatively simple solution for the implementation of VRI could be designed and implemented in commercial vineyards, showing that precision irrigation techniques are ready to provide tangible results that may be of interest not only for researchers but also for farmers.

Low-pressure drip and sprinkler irrigation systems are of interest because they can decrease costs and energy consumption. However, drip emitters operating at low pressure are more prone to clogging, and sprinklers produce uneven water distribution patterns, making it Difficult to ensure the quality of the irrigation. In recent years, oscillating pressure has been used in low-pressure irrigation systems, providing a new way to solve the problems in irrigation. Oscillating pressure increases the flow turbulence in an emitter, which improves the anti-clogging performance of the emitter. The low sinusoidal oscillating pressure can improve the distribution of the sprinkler under low pressure.

Zhang *et al.* (2019a) developed a calculation model for the instantaneous pressure head of oscillating water in a pipeline using a complex function to solve the continuity equation and the momentum equation of a pipeline with a water hammer motion and using the Darcy–Weisbach formula. The model provides a theoretical basis for the application of oscillating water flow in irrigation systems and the design of irrigation pipe networks.

Zhang *et al.* (2019b) carried out experiments on a laterally-moving sprinkler irrigation system under low-pressure, sinusoidal oscillating water flow. The sprinkler intensity and impact kinetic energy intensity distribution were investigated. In laterally-moving sprinkler irrigation systems, the uniformity of sprinkler intensity and impact kinetic energy intensity should be no less than 85%, and the impact kinetic energy intensity should be no higher than 0.6 W/m^2. In order to meet this standard, the amplitude of sinusoidal oscillating water pressure in laterally-moving sprinkler irrigation systems ranged from 50 kPa to 60 kPa. When the amplitude of sinusoidal oscillating water flow was 50 kPa, the optimal sprinkler spacing was 3.5–4 m; when the amplitude of sinusoidal oscillating water flow was 60 kPa, the optimal sprinkler spacing was 3.5–4.5 m. The results show that within an optimal range of amplitude and nozzle spacing, sinusoidal oscillating water flow significantly improves the combined sprinkler intensity, impact kinetic energy intensity uniformity, and the spraying quality of laterally-moving sprinkler irrigation systems under low pressure conditions.

Solé-Torres *et al.* (2019) developed a supervisory control and data acquisition (SCADA) system to monitor the pressure and flow across the irrigation laterals in a micro irrigation system. The monitored values of pressure and flow allowed distribution uniformity coefficients to be determined, performing an evaluation of the drip irrigation system in real time. Moreover, SCADA will allow the calculation of the flow distribution uniformity coefficient DUlq without the need for annual field measurements, saving labor costs, in spite of its high investment cost. The proposed method presents automation advantages as it indirectly considers all the irrigation emitters, and so DUlq calculation is as affected by emitter clogging as the Merriam and Keller method. In addition, the proposed method also allows subsurface irrigation installations to be evaluated which would be impossible to evaluate without digging out the laterals.

Biological Control in Sustainable Agriculture: The rapidly increasing population is exerting immense pressure on agricultural lands for higher crop yields, which results in increasing use of chemical fertilizers. That's why fungicides are widely used in agricultural crop production system for quick result and to ensure crop quality and production. However, the indiscriminate use of agrochemicals resulted in adverse effect on the soil fertility, quality of produce, crop productivity and cause adverse effects to aquatic and terrestrial ecosystem. This Negative environmental impact of artificial fertilizers and their increasing costs, emphasizes the need to adopt eco-friendly agricultural practices for food production to maintain sustainable agriculture. Microorganisms have a vital role in agriculture as they not only reduce application and reliance on synthetic pesticides but also promote the exchange of plant nutrients which are very much

Table 2: Commercial biocontrol formulations used for control of plant diseases

Product	Biocontrol	Disease/target pathogens	Crop	Formulation	Application	Manufacture distributor
Blight ban A 506	*Pseudomonas fluorescens* A506	*Erwinia amylovora* and russet inducing bacteria	Almond, cherry, apple	Wettable powder	Spray at the time of blooming and fruiting	Nu farms LIC, Longwood, FL, USA
Cedomon	*Pseudomonas chlororaphis*	Leaf stripe, net blotch, *Fusarium* sp, spot blotch, leaf spot etc.	Barley and oat	Seed treatment	Seed dressing	Bio Agri AM, Uppsala, Sweden
Campanian	*Bacillus subtilis* GBo3, *B. licheniformis*	*Rhizoctonia, Pythium, fusarium and Phytophthora*	Green house and nursery	Liquid	Drench and spray	Growth products, white plains, Ny, USA
Primastop	*Gliocladium catenulatum*	Soil borne pathogens causing rots and wilt	ornamental vegetables and orchard crop	Powder	Drench spray or through irrigation system	Ag Bio development Inc.,Westminster CO, USA
Rootsheild	*Trichoderma harzianum* Stain KRL	*Rhizoctonia,solani, Pythium, Fusarium*	Tree shrub ornamental vegetables	Granules or vegetable powder	Soil application as granules or drench	Biowors Inc., Genea, NY, USA
Bioject	*Pseudomonas aureofaciens*	Dollar spot, anthracnose, *pythium aphanidermatum*	Turf and others	Liquid	Overhead irrigation	Eco soil system san Diego, CA USA
Soil Gard	*Gliocladium virens* GL-21	Damping off and rot rot pathogen	Ornamental and food crop	Granules	Soil application	Certis Inc., Colombia MD, USA
Biosave	*Pseudomonas syringae*	*Botrytis* spp. *Penicillium, Mucor pyriformis*	Citrus, Pome Fruit, Cherries,	Lyophilized product, frozen cell pellets	Fruit tree drench, drip or spray	Village farm LLC, Longwood, FL, USA

essential for healthy growth and development of plant. Antagonist microorganism as biocontrol agents secreted substances which protect the plants against various pathogens, thus suppressing diseases by different mechanisms of action, induction of host resistance and direct antagonistic interactions between the biocontrol agent and the pathogen, leading to a more efficient use of biocontrol strategies to improve cropping systems (Kumari *et al.,* 2018).

Mechanism of diseases suppression through biocontrol agents: Biocontrol agents play wide role in disease suppression thus increasing growth parameter, plant content, and yield of crop. Diseases suppression can achieve through a number of ways such as, mycoparasitism, antibiosis, competition, cell wall degradation and induced resistance plant growth promotion and rhizosphere colonization capability. The most effective bio agent studied till date appears to antagonize pathogen using multiple mechanisms as in *Pseudomonas*, utilizing both antibiosis and induction of host resistance to suppress the disease causing microorganisms. It produces Phenazine and 2, 4-diacetyl-phloroglucinol (DAPG) displays improved capacities to suppress diseases in field grown wheat. Additional DAPG producers aggressively colonize roots that further contribute to increased disease suppression in the rhizosphere through competition. As the bioagent represents a living system, it needs to be mass produced and formulated into various commercial products in a way it remains viable for at least two years.

Growth and biomass parameter

Application of BCA like *Trichoderma harzianum* and *Bacillus brevis* effectively suppressed disease and also enhanced plant and root growth, leading to increased flower production and quality in bulb when tested separately and in combination against *F. oxysporum* f. sp. *tuberose*. (Nosir, 2016). *Trichoderma* spp. enhanced the plant growth, seed germination, nodulation in faba bean infected with charcoal rot caused by *Machrophomina phaseolina* by reducing the root rot severity (Kumari *et al.,* 2017). Plant Growth Promoting Rhizobacteria (PGPR) significantly increased the plant growth parameters when tomato seedlings were inoculated with four isolates of PGPR. *Paenibacillus polymyxa* also promote the growth and biological control of *M. javanica* in tomato crop under greenhouse conditions (Sohrabi *et al.,* 2018). Bio-control agents (*Trichoderma viride, Pseudomonas fluorescence* and combination of *T. viride* + *P. fluorescence*) significantly enhanced the growth (plant shoot and root length), biomass (fresh and dry weight of shoot and root) and Among the different bio-control agents used, combination of *T. viride* + *P. fluorescence* proved best in enhancing growth i.e. plant height (47.66 cm shoot and 12.8 cm root), biomass i.e. fresh weight (shoot 15.66g and root 0.74g) and dry weight (shoot 2.41g and root 0.16g). Growth of tomato was obtained with four different *Trichoderma* concentrations as treatments, viz., T1, 100 g/m^2; T2, 200 g/m^2 and T3, 300 g/m^2 and was conducted in randomized completely block design (RCBD) with four replications (Jamal Uddin *et al.,* 2015). Significant increase were recorded in germination percentage, root length, shoots length, fresh weight, dry weight of root and shoot, plant height, leaf area, by the use of brassinolide up to 1.5 ppm concentration (Bagdi *et al.,* 2017) (Table 2).

CONCLUSION

The Green Revolution in India which was heralded in the 1960's was a mixed blessing. Progressive use of agro-chemicals boosted food production but also destroyed the agricultural ecosystem. Of late Indian farmers and agricultural scientists have realized this and are anxious to find alternatives – perhaps a non-chemical agriculture – and have even revived their age-old traditional techniques of natural farming. Scientists are working to find economically cheaper and ecologically safer alternatives to agro-chemicals. Soil conservation, Green manure crops, Blue-Green Algae Biofertilizers, Earthworm Vermicomposts (Vermiculture), Crop rotation biological control of pests and herbal biopesticides are showing promise. Saline agriculture and sewage farming are also being promoted in India to augment food production in the face of water scarcity. There is a move to search for alternative foods, which are more nutritious, cheaper and have shorter harvest cycles. Farm and food policy in India has to change its outlook before there can be a second green revolution.

REFERENCES

Ahmad, N.; F. Hassan and G. Qadir. 2007. Effect of subsurface soil compaction and improvement measures on soil properties. *International Journal of Agriculture and Biology*, 9: 509–513.

Alam, A. 2014. Soil degradation: a challenge to sustainable agriculture. *International Journal of Agricultural Science Research*, 1(4): 50–55.

Bagdi, D.L.; S. Dabariya; G.K. Bagri; R. Kumari and D.K. Bagri. 2017. Effect of Brassinolide on Physio-Biochemical Traits, Growth and Yield of Barley (*Hordeum vulgare* L.) under Salt Stress. *Environment & Ecology,* 35(4A): 2872-2879.

Bharali, A.; K.K. Baruah; S.G. Baruah and P. Bhattacharyya. 2017. Impacts of integrated nutrient management on methane emission, global warming potential and carbon storage capacity in rice grown in a northeast India soil. *Environmental Science and Pollution Research*, 2017; https://doi.org/10.1007/s11356-017-0879-0.

Bhatti, M.T.; A.A. Anwar and M.A.A. Shah. 2019. Revisiting Telemetry in Pakistan's Indus Basin Irrigation System. *Water,* 11: 2315.

CSWCR&TI, Annual Report, Central Soil Water Conservation Research and Training Institute, Dehradun, 2012.

Fawusi, M.O.A. 1985. Influence of spatial arrangements on the growth: fruit and grain yields and yield components of intercropped maize and okra (*Abelmoschus esculentus*). *Field Crops Research*, 11: 345–352.

Gavilán, V.; M. Lillo-Saavedra; E. Holzapfel; D. Rivera and A. García-Pedrero. 2019. Seasonal Crop Water Balance Using Harmonized Landsat-8 and Sentinel-2 Time Series Data. *Water*, 11: 2236.

Jamal Uddin, A.F.M.; M.S. Hussain; S.K.S. Rahman; H. Ahmad and M.Z.K. Roni. 2015. Effect of *Trichoderma* concentrations on growth and yield of tomato. *Bangladesh Research Publications Journal*, 11(3): 228-232.

Kamanga, B.C.; G.Y. Kanyama-Phiri; S.R. Waddington; C.J. Almekinders and E. Giller. 2014. The evaluation and adoption of annual legumes by smallholder maize farmers for soil fertility maintenance and food diversity in central Malawi. *Food Security*, 6: 45–59.

Karad, G.U.; M.B. Viradiya; S.P. Deshmukh and S. Rajkumar. 2016. Long term effect of integrated nutrient management on yield and carbon mineralization under groundnut–wheat cropping system in medium black calcareous soil. *Environmental Conservation*, 22: 1465–1471.

Khola, O.P.S.; R.K. Dube and N.K. Sharma. 1999. Conservation and production ability of maize (*Zea* *mays*)-legume intercropping systems under varying dates of sowing. *Indian Journal of Agronomy*, 44(1): 40–46.

Kumari, R.; M.R. Khan; G.K. Bagri; D.K. Bagri and D.L. Bagdi. 2017. Soil application of different species of *Trichoderma* for the management of charcoal rot of faba bean caused by *Macrophomina phaseolina*. *Journal of Pharmacognosy and Phytochemistry*, 6(6): 1483-1486.

Kumari, R.; R. Ashraf; G.K. Bagri; S.K. Khatik; D.K. Bagri and D.L. Bagdi. 2018. Impact of seed treatment from bio-agents and fungicides on growth, biomass and yield of lentil (*Lens culinaris* Medik). *Journal of Pharmacognosy and Phytochemistry,* 7(3): 251-253.

Liu, Q.J.; H.Y. Zhang; J. An and Y.Z. Wu. 2014. Soil erosion processes on row sideslopes within contour ridging systems. *Catena*, 115: 11–18.

Mayer, A.; M. Rienzner; S. Cesari de Maria; M. Romani; A. Lasagna and A. Facchi. 2019. A Comprehensive Modelling Approach to AssessWater Use E_ciencies of Di_erent Irrigation Management Options in Rice Irrigation Districts of Northern Italy. *Water,* 11: 1833.

Munns, R. 2005. Genes and salt tolerance: bringing them together. *New Phytologist*, 167: 645–663.

Nosir, W. S. 2016. *Trichoderma harzianum* as a Growth Promoter and Bio-Control Agent against *Fusarium oxysporum* f. sp. *tuberosi*. *Advances in Crop Science and Technology,* 4: 217.

Ortuani, B.; A. Facchi; A. Mayer; D. Bianchi; A. Bianchi and L. Brancadoro. 2019. Assessing the E_ectiveness of Variable-Rate Drip Irrigation on Water Use E_ciency in a Vineyard in Northern Italy. *Water,* 11: 1964.

Selvam, S.A. 2015. Sustainable development in Indian agriculture. *Journal of Shanlax International Journal of Economics*, 4(1): 42.

Singh, D.K. and A.K. Singh. 2002. Groundwater situation in India: problems and perspective. *International Journal of Water Resources Development*, 18(4): 563–580.

Singh, K.; O.P. Choudhary and H. Singh. 2012. Effects of subsoiling on sugarcane productivity and soil properties. *Journal of Dairy Research*, 2(1): 32–36.

Singh, R.; H. Singh and A.S. Raghubanshi. 2019. Challenges and opportunities for agricultural sustainability in changing climate scenarios: a perspective on Indian agriculture. *Journal of Tropical Ecology*, 60(2): 167–185.

Singh, R.J.; I.P.S. Ahlawat and N.K. Sharma. 2015. Resource use efficiency of transgenic cotton and peanut intercropping system using modified fertilization technique. *International Journal of Plant Production*, 9(4): 523–540.

Singh, S.K. and P. Parihar. 2015. Challenges of sustainable agriculture development in India *Journal of Agroecology and Natural Resource Management*, 2(5): 355-359.

Singh, S.K. and P. Parihar. 2015. Challenges of sustainable agriculture development in India. *Journal of Natural Resource Policy Research*, 2(5): 355–359.

Sohrabi, F.; M. Sheikholeslami; R. Heydari; S. Rezaee and R. Sharifi. 2018. Evaluation of four *Rhizobacteria* on tomato growth and suppression of root-knot nematode, *Meloidogyne javanica* under greenhouse conditions, a pilot study. *Egyptian Journal of Biological Pest Control*, 28: 56.

Solé-Torres, C.; M. Duran-Ros; G. Arbat; J. Pujol; F. Ramírez de Cartagena and J. Puig-Bargués. 2019. Assessment of Field Water Uniformity Distribution in a Microirrigation System Using a SCADA System. *Water,* 11: 1346.

Sreekanth, M.; A.H. Hakeem; Q.J.P. Ahmed and I. Rashid. 2017. Low productivity of Indian agriculture with special reference on cereals. *Journal of Pharmacy and Pharmacology*, 6(5): 239–243.

Srinivasarao, Ch. *et al.* 2009. Carbon stocks in different soils under diverse rainfed production systems in tropical India. *Communications in Soil Science and Plant Analysis*, 40: 2338–2356.

Srinivasarao, Ch. *et al.*, 2009. Carbon sequestration strategies under rainfed production systems of India. CRIDA, Hyderabad, pp. 102.

Srinivasarao, Ch.; A.K. Indoria and K.L. Sharma. 2017. Effective management practices for improving soil organic matter for increasing crop productivity in rainfed agroecology of India. *Current Science*, 112: 1497–1504.

Srinivasarao, Ch.; B. Venkateswarlu; S. Dixit; S. Kundu and K. Gayatri Devi. 2011. Livelihood impacts of soil health improvement in backward and tribal districts of Andhra Pradesh, CRIDA, Hyderabad, pp. 1–119.

Srinivasarao, Ch.; K.L. Sharma and S. Kundu. 2020. Potential soil carbon sequestration in different land use management systems in peninsular India. In *Carbon Management in Tropical and Sub- Tropical Terrestrial Systems* (Ghosh, P. K. *et al.*), Springer Nature, 2020, pp. 3–21.

Srinivasarao, Ch.; R. Lal; S. Kundu; M.B.B. Prasad Babu; B. Venkateswarlu and K. Singh. 2014. Soil carbon sequestration in rainfed production systems in the semiarid tropics of India. *Science of the Total Environment*, 487: 587–603.

Srinivasarao, Ch.; S.C. Lakshmi; S.S. Kundu; R.G. Kumar, R. Manasa and S. Rakesh. 2020. Integrated nutrient management strategies for rainfed agro-ecosystems of India. *Indian Journal of Fertilisers*, 16(4): 344–361.

Subudhi, C.R. and R. Subudhi. 2018. Effect of contour bunding on yield of maize crop in north Eastern Ghat zones of Odisha. *International Journal of Agricultural Research*, 5(9): 19–20.

Venkatesh, M.S. *et al.* 2017. Long-term effect of crop rotation and nutrient management on soil–plant nutrient cycling and nutrient budgeting in Indo-Gangetic plains of India. *Archives of Agronomy and Soil Science,* doi:10.1080/03650340.2017.1320392.

Wicke, B. *et al.* 2011. The global technical and economic potential of bioenergy from salt-affected soils. *Energy & Environmental Science*, 4: 2669–2681.

Zhang, K.; B. Song and D. Zhu. 2019. The Development of a Calculation Model for the Instantaneous Pressure Head of Oscillating Water Flow in a Pipeline. *Water,* 11: 1583.

Zhang, K.; B. Song and D. Zhu. The Influence of Sinusoidal Oscillating Water Flow on Sprinkler and Impact Kinetic Energy Intensities of Laterally-Moving Sprinkler Irrigation Systems. *Water,* 11: 1325.

Zhang, X. and H. 2019. Khachatryan. Investigating Homeowners' Preferences for Smart Irrigation Technology Features. *Water,* 11: 1996.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 312-320

Impact Analysis of KVK Activities on Production and Productivity of *Kharif* Season Crops in Jammu District

Kartik Kumar[1], Rakesh Sharma[2]*, Rajinder Peshin[3] and Anil Bhat[4]
[1]M.Sc. Student, [2]Associate Professor, Agricultural Extension Education, SKUAST- Jammu
[3]Professor & Controller Examination, SKUAST-Jammu
[4]Assistant Professor, Agricultural Economics & ABM, SKUAST-Jammu

ABSTRACT

The study was conducted in Jammu district of Jammu and Kashmir UT to analyse the impact of KVK activities on production and productivity of k*harif* season crops in Jammu district. The total sample size for the study was 150. There was significant difference in the productivity of rice, maize and sorghum crops before and after intervention in the KVK adopted villages. There was significant difference in the productivity of maize, mash and sorghum crops between KVK adopted villages and non-adopted villages. The significant change in production and productivity of the farmers of KVK trained villages was due to high adoption of technologies namely application of Urea, DAP, MoP, FYM, herbicides, insecticide and fungicides was in rice, maize, mash and sorghum by the KVK trained farmers whereas in non-adopted villages it was low to medium. Significant difference in the adoption index of recommended technologies adopted by the farmers in rice, maize, mash and sorghum in KVK adopted villages and non-adopted villages. Factors that significantly affected the adoption of recommended technologies were participation in the training programme organised by the KVK, distance of the farmers' villages from KVK, distance from market and farming experience.

Keyword: Impact, Adoption, *Kharif crops*, Recommended technologies

INTRODUCTION

Agriculture is fastest growing sectors in India economic sector. Agriculture progress is intimately connected to national progress. In a country where over half of the population lives in villages and where agriculture and allied sectors (including agriculture, livestock, forestry, and fisheries) are estimated to generate nearly 13.9 per cent of national GDP and 17 per cent of Gross Value added (GVA) in 2017 (at 2011-12 prices) and employ nearly half of the workforce (Chowdappa *et al.*, 2018). In the past decade, research has made major contributions in all sectors. However, there is still a gap between efficient better agricultural technologies, and the improved agricultural technologies now accessible cannot be effectively used for increasing output speed until this gap is closed. This should be of great importance to both government and non-government organisations interested in agricultural development. Krishi Vigyan Kendras (Agricultural Science Centres) were recommended by the Indian Council of Agricultural Research (ICAR) as an innovative institution for providing vocational training to practising farmers, school dropouts, and field level extension employees. The ICAR standing committee on agricultural education stated in 1973 that the establishment of KVK was of national importance since it would increase agricultural production and improve the socio-economic status of farmers. Under the supervision of the Tamil Nadu agriculture university in Coimbatore, the first KVK was established in Pondicherry in 1974. The KVK was significant on a national level since it would help farmers' socioeconomic conditions and provide self-employment options to the growing rural population. KVKs are in the best position to discover field difficulties, define field conditions, and then apply evidence-based "pressure" to national agricultural research, state research centres, and the complete

*Corresponding author email id: sharmar1975@gmail.com

network of fellow KVKs. In short, KVK will help NARS as a whole become more important and useful in the community (Katole *et al.,* 2017). After KVKs transferred technology, the area under cropping, this includes cereals, pulses, and horticulture produce, increased by 74.58 per cent, and crop yield and productivity increased to a modest 8.37 per cent at the national level over the last five years. KVK Jammu was established in 1992 with the sustained and sincere efforts of its scientist and workers, Krishi Vigyan Kendra, Jammu has been able to motivate farmers to develop various agro- vocational enterprises' from 1992-2021. As a horizontal multiplier effect, the KVK trained farmers are now imparting training to various fellow farmers. India has numerous growing seasons, due of the long-term presence of high temperatures. The following are the different crop seasons viz., *kharif, rabi and zaid.* The present study was conducted to assess the impact of KVK activities on production and productivity of *kharif* season crops of Jammu district. The *Kharif* season varies by crop and area, although it generally begins in May and ends in January. In Jammu, the season is traditionally said to begin in June and last in October. The main *Kharif* crops of the Jammu region are paddy, maize, pulses, vegetables and fodder, covering 78 per cent of the net sown area. Many projects/programme being run by the KVK- Jammu for enhancing the productivity of the farm that results in increased farm income. Frontline demonstration (FLDs) of crops, enterprises was conducted in an area of 420.55 ha on 2008 farmer's fields in the last five years. 46 on-farm testing (OFTs) were laid out by KVK on 194 farmer's fields in the last five years. Therefore the present study entitled was undertaken to find out Impact Analysis of KVK activities on Production and Productivity of *kharif* season crops in Jammu district.

MATERIALS AND METHODS

The study was carried out in Jammu district of Jammu and Kashmir Union Territory. Five clusters namely R.S Pura, Nagrota, Bhalwal, Akhnoor and Bishnah in which maximum number of KVK extension activities were carried out from 2018-20 were selected. KVK adopted villages Samka, Kaloian, Deoli, Kotla, Garkhal, GurahManahsa, Jandiyal, and Katta Battal were selected purposively as the maximum numbers of activities were carried out in these villages. To avoid the potential diffusion effect, villages in the control group were chosen 5 kilometres apart from cluster villages, namely Badyal Qazian, Ratnal, Bathera, Gharota, and Dmuni. A total of 100 farmers were selected from selected five clusters. Besides, 50 farmers were selected from nearby villages located 5 km away from selected clusters villages. Therefore, the total sample size for the study was 150. The data were analysed with the help of suitable statistical measures such as frequencies, percentages, mean, standard deviation, Singh cube root method, adoption index, two sample't' test, paired't' test and linear regression model.

RESULTS AND DISCUSSION

The average age of the farmers of KVK adopted villages was 54.55 ± 11.05 year whereas; in case of farmers of non-adopted villages it was 52.62 ± 13.39 year. Maximum percentage of the farmers 47.00 per cent and 44.00 per cent of KVK adopted and non-adopted villages fall between 46 to 63 years old age categories. Age of respondents in KVK adopted villages ranged between of 27 to 80 whereas in case of respondents of non-adopted villages 28 to 88 (Table 1). This highlighted that in farming activities, middle and elderly farmers were chosen over young farmers. In comparison to farming, the youth were more interested in government careers, business, and other occupations. The findings are consistent with those of Indumathy *et al.* (2013) and Medhi *et al.* (2020). Finding also showed that majority i.e. 56 per cent and 44 per cent of the farmers in KVK adopted villages and non- adopted villages had formal education up to 'matriculation' level followed by 19 per cent and 28 per cent of the respondents of KVK adopted villages and non-adopted villages had formal education up to 'middle level', nine per cent of farmers in KVK adopted villages and eight per cent of farmers in non-adopted villages had formal education up to '10+2', three per cent and six per cent of KVK adopted villages and non-adopted villages farmers had formal education up to 'primary' level and two per cent of the KVK adopted villages farmers had formal education up to ' post graduate' level. The percentage of illiterate respondents of KVK adopted villages and non-adopted villages were 11 per cent and 12 per cent, respectively. This suggests that farmers of both group villages in the research area had a medium to high level of education, perhaps this was the reason that more and more training programme were attended by the

Table 1: Descriptive statistics regarding socio-economic profile of the sampled farmers

Parameters	KVK adopted villages (n=100)	Non-adopted villages (n=50)	t-value	p-value
Mean age (years)	54.55 ±11.05	52.62 ±13.39	0.93	0.35
Categorization of age				
Below 46 years	25(25)	18(36)		
46-63 years	47(47)	22(44)		
Above 63 years	28(28)	10(20)		
Mean education (formal number of schooling years completed)	8.27 ± 3.35	7.94± 3.39	0.56	0.57
Education level (% farmers)				
Illiterate	11	12		
Primary	03	06		
Middle	19	28		
Matriculation	56	44		
10+2	09	08		
Graduate and above	02	00		
Mean farming experience (years)	28.35 ± 8.64	29.92 ±14.75	0.81	0.41
Average operational land holding (ha)	1.39 ± 1.10	1.16 ± 0.65	1.33	0.18
Average owned land (ha)	1.19 ± 0.89	1.16	± 0.65	
Average leased in (ha)	0.20 ± 0.53	0.00		
Categorization of farm size				
Marginal (<1ha)	50	44		
Small (1-2 ha)	27	34		
Semi-medium (2- 4 ha)	17	22		
Medium (4-10 ha)	06	00		
Average distance of village from the nearest market (km)	5.55 ± 3.41	5.76 ± 4.50	0.30	0.76
Average distance of village from the nearest seed store (km)	4.82 ± 1.92	5.56 ± 4.28	1.44	0.15
Average distance of village from the pesticide shop (km)	4.24 ± 2.35	5.36 ± 4.32		
Average distance of village from KVK (km)	40.40±21.3	35.6±19.15	1.34	0.18
Extension contact (% farmers)##				
KVK scientist	49	00		
Agriculture department	37	06		
Progressive farmers	29	08		

±: Standard deviation, ##: Multiple contacts

farmers and followed the scientific production technique and adopted them. The findings are accompanied by findings of Natraju *et al.* (2013) and Nath *et al.* (2017).

In land holding, the average operational land holding of the KVK adopted villages was 1.39 ha while in non-adopted villages it was 1.16 ha. The average owned land holding was 1.19 ha in KVK adopted villages and 1.16 ha in case of non-adopted villages. Average leased in land in KVK adopted villages was 0.20 ha where there is no leasing in was done by the farmers of non-adopted villages. The reason for the higher operational land holdings could be that the practice of leasing out agricultural land is almost negligible as agriculture is the primary occupation of the majority of the respondents. The findings are in line with the findings of Mahajan (2020). About 50 per cent of KVK adopted villages and 44 per cent farmers' non-adopted villages belonged to marginal land holding of less than 1 ha, reason of farm size decreases as a result of their forefathers' land inheritance. The findings are accompanied by findings of Venkatesan and Sundaramari (2012); Sulaja *et al.* (2013) and Medhi *et al.* (2020). The average farming experience of KVK adopted farmers was 28.35±8.64 whereas in case of non-adopted villages farmers had farming experience 29.92±14.75 which belongs to more than 20 years of farming experience. The reasons may be that both of the groups respondents were having agricultural background and living in villages and majority of the farmers from both KVK adopted and non-adopted villages belonged to the marginal land holding group i.e. land holdings of less than 1.0 ha, and the majority of the farmers were only educated up to high school, hence the majority of the respondents had medium experience. The findings are accompanied by findings of Venkatesan (2013) and Vekariya *et al.* (2017). About 49 per cent of the KVK adopted villages respondent had contact with KVK scientist, 37 per cent KVK adopted villages farmers and six per cent non-adopted farmers had contact with agricultural department and 29 and eight per cent had contact with progressive farmers in KVK adopted and non-adopted villages farmers, respectively. The high level of extension contact between farmers of KVK scientists and agricultural department was due to the fact that they were their primary source of information about modern agricultural techniques and provided information about hybrid seed, encouraging them to adopt these newly released varieties and technologies. The conformity of the study was with the finding of Patil *et al.* (2019). The average distance of the villages from the nearest market was 5.55 kilometers in KVK adopted villages whereas from non-adopted villages 5.76 km, distance from seed store was 4.82 and 5.56 km, while from pesticide shop 4.24 and 5.36 km in KVK adopted villages and non-adopted villages, respectively. Average distance of villages from KVK was 40.4 km in case of KVK adopted villages and 35.6 km in non-adopted villages. The maximum distance between the study region and Krishi Vigyan Kendra was due to the KVK being placed at distant from the sample villages. Markets, seed stores, and pesticide stores, on the other hand, were not far away due to their extensive network in the research area. The conformity of the study was with the finding of Bagal (2014).

The data in the Table 2 present the area and productivity of different *kharif* crops in KVK adopted villages. In rice, total area covered by farmers before intervention were 79.85 ha whereas after intervention it was 80.00 ha. Productivity of rice before intervention was 30.13 quintal per hectare while after intervention it was 34.69 q/ha in KVK adopted villages. Before and after per cent difference in area and productivity of rice was 0.18 and 15.13 per cent, respectively. There was no significant per cent difference observed in area of rice (t=0.15). But significant per cent difference was observed in productivity of rice (t=3.28). In maize, total area covered by farmers before intervention were 41.85 ha whereas after intervention it was 43.20 ha. Productivity of maize before intervention was 16.77 q/ha while after intervention it was 35.82 q/ha in KVK adopted villages. Before and after per cent difference in area and productivity of maize was 3.22 and 113.59 per cent, respectively. There

Table 2: Area and productivity of different crops in KVK adopted villages

Crop	Before		After		% difference	
	Area (ha)	Productivity (q/ha)	Area (ha)	Productivity (q/ha)	Area	Productivity
Cereal Crop						
Rice	79.85	30.13	80.00	34.69	0.18(0.155)	15.13*(3.28)
Maize	41.85	16.77	43.20	35.82	3.22(0.366)	113.59**(4.68)
Fodder crop						
Sorghum	7.70	31.80	8.50	45.53	10.38(1.838)	43.17**(5.90)
Pulse crop						
Mash	2.20	6.39	4.35	7.55	97.72(0.513)	18.33(1.87)

Figures in the parenthesis are significant t value, *: Deviation significant at $p<0.05$, ** Deviation significant at $p<0.01$

was no significant per cent difference observed in area of maize in before and after intervention (t=0.36). But significant per cent difference was observed in productivity of maize (t=4.68). The findings were consistent with the findings of Sharma *et al.* (2019).

In sorghum, total area covered by farmers before intervention were 7.70 ha whereas after intervention it was 8.50 ha. Productivity of sorghum before intervention was 31.80 q/ha while after intervention it was 45.53 q/ha in KVK adopted villages. Before and after per cent difference in area and productivity of sorghum was 10.38 and 43.17 per cent, respectively. There was no significant per cent difference observed in area (t=1.83) whereas there was significant per cent difference observed in productivity (t=5.90) of sorghum in before and after intervention of KVK adopted villages. Finding of the study was in line with the study of Shankar *et al.,* (2019). The total area covered under mash by farmers before intervention was 2.20 ha whereas after intervention area under mash was 4.35 ha. Productivity mash before intervention was 6.39 q/ha while after intervention productivity was 7.55 q/ha. Before and after per cent difference in area and productivity of mash was 97.72 and 18.33 per cent, respectively. There was no significant per cent difference observed in area (t=0.51) and productivity (t=1.87) of mash in before and after intervention of KVK adopted villages. Finding of the study was in line with the study of Devi *et al.* (2017) and Kothyari *et al.* (2018).

Table 3 present the area and productivity of different cereal crops in KVK adopted villages. In rice, total area covered by farmers in KVK adopted villages were 80.00 ha whereas in non-adopted villages it was 38.30 ha. Productivity of rice in KVK adopted villages was 34.69 quintal per hectare while in non-adopted villages it was 25.60 q/ha in KVK adopted villages. The per cent difference in productivity of rice was 35.50 per cent, respectively. There was no significant per cent difference observed in productivity of rice (t=0.20) in KVK adopted and non-adopted villages.

In maize, total area covered by farmers in KVK adopted villages were 43.20 ha whereas in non-adopted villages it was 16.64 ha. Productivity of maize in KVK adopted villages was 35.82 q/ha while non-adopted villages it was 23.31 q/ha in KVK adopted villages. The per cent difference in productivity of maize was 53.36 per cent. There was significant per cent difference was observed in productivity of maize (t=3.23). The total area covered under mash by farmers of KVK adopted villages was 4.35 ha whereas in non-adopted villages area under mash was 0.95 ha. Productivity mash KVK adopted villages was 7.55 q/ha while in non-adopted villages productivity was 7.27 q/ha. The per cent difference of productivity of mash was 3.85 per cent. There was significant per cent difference observed in productivity (t=2.22) of mash in KVK adopted villages and non-adopted villages. In sorghum, total area covered by farmers of KVK adopted villages was 8.50 ha whereas in non-adopted villages it was 1.82 ha. Productivity of sorghum in KVK adopted villages was 45.53 q/ha while in non-adopted villages it was 37.48 q/ha in KVK adopted villages. The per cent difference of productivity of sorghum was 13.03 per cent. There was significant per cent difference observed in productivity (t=2.84) of sorghum in KVK adopted villages and non-adopted villages.

Table 3: Comparison of area and productivity of different crops between KVK adopted and non-adopted villages

Crop	**KVK adopted villages**		**Non-adopted villages**		**% difference**
	Area (ha)	**Productivity (q/ha)**	**Area (ha)**	**Productivity (q/ha)**	**Productivity**
Cereal crop					
Rice	80.00	34.69	38.30	25.60	35.50(0.20)
Maize	43.20	35.82	16.64	23.31	53.36*(3.23)
Pulse crop					
Mash	4.35	7.55	0.95	7.27	3.85*(2.22)
Fodder crop					
Sorghum	8.50	45.53	1.82	37.48	13.03*(2.84)

Figures in the parenthesis are significant t value, *: Deviation significant at $p<0.05$.

Table 4: Extent of adoption of technologies by farmers on the basis of level of adoption in cereal crops (% farmers)

Cereal crops	KVK adopted villages	Non-adopted villages
Rice		
Low	08.00	38.00
Medium	45.00	56.00
High	47.00	06.00
Maize		
Low	06.00	34.00
Medium	38.00	37.00
High	56.00	29.00
Mash		
Low	12.00	36.00
Medium	42.00	48.00
High	46.00	16.00

The data in Table 4 shows the extent of adoption of technologies by farmers on the basis of level of adoption in *kharif* crops. In rice, eight per cent of the farmers had low adoption of technologies whereas 45 per cent of the farmers had medium adoption and 47 per cent had high level of adoption of technologies in KVK adopted villages while in non-adopted villages 38 per cent of the farmers had low, 56 per cent medium and six per cent of the farmers had high level of adoption of technologies. In maize, overall six per cent of the farmers had low adoption of technologies whereas 38 per cent of the farmers had medium adoption and 56 per cent had high level of adoption of technologies in KVK adopted villages while in non-adopted villages 34 per cent of the farmers had low, 37 per cent medium and 29 per cent of the farmers had high level of adoption of technologies.

In mash, overall 12 per cent of the farmers had low adoption of technologies whereas 42.00 per cent farmers had medium adoption and 46 per cent had high level of adoption of technologies in KVK adopted villages while in non-adopted villages 36 per cent of the farmers had low, 48 per cent had medium and 16.00 per cent farmers had high level of adoption of technologies.

The data in the Table 5 presents the adoption index of the recommended technologies adopted by farmers in different crops. In rice, average adoption index of

Table 5: Adoption index of recommended technologies adopted by farmers of KVK adopted villages and non-adopted villages

Crop	KVK adopted villages	Non-adopted villages	t-value
Rice	54.11	45.33	6.77**
Maize	50.77	36.88	4.47**
Sorghum	30.66	16.00	7.39**
Mash	55.81	35.55	3.578**

*: Deviation significant at $p<0.05$; **: Deviation significant at $p<0.01$

the technologies was 54.11 per cent in KVK adopted villages whereas in non-adopted villages it was 45.33 per cent. There was significant difference observed in adoption index of technologies adopted by farmers in rice crop in KVK adopted villages and non-adopted villages (p=0.000). In maize, average adoption index of the technologies adopted by farmers in KVK adopted villages was 50.77 per cent while, it was 36.88 per cent in non-adopted villages. There was significant difference observed in adoption of technologies by maize growers in KVK adopted villages and non-adopted villages.

In sorghum, average adoption index of the technologies adopted by farmers in KVK adopted villages was 30.66 per cent while, it was 16.00 per cent in non-adopted villages. There was significant difference observed in adopted index of technologies adopted by farmers in sorghum crop in KVK adopted villages and non-adopted villages (p=0.000). In mash, average adoption index of the technologies adopted by farmers in KVK adopted villages was 55.81 per cent while, it was 35.55 per cent in non-adopted villages. There was no significant difference observed in adoption of technologies by mash growers in KVK adopted villages and non-adopted villages (p=0.00).

To identify the factors affecting adoption of technologies in different crops, age, education, family size, land holding, land fragmentation, fragments, extension contact, training, occupation, farming experience and distance of villages from different places such as market, pesticide shop, seed store, and KVK variables were selected for the study.

In the Table 6, the model applied has F value=33.07 which was significant at p=0.00. The result

Table 6: Socio-Economic factors affecting adoption of technologies in different crops

Crop	Variable	Coefficient(B)	S.E.	t- value	p-value	Model Summary
Rice	Constant	21.30	3.86	13.27	0.00	R^2=0.30; d.f=121
	Training	23.65	3.44	6.87	0.00	F=33.07; p=0.00
	Distance from KVK	-0.16	0.07	2.12	0.03	
Maize	Constant	45.04	4.72	9.53	0.00	R^2=0.11; d.f=106
	Distance from KVK	0.19	0.08	2.27	0.02	F=4.65; p=0.00
	Distance from market	1.25	0.58	2.12	0.03	
	Agriculture+business	-19.38	7.60	2.54	0.01	
Sorghum	Constant	27.37	4.28	6.38	0.00	R^2=0.24; d.f=123
	Training	12.25	2.75	4.44	0.00	F=12.71; p=0.00
	Agriculture + labour	-10.79	3.47	3.10	0.00	
	Farming experience	-0.24	0.12	1.99	0.04	
Mash	Constant	47.46	6.77	7.00	0.00	R^2=0.22; d.f=63
	Training	19.65	4.58	4.28	0.00	F=11.50; p=0.00
	Distance from KVK	-0.30	0.13	2.32	0.01	

shows that R^2 value was 0.30 which indicate that there is 30 per cent variation in adoption of technologies in rice crop was explained by variables selected for the analysis. The variable Training (p=0.00) and distance from KVK (p=0.03) significantly affected the adoption of technologies by farmers in rice crop. It was observed that, a unit increase in training, increases adoption of technologies by 23.65 per cent whereas a unit decrease in distance of villages from KVK adoption of technologies decreases by 0.16 per cent in rice crop.

The model applied has F value= 4.65 which was significant at p=0.00. The result shows that R^2 value was 0.11 which indicate that there is 11 per cent variation in adoption of technologies in maize crop was explained by variables selected for the analysis. The variable distance from KVK (p=0.02), distance from market (p=0.03) and agriculture+business (p=0.01) significantly affected the adoption of technologies by farmers in maize crop. It was observed that, a unit increase in distance from KVK and market, increases adoption of technologies by 0.19 and 1.25 per cent, respectively. A unit decrease in agriculture+business adoption of technologies decreases by 19.38 per cent in maize crop.

The model applied has F value= 12.71 which was significant at p=0.00. The result shows that R^2 value was 0.24 which indicate that there is 24 per cent variation in adoption of technologies in sorghum crop was explained by variables selected for the analysis. The variable training (p=0.00), agriculture + labour (p=0.00) and farming experience (p=0.04) significantly affected the adoption of technologies by farmers in sorghum crop. It was observed that, a unit increase in training, increases adoption of technologies by 12.25 per cent. One unit decrease in agriculture+labour, adoption of technologies decreases by 10.79 per cent in sorghum crop (Table 6).

The model applied has F value= 11.50 which was significant at p=0.00. The result shows that R^2 value was 0.22 which indicate that there is 22 per cent variation in adoption of technologies in mash crop was explained by variables selected for the analysis. The variable training (p=0.00) and distance from KVK (p=0.01) significantly affected the adoption of technologies by farmers in mash crop. It was observed that, one unit increase in training, increases adoption of technologies by 19.65 per cent whereas one unit decrease in distance of villages from KVK adoption of technologies decreases by 0.30 per cent in mash crop.

CONCLUSION

It is concluded on the basis of findings that before KVK intervention, total area covered by rice, maize, mash and sorghum was 79.85, 41.85, 2.20 and 7.70 ha with productivity 30.13, 16.77, 6.77 and 31.80 q/ha respectively. Whereas after KVK intervention, total area covered by rice, maize, mash and sorghum was 80.00, 43.20, 4.35 and 8.50 ha with productivity 34.69, 35.82, 7.55 and 45.53q/ha respectively. There was significant difference in the productivity of rice, maize and sorghum before and after intervention. The productivity of rice, maize mash and sorghum was 25.60, 23.31, 7.27, and 37.48q/ha. There was significant difference in the productivity of maize, mash and sorghum in KVK adopted villages and non-adopted villages. The significant change in production and productivity of the farmers of KVK trained villages was due to high adoption of technologies namely application of Urea, DAP, MoP, FYM, herbicides, insecticide and fungicides was in rice, maize, mash and sorghum whereas in non-adopted villages it was low to medium. There was significant difference in the adoption index of recommended technologies adopted by the farmers in rice, maize, mash and sorghum in KVK adopted villages and non-adopted villages. Adoption index of recommended technologies adopted by the farmers in rice, maize, mash and sorghum was 54.11, 50.77, 55.81 and 30.66 in KVK adopted villages while in non-adopted villages 45.33, 36.88, 35.55 and 16.00 respectively. Factors that significantly affected the adoption of recommended technologies were training, distance from KVK, distance from market and farming experience.

REFERENCES

Bagal, Y.S. 2016. *Utilization of Communication Sources by Wheat Growers of Samba district*. M.Sc. thesis, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, J&K, India.

Chowdappa, P.; T.S. Manojkumar; S. Leena and J. George. 2018. *ICAR-Krishi Vigyan Kendra Kasaragod: A Journey with the Farmers*. ICAR- Central Plantation Crop Research Institute, Kadaragod, Kerela, India. P 164.

Devi, M.G.; C.A. Kumar and D.S. Kumar. 2017. Impact analysis of trainings and front line demonstrations in Black Gram (Vigna mungo) cultivation. *Integrated pest management*, 6(1): 97-100.

Indumathy, K.; P.M. Manoharan; S. Sangeetha and M.V.K.J. Mary. 2013. Relationship between socio-psychological characteristics and attitude of Jawadhu tribes towards tribal development programmes. *Journal of Extension Education,* 25(4): 5154-5159.

Katole, S.B.; J.H. Bhatt and G.G. Patel. 2017. Impact analysis of activities of Krishi Vigyan Kendra. *Gujarat Journal of Extension Education*, 28(2): 267-270.

Kothyari, H.S.; K.C. Meena; B.L. Meena and R. Aseray. 2018. Evaluation of cluster front line demonstration on black gram in Sawai Madhopur district of Rajasthan, India. *International Journal of Current Microbiology and Applied Science*, 7(1): 1569-1573.

Mahajan, R. 2020. *Impact Evaluation of Public and Private Sector Interventions on Basmati Rice Production in Jammu District.* M.Sc. thesis, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, J&K, India.

Medhi, S.; A.K. Singha; R. Singh and R.J. Singh. 2020. Socio-economic, psychological profile and constraints faced by the KVK adopted farmers for improved rice cultivation in west Garo Hills District. *Economic Affairs*, 65(3): 379-388.

Meshram, S.G.; E. Kahya; C. Meshram; M.A. Ghorbani; B. Ambade and R. Mirabbasi. 2016. Long-term temperature trend analysis associated with agriculture crops. *Theoretical and Applied Climatology*, 140(3): 1139-1159.

Nataraju, M.S.; S.M. Raghavendra and R. Shashidhar. 2013. Women empowerment through national afforestation programme in Karnataka. *Journal of Extension Education,* 25(3): 5069-5077.

Nath, D.; P.K. Jain; R.K. Talukdar and B.S. Hansra. 2017. Performance of KVKs in north eastern region of India under different administrative units. *International Journal of Agriculture Sciences*, 9(39): 4589-4593.

Patil, N.G.; J.V. Ekale and S.P. Dhoke. 2019. Study profile of beneficiaries and non-beneficiaries of KVK. *International Journal of Chemical Studies*, 7(5): 3390-3392.

Shankar, K.R.; G. Nirmala; K. Nagasree; P.K. Pankaj; J. Samuel; K. Sindhu; B.M.K. Raju; S.V. Kumar and G.R. Chary. 2019. Adoption outcomes of Krishi Vigyan Kendra, Central Research Institute for Dry land Agriculture Technologies by farmers in South India. *Asian Journal of Agricultural Extension, Economics & Sociology*, 37(4): 1-13.

Sharma, R.; P. Choudhary and V. Tandon. 2019. Initiatives of Krishi Vigyan Kendra (KVK) in doubling of farmers income: A case study of village Sagoon, Jammu. *Journal of Community Mobilization and Sustainable Development,* 14(3): 379-383.

Sulaja, O.R.; S. Bhaskaran and J.S. Minimol. 2013. Training impact on entrepreneurs' characteristics. *Journal of Extension Education,* 25(4): 4905-4906.

Tarai, R.K.; G. Prasad; G.R. Sahoo; T.R. Das; L. Mallik; T. Majhi and M. Jena. 2015. Role of KVK, Kalahandi for enhancing income and productivity of small and marginal farmers. *International Journal of Scientific Research and Engineering Studies*, 2(9): 21-25.

Vekariya, S.J.; R. Kumar; H.H. Savsani; C.R. Kotadiya; G.M. Chaudhari and B.B. Chatrabhuji. 2016. Socio-economic profile of Maldhari dairy farmers of south Saurashtra region. *Young*, 17: 14-17.

Venkatesan, P. 2013. Training needs of cotton growers in Dindigul district. *Journal of Extension Education*, 25(3): 5099-5104.

Venkatesan, P. and M. Sundaranari. 2012. Socio-economic correlate with perceived effectiveness of Indigenous tribal agricultural practices. *Journal of Extension Education*, 24(3): 4823-4826.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 321-326

Utilization Pattern of ICT Tools Among Farm Women in Uttarakhand

Shivani Jha[1]* and S.K. Kashyap[2]
[1]Ph.D. Scholar, Punjab Agricultural University, Ludhiana, Punjab
[2]Dean, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand

ABSTRACT

ICT tools are the new tools used for gathering latest information. A study was carried out to find the utilization pattern of ICT tools among farm women of tarai region of Uttarakhand during 2019-2020. The data were collected from 120 respondents using structured interview schedule, as personal interview schedule reduces the bias of respondents and help in collection of credible data. Findings revealed that majority of the farm women (79.16%) used the Mobile daily once or twice. Television was watched by farm women (61.66%) daily once or twice. Most of the farm women used ICT tools for general purpose than agriculture purpose. Hence, concerted efforts like; formal education of ICT tools, easy access and usage, cost effectiveness measures, etc. have to be made by the policy makers, administrators and academicians concerned to make necessary improvements in planning and implementing ICTs strategies, so that farm women must be made aware of use of ICT tools and promote interest among them for its optimum agriculture use. Study also revealed that Education, Annual family income, Media ownership and Social participation with their extent of use of ICT tools had positive and significant correlation at 0.01 level of probability.

Keywords: Farm women, ICT tools, Utilization pattern

INTRODUCTION

Agriculture is the base of Indian economy. About 70 per cent population lives in village out of which primarily 47 per cent workforce is in agriculture (FAO, 2011). Thus, we can say that Indian economy is primarily an agrarian economy. Agriculture is a basic driver of economic growth and poverty reduction for many developing countries. Mishra and Sundaram (1970) said that agriculture is the largest livelihood provider in community life and occupationally it is highly dependent on various cropping system, animal husbandry and allied sectors. ICT tools aims to improve the lives of farm household especially in the rural areas by providing them the appropriate and relevant information. Traditionally the extension services have focused on male farmers. In the last few decades the concern regarding farm women have been raised globally. Farm women play an important and crucial role in agricultural development. Agriculture sector employs 80 per cent of all economically active women out of which 33 per cent constitute the agriculture labour force and 48 per cent are self-employed (OXFAM, 2018). Around 70 per cent of all women engaged in cultivation are from households witnessing migration (NSSO, 2013). According to The State of Food and Agriculture (FAO, 2011), "women comprise, on average, 43 per cent of the agricultural labour force in developing countries, ranging from 20 per cent in Latin America to 50 per cent in Eastern Asia and Sub-Saharan Africa". Information and Communication Technology (ICT) is for everyone and women have to be an equal beneficiary to the advantages offered by the technology, and the products and processes, which emerge from its use. The benefits of the information provided by ICT tools, need not be restricted to the upper strata of the society but have to freely flow to all segments of the society. Information and Communication Technology (ICT) include technologies

*Corresponding author email id: jha.shivani123@gmail.com

that give access to information through communication (Khan *et al.*, 2012). ICTs in agriculture have the potential to facilitate greater access to information that drive or support knowledge sharing. ICTs essentially facilitate the creation, management, storage, retrieval, and dissemination of any relevant data, knowledge, and information that may have been already processed and adapted (Bachelor, 2002; Chapman and Slay Maker, 2002; Rao, 2007; Heeks, 2002). ICT is defined as the technology which covers any product that stores, retrieves, manipulates, transmits or receives information electronically in a digital form. ICT stands for information and communication technology and is sometimes used both as singular and plural nouns. It is used almost synonymously with IT or information technology (Garai and Shadrach, 2006). The real challenge of the information era is not producing information or storing information, but rather getting people to use the information (Annor-Frempong and Edumadze, 2009). Keeping in view the above facts and importance, the study was conducted with the objective to assess the ICT tools utilization pattern among farm women of tarai region Uttarakhand.

MATERIALS AND METHODS

The study was carried out in Udham Singh Nagar district of Uttarakhand state out of which two blocks were selected randomly i.e. Rudrapur and Kashipur by following Simple Random Sampling without replacement method. From each block, two villages were selected randomly. Kolaria and Chhatarpur were selected from Rudrapur block and Gopipura and Chandpur were selected from Kashipur block. Data were collected from each of 120 selected farm women as respondent with help of interview schedule. Statistical techniques used in data analysis include: frequency, percentage, mean, Standard deviation, correlation and Garett ranking.

Empirical data were tabulated and analyzed with the help of appropriate statistical tools using Statistical Package for Social Sciences (SPSS). Under Utilization pattern there were three components measured i.e.; Accessibility of ICT tools, Extent of use of ICT tools, Purpose of ICT use in agriculture and for general purpose. Extent of use of ICT tools was dependent variable in the study. The responses of farm women were obtained on five-point continuum scale in case of extent of use of ICT tools as Daily (Once or twice), Weekly (Once or twice), Monthly, whenever needed, never and scores were given as 4, 3, 2, 1 and 0, respectively. After that frequency was multiplied with the score (4, 3, 2, 1 or 0).

RESULTS AND DISCUSSION

Results of the study are presented and discussed under broad headings as accessibility of ICT tools, extent of use of ICT tools, purpose of ICT use in agriculture, utilization of ICTs by the respondents for General purpose and relationship between socio-economic and communication characteristics with extent of use of ICT tools. Its time of ICT as lots of information can be obtained in various fields using different ICT tools. But it doesn't mean that one should own ICTs. Important is the access to ICTs may be own or others as with family members, neighbor, friends, ICT centers, school, college or any other sources.

Table 1: Distribution of respondents according to their access to ICT tools

Tools	Yes	No
Mobile	120(100%)	0
Television	86(71.66%)	34(28.33%)
Radio	19(15.83%)	101(84.16%)
Computer	10(8.33%)	110(91.66%)
Internet	45(37.5%)	75(62.5%)

The information regarding access to ICTs presented in Table 1 reveals that all the respondents (100%) have access to Mobile Phone whereas 86 per cent of respondents have access to Television followed by 19 per cent respondents also had access to radio. Further, 45 per cent respondents had access to internet and 10 per cent respondents had access to computer.

Data in Table 2 depict that 79.16 per cent of the respondents were using Mobile daily whereas 61.66 per cent of respondents watched Television daily and 12.5 per cent of respondents used internet daily whereas only 1.66 per cent of respondents used radio daily. Computer was not used by majority of the respondents as not many respondents were having access to it. The respondents having access to computer and internet were using it mostly weekly/fortnightly/ monthly and very less percentage of respondents were using it daily

Table 2: Distribution of respondents according to extent of use of ICT tools

Tools	Daily (Once or twice)	Weekly (Once or twice)	Monthly	Whenever needed	Never
Mobile	95(79.16%)	25(20.83%)	0	0	0
Television	74(61.66%)	32(26.66%)	10(8.33%)	0	0
Radio	2(1.66%)	4(3.33%)	12(10%)	1(0.83%)	0
Computer	0	2(1.66%)	6(5%)	4(3.33%)	0
Internet	15(12.5%)	18(15%)	7(5.83%)	5(4.16%)	0

Table 3: Utilization of ICTs by the respondents for Agriculture purpose (n= 120)

Information needs	Mobile	Television	Radio	Computer	Internet
Latest information on agriculture	60(50%)	45(38%)	19(16%)	10(8.33%)	40(32.32%)
High yielding varieties in various crops	50(41.66%)	35(29.16%)	15(12.5%)	6(5%)	18(15%)
Insecticide and pesticide use	33 (27.5%)	31(25.83%)	7(5.83%)	4(3.33%)	15(12.49%)
Weather information	70(58.33%)	60(50%)	19(15.83%)	8(6.66%)	45(37.5%)
Precautionary measure in field	30(25%)	38(31.66%)	4(3.33%)	6(5%)	27(22.5%)
Types of soil	38(31.66%)	23(19.16%)	9(7.5%)	6(5%)	10(8.32%)
Price of products	51(42.5%)	40(33.33%)	17(14.16%)	9(7.5%)	27(22.5%)

while none of respondents were using computer daily. Mobile was used by 20.83 per cent weekly whereas Television was used by 26.66 per cent weekly and 8.33 per cent of respondents used monthly. Radio was used by 3.33 per cent of respondent weekly, 10 per cent of respondent used monthly and 1 respondent used it whenever needed. Computer was used by 1.66 per cent weekly, 5 per cent monthly and 3.33 per cent whenever needed by the respondents. Similarly Internet was used daily, weekly, monthly and whenever needed by 12.5, 15, 5.83 and 4.16 per cent respondents, respectively.

The major ICTs used were only Television and mobile phone and internet was also accessed by respondents on their mobile phone.

Perusal of Table 3 reveals that more number of respondents used mobile to get weather information (58.33%) followed by latest information on agriculture (50%). Further mobile phone was used to know price of products (42.5%) followed by information related to high yielding varieties of various crops by 41.66 per cent respondents, different types of soil by 31.66 per cent respondents, for knowledge of insecticide and pesticide by 27.5 per cent respondents and to know precautionary measures in field by 25 per cent respondents.

Data in Table 3 depict that 38 per cent of the respondents used TV for the purpose of getting latest information in agriculture and 50 per cent respondents used for weather information followed by 33.33 per cent respondents used TV to get information about price of product and precautionary measure by 31.66 per cent respondents. Further 25-26 per cent respondents used TV for use of insecticides and pesticides, high yielding varieties in various crops (29.16%) and having knowledge of different types of soil (19.16%).

Data presented in Table 3 reveal that 16 per cent of the respondents used radio for the purpose of getting latest information in agriculture and 15.83 per cent respondents used for weather information. Radio was used by the respondents for getting information about price of product (14.16%) and 12.5 per cent respondents used radio for the purpose of high yielding varieties in various crops followed by getting information about different types of soil (7.5%), insecticide and pesticide use (7%) and precautionary measures in field (3.33%).

It is evident from the data presented in Table 3 that 8.33 per cent respondents used computer to get latest agriculture information followed by 7.5 per cent respondents used for the information on price of products, information about price of products (5%), weather information (6.66%), high yielding varieties of various crops (5%), types of soil (5%), precautionary measure in field (5%) and insecticide and pesticide use (3.33%).

Data presented in Table 3 reveal that 37.5 per cent respondents used internet for the weather information followed by 32.32 per cent for the purpose of getting latest information about agriculture. Further 22.5 per cent respondents used for the purpose of knowing precautionary measures in field, information about price of product (22.5%), high yielding varieties of various crops (15%), insecticide and pesticide use (12.49%) and different types of soil (8.32%).

Perusal of Table 4 reveal that all the respondents used mobile for communication and to maintain social relationship, around 82.5 per cent used for entertainment purpose, for messaging (52.5%), for news (40%), to gather information (34.16%), for health information (30%), to know current issues (28.32%), Sanitation and environment issues (25.83%) followed by for general knowledge (19.16%).

It is evident from Table 4 that most of the respondents watched T.V for news and entertainment purpose i.e. (59.16%) and (52.5%) respectively. T.V. was watched to gather information by 57.5 per cent respondent, for health information (46.66%), to know current issues (35%), sanitation and environment issues (25.83%) and for general knowledge (20%).

Data presented in Table 4 reveal that most of the respondents listened radio to gather information and entertainment purpose i.e. (15.5%) and (13.33%) respectively. For news (8.33%), for health information (7.5%), to know current issues (6.66%), for general knowledge (5%) and sanitation and environment issues (4.16%).

It is evident from Table 4 that most of the respondents used computer to gather information and maintain social relationship i.e. (6.66%) and (6.66%) respectively. For messaging (5.82%), for health information (4.16%), for news (4.16%), for entertainment (4.16%) and for communication (4.16%).

Data presented in Table 4 reveal that most of the respondents used internet to maintain social relationship and for communication purpose i.e. (30%) and (25.83%) respectively. For messaging (24.16%), for entertainment (21.66%), to gather information (19.16%), for news (18.32%), for health information (10.83%), sanitation and environment issues (6.66%), to know current issues (5%) and for general knowledge (2.5%).

Overall it can be said that among the various ICTs, mainly used technologies by the respondents were T.V. and mobile phone. The reason for such findings could be that the respondents were having access to Television and mobile phone and not having access to the other technologies. Further these technologies are costly and require some skills to operate.

It is clear from the Table 5 that the 'correlation coefficient' between the farm women personality traits like education (0.750), annual family income (0.896), media ownership (0.804) and social participation (0.749) exhibited positive and significant correlation at 0.01

Table 4: Utilization of ICTs by the respondents for General purpose

Information needs	Mobile	Television	Radio	Computer	Internet
For communication	120(100%)	–	–	5(4.16%)	31(25.83%)
Maintain social relationship	120(100%)	–	–	8(6.66%)	36(30%)
For entertainment	99(82.5%)	63(52.5%)	16(13.33%)	5(4.16%)	26(21.66%)
To gather information	41(34.16%)	69(57.5%)	19(15.5%)	8(6.66%)	23(19.16%)
For messaging	63(52.5%)	–	–	7(5.82%)	29(24.16%)
For news	48(40%)	71(59.16%)	10(8.33%)	5(4.16%)	22(18.32%)
For health information	36(30%)	56(46.66%)	9(7.5%)	5(4.16%)	13(10.83%)
To know current issues	34(28.32%)	42(35%)	8(6.66%)	0	6(5%)
For general knowledge	23(19.16%)	24(20%)	6(5%)	0	3(2.5%)
Sanitation and environment issues	31(25.83%)	31(25.83%)	5(4.16%)	0	8(6.66%)

Table 5: Relationship between socio-economic and communication characteristics with extent of use of ICT tools

Independent variable	r value	$t_{calculated}$ value
Age	-0.268**	3
Education	0.750**	12.27
Family size	-0.790**	13.97
Family land holding	0.148	1.62
Annual family income	0.896**	21.81
Media ownership	0.804**	14.64
Social participation	0.749**	12.21
Attitude towards ICT tools based extension services	-0.029	0.31
Farming experience (years)	0.085	0.91

* 5% level of significance, n=120, degree of freedom =n-2, ttab=±1.980** 1% level of significance, n=120, degree of freedom =n-2, ttab=±2.617

level of probability with their extent of use of ICT tools and age (-0.268), family size (-0.790) exhibited negative and significant correlation at 0.01 level of probability with their extent of use of ICT tools, while Family land holding (0.148), Attitude towards ICT tools based extension services (-0.029), Farming experience (0.085) of the respondent did not show any significant correlation.

The findings were similar to the study of Mittal (2002) who reported that there was a significant impact of age on duration of viewing Television. Jain *et al.* (2012) who reported that highest education in the family and total income was observed as positively affecting the access and use of ICT tools. Iorliam *et al.* (2012) also confirmed that level of education, and incomes were the significant (P<0.05) determinants of ICT adoption. Mahalakshmi (2003) also reported that majority of respondents had medium level of social participation. Parmar *et al.* (2015) who reported in a study where education, annual income and social participation were found to be significantly correlated with the attitude of the respondents towards the use of Kisan Call Center.

The results of this study indicate that a majority of farm women need capacity building programme as they possess low level of knowledge and skill in applying ICT tools. Further, the study results reveals that organising workshop/training aiming at enhancing the farm women acquaintance with ICT tools will improve the usage of these technologies. This paper recommends that training institutions in India need to embark on tasks to integrate ICT tools in their institutions for teaching how to use ICT tools. While doing so, the drivers identified in this study need to be taken into account for successful implementation.

CONCLUSION

All the respondents (100%) have access to Mobile Phone whereas 86 per cent of respondents have access to Television followed by 19 per cent respondents also had access to radio. Further, 45 per cent respondents had access to internet and 10 per cent respondents had access to computer, 79.16 per cent of the respondents were using Mobile daily whereas 61.66 per cent of respondents watched Television daily and 12.5 per cent of respondents used internet daily whereas only 1.66 per cent of respondents used radio daily. Mobile was used by 20.83 per cent weekly whereas Television was used by 26.66 per cent weekly and 8.33 per cent of respondents used monthly. Radio was used by 3.33 per cent of respondent weekly, 10 per cent of respondent used monthly and 1 respondent used it whenever needed. Computer was used by 1.66 per cent weekly, 5 per cent monthly and 3.33 per cent whenever needed by the respondents. Similarly Internet was used daily, weekly, monthly and whenever needed by 12.5, 15, 5.83 and 4.16 per cent respondents, respectively. More number of respondents used mobile to get weather information (58.33%) followed by latest information on agriculture (50%). Further mobile phone was used to know price of products(42.5%) followed by information related to high yielding varieties of various crops by 41.66 per cent respondents, different types of soil by 31.66 per cent respondents, for knowledge of insecticide and pesticide by 27.5 per cent respondents and to know precautionary measures in field by 25 per cent respondents. Most of the respondents watched T.V for news and entertainment purpose i.e. (59.16%) and (52.5%) respectively. T.V. was watched to gather information by 57.5 per cent respondent, for health information (46.66%), to know current issues (35%), sanitation and environment issues (25.83%) and for general knowledge (20%). Most of the respondents listened radio to gather information and entertainment purpose i.e. (15.5%) and (13.33%)

respectively. For news (8.33%), for health information (7.5%), to know current issues (6.66%), for general knowledge (5%) and sanitation and environment issues (4.16%). Most of the respondents used computer to gather information and maintain social relationship i.e. (6.66%) and (6.66%) respectively. Overall it can be said that among the various ICTs, mainly used technologies by the respondents were T.V. and mobile phone. Correlation coefficient between the farm women personality traits like education (0.750), annual family income (0.896), media ownership (0.804) and social participation (0.749) exhibited positive and significant correlation at 0.01 level of probability with their extent of use of ICT tools and age (-0.268), family size (-0.790) exhibited negative and significant correlation at 0.01 level of probability with their extent of use of ICT tools, while Family land holding (0.148), Attitude towards ICT tools based extension services (-0.029), Farming experience (0.085) of the respondent did not show any significant correlation.

REFERENCES

Annor-Frempong, F. and J.K.E. Edumadze. 2009. The use of the internet among agricultural students at University of Cape Coast in Ghana. *Culture, Science and Sustainable Development in Africa*, 10th edn, Vol. 2, pp. 377-87. In K. Opuku-Agyemang (Eds). University Press, Cape Coast, Ghana.

Batchelor, S. 2002. Using ICTs to Generate Development Content. IICD Research Report 10. *The Hague: International Institute for Communication and Development*, 5(4): 31-36.

Chapman, R. and T. Slaymaker. 2002. ICTs and Rural Development: Review of the Literature, Current Interventions, and Opportunities for Action. ODI Working Paper 192. *London: Overseas Development Institute*, 6(2): 25-29.

Food and Agriculture Organization (FAO), 2011. The state of food and agriculture 2010–2011.

Garai, A. and B. Shadrach. 2006. Taking ICT to every Indian village: Opportunities and challenges. *One World South Asia.*

Heeks, R. 2002. Information Systems and Developing Countries: Failure, Success and Local Improvisations. *The Information Society,* 18(4): 101–112.

Iorliam, T.; E.N. Imbur and P. Iortima. 2012. Adoption of information and communication technologies as source of information on agricultural innovations among farm households in Nigeria: Evidence from Benue state. *International Journal of Development and Sustainability*, 1(3): 924-931.

Jain, R.; U.R. Ahuja and A. Kumar. 2012. ICTs and farm women: Access, use and impact. *Indian Journal of Agricultural Economics*, 67(3): 385-394.

Khan, M.S.H.; M. Hasan and C.K. Clement. 2012. Barriers to the introduction of ICT into education in developing countries: The example of Bangladesh. *International Journal of instruction*, 4(2): 14-21.

Mahalakshmi, B. 2003. Socio-economic impact on pulse growers. Thesis, M.Sc. (Ag.). Tamil Nadu Agricultural University, Coimbatore.

Mishra, R.P. and K.V. Sundaram. 1970. Rural Area Development Perspective and Approaches, p.1. Sterling Publication.

Mittal, P. 2002. Television viewing behavior of selected Urban slum community with special reference to women improvement negated programmers of Jaipur Doordarshan. Unpublished M.Sc. Thesis, Dept. of Home Science Extension, University of Rajasthan, Rajasthan. 91p.

National Sample Survey Office (NSSO) 2013. Key indicators of Employment and Unemployment in India for 2011-12. Ministry of Statistics and Programme Implementation, Government of India, June 2013. http://mospi.nic.in/Mospi_New/upload/press%20release68th-E&U.pdf last assessed on 8 November 2019.

OXFAM. 2018. Move over 'Sons of the soil': Why you need to know the female farmers that are revolutionizing agriculture in India. *Briefing Paper. [Accessed on 7 January, 2020].* https://www.oxfamindia.org/women-empowerment-india-farmers.

Parmar, V.S. 2014. Knowledge and attitude of farmers towards the use of kisan call center in south Gujarat region. (Doctoral dissertation, agricultural extension dept., college of agriculture, Navsari agricultural university, Navsari).

Rao, N.H. 2007. A Framework for Implementing Information and Communication Technologies in Agricultural Development in India. *Technological Forecasting and Social Change*, 7(5): 491–518.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 327-334

Climate Smart Agriculture: From Ensuring Food Security, Reducing Green-house Gases to Mitigating Climate Change

Mahreena Farooq[1]*, Rumisa Ashraf[2] and Mushtaq Ahmad Bhat[3]
[1]Ph.D. Student, [3]Senior Scientist, Division of Plant Pathology, [2]Ph.D. Student, Division of Entomology, SKUAST-K, J&K

ABSTRACT

Overpopulation and climate change are among the greatest challenges the world faces. Maximizing production with scarce resources is a necessity and requires the substantial transformation of agriculture and special attention should be paid to climate change, especially to food security, climate change and reduction of greenhouse gas (GHG) emissions. Agriculture faces some stiff challenges ahead. In the face of global environmental change, the notion of climate smart agriculture (CSA) has emerged as an approach that aims to transform, reorient, and develop agricultural systems based on digital technologies, aiming to contribute to an increasing global food security as part of climate change adaptation and mitigation efforts is seeking to overcome the food security problem and develop rural livelihoods while minimizing negative impacts on the environment. The climate-smart agriculture (CSA) concept is gaining considerable attraction at international and national levels to meet the challenges of addressing agricultural planning under climate change Climate Smart Agriculture (CSA) has attracted interest given its promise to increase agricultural productivity under a changing climate while reducing green- house gases emission. It is a concept that calls for integration of the need for adaptation and the possibility of mitigation in agricultural growth strategies to support food security. It involves farming practices that improve farm productivity and profitability, help farmers adapt to the negative effects of climate change and mitigate climate change effects, e.g. by soil carbon sequestration or reductions in greenhouse gas emissions. Climate-smart practices, such as the locally practiced conservation agriculture, aim at conserving soil moisture, retaining crop residues for soil fertility, disturbing the soil as minimally as possible and diversifying through rotation or intercropping, because mostly the agriculture sector is significantly impacted from increased temperatures and shifting precipitation patterns. It also explores the links among the components of CSA (productivity, adaptation and mitigation) and their contribution to achieving the goal of sustainable agricultural development.

Keywords: Climate Smart Agriculture, Food security, Adaptation. Mitigation, Soil carbon sequestration, Green-house gases

INTRODUCTION

According to the latest available projection of the United Nations, the global population is forecasted to grow to 9.7 billion by 2050. Producing enough food seems to be the greatest challenge of the agri-food industry. As the available agricultural land is limited, this requires enormous efficiency gains. Maximizing production with scarce resources is a necessity and requires the substantial transformation of agriculture (Ayaz *et al.,* 2019). On the other hand, special attention should be paid to climate change, especially to the reduction of greenhouse gas (GHG) emissions. Its atmospheric concentration is projected to double by 2030, which causes a significant increase in global temperature (IPCC, 2019). To achieve food security and agricultural development goals, adaptation to climate change and lower emission intensities per output will be necessary. This transformation must be accomplished without depletion of the natural resource base. Climate change is already having an impact on agriculture and food security as a result of increased

*Corresponding author email id: mahirather0913@gmail.com

prevalence of extreme events and increased unpredictability of weather patterns. This can lead to reductions in production and lower incomes in vulnerable areas. These changes can also affect global food prices. These initiatives interrelate in climate-smart agriculture (CSA), that can help to meet these challenges by increasing resilience to weather extremes, adapting to climate change and decreasing agriculture's greenhouse gas (GHG) emissions that contribute to global change. Food security, poverty and climate change are closely linked and should not be considered separately. The United Nations Framework Convention on Climate Change (UNFCCC) places a high priority on agriculture. Climate-Smart Agriculture is a very significant part of the solution for both Climate Change mitigation and Sustainable Agriculture. The FAO defined climate-smart agriculture as "that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances achievement of national food security and development goals" (FAO, 2010). The overall aim of CSA is to support efforts from the local to global levels for sustainably using agricultural systems to achieve food and nutrition security for all people at all times, integrating necessary adaptation and capturing potential mitigation. Three objectives are defined for achieving this aim: (1) sustainably increasing agricultural productivity to support equitable increases in incomes, food security and development; (2) adapting and building resilience to climate change from the farm to national levels; and (3) developing opportunities to reduce GHG emissions from agriculture compared with past trends Food and Agriculture Organization of the United Nations, 2013). The successful implementation of these objectives accomplishes the so-called "triple win" when the implementation of the different innovative practices results in higher yields, climate change mitigation, as well as lower GHG emissions (FAO, 2013). The recent increase in extreme weather events (climate shocks) threatens disruptive impacts on agriculture Projected adaptive actions include improving plant performance (for example, nutrition, yields, food quality) in response to elevated CO_2 and rising temperatures avoiding pest damage

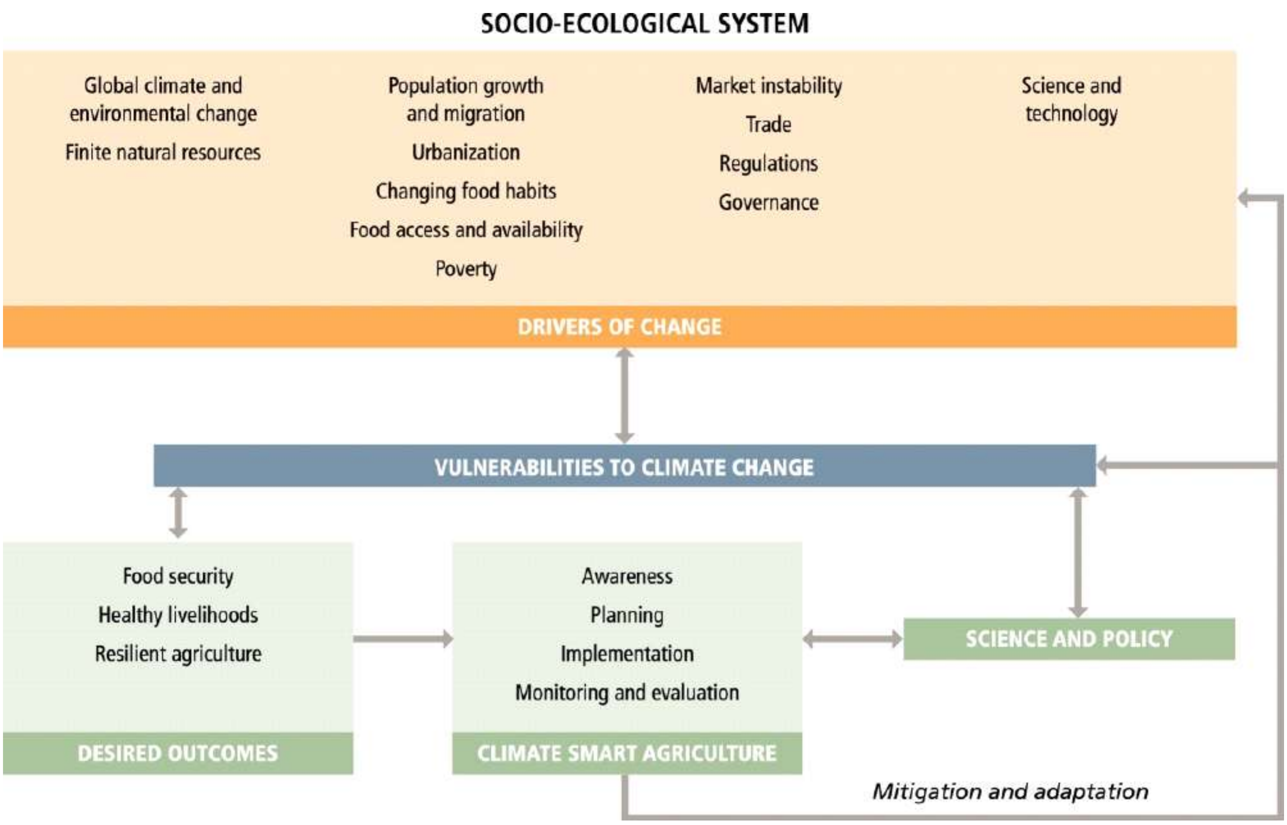


Diagram illustrating how climate-smart agriculture can be utilised as an agent for developing resilience, mitigation and adaptation within the socioecological system.

and food waste developing forecasting, management and insurance options to decrease the risk due to unexpected rainfall patterns, higher temperatures and shifting length in growth seasons and managing natural resources at the landscape and regional levels to assure the environmental quality and ecosystem services upon which agriculture depends.

Although not exclusively within the purview of climate-smart agriculture (CSA), 'adaptation and mitigation' in this figure are implied to be derived from an iterative CSA strategy. Adaptation and mitigation affect 'drivers of change' to diminish existing 'vulnerabilities to climate change' in the socioecological system, leading to the long-term goals of CSA in 'desired outcomes'. The arrow between CSA and 'science and policy' indicates the vital role of novel science–policymaking partnerships and science-based actions in CSA. Food security climate change reduction in green-house gas emission: three intertwined challenges. Agriculture and food systems must improve and ensure food security, and to do so they need to adapt to climate change and natural resource pressures, and contribute to mitigating climate change. These challenges, being interconnected, have to be addressed simultaneously.

Ensuring Food Security

Climate-smart agriculture (CSA) is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. Widespread changes in rainfall and temperature patterns threaten agricultural production and increase the vulnerability of people dependent on agriculture for their livelihoods, which includes most of the world's poor. Climate change disrupts food markets, posing population-wide risks to food supply (Lipper *et al.,* 2014). Responding to effects of climate change that influence the closure of the yield gap between potential and actual production will require continuation of existing 'best management practices' coupled with improvements in agronomic management practices and crop-breeding (Tittonell and Giller, 2013; George, 2014). The four types of agronomic practices included under the rubric of CSA (no-till, integrated soil fertility management, nitrogen use efficiency, and alternate wetting-and-dry) can increase agricultural production and reduce climate-driven food insecurity worldwide (Langridge and Fleury, 2011). Molecular approaches provide opportunities to establish linkages between biochemical pathways and physiological responses. In cereals such as rice, grain yield is highly dependent on the carbohydrate source (top leaves) and sink (florets) relationship, which is strongly influenced by the plant hormone cytokinin (Peleg and Blumwald, 2011). Cytokinin production also affects drought tolerance and senescence, and isopentenyl transferase (IPT) expression controls upregulation of pathways for cytokinin degradation. Therefore, it follows that tolerance of abiotic stress by delaying stress-induced senescence through manipulation of IPT expression in transgenic lines could maintain optimal levels of cytokinin, resulting in greater fitness and more seed and grain production (Peleg *et al.,* 2011). Complementary approaches are necessary for solving complex physiological plant responses to climate and management. Changes in temperature, precipitation, water delivery, salinity and CO_2 concentrations will occur simultaneously. Direct experimentation, high-throughput screening platforms using molecular-based techniques and predictive modelling are a set of tools for achieving multiple goals (Heslot *et al.,* 2014), which include exploration of genetic resources for broader use and dissemination, gene pool expansion and yield stability in the face of inter annual weather variation. In addition, these tools can help with other crop selection criteria, including quality of food and feed, source–sink relationships, pest and disease resistance, plant–microbe interactions that reduce CH_4 and N_2O emissions, and postharvest storage (Newton *et al.,* 2011). The idea that agriculture should mitigate climate change is controversial because of the sector's importance for food security. But agriculture is projected to be a major source of emissions. CSA therefore prioritizes food security but also considers the potential and costs of capturing mitigation benefits. Mitigation is leveraged to support food security and adaptation, rather than hampering or harnessing them. For example, more efficient resource use in agricultural pro-duction systems offers considerable potential for increasing agricultural incomes and the resilience of rural livelihoods while reducing the intensity of agricultural emission. Increasing resource-use efficiency requires evidence on which practices contribute most to efficiency across heterogeneous agro-ecologies and production systems, and the barriers to their adoption. Improved livestock feeding practices illustrate these issues. Options for improved feeding can be identified in different production systems, with potential to increase returns and the resilience of producers. But adoption rates of improved livestock feeding practices have rarely exceeded (1%) per year. Accelerated adoption could generate significant growth in livestock productivity and incomes, and offers approximately (7%) of global agricultural mitigation potential to 2030. Barriers vary by system and location, but generally involve institutional gaps and weaknesses; missing and weak institutions also constitute a significant barrier to adoption of sustainable land management practices that enhance resilience.

Nitrogen management: agricultural production, greenhouse gas mitigation, and adaptation

Agricultural lands make up approximately (37%) of the global land surface, and agriculture is a significant source of greenhouse gas (GHG) emissions, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Those GHGs are responsible for the majority of the anthropogenic global warming effect. Agricultural GHG emissions are associated with agricultural soil management (e.g. tillage), use of both synthetic and organic fertilisers, livestock management, burning of fossil fuel for agricultural operations, and burning of agricultural residues and land use change. Climate smart agricultural management practices, including conservation tillage, use of cover crops and biochar application to agricultural fields, and strategic application of synthetic and organic fertilisers have been considered away to reduce GHG emission from agriculture. Agricultural management practices can be improved to decreasing disturbance to the soil by decreasing the frequency and extent of cultivation as a way to minimise soil C loss and/or to increase soil C storage. Fertiliser nitrogen (N) use efficiency can be improved to reduce fertilizer N application and N loss (Prokopy *et al.,* 2013). Cropping system diversification, careful selection of crop rotations to reduce nutrient loss, and improved soil organic matter content are means by which to promote sustainable intensification. Yet, this often involves a set of complex trade-offs for producers and their livelihoods (Smith *et al.,* 2007), emphasizing the need for a CSA strategy that involves stakeholders from the beginning to develop viable scenarios that include both mitigation and adaptation to climate change. Enhanced-efficiency fertilizers (EEFs), such as slow-release fertilizers or those containing nitrification inhibitors and urease inhibitors, hold potential to mitigate GHG emissions. Mitigating GHG emissions through C sequestration depends on the stability of soil C pools. Declining productivity in the rice–wheat cropping systems of India's Indo-Gangetic plains has been attributed to reductions in soil C (Singh and Kaur, 2012) found that, to combat this, addition of NPK fertilizer during double-rotations of rice led to increases in soil organic C stocks compared to adding just N or N P alone (Mandal *et al.,* 2008).. When compost was applied during rice production, as much as (29%) of compost-derived C was stabilized. This was attributed to high lignin and polyphenol content in crop residue and compost and also to the diminished soil C decomposition stemming from anaerobic conditions due to soil submergence under rice cultivation. Crop residue management improves poor soil fertility through soil organic matter accumulation, leading to reductions in soil N loss by leaching and gaseous emissions; in many situations in developing countries, however, crop residues are used to feed animals, to provide fuel for cooking or are turned into biochar (Smith *et al.,* 2013; Joseph *et al.,* 2014). Developers of mitigation strategies for increasing soil C and decreasing N_2O emissions have to take into account the dynamics of crop residue, tillage and nutrient management, along with climate, in order to evaluate the efficacy of different practices across locations (Hatfield *et al.,* 2012).

Conservation Agriculture

Conservation agriculture includes practices such as minimum mechanical soil disturbance, permanent organic soil cover and crop rotation, all of which typically increase soil C storage, especially when applied in concert (FAO, 2014; Shaxson *et al.,* 2008) Reports of conservation agriculture's widespread adoption may be overrated, though, because many farmers seem to adopt technologies only while incentives are offered and the project is actively supported, and then they quickly return to their former crop management practices once project support ceases (Giller *et al.,* 2009). Constraints to adoption include strong competition for mulched crop residues for livestock feeding, increased labour demand for weeding (which often changes cultural gender divisions of agricultural work) and lack of access to and/or use of herbicides and other inputs (Ndlovu *et al.,* 2014). Although there are some recognized factors that influence adoption (for example, larger farm size and more education), no universal variables seem to explain adoption (Knowler and Bradshaw, 2007), leading some to suggest that conservation farming may be successful only under certain agroecological conditions (Giller *et al.,* 2011).

Climate change

Climate change is a threat to agriculture production around the world, especially for developing countries and at lower latitudes. The impacts are starting to accumulate: Climate change may have already contributed to a (1%-2%) loss of crop yields per decade in the past century (Zaman *et al.,* 2021). Climate change has already significantly impacted agriculture (Lobell *et al.,* 2011) and is expected to further impact directly and indirectly food production. Increase of mean temperature; changes in rain patterns; increased variability both in temperature and rain patterns; changes in water availability; the frequency and intensity of 'extreme events'; sea level rise and salinization; perturbations in ecosystems, all will have profound impacts on agriculture, forestry and fisheries (Gornall *et al.,* 2010; Thornton and Cramer, 2012). The impacts of climate change will have major effects on agricultural production, with a decrease of production in certain areas and increased variability of production to the extent that important changes may need to be made in the geographic area where crops are cultivated. Local impacts will bring global imbalances. Broadly speaking, with everything else being equal, climate change may lead to an increase in both crop and livestock productivity in mid- to high latitudes (IPCC, 2007) and a decrease in tropical and subtropical areas. Among the most affected areas are economically vulnerable countries already food insecure and some important food exporting countries. This will induce significant changes in trade, impacting prices and the situation of net food importing countries. Consequently, climate change is expected to increase the gap between developed and developing countries as a result of more severe impacts in already vulnerable developing regions, exacerbated by their relatively lower technical and economical capacity to respond to new threats (Padgham, 2009). Smallholders and pastoralists will suffer complex, localized impacts. According to the International Food Policy Research Institute (IFPRI) (Nelson *et al.,* 2010), it will cause an increase of between 8.5 and 10.3 percent in the number of malnourished children in all developing countries, relative to scenarios without climate change. Rather than being focused solely on climate-change constructs, such vulnerability assessments also include changes in CO_2 concentrations, GHG emission management, N deposition, land use, and socioeconomic trends to manage vulnerability. Unlike global trends, European trends included moderate or no population increase, little urbanization, increased forest area and decreasing demand for agricultural land.

Soil carbon and Achieving Multifunctionality through Mitigation and Adaptation

Soil resource degradation has led to loss of functions and ecosystem services, such as water availability, water-holding capacity, C storage, mitigation of GHG emissions and sustained agricultural productivity (Lal *et al.,* 2013; Qadir *et al.,* 2013). Soil degradation limits resilience to climate change and extreme events, such as drought, and therefore impacts food security and augments susceptibility to poverty, Better understanding of the biophysical capacity of agricultural landscapes to act as C sinks through capture and storage of atmospheric CO_2 in soils and perennial vegetation leads to strategic design and operational management for both mitigation and adaptation actions (Cochard, 2013). Towards more efficient and resilient systems most of the GHG emissions of the agricultural sector are directly driven by the use of resources: new land being deforested or turned from grassland to crop land, fertilizers, livestock, energy. Increasing efficiency in the use of resources (i.e. producing more of a given output using less of a given input) is thus key to reducing emissions intensity per kilo of output. It is also key to improve food security, especially in resource scarce areas. Increasing efficiency in the use of resources is also one of the driving principles of CSA. GHG emissions from agriculture are linked to its use of resources. Three production factors have an important influence on total agricultural GHG emissions: (i) area, since converting land into cultivations would require either deforestation or grasslands being converted to croplands, which would induce higher CO_2 emissions; (ii) fertilizers, whose production is an important source of CO_2 and which at the field level translate into nitrous oxide emissions; and (iii) livestock, which is an important source of methane and nitrous oxide emissions. Physical capital, such as buildings and machines are also a factor, both directly by energy use and indirectly by their production. Everything else being equal, increasing the efficiency in the use of one of these production factors decreases the emissions intensity of output. As irrigation often demands considerable energy, water efficiency is another key factor for increasing production, adapting to climate change and reducing emissions.

CONCLUSION

Addressing food security and climate change challenges has to be done in an integrated manner. To increase food production and to reduce emissions intensity, contributing to mitigate climate change, food systems have to be more efficient in the use of resources. To ensure food security and adapt to climate change they have to become more resilient. This has to happen globally, worldwide and everywhere. Increased efficiency in one part of the world provides food and income where it takes place but it also provides more food, globally and thus can provide food elsewhere and reduce its cost, globally. With increased risks, increasing resilience of the worldwide food system also means that efficiency and resilience have to be improved everywhere, so as to spread risk. Therefore, CSA is a dynamic approach that concerns all farmers, all over the world to meet the present challenges of food security, green-house gases emission and mitigating climate change.

REFERENCES

Ayaz, M.; M. Ammad-Uddin; Z. Sharif; A. Mansour and E.H.M. 2019. Aggoune. Internet-of-Things (IoT)-based smart agriculture: Toward making the fields talk. *IEEE Access* 7: 129551–129583.

Climate-Smart Agriculture Sourcebook Executive Summary (Food and Agriculture Organization of the United Nations, 2013).

Cochard, R. 2013. Natural hazards mitigation services of carbon-rich ecosystems. In Ecosystem Services and Carbon Sequestration in the Biosphere. Edited by Lal R, Lorenz K, Hüttl RF, Schneider BU, *von Braun J. New York: Springer Science,* 221–293.

FAO. "Climate-Smart" Agriculture. Policies, Practices and Financing for Food Security, Adaptation and Mitigation; Food and Agriculture Organisation of the United Nations: Rome, Italy, 2010.

FAO. Climate-Smart Agriculture Sourcebook; Food and Agriculture Organisation of the United Nations: Rome, Italy, 2013.

Food and Agriculture Organization of the United Nations (FAO): Investingin Sustainable Agricultural Intensification: The Role of Conservation Agriculture. A Framework for Action. Rome: FAO; 2008. [http://www.fao.org/ag/ca/doc/proposed_framework.pdf] (accessed 26 July 2014).

George, T. 2014. Why crop yields in developing countries have not kept pace with advances in agronomy. *Global Food Security,* 3: 49–58.

Giller, K.E., Tittonell P, Rufino MC, van Wijk MT, Zingore S, Mapfumo P, Adjei-Nsiah S, Herrero M, Chikowo R, Corbeels M, Rowe E C, Baijukya F, Mwijage A, Smith J, Yeboah E, van der Burg W J, Sanogo O M, Misiko M,de Ridder N, Karanja S, Kaizzi C, K'unguJ,Mwale M, Nwaga D, Pacini C, Vanlawe B. 2011. Communicating complexity: integrated assessment of trade-offs concerning soil fertility management within African farming systems to support innovation and development. *Agricultural Systems,* 104: 191–203.

Giller, K.E.; E. Witter; M. Corbeels and P. Tittonell. 2009. Conservation agriculture and smallholder farming in Africa: the heretics' view. *Field Crops Research,* 114: 23–34.

Gornall, J.; R. Betts; E. Burke; R. Clark; J. Camp; K. Willett and A. Wiltshire. 2010. Implications of climate change for agricultural productivity in the early twenty-first century. *Philosophical Transactions of the Royal Society B-Biological Sciences,* 365: 2973–2989.

Hatfield, J.L.; T.B. Parkin; T.J. Sauer and J.H. Prueger. 2012. Mitigation opportunities from land management practices in a warming world: increasing potential sinks. In Managing Agricultural Greenhouse Gases: Coordinated Agricultural Research through GRACEnet to Address Our Changing Climate. Edited by Liebig MA, Franzluebbers AT, Follett RF. Waltham, MA: Academic Press, pp. 487–504.

Heslot, N.; D. Akdemir; M.E. Sorrells and J.L. Jannink. 2014. Integrating environmental covariates and crop modeling into the genomic selection frame work to predict genotype by environment interactions. *Theoretical and Applied Genetics,* 127: 463–480.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change 2007: impacts, adaptation and vulnerability, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linder & C.E. Hanson, eds. pp. 869-883. Contribution of Working Group II to the Fourth Assessment Report of the IPCC. Glossary . Cambridge, Cambridge University Press

IPCC. Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty; Intergovernmental Panel on Climate Change: Geneva, Switzerland, 2019.

Joseph, S.; D.D. Khoi; N.V. Hien; M.L. Anh; H.H. Nguyen; T.M. Hung; N.T. Yen; M.F. Thomsen; J. Lehmann and C.H. Chia. 2014. North Vietnam Villages Lead the Way in the Use of Biochar: Building on an Indigenous Knowledge Base. *International Biochar Initiative*.

Knowler, D. and B. Bradshaw. 2007. Farmers' adoption of conservation agriculture :a review and synthesis of recent research. *Food Policy,* 32: 25–48.

Lal, R.; K. Lorenz; R.F. Hüttl; B.U. Schneider and J. von Braun. 2013. Ecosystem Services and Carbon Sequestration in the Biosphere. New York: Springer Science.

Langridge, P. and D. Fleury. 2011. Making the most of "omics" for crop breeding. *Trends in Biotechnology,* 29: 33–40.

Lipper, L.; P. Thornton; B. Campbell *et al.* 2014. Climate-smart agriculture for food security. *Nature Climate Change,* 4: 1068–1072.

Lobell, D.; W. Schlenker and J. Costa-Roberts. 2011. Climate trends and global crop production since 1980. Science

Mandal, B.; B. Majumder; T.K. Adhya; P.K. Bandyopadhyay; A. Gangopadhyay; D. Sarkar; M.C. Kundu; S.G. Choudhury; G.C. Hazra; S. Kundu; R.N. Samantaray and A.K. Misra. 2008. Potential of double-cropped rice ecologytoconserve organic carbon under subtropical climate. *Global Change Biology,* 14: 2139–2151.

Ndlovu, P.V.; K. Mazvimavi; H. An and C. Murendo. 2014. Productivity and efficiency analysis of maize under conservation agriculture in Zimbabwe. *Agriculture System,* 124: 21–31.

Nelson, G.C., Rosegrant, M.W., Palazzo, A., Gray, I., Ingersoll, C., Robertson, R., Tokgoz, S., Zhu, T., Sulser, T., Ringler, C., Msangi, S. and You, L. 2010. Food security, farming, and climate change to 2050: scenarios, results, policy options. International Food Policy Research Institute, Washington D.C. (available at www.ifpri.org/sites/ default/files/publications/rr172.pdf)

Newton, A.C.; S.N. Johnson and P.J. Gregory. 2011. Implications of climate change for diseases, crop yields and food security. *Euphytica,* 179: 3–18.

Padgham, J. 2009. Agricultural development under a changing climate: opportunities and challenges for adaptation. Washington D.C., The World Bank.

Peleg, Z. and E. Blumwald. 2011. Hormone balance and abiotic stress tolerance in crop plants. *Current Opinion in Plant Biology,* 14: 290–295.

Peleg, Z.; M. Reguera; E. Tumimbang; H. Walia and E. Blumwald. 2011. Cytokinin mediated source/sink modifications improve drought tolerance and increase grain yield in rice under water-stress. *Plant Biotechnology Journal,* 9: 747–758.

Prokopy, L.S.; T. Haigh; A.S. Mase; J. Angel; C. Hart; C. Knutson; M.C. Lemos; Y.J. Lo; J. McGuire; L.W. Morton; J. Perron; D. Todey and M. Widhalm. 2013. Agricultural advisors: a receptive audience for weather and climate information? *Weather, Climate, and Society,* 5: 162–167.

Qadir, M.; A.D. Noble and C. 2013. Chartres. Adapting to climate change by improving water productivity of soils in dry areas. *Land Degrad Development,* 21: 12–21.

Shaxson, F.; A. Kassam; T. Friedrich and A. Adekunle. 2008. Conservation Agriculture: Looking beneath the Surface. Nakuru, Kenya: Food and Agriculture Organization of the United Nations (FAO). Conservation Agriculture Workshop; 2008. [http://www.fao.org/ag/ca/CA-Publications/Nanyuki% 202008.pdf] (accessed 4 August 2014).

Singh, A. and J. Kaur. 2012. Impact of conservation tillage on soil properties in rice-wheat cropping system. *Agricultural Science Research Journal,* 2: 30–41.

Smith, P.; D. Martino; Z. Cai; D. Gwary; H. Janzen; P. Kumar; B. McCarl; S. Ogle and F. O'Mara. 2007. Agriculture. In Climate Change 2007: Mitigation, Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Edited by Metz B, Davidson O, Bosch P, Dave R, Meyer, L. 2007. Cambridge, UK: Cambridge University Press; pp. 497–540.

Smith, P.; H. Haberl; A. Popp; K.H. Erb; C. Lauk; R. Harper; F.N. Tubiello; A. de Siqueira Pinto; M. Jafari; S. Sohi; O. Masera; H. Böttcher; G. Berndes; M. Bustamante; H. Ahammad; H. Clark; H. Dong; E.A. Elsiddig; C. Mbow; N.H. Ravindranath; C.W. Rice; C. Robledo Abad; A. Romanovskaya; F. Sperling; M. Herrero; J.I. House and S. Rose. 2013. How muchland-based green house gas mitigation can be achieved without compromising food security and environmental goals? *Global Change Biology,* 19: 2285–302.

Tester, M. and P. Langridge. 2010. Breeding technologies to increase crop production in a changing world. *Science,* 327: 818–822.

Thornton, P. and L. Cramer eds. 2012. Impacts of climate change on the agricultural and aquatic systems and natural resources within the CGIAR's mandate. CCAFS Working Paper No. 23. CCAFS, Copenhagen, Denmark.

Tittonell, P. and K.E. Giller. 2013. When yield gaps are poverty traps: the paradigm of ecological intensification in African smallholder agriculture. *Field Crops Research,* 143: 76–90.

Zaman, M., Kleineidam, K., Bakken, L., Berendt, J., Bracken, C., Butterbach-Bahl, K., Cai, Z., Chang, S.X., Clough, T., Dawar, K. and Ding, W.X., 2021. Climate-Smart Agriculture Practices for Mitigating Greenhouse Gas Emissions. *Measuring Emission of Agricultural Greenhouse Gases and Developing Mitigation Options using Nuclear and Related Techniques*, pp. 303-328.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 335-339

Problems with Paddy Straw Management Technologies in South-Western Punjab

Amanjot Kaur*, Prabhjot Kaur and Pankaj Kumar
Punjab Agricultural University, Ludhiana, Punjab

ABSTRACT

The goal of the study was to examine the challenges faced by respondents after adopting paddy straw management technologies. The reasons for the non-adoption of these technologies were also studied. The research was carried out in the Bathinda district, which falls under the south-western region of Punjab. Adopters of the different paddy straw management technologies viz. happy seeder, mulcher, and chopper-cum-spreader, experienced an increase in rodent and insect pest attack on their succeeding crops. The sowing operation, done with a happy seeder and a super straw management system, was hindered by leftover residue of previous crop in the fields, reported by 90 and 78 percent, respectively. The baler was not available to the majority of farmers at the appropriate time. Rent was paid for hiring the super straw management system, baler, and chopper-cum-spreader, which increased production costs, as reported by 64, 61, and 48 percent of the adopters, respectively. Eighty-seven percent of non-adopters of Happy Seeder claimed that wheat straw yield had decreased due to germination issues. All the respondents wanted to use a baler but couldn't adopt it because of a lack of technology at the right time. Due to a lack of skilled manpower, about 60 percent of respondents did not adopt mulchers, as after managing paddy straw with them, sowing of the next crop was done by broadcasting. Ninety-three percent of non-adopters didn't adopt a combine equipped with a super straw management system because more shattering of grains occurs in the field. All the non-adopter respondents reported that there was difficulty in sowing operations due to residue in fields when managing straw with a super straw management system.

Keywords: Management, Paddy, Problems, Straw, Technology

INTRODUCTION

The agriculture industry is India's economic backbone (Sunder, 2018). Agriculture employs over 43 percent of India's population. Agriculture, along with food grain production, also produces crop residue. Cereal crop residue accounts for 70 per cent of total agricultural residue production. Paddy accounts for 51 to 57 percent of total cereal crop residues. Paddy residue management is a key barrier to paddy farming in north-west India, that is, Punjab, Haryana, and Uttar Pradesh compost (Lohan *et al.,* 2018).

Crop residue has become a serious impediment in agriculture as a result of agricultural mechanization (Sood, 2015). Agriculture was forced to mechanize due to a lack of skilled laborers and a slew of other costs. Paddy stubbles that can't be uprooted by combine harvesters are left on the farms, causing farmers' troubles, and they've realized that burning paddy straw is the quickest way to deal with them. Farmers want to clear fields so that they can plant another crop. Because there is a shorter gap between paddy harvest and wheat sowing, residue burning is used to keep the farm clean. Farmers are not able to employ any other management measures since managing the straw takes time and causes the wheat sowing procedure to be hindered (Amir and Aslam, 1992).

Burning of crop residue in fields releases not only greenhouse gases and particulates, but also leads to the

*Corresponding author email id: dhaliwala290@gmail.com

loss of necessary nutrients required for plant growth, resulting in economic losses (Lohan *et al.,* 2018).

To resolve these concerns, experts developed a variety of paddy straw management options (Verma, 2014). Paddy straw confinement in situ aids in the restoration of organic matter and soil nutrients. Paddy residue can be managed in-situ with the aid of a happy seeder (Sidhu *et al.,* 2015). Paddy straw conservation, rather than burning, is likely to be advantageous for biogas production. Paddy straw bio-ethanol is created by processing paddy straw, while traditional ethanol is made from fruits. The ash that remains after paddy straw is utilised for energy generation is used in the construction sector (Athira *et al.,* 2019).

Residue burning has just become harmful, posing a threat to human life, soil, and air. Yet, after the advent of a range of paddy straw management technologies, it was found in southwestern Punjab that different paddy straw management technologies were adopted by a lower number of farmers. Kaur 2020 found that about thirty and three percent of farmers used a happy seeder and a chopper-cum-spreader, respectively, out of the total number of respondents in the study. Farmers who cultivated wheat after managing paddy straw in an eco-friendly manner noticed a loss in production of up to 4 quintals per acre and pesticides were used more frequently as a result of the increased insect-pest attack (Athira *et al.,* 2019). There seem to be a number of reasons why environmentally friendly paddy straw management is not widely used by farmers. The current study was executed to examine the reasons behind the non-adoption of these technologies and what problems are confronted by farmers after the adoption of these technologies.

MATERIALS AND METHODS

The study was carried out in Punjab state. As per a report done by Punjab Agricultural University in 2018, the maximum amount of paddy straw was burned in Punjab's South-Western regions. Bathinda district was selected for the study because it had the highest number of paddy straw burning incidences among Punjab's south-western districts (Mahal *et al.* 2019). All nine blocks of the Bathinda district were selected for the study. For the study, one village was randomly selected from each block, making a total of nine villages randomly selected from the Bathinda district. As a result, the sample included nine villages, viz., Bibi Wala, Balahar Mehma, Bhagibandar, Sangat Kalan, Sukha Singh Wala, Bhagta, Rampura, Phul, and Jassi Pauwali. A total of 15 farmers were picked at random from each of the nine villages. A total of 135 farmers were selected from the 9 villages. Personal interviews with respondents were used to obtain data. More investigative questions were asked of the respondents in order to make them aware of the various parameters under investigation. Data was collected using adequate precautions in order to obtain an unbiased answer from the respondents. Comprehensive discussions with respondents were held with the goal of conducting a thorough investigation. The data was compiled by converting it to a computer-based spreadsheet and analysing it with statistical software. The data was analysed using frequency and percentage.

RESULT AND DISCUSSION

Table 1 demonstrates the various issues raised by adopters in the adoption of various technologies for the management of paddy straw. All the adopters of the Happy Seeder stated that a higher horsepower tractor was needed for the work of the happy seeder, but it was not readily accessible to the respondents. When wheat was sown using a happy seeder, all the adopters also experienced an increase in rodent problems, insect pest attacks, and poor plant germination, which resulted in a decline in wheat straw. Approximately 91 per cent of them experienced yellowing of wheat plants during the germination stage, as well as difficulties in sowing due to the presence of stubble in the fields. The results are supported by the finding of Roy (2015), stated that management issues were a prominent issue for adopters.

Only fifty-four percent of respondents adopted super straw management technology. Overall, respondents that adopted the super straw management system mentioned that this resulted in higher grain loss while harvesting because of the shattering of grains, lowering crop yield. Seventy-seven percent of adopters said straw was unevenly distributed on farms, causing problems such as drill machines choking while sowing. When comparing combines with and without a super straw management system, 64.20 percent of adopters stated that combines with a super straw management

Table 1: Distribution of adopters according to the problems confronted by adopters of different paddy straw management technologies

Problems	F	%
Happy seeder (n=43)		
Requirement of higher horsepower tractor	43	100
Poor germination	43	100
More attack of rodents	43	100
Stubble interface in sowing operation	39	90.22
Insect-pest attack	43	100
Yellowing at seedling stage	39	90.22
Baler (n=31)		
Non Availability at proper time	31	100
High rent of baler	19	61.29
Super straw management system (n=54)		
More grain loss due to shattering	54	100
High rent	35	64.20
Uneven spreading of straw	42	77.78
Mulcher (n=9)		
Costly	4	44.45
Non-Availability	7	77.78
More attack of Rodents	9	100
More Insect-pest attack	9	100
Working not properly on wet straw	9	100
Chopper-cum-spreader(n=5)		
More cost of production	2	48.46
Non-Availability	4	80.00
More attack of Rodents in subsequent crop	5	89.23
More Insect-pest attack in subsequent crop	3	60.00
High maintenance cost due to frequent wear and tear of blades	4	80.00

(Multiple response*)

system required more rent. Out of 135 respondents, thirty-one of them adopted a baler for managing paddy straw. The main concern for adopters of the baler was its lack of availability at the proper time. More than half of the adopters reported a higher cost of production as a result of the rent they paid.

Only 9 respondents adopted mulcher for managing paddy straw in an eco-friendly manner. All the respondents who adopted mulchers had a severe problem due to rats and insect pests, and they didn't use mulchers when the straw had been wet. The majority of adopters of mulchers also stated that machinery was unavailable, causing sowing operations to be delayed. Approximately 45 per cent of adopters noticed a spike in production costs due to rent paid for machines and additional insecticide and pesticide costs.

Out of 135 respondents, only five of them adopted the chopper-cum-spreader. Respondents who used the chopper-cum-spreader reported more rodent attacks on the crop that followed. Sixty percent of them also reported an increase in insect pest attacks on the following crop. About half of them said it was too expensive and that the cost of production had increased. About eighty percent of adopters said that since straw was moist, the blades became dull and did not perform correctly, sowing operations had been delayed, and blade maintenance was more frequently required.

The information in Table 2 indicates that there have been a number of reasons why respondents have not adopted paddy straw management technologies despite knowing about them. After receiving complete information about the happy seeder, ninety-two respondents did not adopt this technology. All the non-adopters of happy seeder decided not to go for it due to increased production costs after adopting it. Approximately 87 percent of respondents did not use it due to poor plant germination, resulting in a decrease in wheat straw yield when sowing in standing stubbles with a happy seeder, though yield was also reduced in the first years. Due to increased rodent and insect pest attacks on crops, majority of respondents did not adopt it.

Out of 135 respondents, 104 respondents didn't adopt baler. The non-adopters of baler didn't adopt it because of its non-availability at the proper time. Fifty-six respondents had thorough information on mulchers; however, twenty-one of these did not use them since the cost of production increased during adoption. Because of increased insect-pest attacks on crops, 86 percent of non-adopters didn't adopt it. This was not adopted by around 72 per cent of non-adopters due to a lack of availability. The lack of skilled labour, which has been required for handling paddy straw with a mulcher and broadcasting seed on the farms, was also a major hurdle, according to 58 per cent of non-adopters. The non-adoption of the super

Table 2: Distribution of respondents according to reasons for the non-adoption of paddy straw management technologies

Reasons	F	%
Happy seeder (n=92)		
Attack of rodents	85	92.39
Decrease in wheat straw production	80	86.95
Decrease in yield during initial years	80	86.95
More insect-pest attack	85	92.39
More cost of production	92	100
Baler (n=104)		
Non-availability of machines	104	100
Mulcher (n=21)		
Non-availability of machines	15	71.42
More insect-pest attack	18	85.71
More cost of production	21	100
Non-availability of skilled labor to operate	12	57.14
Super straw management system (n=81)		
Decrease in yield due to shattering	75	92.59
More insect-pest attack	69	85.18
Difficulty in sowing due to uneven spreading of straw	81	100
More rent paid	81	100.
Chopper-cum-spreader (n=34)		
Non-availability of machines	25	73.52
More insect-pest attack	32	94.12
More cost of production	34	100
Delayed in sowing operation	32	94.12

straw management system by eighty-one respondents was due to difficulties in sowing operations because of uneven straw distribution, and rent was higher on combines to which the super straw management system was connected. This was not adopted by around 93 percent of the non-adopters due to a reduction in crop yield due to the shattering of grains during harvesting. Due to increased insect pest infestations, more than 85 percent of non-adopters did not use this technique. Sixty-eight respondents were aware of the chopper-cum-spreader, but thirty-four of them did not use it, resulting in increased production costs. About ninety-four percent did not utilise a chopper-cum-spreader due to increased insect-pest attacks. The sowing operation was also delayed due to the time required to chop straw rather than burn it. Seventy-four percent of non-adopters did not use a chopper-cum-spreader because it was not available at the proper time.

CONCLUSION

To manage paddy straw, different technologies are available among the farmers. Farmers are facing some problems after the adoption of these technologies, like increasing the attack of insect-pest and rodent problems. Due to the non-availability of some technology like balers, farmers are not able to manage paddy straw eco-friendly because of the delay in sowing of succeeding crop rent paid by farmers for the use of this technology, which increases the cost of production for farmers. Due to the decrease in yield and straw of the wheat crop after managing paddy straw with happy seeder and super straw management technologies, some farmers do not adopt these technologies. There is a need to resolve these problems through proper research. This will help to increase the adoption of these paddy straw management technologies.

REFERENCES

Amir, P. and M. Aslam. 1992. The rice-wheat system of the Punjab: A conflict in crop management. In: Berlese D, Husain T (Eds.) *Far Sys Pak* Pp 201-13. Vanguard Books, Lahore.

Athira, G.; A. Bahurudeen and S. Appari. 2019. Sustainable alternatives to carbon intensive paddy field burning in India: A framework for cleaner production in agriculture, energy, and construction industries. *Journal of Cleaner Production*, 236(2): 78-103.

Kaur, A.; P. Kaur and P. Kumar. 2021. Status of paddy straw management technologies in Punjab. *Indian Journal of Extension Education,* 57(3): 78-83.

Lohan, S.K.; H.S. Jat; A.K. Yadav; H.S. Sidhu; M.L. Jat; M. Choudhary; J.K. Peter and P.C. Sharma. 2018. Burning issues of paddy residue management in north-west states of India. *Renewable & Sustainable Energy Reviews,* 81(4): 693-706.

Mahal, J.S.; G.S. Manes and R. Kumar. 2019. Adoption of paddy straw management practices in Punjab-Issues and regional variations. *Progress Farming,* 55(5): 4-6.

Sidhu, H.S.; M. Singh; Y. Singh; J. Blackwell; S.K. Lohan; E. Humphreys; M.L. Jat; V. Singh and S. Singh. 2015. Development and evaluation of the Turbo Happy Seeder for sowing wheat into heavy rice residue in NW India. *Field Crop Research,* 184(5): 201-212.

Sood, J. 2015. Not a waste until wasted down to earth. Retrieved from http: //www.downto earth.org in/ content/not-waste-until-wasted on 04-03-19.

Sunder, S. 2018. Indian economic survey. Retrieved from / https: //www.google.com/amp /s/www.financial express.com/budget/india-economic-survey-2018-for-farmers-agriculture-gdp-msp/1034266/lite on 06-03-19.

Verma, S.S. 2014. Technologies for stubble use. *Journal of Agriculture & Life Sciences,* 1(4): 106-110.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 340-344

Standardization of Low Gluten Mathri Mix Fortified with Maize-soy Blends for Baked Mathri

Priyanka Agrawal[1], Kanak Saxena[2]* and Alpana Singh[1]
[1]Department of Food Science and Technology, Jawaharlal Nehru Krishi Vishwa Vidhyalaya, Jabalpur, Madhya Pradesh
[2]Department of Genetics and Plant Breeding, Rabindranath Tagore University, Bhopal, Madhya Pradesh

ABSTRACT

The consumption of gluten causes self-perpetuating damage to the intestinal mucosal and diarrhoea leads to celiac disease. Therefore the present study was conducted to test the suitability of soy and maize flour in developing low gluten instant mathri mix. The mix prepared with the ratio of 30:45:25 respectively of refined wheat flour: maize flour: soy flour was found best with excellent sensory qualities. Hunter colour analysis of mathri showed decreased in L-value with supplementation of different flours to mix and simultaneously increase in a* and b* values. The gluten per centage was found to be lowest (2.31/100g) in improved mathri as compared to control. Polypropylene was found to be the best as compared to low density polyethylene for storage of baked mathri up to 60 days. It can be concluded that replacement of refined wheat flour with full fat soy and maize flour resulted reduced gluten content and enhanced nutritional composition in terms of fibre, protein, ash, minerals, fat compared to traditional recipe which could help to alleviate the problem of patients suffering from celiac diseases.

Keywords: Fortified, Gluten content, Maize-soy blends, Polypropylene, Mathri, Protein

INTRODUCTION

Mathri is a popular deep fat fried Indian snack traditionally prepared from refined wheat flour (maida) containing gluten protein. It has various side effects and disadvantages and also known as slow poison. It spikes sugar levels because it has very high glycaemic index. Maida also leads to peptic ulcer and gall bladder disease. In recent years, the impressive rise of Celiac Disease incidence, dramatically prompted changes in the dietary habit of an increasingly large population, with a rise in demand of low gluten product. Soybean protein provides all the nine essential amino acids in the amounts needed for human health. Fortification of cereals with soy will not only improve protein quantity but also improve the quality of food nutrients such as amino acid balance. Maize (*Zea mays*) is one of the most important cereal crops of the world. In India, maize is emerging as third most important crop after rice and wheat. Maize with its high content of carbohydrates, fats, proteins, some of the important vitamins and minerals, acquired a well-deserved reputation as a 'poor man's nutri-cereal. Keeping in view, the present investigation was undertaken to develop low gluten mathri mix by replacing maida with soy and maize flour, and analysing its various quality parameters.

MATERIALS AND METHODS

Food commodities: Maida (Refined wheat flour), Soybean (*Glycine max*), Maize (*Zea mays*) flour, were procured from the local market of Adhartal, Jabalpur.

Preparation of full fat soy flour: Soybean grains were thoroughly cleaned to remove the dust and other foreign materials. The cleaned grains were soaked in water for 6-8 hours and boiled for 20 minutes to remove the beany flavour and as well as to enhance easy dehulling. The autoclaved beans were cooled and dried at 60°C for about 24 hours. The dried beans were milled to make fine flour and sieved through 80–100 mesh sieves (Ajibola and Filani, 2015).

*Corresponding author email id: kanak.saxena@aisectuniversity.ac.in

Drying of spices: The fresh leaves of fenugreek were washed under tap water and dried in hot air oven at 65°C for 6-7hrs.

Sensory evaluation of products: The sensory quality characteristics of the products such as colour and appearance, taste, texture, flavour, after taste and overall acceptability were evaluated by panel of 15 trained judges using nine point hedonic scales as described by Amerine *et al.* (1965).

Physical properties

Hunter colour measurement: Colour measurement of different instant baked mathri mixes as well as mathri prepared from it was done by using a Hunter colour measuring system and expressed in terms of L*, a*, b*, according to the CIE method (1976). L* represents the brightness from white (100) to black (0). Red to green colour component was indicated by the a* values and yellow to blue colour components were indicated by the b* values.

Proximate composition of baked mathri: The moisture content of the sample was determined by the using moisture meter, protein content by conventional Micro-Kjeldhal digestion and distillation procedure as given in AOAC (1992) using pelican's kel plus digestion and distillation assembly. The fat, ash and crude fibre content of the sample was determined by the procedure as described in AOAC (1992) using Sox plus automatic fat analysis system, Muffle furnace & automatic fibre analysis system (Make- Pelican) respectively. Total carbohydrate was estimated by subtracting the sum of moisture, protein, fat, ash and crude fibre from 100 (Merrill and Watt, 1973). The total energy value (kcal) was calculated by using the Atwater factor method [(9 x fat) + (4 x carbohydrate) + (4 x protein)] as described by Nwabueze (2007). Mineral contents of different mathri mixes were obtained by calculation using table values (Gopalan *et al.,* 1996).

Functional properties of mathri

Water and fat absorption capacities: Water and fat absorption capacities of the mathri samples were determined by Sosulski *et al.* (1962) and Sosulski *et al.* (1976). method.

Storage studies: The storage stability of instant mathi was carried out using low density polyethylene (LDPE) and Polypropylene (PP) pouches for a period of 2 months at ambient conditions. All samples were drawn periodically after 0, 30, 60 days and analysed for sensory qualities, moisture, free fatty acid and peroxide value.

Free Fatty Acid (FFA) and Peroxide Value (PV): Free fatty acid was determined as per the method of AOAC (1992). And Peroxide value in stored samples was estimated by the method of Ranganna (1986).

Statistical analysis: The data obtained from various experiments were statistically analyzed. A complete randomized design was adopted for statistical analysis of data by following the procedure as described by Panse and Sukhatme (1963)

RESULT AND DISCUSSION

A number of trials were conducted by taking varying refined wheat flour (maida), maize flour along with full fat soy flour keeping ajwain and dried methi leaves level constant with salt to taste, hot oil/ghee and lukewarm water. Accordingly mathri were prepared using earlier mentioned basic recipe for mathri with 30-50 per cent refined wheat flour, 40-45 per cent maize flour with 10-25 per cent full fat soy flour. Control mathri was prepared with (100g) refined wheat flour, salt (2g), ajwain (2g) and (1g) dried methi leaves were added. In the primary sensory evaluation test baked mathri were prepared from different formulations and were evaluated by panelists. The score for the products with 30-50 per cent refined wheat flour, 10-25 per cent soy flour and 40-45 per cent maize flour were highest in terms of all sensory attributes. Panelists recommended preparation of mathri with sieved maize flour but without baking soda. Panelists suggested that the 15ml oil, 1.5g salt, 2g ajwain and 1g dried methi leaves for baked mathri must be added for softness, good taste and texture (Table 1).

Four variations of value added instant baked mathri were formulated by using the selected ingredients. For choosing the best variation amongst four product of all the variations was prepared and it was evaluated for it's sensorial attributes against basic recipe. The mean scores of different combinations (MB4) ranged from colour and appearance (8.80), taste (8.00), flavour (8.60), texture (8.40), and overall acceptability (8.45) as compared to other modified combinations. In present study deep-fat fried/baked snacks showed only minor

Table 1: Sensory attributes of baked mathri

Formulations	Colour and Appearance	Flavor	Texture	Taste	Overall acceptability
MB1	8.76	8.60	8.60	8.40	8.59
MB2	8.60	7.86	7.50	7.70	7.91
MB3	8.54	7.72	7.00	7.52	7.69
MB4	8.80	8.60	8.40	8.00	8.45
SEM ±	0.029	0.073	0.057	0.129	0.065
CD at 5 %	0.092	0.230	0.181	0.408	0.206

variation in brightness, redness and yellowness values at different levels of soy/maize ûour incorporation. Similar results are reported by Senthil *et al.* (2002) with regards to soy flour incorporation. The crisper texture in the products with added fat enhanced the acceptability scores. The similar result reported by Geetalakshmi and Prakash (2000).

Proximate content of baked mathri are presented in Table 2. Moisture content varied from 4.17 to 4.89 per cent, protein content 10.80 to 18.50 per cent, fat 22 to 31.4 per cent, carbohydrate 60.19 to 42.55 per cent, crude fiber 0.82 to 1.98 per cent, ash 1.3 to2.21 per cent, energy value 481.96 to 525.2 Kcal/100 g, in all baked mathri. The data from revealed about the significant increase in protein, fiber, ash contents, energy value and decrease carbohydrates in baked mathri as compared to control. The decreased level of carbohydrate with increased level of soy flour substitution supporting the claims of Akpapunam (1997). Maize flour has higher content of ash, moisture, fats and dietary fibre which explains the slight increases in these components with increased substitution (Whistler *et al.,* 1984; Potter and Hotchkiss, 1985).

Colour is one of the most important factors in the quality of baked products. In baked mathri the highest value of lightness (65.24) was obtained from MB1 followed by MB2 (56.74) and MB4 (55.40) while the lowest value (54.50) was obtained from MB3. The highest a & b values of mathri (12.82) (34.69) obtained from MB4 and lowest from MB1 (3.75) (24.68) formulation respect (Table 3 & 4).

Table 3: Physical attributes of baked mathri

Formulations	Hunter Colour Analysis		
	L	a	b
MB1	65.24	3.75	24.68
MB2	56.74	8.43	32.04
MB3	54.50	10.96	32.11
MB4	55.40	12.82	34.69

Table 4: Functional attributes of baked mathri

Formulations	Water absorption capacity (ml/100 g)	Fat absorption capacity (ml/100g)
MB1	256	165
MB2	270	180
MB3	268	186
MB4	257	213

Table 2: Proximate analysis of baked mathri

Formulations	Moisture (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Crude Fiber (%)	Ash (%)	Energy value (kcl)
MB1	4.89	10.80	22	60.19	0.82	1.3	481.96
MB2	4.17	14.48	27.6	50.62	1.60	1.53	508.8
MB3	3.58	18.60	31.4	42.55	1.80	2.07	525.2
MB4	4.17	18.50	26.4	46.74	1.98	2.21	498.56
SEM±	0.057	0.083	0.05	0.081	0.117	0.066	0.623
CD at 5%	0.187	0.262	0.070	0.257	0.371	0.210	0.196

All experimental material evaluated for water absorption capacity and fat absorption capacity. The highest value of WAC in baked mathri mix attained by MB2 (Table 5). While in baked mathri the WAC ranged from 256 to 270 ml/100g with the combination MB1 and MB4 respectively. The value of fat absorption capacity of soy-maize based baked mathri was found to be higher in MB4 (213ml/100g) followed by MB3, MB2 and MB1 formulations. The FAC also makes the flour suitable in facilitating enhancement in flavour and mouth feel when used in food preparation (Chandra and Samsher, 2013). MB4 formulation record highest value. Increase in fat absorption capacity may be due the addition of soy/maize flour in instant mathri mix. The similar value was reported by Nath and Rao (1981) for soya meal and higher value reported by Tasneem et al. (1982) with regard to soya flour. Water absorption capacity was increased due to addition of soy flour. Similar findings were reported by Dhawan (1998), Senthil *et al.* (2002) and Abioye *et al.* (2011) with regards to soy flour incorporation.

Results indicated that the significant increase was observed in moisture content of the baked mathri during storage in both the packaging materials. The data revealed that moisture content of baked mathri had an initial value of 4.17 per cent which was increased gradually up to 6.60 for P1MB4 packed in LADP. The moisture content of baked mathri P2MB4 found to be 4.17 at initial further increased up to 6.20. The peroxide value of the product at the end of the storage period found to be increased from initial 1.62meq/kg to 2.08 meq /kg for P1MB4. The PV of the baked mathri ranged from 1.62 to 2.00 (P2MB4). Overall acceptability of all baked mathri was slightly decreased with increase in storage period. The overall acceptability of the product at the end of the storage period found to be decreased from initial 8.82 to 8.35 for P1MB4. Formulation MB4 (baked mathri) packed in polypropylene (P2MF4) exhibited the highest acceptability (8.68) up to the end of storage at 60 days. The value of free fatty acid observed in control sample was 0.90 to 1.05 (P1MB4). The initial value of baked mathri was 0.90 increased up to 1.01 (P2MB4).

Thus, peroxide value is a measure of oxidation during storage and the freshness of lipid matrix. So, greater the PV, the more will be the rate of oxidation of the oil (Atinafu and Bedemo, 2011). Increasing trends of free fatty acid content on storage for wheat flour cookies were also reported by Nagi *et al.* (2012).

CONCLUSION

Substitution of refined wheat flour with full fat soy flour and maize flour at levels of 25 and 45 per cent respectively resulted reduced gluten content and enhanced nutritional composition in terms of fiber, protein, ash, minerals, fat compared to traditional recipe. The modified baked mathri comparatively with low

Table 5: Shelf life of baked mathri

Parameters	Formulations	0 days	30 days	60 days
Moisture Content (%)	P1MB1	4.89	5.90	6.30
	P2MB1	4.89	5.70	6.00
	P1MB4	4.17	5.40	6.60
	P2MB4	4.17	5.20	6.20
FFA (% oleic acid)	P1MB1	0.89	0.92	0.96
	P2MB1	0.89	0.90	0.93
	P1MB4	0.90	0.96	1.05
	P2MB4	0.90	0.92	1.01
PV(Meq. of O_2/kg fat)	P1MB1	2.98	3.20	3.50
	P2MB2	2.98	2.82	2.92
	P1MB4	1.62	1.90	2.08
	P2MB4	1.62	1.85	2.00
OAA	P1MB1	8.80	8.60	8.55
	P2MB1	8.80	8.70	8.65
	P2MB4	8.82	8.62	8.53
	P2MB4	8.82	8.73	8.68

fat is much better option than traditional fried mathri in terms of health aspects. The reduction of gluten content of mathri with the addition of soy and maize flour could help to alleviate the problem of patients suffering from celiac diseases.

REFERENCES

Abioye, V.F.; B.I.O. Ade-Omowaye; G.O. Babarinde and M.K. Adesigbin. 2011. Chemical, physico-chemical and sensory properties of soy-plantain flour. *African Journal of Food Science,* 5(4): 176–180.

Ajibola, C.F. and A. Filani. 2015. Storage Stability of Deep-fried Cowpea Products (AKARA) Incorporated with Soy-flour and *Aframomum danielli*. *British Journal of Applied Science & Technology,* 8(2): 204-212.

Akpapunam, M.A.; G.I.O. Badifu and E.P. Etokudo. 1997. Production and quality characteristics of Nigerian "Agidi" supplemented with soy flour. *Journal of Food Science and Technology,* 34(2): 143-145.

Amerine, M.A.; R.M. Pangborn and E.B. Roessler. 1965. Principle of sensory evaluation of foods, Academic Press, New York. 349p.

AOAC. 1992. Official methods of analysis 16 edition. Association of official Analytical Chemistry Inc. Arlington VA.

Atinafu, D.G. and B. Bedemo. 2011. Estimation of total free fatty acid and cholesterol content in some commercial edible oils in Ethiopia, Bahir DAR. *Journal of Cereals Oilseed,* 2: 71-76.

Chandra, S. and Samsher. 2013. Assessment of functional properties of different flours. *African Journal of Agricultural Research,* 8(38).

CIE, "Commission International de l' Éclairage," 1976. http://www.cie.co.at.

Dhawan, S. 1998. Studies on incorporation of defatted soya flour and rice flour in sev preparation. M.Sc. Ag. Thesis (unpublished). Govind Ballabh Pant University of Agriculture and Technology Pantnagar, India.

Geethalakshmi, V. and Jamuna Prakash. 2000. Processing variables and quality Parameters of chakli- an Indian traditional deep fried product. *Journal of Food Science and Technology,* 37: 227-232.

Gopalan, C.; B.V. Ramasastri and S.C. Balasubramaniam. 1996. Nutritive value of Indian foods. National institute of nutrition. Indian Council of Medical Research, Hyderabad, India.

Merrill, A.L. and B.K. Watt. 1973. Energy value of foods: basis and derivation. In: Agriculture Handbook No. 74, United States Department of Agriculture, Washington. pp 2-4.

Nagi, H.P.S.; J. Kaur; B.N. Dar and S. Sharma. 2012. Effect of Storage Period and Packaging on the Shelf Life of Cereal Bran Incorporated Biscuits. *American Journal of Food Technology,* 7: 301-310.

Nath, J.P. and M.S. Narsing Rao. 1981. Functional properties of gour protein. *Journal of Food Science,* 46:12-55.

Nwabueze, T.U. 2007. Nitrogen solubility index and amino acid profile of extruded African breadfruit (*T. africana*) blends. *Nigerian Food Journal,* 25: 23-35.

Panse and P.V. Sukhamte. 1963. Statistical methods for agricultural workers, Indian council for agricultural research, New Delhi, India.

Potter, N.N. and J.H. Hotchkiss. 1995. Food Science 5th ed. Chapman and Hall, New York pp. 381–406.

Ram, K.; S. Kanak; M.S. Tushar and B. Geeta. 2016. A study on genetic variability, correlation and path analysis in pigeon pea [*Cajanus cajan* (L.) Millspaugh]. *International Journal of Agriculture Sciences,* 8(51): 2287-2289.

Ranganna, S. 1986. Handbook of analysis and quality control for fruit and vegetable products. Second edition. Tata McGraw Hill Publication Co. Ltd., New Delhi. 105p.

Saxena, K. and R. Bisen. 2017. Genetic variability studies in sesame (*Sesamum indicum* L.). *Annals of Plant and Soil Research,* 19(2): 210-213.

Saxena, K. and R. Bisen. 2017. Genetic variability, heritability and genetic advance for the phenotypic traits in sesame (*Sesamum indicum* L.). *Indian Journal of Pure & Applied Biosciences,* 5(2): 1126-1131.

Senthil, A.; R. Ravi; K.K. Bhat and M.K. Seethalakshmi. 2002. Studies on the quality of fried snacks based on blends of wheat ûour and soya ûour. *Food Quality and Preference,* 13: 267–273.

Senthil, A.; R. Ravi; K.K. Bhat and M.K. Seethalakshmi. 2002. Studies on the quality of fried snacks based on blends of wheat ûour and soya ûour. *Food Quality and Preference*, 13: 267–273.

Sosulki, F.W. 1962. The centrifuge methods for determining flour absorption in hard red spring wheat. *Cereal Chemistry,* 39: 344.

Sosulski, F.N.; E.S. Humbert; K. Bui and J.D.S. Jones. 1976. Functional properties of rapeseed flour, concentrate and isolate. *Journal of Food Science,* 41: 1348-1350.

Tasneem, R.; S. Ramamani and N. Subramanian. 1982. Functional properties of guar seed meal detoxified by different methods. *Journal of Food Science and Technology,* 47: 1175.

Whistler, R.L.; N.J. Bemilier and E.F. Pascal. 1984. Starch Chemistry and technology. Academic Press Inc. London pp. 25–30.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 345-350

Status and Prospects of Green Manuring in Punjab State of India

Davinder Singh[1]* and Prabhjot Kaur[2]
[1]Extension Scientist, [2]Professor, Department of Extension Education, Punjab Agricultural University, Ludhiana-141001, Punjab

ABSTRACT

Green manuring is a way for sustainable agriculture under present intensive cropping system. It helps to improve overall soil health. The survey was conducted during *rabi* season 2019, on farmers practicing green manuring in Punjab, India to understand the status, economic benefits, ease of access and complexity, recommended practices (POP) followed and reasons for the non-adoption of recommended practices. It was found that green manuring was practised since the year 2000 among surveyed farmers. Fellow farmers, friends and Punjab Agricultural University were the major source of information regarding this practice. On an average about half (51.21%) of the total operational land holding of sampled farmers was under green manuring. Seeds of green manuring crops were easily available and this was a simple practice as perceived by all the farmers. Input expenditure was increased after practicing green manuring. There was a negative change in net income as reported by the farmers. Almost all other recommended practices were followed by majority of the respondents. Majority of the respondents were willing to continue green manuring in coming years. The findings will be of great utility in formulating the relevant policies and programmes in more efficient way to boost the promotion and adoption of green manuring practice which ultimately leads to improve soil health.

Keywords: Green manuring, Nutrient management, Organic farming, Soil conservation, Sustainable farming

INTRODUCTION

Indian agriculture has come a long way from shortage of food grains supplies to attainment of self-sufficiency in food. Indian agricultural production growth has been able to keep pace with population demand for food in the country mainly due to adoption of modern technologies inducing yield growth, followed by area expansion (Hobbs and Morris,1996). Punjab is one of the most fertile regions on the earth. It is called bread-basket of India. The state of Punjab contributed 31 per cent of wheat and 38 per cent of rice to central pool during the year 2017-18 (Government of Punjab, 2018). The major contributing factors to grain production include use of fertilizers, better irrigation facilities and high yielding variety crops. High use of fertilizers direct great pressure on the ecological system of the Punjab state, leading to soil resources deterioration and environmental pollution from farm chemicals (Krishan *et al.,* 2014). The present intensive cropping system is no more sustainable in Punjab (Dhillon *et al.,* 2011). In recent years the negative consequences of such practices are becoming more evident in the Punjab. The new challenges demand efficient resource use by adopting conservation agriculture (CA) to meet emerging needs (Bhatt and Arora, 2019; Long, *et al.,* 1998). To achieve sustainability, available inputs and natural resources must be used most efficiently with minimal damage to the environment (Ramesh *et al.,* 2016). Efficient inputs use can be achieved by assessment of available inputs and conservation against possible losses, integrated use of inputs, maximizing input use efficiency by developing suitable technologies/practices (Dhillon *et al.,* 2011). CA has emerged as a way for sustainable intensive crop production system which primarily focuses on resource savings through minimal tillage, ensuring soil nutrients and moisture conservation through crop residues and growth of cover crops and adoption of spatial and

*Corresponding author email id: sdavinder.singh2@gmail.com

temporal crop sequencing (Bhan and Behera, 2014). Green manuring is one of the traditional but effective ways of increasing and maintaining the fertility of the soils at a relatively low cost while sustaining agriculture (Singh, *et al.,* 2019). The adoption of such resource conservation practices is expected to yield benefits to the farmers in terms of reduced losses due to soil erosion, saving of soil health, increased productivity and water-use efficiency, increased nutrient-use efficiency and adoption of new crop rotations (Singh *et al.,* 2011). So, it is considered imperative to recognize the current status of green manuring in terms of farmer's perception and how far this practice have been adopted by the farmers in the state. To find answers to these questions the present study was undertaken. The findings of the present study will be of great utility to agricultural planners, educators and administrators in general in formulating the relevant policies and programmes on the basis of which, the right programmes for promotion and adoption of green manuring can be planned and implemented in a more efficient way so that maximum number of farmers could be benefitted.

MATERIALS AND METHODS

The study was conducted in Punjab state of India. For the selection of respondents two stage cluster sampling design was used. Data regarding area under green manuring were procured from the Punjab State Department of Agriculture & Farmers Welfare. Clusters for green manuring were identified with the help of procured data. Number of clusters identified was 14 (G1 to G14). Out of these identified clusters, four clusters were selected randomly. The selected clusters (G6, G10, G7 and G12) for green manuring were spread over Hoshiarpur, Ludhiana, Ferozepur and Sangrur districts. At the second stage of sampling design, 50 farmers who adopted were selected using probability proportional to number of farmers in each cluster. Green manuring for the present investigation was studied in terms of area under green manuring, economic benefits of green manuring, ease of access of seeds, complexity and package of practices followed by the respondents in adoption of green manuring. The area under green manuring during 2018-19 was considered for the present study. It was measured in terms of proportion of area under green manuring to the total operational landholding. Respondents were categorised into three categories i.e. low (5-36%), medium (37-68%) and high (69-100%) using range method of categorization.

Economic benefits were operationalized in terms of increase in yield, decrease in expenditure on inputs used, increase in income, improvement in soil health as an outcome of use of green manuring. Increase in yield was operationalized as per cent change in crop yield while practicing green manuring. It was measured in terms of per cent increase/decrease in yield obtained by practicing green manuring as compared to no green manuring. Expenditure was operationalized in terms of total amount (Rs./hectare) saved on inputs (variable costs only) after the adoption of green manuring as compared to no green manuring. Increase in income was operationalized in terms of per cent change in income while practicing green manuring. It was measured as a difference between per hectare net income obtained after practicing green manuring in comparison to no green manuring over variable costs. Further, improvement in soil health was measured in terms of improvement in soil structure and organic matter due to use of green manuring as perceived by farmers. Complexity is defined as degree to which the green manuring is perceived as difficult to understand and practice. It was classified into three categories; more complex, less complex and simple. The primary data were collected with help of interview schedule by personal interview method during *rabi* season (2019) for the crop year 2018-19. After completion of data collection process, collected data were further entered, classified and analyzed on computer-based spreadsheet software in order to reach on final results, discussion and conclusion. Statistical tools such as frequencies, percentage, mean and standard deviation were used for the analysis of data.

RESULTS AND DISCUSSION

Source of information is a one of the important components of diffusion process as innovation is first exposed to the social system through different communication channels. 38 per cent of the respondents got information regarding green manuring from their friends followed by 26 per cent of the respondents who got information about green manuring from fellow farmers (Figure 1).

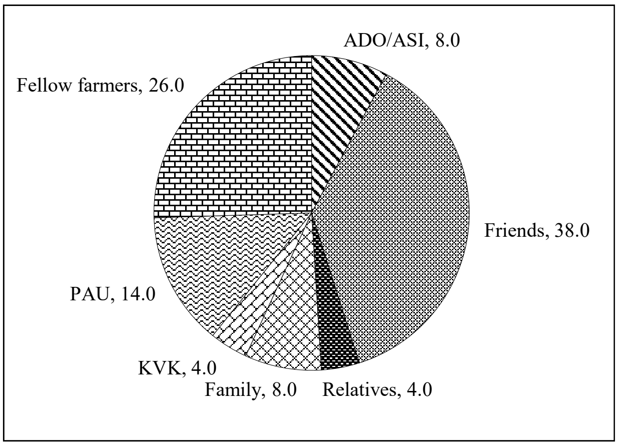


Figure 1: Distribution of respondents on the basis of first source of information regarding green manuring

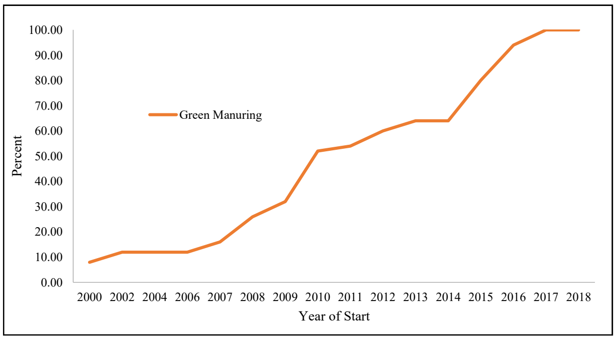


Figure 2: Distribution of respondents on the basis of year of start of green manuring

It was found that green manuring was practised since 2000. In 2010, twenty per cent of the respondents started green manuring technology. No respondent had started green manuring in 2018 as green manuring practice was already adopted by the respondents (Figure 2). Almost none of the respondent had attended any kind of training regarding green manuring.

Area under any technology/practice is one of the indicators to observe its extent of adoption. It mainly depends on its attributes i.e. complexity, observability, trialability, relative advantage, etc. Regarding green manuring, 58 per cent of the respondents had adopted this practice on 2 to 4 hectares of their farm. About one fourth (26%) of the respondents grown green manuring crop on less than 2 hectares of land (Figure 3). Only 16 per cent of the respondents grow green manuring crop on more than 4 hectares of their land. The average area under green manuring crop was 3.56 hectare. About half (46%) of the respondents practised green manuring on 33 to 66 per cent of their land on the basis of percent area covered. On an average respondent practised green manuring on 51.21 per cent area of total operational land.

In adoption process, ease of availability of a technology directly affects its adoption. Regarding green manuring, majority of the respondents (80%) easily availed seeds of green manuring crop. It was due to the reason that the seeds of green manuring crop were easily available with agriculture development officers at a subsidized rate. Moreover, there are numerous private seed firms where respondents can easily get seeds of green manuring crops. Reason behind

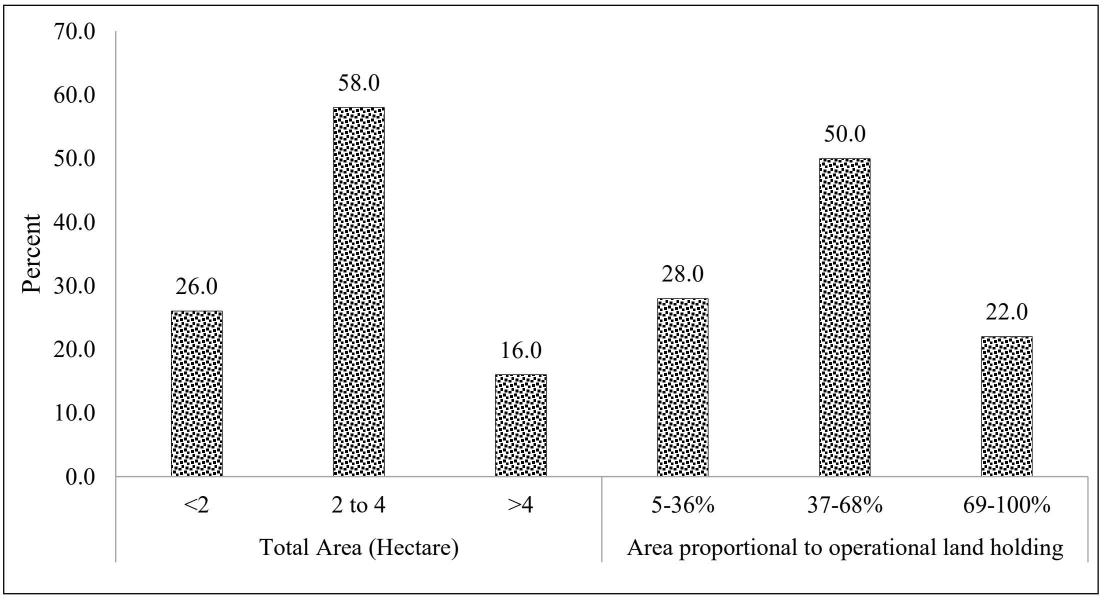


Figure 3: Area under green manuring

non-availability of seed (20%) was less and late supply of seed from concerned departments as reported by the respondents. All the respondents who adopted green manuring perceived it as simple farm practice due to its easy cultivation.

It was evident that a large majority of the respondents (92%) perceived green manuring was helpful in improving soil structure as well as soil organic matter. Results are in line with Dubey *et al.* (2015), Nayak and Vaidya (2018) and Sinha *et al.* (2019).

Change in yield was calculated as difference between yield obtained by using green manuring against no green manuring. Survey revealed that majority of the respondents (76%) observed no change in yield of wheat crop with adoption of green manuring (Figure 4). About one fourth (24%) of the respondents noticed an increase in yield of wheat crop ranging from 3.57 to 18.75 per cent as compared to wheat yield obtained without green manuring. An overall per cent change in yield of wheat crop was 1.73 due to green manuring.

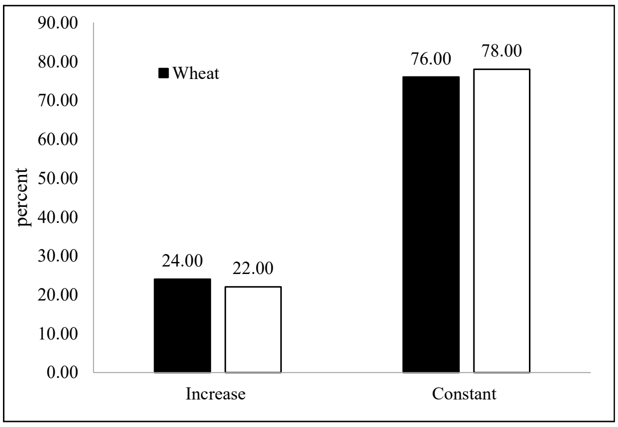


Figure 4: Distribution of respondents on the basis of change in yield with the adoption of green manuring

In case of rice crop, majority of the respondents (78%) did not observe any change in yield while practicing green manuring. On the other hand, 22 per cent of the respondents noticed an increase in yield of rice ranging from 2.50 to 11.11 per cent as compared to rice yield obtained without green manuring. On an overall, rice yield was increased by 1.07 per cent with green manuring. These findings are in accordance to Meena *et al.* (2018). The increase in yield was due to an increase in organic matter and soil humus, improved soil structure and readily available nutrients to the next crop as a result of green manuring.

On an average Rs. 4715.95 per hectare were spent on inputs used while practising green manuring. This was the extra farm expenditure for the respondents. The findings are not in line with Kurnar *et al.* (2017).

With the adoption of green manuring, there was a negative change in net income of Rs 793.75 per hectare/year. These results are in conformity with those reported by Kumar *et al.* (2017), Rayns and Rosenfeld (2008), Pandey and Singh (2016) and Nayak and Vaidya (2018). It was mainly due to the increased expenditure on inputs used by green manuring. But it may be noted that green manuring is recommended mainly to improve soil health. Thus, from the findings it can be concluded that green manuring costs very low in terms of improvement in soil health.

Under Punjab conditions, the recommended crops for green manuring are *dhaincha* (*Sesbania bispinosa*), cowpea (*Vigna unguiculate*) and sunnhemp (*Crotalaria*

Table 1: Distribution of respondents on the basis of recommendations followed for green manuring (n=50*)

Practices	Recommendations	Follower
Soil type	Sandy loam to loamy soils	34 (72.34)
Soil Amendment	Apply Gypsum (for soil having pH more than 9.3)	6 (12.77)
Seed rate	50 kg per hectare	29 (61.70)
Sowing	With drill in lines 20-22.5 cm apart	2 (4.26)
Sowing time	April to July	44 (93.62)
Fertilization application	30 kg of P_2O_5 per hectare at the time of sowing	10 (21.28)
Irrigation	Three to four irrigations during summer period	15 (31.91)
Plant protection measures	Spray 150ml of novaluron against tobacco caterpillar	-
Incorporation	Bury 6-7 weeks old green manuring crops	42 (89.36)

*Figures in parenthesis represent percentage; *Multiple responses* *juncea*). Summer moong (*Vigna radiata*) can also be used under green manuring with additional benefits as pulse crop. But as such no recommendations were available for summer moong as a green manuring crop. Out of 50 adopter of green manuring, three respondents were growing summer moong as green manure. But due to unavailability of recommendations for summer moong, these three respondents were excluded from Table 1 i.e. n=47. Majority of the respondents (87.23%) did not apply gypsum as a soil amendment as pH of their field was neutral. Further, 61.70 per cent of the respondents applied recommended seed rate of green manure crops i.e. 50 kg per hectare. About 38 per cent of the respondents used less than recommended seed rate. As far as sowing method was concerned, a large majority of the respondents (95.74%) did not follow recommended method of sowing (i.e. with drill in lines 22-22.5 cm apart) as they had sown the seed using broadcast method which is more economical. Almost all the respondents had sown seeds of green manuring crop on recommended sowing time (April to July) (Table 1) (Kaul *et al.,* 2015; Dubey *et al.,* 2015). A small proportion of the respondents (6.38%) did not follow recommended sowing time due to late availability of seed. Majority of the respondents (78.72%) did not apply recommended dose of fertilizer as there was sufficient availability of phosphorus in the soil on soil testing report basis. The recommended number of irrigations was three to four during the summer period for green manuring crop but majority of the respondents (68.09%) applied more irrigation to green manuring crops as water and electricity is free of cost in Punjab for irrigation. Majority of the respondents (89.36%) bury green manuring crops into the soil on the recommended time (Dubey *et al.,* 2015).

Data presented in Table 2 show that majority of the respondents (70.00%) were willing to continue green manuring in coming years on the same acres of land as last year. A major reason behind it was that respondents grow green manuring crop, on alternate years on the same fields. While some respondents had already adopted green manuring on their all land holdings. Moreover, other respondents reported that they will continue green manuring on their half fields year after year.

Table 2: Distribution of respondents on the basis of prospects of green manuring (n=50)

Prospects	Frequency	Percentage	Percent change
Discontinue	11	22.00	NA
Increase	4	8.00	116.67
Constant	35	70.00	-

*Multiple Responses; NA= Not Applicable; Percent change from year 2018-19 to 2019-20

A close look at data further reveal that slightly less than one fourth (22.00%) of the respondents did not want to continue the green manuring practice in the coming years. The major reasons were lack of irrigation facilities, late availability of seed and costly seed of green manure crops. Poor functioning of seed drill in succeeding crop is also a factor which leads to discontinuous of this practice by the farmers. But this problem was only restricted to the farmers who did not follow recommendations. Only a small proportion of the respondents (8.00%) wanted to increase the area under green manuring crops up to 116.67 per cent. The major reason behind this was due to reduced fertilizer consumptions and yield increase of succeeding crops.

CONCLUSION

The survey results described in this study identified several measures to enhance the adoption and effectiveness of green manuring. First source of information of green manuring is still friends and fellow farmers. Formal institutes (KVKs, ADOs etc.) needs to be strengthened to provide first-hand and authentic information to the farmers. Farmers were practicing green manuring on near about half of their land. Green manuring was easy to understand and a simple practice as reported by majority of the farmers. Majority of the farmers want to continue green manuring on constant area. It shows a positive attitude of farmers towards green manuring. But due to weak infrastructure and management, some farmers discontinued using this practice mainly due to lack of irrigation facilities, late availability and high cost of seed of green manuring crops. Seeds of green manure crop should be made timely available at low cost to the farmers as it emerged as major constraints in green manuring. Joint efforts of researchers, input providers and extension agencies are required to resolve and remove various problems relating to green manuring to boost its adoption.

REFERENCES

Bhan, S. and U. K. Behra. 2014. Conservation agriculture in India – problems, prospects and policy issues. *International Soil and Water Conservation Research*, 2: 1-12.

Bhatt, R. and S. Arora. 2019. Tillage and mulching options for conserving soil and water and improving livelihoods in foothills of lower Shiwaliks. *Journal of Soil and Water Conservation,* 18(3): 230-234.

Dhillon, D.S.; P. Kaur and S.K. Saini. 2011. Popularizing resource conservation technologies for sustainable agriculture in Punjab. *Agriculture Update,* 6: 158-60.

Dubey, L.; M. Dubey and P. Jain. 2015. Role of green manuring in organic farming. *Plant Archives,* 15: 23-26.

Government of Punjab. 2018. Statistical abstracts of Punjab. Economic Adviser, Government of Punjab. Retrieved from http://www.esopb.gov.in/static/PDF/Abstract2018.pdf on 01-06-2019.

Hobbs, P.R. and M. Morris. 1996. Meeting south Asia's future food requirements from rice-wheat cropping systems: priority issues facing researchers in the post-green revolution era. *Natural Resources Group,* 96: 01.

Kaul, A.; R. Kaur; A.K. Choudhary; S. Sepat and A. Dass. 2015. Importance of green manuring in sustainable agriculture. *Kheti,* 3: 8-12.

Krishan, G.; M.S. Rao; R.S. Loyal; A.K. Lohani; N.K. Tuli; K.S. Takshi; C.P. Kumar; P. Kumar and S. Kumar. 2014. Groundwater level analyses of Punjab, India: A quantitative approach. *Octa Journal of Environmental Research,* 2(3): 221-226.

Kumar, A.; R. Singh; S. Singh; R. Sendhil; R. Chand and J.K. Pandey. 2017. Impact of resource conservation technologies in Haryana. *Journal of Community Mobilization and Sustainable Development,* 12(2): 257-264.

Kumar, S.; S. Kumar; S. Mondal; S.S. Singh and K.M. Singh. 2017. Economics and yield response in rice (Oryza sativa)-wheat (*Triticuma estivum*) cropping system as influenced by different tillage and sowing methods in Eastern Region. *Indian Journal of Agronomy,* 62: 394-400.

Long, W.; R. Tate; M. Neuman; J. Manfreda; A. Becker and N. Anthonisen. 1998. Respiratory symptoms in a susceptible population due to burning of agricultural residue. *Chest,* 113: 351.

Meena, B.L.; R.K. Fagodiya; K. Prajapat; M.L. Dotaniya; M.J. Kaledhonkar; P.C. Sharma; R.S. Meena; T. Mitran and S. Kumar. 2018. Legume green manuring: an option for soil sustainability. *Springer Nature,* 45: 387-408.

Nayak, J.J. and A.C. Vaidya. 2018. Green manure in crop production and soil health. *International Journal of Innovative Research in Science, Engineering and Technology,* 7: 7378-80.

Pandey, A.K. and M.K. Singh. 2016. Importance and uses of green manuring in field crops. *Rashtriya Krishi,* 11: 35.

Ramesh, Negi, S.C. and S.S. Rana. 2016. Resource Conservation Technologies (RCTs)-Needs and future prospects: A review. *Agricultural Reviews,* 37(4): 257-267.

Rayns, F. and A. Rosenfeld. 2008. Green Manures. A review conducted by HDRA as part of HDC Project. Retrieved from http://www.organicresearchcentre.com/ manage/authincludes/article_uploads/iota/technical-leaflets/green-manures-leaflet.pdf on 12-05-19.

Singh, D. 2016. *Adoption of water-saving technologies in Sri Muktsar Sahib District of Punjab*. M.Sc. thesis, Punjab Agricultural University, Ludhiana, India.

Singh, D.; P. Kaur and D. Singh. 2019. Comparative Analysis of Psychological Characters of Farmers Adopting Various Resource Conservation Technologies. *Indian Research Journal of Extension Education,* 20(1): 61-66.

Singh, N.P.; R.P. Singh; R. Kumar; A.K. Vashist; F. Khan and N. Varghese. 2011. Adoption of Resource Conservation Technologies in Indo-Gangetic Plains of India: Scouting for Profitability and Efficiency. *Agricultural Economics Research Review*, 24: 15-24.

Sinha, N.K.; U.K. Chopra; A.K. Singh; N. Kumar; M. Mohanty and J. Somasundaram. 2019. Soil physical quality as quantified by S index under different management system in rice-wheat system. *Journal of Soil and Water Conservation,* 18(1): 27-34.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 351-355

Effect of Genotypes and Fertility Levels on Performance of Indian Mustard Under Rainfed Conditions in Haryana

Suresh Kumar[1]* and Ram Avtar[2]
[1]Directorate of Research, [2]Department of Genetics & Plant Breeding, CCS Haryana Agricultural University, Hisar, Haryana

ABSTRACT

A field experiment was conducted at Oilseeds Research Farm, CCS Haryana Agricultural University Hisar during *rabi* 2016-17 to evaluate performance of promising Indian mustard genotypes under different fertility levels under rainfed conditions. The soil of experimental field was sandy loam in texture, low in organic carbon (0.31%), low in available nitrogen (160 kg/ha), medium in Phosphorus (12.3 kg/ha) and high in Potash (332 kg/ha) and Sulphur (28 ppm) with slightly alkaline in reaction (pH 8.1). The experiment was laid in split-plot design with 6 genotypes (RGN 48, DRMR 1165-40, RH 725, RH 406, Albeli-1 and Kranti) in main plots and three fertilizer levels (100% RDF: 40-20 kg NP_2O_5/ha, 125% RDF, 150% RDF) in sub plots with 3 replications. Maximum seed yield (3515 kg/ha) was obtained from the mustard genotype RH 725, which was 20.2, 20.9, 22.3, 26.5, and 25.4 per cent higher than the seed yield recorded by genotypes DRMR 1165-40, Albeli, RGN 48, Kranti and RH 406, respectively. With addition of fertilizer, seed yield increased, but not at significant rate, implying that irrespective of the genotypes, mustard crop did not respond significantly to increase in fertility levels above the recommended dose of NPK (40-20-00 kg/ha). The genotypes other than RH 725 were statistically at par among themselves in seed yield. Oil content was not influenced significantly either with mustard genotypes or fertility levels. Maximum oil yield was also produced by RH 725 (1413 kg/ha), being significantly superior to rest of the genotypes. Variation due to interaction effect in mustard genotypes and fertility levels was not found to be significant.

Keywords: Indian mustard, Genotypes, Rainfed, Fertility levels, Seed yield, Oil content

INTRODUCTION

India is one of the largest oilseeds producing country and oilseeds are the second largest agricultural commodity after cereals in India. India is the third largest producer of rapeseed-mustard after Canada, China and contributing to around 11 per cent of world's total production. Rapeseed-mustard are the important oilseed crops and also one of the second largest oilseed crops in India. Of the total area and production under the nine oilseeds crops grown in India, rapeseed-mustard accounts for 23.2 per cent of the acreage and 26.2 per cent of the production (DRMR, 2022). The mustard growing areas in India are experiencing the vast diversity in the agro-climatic conditions and different species of rapeseed-mustard are grown in some or other part of the country. It is grown in 6.70 million hectare area in India producing 7.10 m tones with average yield of 1060 kg/ha (USDA, 2022). Indian mustard accounts for about 75-80 per cent of this area in the country Kumar *et al.* (2022). Though the average yield of mustard in Haryana (1793 kg/ha) is highest in the country, it is far below the average yield of mustard in Europian Union, Canada, Ukraine and Belarus. It is even below the world average yield of 2010 kg/ha (USDA, 2022). Mustard is cultivated in mostly under temperate climates. It is also grown in certain tropical and subtropical regions as a cold weather crop. Mustard requires well-drained sandy loam soil. Indian mustard has a low water requirement (240–400 mm) which fits well in the rainfed cropping systems (Shekhawat *et al.*, 2012). Nearly 30.7 per cent area under rapeseed-mustard is under rainfed farming. Indian mustard (*Brassica juncea*) is predominantly

*Corresponding author email id: sureshsilla@hau.ac.in

cultivated in the states of Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat under irrigated and rainfed conditions, which contribute more than 80 per cent area and production. Two major factors that determine the quantum of yield response to fertilizer are genotype and environment. Nitrogen is the most responsive nutrient for rapeseed-mustard, which is structural component of protein molecules, amino acids, chlorophyll and other constituents. The nitrogen requirement of the crop also depends on the soil type and organic matter content and this nutrient element is commonly lacking in many soils. Improved varieties of mustard have been reported to respond to higher nitrogen levels. Consequent upon the release of improved cultivars, a significant change occurred in plant type and fertilizer use efficiency compared to traditional varieties. Adequate phosphorus helps the mustard plant to partition greater proportion of the additional dry matter into the grain and the soils of Haryana generally fall in the medium range of available phosphorus. Mustard genotypes exhibit differential response to phosphorus application. New genotypes are continuously evolved by the scientists to enhance the potential productivity of the crop. Some genotypes with production potential upto 3500 kg/ha have been developed recently by the mustard researchers for the rainfed conditions of the zone-II of mustard cultivation in India comprising the states of Haryana, Punjab, Delhi and parts of Rajasthan. However, there is wide gap between the genetic potential of the released varieties and the actual average yield. Fertilizer management plays an important role to fully exploit the genetic potentiality of a variety. The newly released high yield varieties are responsive to inputs in general and fertilizers in particular. So, the study was planned to evaluate effect of genotypes and fertility levels on performance of Indian mustard under rainfed conditions in Haryana.

MATERIAL AND METHODS

A field experiment was conducted at Research Farm of Oilseeds Section, Department of Genetics and Plant Breeding, CCS, Haryana Agricultural University Hisar, Haryana (India) situated at 29°10' N latitude and 75° 46' E longitude at an elevation of 215.2 m above mean sea level during rabi 2016-17 to evaluate performance of promising Indian mustard genotypes under different fertility levels. Hisar has semi-arid climate with severe cold during winter and hot dry and desiccating winds during summer. Maximum temperature is about 45°C during hot summer months of May and June, while during winter months of December and January the minimum temperature may be sub zero. The average annual rainfall of the area is around 450 mm of which, 70-80 per cent is received during monsoon period *i.e.*, July to September and the rest is received in showers of cyclic rains during the winter and spring seasons. The mean relative humidity remains nearly constant at about 75 to 90 per cent from July to March, steadily decrease in April and remains around 40-50 per cent during hot summer months of May and June. The mean weekly meteorological data during the crop seasons of 2016-17 are given in Figures 1. The soil of experimental field was sandy loam in texture, low in organic carbon (0.31%), low in available nitrogen (160 kg/ha), medium in Phosphorus (12.3 kg/ha) and high in Potash (332 kg/ha) and Sulphur (28 ppm) with slightly alkaline in reaction (pH 8.1). The crop was sown with a pre-sowing irrigation and raised under rainfed conditions. The total rainfall received during the crop season was 44.1 mm. The experiment was laid in split-plot design with 6 genotypes (RGN 48, DRMR 1165-40, RH 725, RH 406, Albeli-1 and Kranti) in main plots and three fertilizer levels (100% RDF: 40-20-00 kg N-P_2O_5-K_2O/ha, 125% RDF and 150% RDF) in sub plots with 3 replications. The gross plot size was 4.5 m x 6.0 m, whereas net plot size was 3.6 m x 5.7 m. All the genotypes were sown on October 13, 2016 with hand plough at a row to row spacing of 45 cm. Thinning was done after about three weeks of sowing to maintain plant to plant distance of 15 cm. Full dose of nitrogen and phosphorus was applied at sowing as per the treatments. All the other recommended package of practices for rainfed mustard was followed for raising the crop. The crop was harvested on March 21, 2017 after attaining full physiological maturity manually with help of sickle and bundles of crop from different plots were kept in the field for sun drying. After complete drying, the produce was threshed, winnowed and the seeds were separated and their weight was recorded. The data were subject to standard statistical analysis to draw conclusions.

RESULTS AND DISCUSSION

Plant height was significantly influenced by genotypes, the maximum plant height being recorded by RH 725 (196.6 cm), which was statistically at par with RH 0406

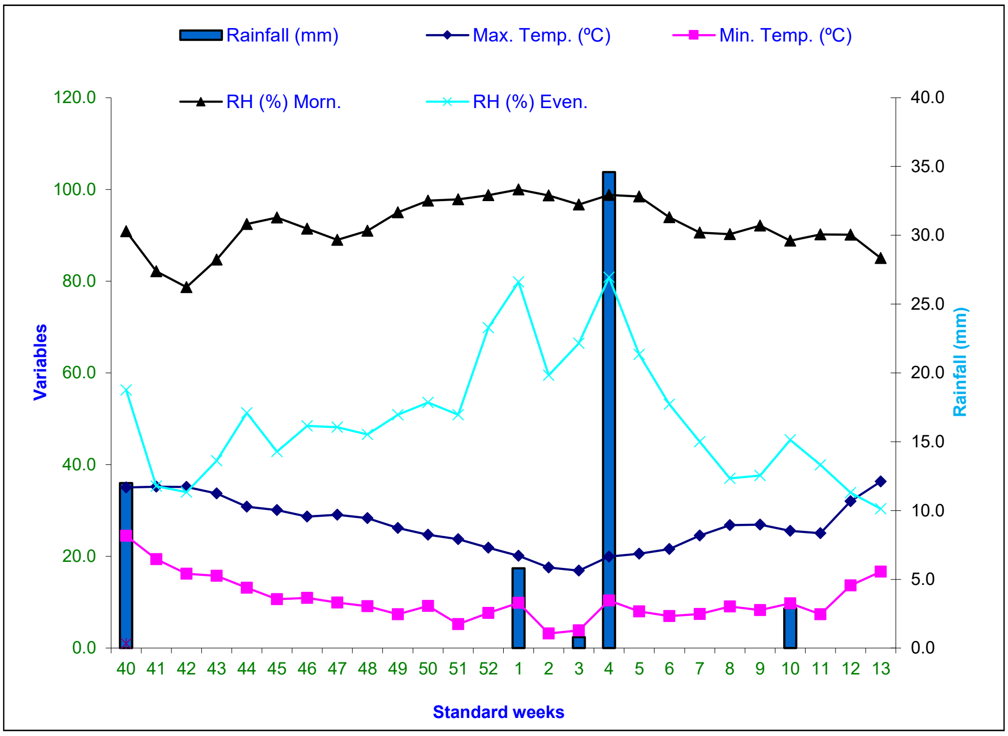


Figure 1: Mean weekly meteorological data during the crop seasons (October 2016 to March 2017)

(194.4 cm) and significantly superior to rest of the genotypes (Table 1). Minimum plant height (189.5 cm) was recorded by Albeli-1 being statistically at par with Kranti (189.6 cm). The difference in plant height may be due to their individual genotype characters. Similar variation in plant height due to genotypes have also been reported by Banga *et al.* (2013).

Among the fertilizer levels, the plant height did not increase significantly with application of 100% RDF, though maximum plant height (192.3 cm) was recorded with application of 150% RDF. Similar results have been reported by Banga *et al.* (2007) and Banga *et al.* (2013). The yield attributes were influenced significantly by genotypes and well as fertility levels

Table 1: Plant height and yield attributes of rainfed mustard as influenced by genotypes and fertility levels

Treatments	Plant height (cm)	Number of Siliqua on main shoot (No.)	Number of Seeds per siliqua (No.)	1000-Seed weight (g)
Genotypes				
RGN 48	190.1	46.1	11.9	4.49
DRMR 1165-40	191.2	46.5	12.8	4.60
RH 725	196.6	51.8	13.8	6.10
RH 0406	194.4	44.8	10.6	5.93
Albeli-1	189.5	46.3	12.2	5.34
Kranti	189.6	45.3	12.5	4.23
CD (5%)	4.4	4.2	1.0	0.37
Fertility levels				
100 % RDF	191.5	46.4	11.8	5.17
125 % RDF	191.9	46.9	12.3	5.12
150 % RDF	192.3	47.1	12.8	5.06
CD (5%)	NS	NS	NS	NS

(Table 1). The maximum number of siliqua on main shoot (51.8), number of seeds/siliqua (13.8) and 1000-seed weight (6.10 g) were recorded in the genotype RH 725, being significantly superior to all other genotypes, except that of DRMR 1165-40 in case of seeds/siliqua (12.8) and RH 0406 in case of 1000-seed weight (5.93 g). The difference in yield attributes may be ascribed to their individual varietal characters. Similar variation in yield attributes due to genotypes have been reported by Banga *et al.* (2013).

Among the fertilizer levels, number of siliqua on main shoot and number of seeds/siliqua of mustard increased with increase in fertility level, but the increase was not found significant, though maximum number of siliqua on main shoot (44.1) and number of seeds/siliqua (12.8) was recorded with application of 150% RDF. However, the 1000-seed weight decreased with increasing the fertilizer level from 100% RDF to 150% RDF, but the differences were not found significant. Similar results have been reported by Banga *et al.* (2013).

Maximum seed yield (3515 kg/ha) was produced by the mustard genotype RH 725, which was 20.2, 20.9, 22.3, 26.5, and 25.4 per cent higher than the seed yield recorded by genotypes DRMR 1165-40, Albeli-1, RGN 48, Kranti and RH 0406, respectively (Table 2). The genotypes other than RH 725 were statistically at par among themselves in seed yield. The increase in seed yield of RH 725 as compared to other genotypes has been achieved because of its higher number of siliqua, seeds/siliqua and 1000-seed weight. Similar variation in seed yield due to genotypes has been reported by Banga *et al.* (2013). With addition of fertilizer, seed yield increased, but not at significant rate, implying that irrespective of the genotypes, mustard crop did not respond significantly to increase in fertility levels above the recommended dose of NPK (40-20-00 kg/ha).

Oil content ranged from 39.89% in the genotypes Albeli-1 to 40.39% in Kranti, but it was not influenced significantly by mustard genotypes (Table 3). However, Banga *et al.* (2013) reported significant variation in oil content due to mustard genotypes. As oil yield is a product of seed yield and oil content, the trend of seed yield was observed in oil yield also (Table 4). Maximum oil yield was produced by RH 725 (1413 kg/ha), being significantly superior to rest of the

Table 2: Seed yield (kg/ha) of rainfed mustard as influenced by genotypes and fertility levels

Genotypes	100% RDF	125% RDF	150% RDF	Mean
RGN 48	2773	2880	2973	2876
DRMR 1165-40	2765	3000	3013	2926
RH 725	3373	3533	3644	3517
RH 0406	2729	2782	2832	2781
Albeli-1	2876	2898	2951	2908
Kranti	2751	2813	2849	2804
Mean	2878	2984	3044	
CD (p=0.05)	Genotypes : 247; Fertility levels : NS Fertility at same genotype : NS Genotypes at same level of fertility : NS			

Table 3: Oil content (%) of rainfed mustard as influenced by genotypes and fertility levels

Genotypes	100% RDF	125% RDF	150% RDF	Mean
RGN 48	40.38	40.27	40.11	40.25
DRMR 1165-40	40.01	39.95	39.75	39.90
RH 725	40.38	40.15	40.01	40.18
RH 0406	40.28	39.95	39.61	39.94
Albeli-1	40.02	39.93	39.73	39.89
Kranti	40.57	40.51	40.11	40.39
Mean	40.27	40.12	39.88	
CD (p=0.05)	Genotypes : NS; Fertility levels : NS Fertility at same genotype : NS Genotypes at same level of fertility : NS			

Table 4: Oil yield (kg/ha) of rainfed mustard as influenced by genotypes and fertility levels

Genotypes	100% RDF	125% RDF	150% RDF	Mean
RGN 48	1118	1159	1192	1156
DRMR 1165-40	1105	1200	1198	1168
RH 725	1361	1420	1459	1413
RH 0406	1099	1112	1122	1111
Albeli-1	1151	1157	1172	1160
Kranti	1115	1139	1143	1133
Mean	1158	1198	1214	
CD (p=0.05)	Genotypes : 98; Fertility levels : NS Fertility at same genotype : NS Genotypes at same level of fertility : NS			

genotypes. Banga *et al.* (2013) also reported significant variation in oil content due to genotypes.

Among the fertility levels, the oil content decreased from 40.27% to 39.88% with the increase in the fertilizer level from 100% RDF to 125% RDF, however, the decrease was not found to be statistically significant. The results are in conformation with Jat *et al.* (2018) and Banga *et al.* (2013). Oil yield was not influenced significantly with increase in fertilizer levels from 100% RDF (1158 kg/ha) to 150% RDF (1214 kg/ha). It was due to the statistically at par seed yield and oil content among different fertility levels, as oil yield is a product of seed yield and oil content.

CONCLUSION

Maximum seed yield (3515 kg/ha) and oil yield (1413 kg/ha) was obtained from the mustard genotype RH 725, which was significantly higher than DRMR 1165-40, Albeli-1, RGN 48, Kranti and RH 0406. Irrespective of the genotypes, mustard crop did not respond significantly to increase in fertility levels above the recommended dose, implying that there is no need to apply fertilizers beyond the current recommendation of fertilizer dose of NPK (40-20-00 kg/ha) in Indian mustard under rainfed conditions of Haryana.

REFERENCES

Banga, R.S.; R.S. Bisht and Ashok Yadav. 2007. Variation in growth rate and seed yield of Brassica juncea genotypes as affected by nitrogen levels. *Proceedings of 12th IRC Wuhan, China,* 3: 246-247.

Banga, R.S.; K. Dhawan and D. Singh. 2013. Quality and yield of Indian mustard genotypes as influenced by different fertility levels. Oilseeds Section. Department of Plant Breeding, CCS Haryana Agricultural University, Hisar, India. http://www.australianoilseeds.com/data/assets/pdf_file/0005/6863/55

ICAR-DRMR. 2022. ICAR-Directorate of Rapeseed-Mustard Research, Sewar, Bharatpur (Rajasthan). https://www.drmr.res.in/director_desk.php

Jat, A.L.; A.G. Desai; K.P. Prajapati; P.J. Patel and J.R. Patel. 2018. Effect of fertility levels on growth, yield and economics of Indian mustard (*Brassica juncea* L.) under north Gujarat region. *Journal of Pharmacognosy and Phytochemistry,* 7(3): 1649-1652.

Kumar, P.; S. Kumar; V.S. Hooda; R. Avtar; S. Kumar and K. Malik. 2022. Influence of sowing window, irrigation and fertilizer levels on growth and yield of late sown Indian mustard. *Journal of Oilseed Brassica*, 13(1): 1-6.

Shekhawat, K.; S.S. Rathore; O.P. Premi; B.K. Kandpal and J.S. Chauhan. 2012. Advances in agronomic management of Indian mustard (*Brassica juncea* (L.) Czernj. Cosson): An Overview. *International Journal of Agronomy*, doi:10.1155/2012/408284

USDA. 2022. World Agricultural Production. Foreign Agricultural Service, United States Department of Agriculture (USDA). *Circular Series*, WAP 4-22, April 2022.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 356-360

Formal and Informal Seed Supply Chain of Wheat Crop in Jammu District

Neha Thakur[1]*, Anil Bhat[1], Rakesh Sharma[2], Jyoti Kachroo[1], Sabbey Sharma[1] and Malika Sharma[1]

[1]Division of Agricultural Economics and ABM, [2]Division of Agricultural Extension Education, SKUAST-Jammu, J&K

ABSTRACT

A Study on Formal and Informal Seed Supply Chain of Wheat Crop in Jammu District was carried out in which 60 farmers and 56 dealers were interviewed using a pre-tested schedule to analyse the formal systems related to delivery of improved varieties and informal seed systems for maintaining the traditional seed and the profitability of seed production to farmers in comparison with grain production. It was noticed that 40,532 quintals of wheat seed were found deficit in the Jammu district as their total requirement was 71,000 quintals with a supply of 30,910.47 quintals. Department of Agriculture, Jammu was responsible for maximum supply of wheat seed to the farmers of Jammu at 18517 quintals with per cent share of 60.77 followed by the supply chain of 'Wholesaler-Dealer-Retailer-Farmer' with the per cent share of 31.62. All the selected 30 Farmers of irrigated area earned an income of Rs. 9,450,911.25 from selling wheat under Seed village programme and Rs. 4,783,085 by selling the rejected seeds as well as farmer so frainfed area earned an Income of Rs. 6,903,047.25 from selling wheat seed under seed village programme and Rs. 1,329,662 by selling the rejected seeds in the market. Average income per farmer was found to be Rs. 80966.99 in irrigated area and Rs. 65967.97 in rainfed area, respectively with an overall average of Rs. 74739.85 per hectare. Rejection of sample by Department of Agriculture, Late release of funds, Storage Problem, Laborious and cost affair and Price fluctuation were some of the major bottlenecks faced by the sample farmers.

Keywords: Quality seeds, Seed village rogramme, Supply channels, Deficit

INTRODUCTION

Wheat cultivation in India has traditionally been dominated by the country's northern regions. Wheat and wheat flour are becoming increasingly significant in the administration of India's food system, according to various studies and research. VL- 832, VL-804, HS-365, HS-240, HD-2781, HW-1085, HW-741 are the main wheat varieties produced in India (www.apeda.gov.in). Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, and Gujarat are the major wheat-growing states in India. Wheat trade is larger than that of all other crops combined. The world's demand for Indian wheat is increasing. During the 2019-20 fiscal year, the country exported 2,17,354.22 MT of wheat to the world, valued at Rs 439.16 crores/ USD 61.84 million. (www.apeda.gov.in). There are mainly two seed systems followed in India namely formal and informal. Informal seed system focuses on farmer management of local varieties, which have been selected over time and produced under local circumstances. The system is often referred to as traditional since it operates on a local level through an exchange mechanism and only allows for a restricted number of transactions per transaction. Informal seed supply systems broadly include farm-saved seed and farmer-to-farmer exchange, farmers' cooperatives, Community groups, Seed growers' associations, non-governmental organizations (NGO's). The formal seed system consists of institutions that are involved in producing, multiplying and disseminating finished varieties as certified seed. It can be publicly or privately supported and it can be organised in different ways (Morris *et al.,* 1998). Formal seed supply systems consist

*Corresponding author email id:

of seed production by National government agencies, State government agencies, Government-assisted and other cooperatives, Multinational corporations (MNCs) or transnational corporations (TNCs), domestic private sector companies which are having their own research and development (R&D) and those which are not having their own R&D, joint venture companies between MNC and domestic private company or between two domestic companies. The public sector's share of seed production in India decreased from 42.72 per cent in 2017-18 to 35.54 per cent in 2020-21, while the private sector's share increased from 57.28 per cent to 64.46 per cent, highlighting the private sector's growing role in the Indian seed industry. Many private seed companies are involved in producing foundation and certified seeds.

In India, the project which aims to transform the entire district as a seed production unit was started in November, 1964 in the Jaunti village of Kanjhawala, Delhi. M.S. Swaminathan, who managed the project stated that the seed village concept is a valuable seed which should be transplanted across the country (Swamiathan, 1968). It is a village, where a group of trained farmers are involved in producing seeds for a variety of crops, taking care of their needs, some local farmers and farmers in neighbouring villages on time at an affordable cost called a "seed village". The seed programme includes cooperative and private institutions. State Departments of Agriculture, State Agriculture Universities, Krishi Vigyan Kendras, State Seeds Corporation, State Farms Corporation of India (SFCI), State Seeds Certification Agencies and the Department of Seed Certification are serving as the implementing agencies. In Jammu district the seed village programme is laid out on wheat and paddy crop. The wheat seed village programme was laid out in three sub-divisions of Jammu district during 2019-20 i.e., RS Pura, Akhnoor and Marh in 300.60 hectare land whereas during Kharif season the paddy seed village programme was laid out in RS Pura only in 40 hectare land (Department of Agriculture Production & Farmer's Welfare Jammu (J&K). The focus of the study is to analyze the impact of the formal systems related to the introduction of improved varieties and informal seed systems for traditional seed storage and the benefits of seed production for farmers as compared to grain production. In Jammu, the good quality of seed is being distributed to farmers through seed village programme by Department of Agriculture. Due to this there is a considerable improvement in seed for wheat. To find out the role played by the formal and informal seed supply agencies and their impact in fulfilling the demand of seed of wheat crop, a study on formal and informal seed supply chain of wheat crop in Jammu district was undertaken during the year 2019-2020 with the objective to assess the requirement and availability of wheat seed in Jammu district and to find out the contribution of different seed supply chains.

MATERIALS AND METHODS

Locale of the Study: The study was conducted purposively in Jammu District of Union Territory of Jammu and Kashmir (J&K).

Sample Design: Two stage sampling design was applied for the selection of samples. In the first stage, Agricultural Sub-divisions of Jammu district were selected and in the second stage villages in which seed village programme was executed by the Department of Agriculture were selected randomly from irrigated and rain-fed areas in equal number. Thus, the total samples selected for the study comprises of 60 farmers (30 each from irrigated and rainfed area) from three sub-divisions RS Pura, Marh, Akhnoor where seed village programme of wheat crop was laid out by the Department of Agriculture, Jammu.

Selection of dealers: List of the dealers was procured from the Department of Agriculture, Jammu. All the 56 Number of dealers of Jammu district associated with seed supply of wheat crop were selected to assess the contribution of private players in the seed chain.

Method of Analysis of Data: Conventional tools like descriptive, percentage analysis, Singh's cube root method, Garrett ranking and other statistical tools were employed for the purpose of analysis.

To work out the requirement and availability of wheat seed, the data regarding area under wheat crop and availability of seed were taken from agriculture production department. Moreover, primary data collected from the respondent farmers also helps to calculate the wheat seed produced by farmer under seed village programme. The data of all the seed dealers of Jammu district reflected the contribution of private sector in wheat seed supply chain.

Percentage analysis: Percentage refers to any share in relations to the whole. It's used to make a comparison between two or more data sets. Because the Percent reduces everything to a common base and so allows meaningful comparisons, they can be used to compare relative items, the distribution of two or more series of data.

$$\text{Percentage} = (x/y) \times (100/1)$$

Where, x= number of respondents respond y= total number of respondents

RESULTS

The data in Table 1 depicts the socio- demographic profile of the sampled farmers in the irrigated and rainfed area of Jammu district. The overall mean age of sampled respondents from both irrigated and rainfed areas was 55 years. The results revealed that 20 per cent of the respondents of irrigated area were in the age group of below 49 years, 36.66 per cent respondents were under age group of 49-60 years and maximum 43.33 per cent of the respondents were under the age group of above 60 years. In rainfed area, 26.66 per cent of the respondents were under the age group of below 49 years, maximum 50 per

Table 1: Socio-demographic profile of the sampled farmers

Particulars	Irrigated farmers (n = 30)	Rainfed farmers (n = 30)	Total (n=60)
Mean age (years) ± SD	57±9.10	53±5.9	55±7.7
Categorization of age			
Below 49	06(20.00)	08(26.66)	14(23.33)
49-60	11(36.66)	15(50.00)	26(43.33)
60 Above	13(43.33)	07(23.33)	20(33.33)
Gender			
Male	30(100.00)	30(100.00)	60(100.00)
Female	00	00	00
Mean Education (Formal number of schooling years completed)	9.7±2.8	8.86 ± 2.7	9.28±2.80
Education level Illiterate	00	00	00
Primary	05(16.66)	07(23.33)	12(20.00)
Middle	08(26.66)	06(20.00)	14(23.33)
Matriculation	06(20.00)	10(33.33)	16(26.66)
10+2	05(16.66)	04(13.33)	09(15.00)
Graduation and above	06(20.00)	03(10.00)	09(15.00)
Marital Status			
Married	30(100.00)	30(100.00)	60(100.00)
Unmarried	00	00	00
Average distance of village from nearest market (km)	2.06 ± 0.9	1.06 ± 0.25	2.88±1.76
Average distance from agriculture office (km)	2.10± 0.88	1.50 ± 0.5	1.80±0.7
Categorization of land holding			
Marginal(<1ha)	00	02(6.66)	02(3.33)
Small(1-2ha)	04(13.33)	04(13.33)	08(13.33)
Semi-medium(2-4ha)	10(33.33)	11(36.66)	21(35.00)
Medium(4-10ha)	15(50.00)	13(43.33)	28(46.67)
Large(>10ha)	01(3.33)	00	01(1.66)

Note- Figure in parenthesis are percentage of total cent were under the age group of 49-60 years and 23.33 per cent were under the age group of above 60 years (Table 1). The study revealed that the respondents of irrigated and rainfed area were 100 per cent male. The mean education of the farmers of irrigated and rainfed area was found to be 9.28 years. Percentage of the irrigated farmers having education up to primary and middle standard were 16.66 per cent and 26.66 per cent, respectively. 20 per cent of the irrigated farmers were matriculate. 16.66 per cent and 20 per cent of the irrigated farmers were educated up to secondary level and graduation and above, respectively. Majority of the respondents i.e., 33.33 per cent were matriculate and only 10 per cent of the respondents were graduate and above in rainfed area. The 100 per cent of respondents of irrigated as well as of rainfed area were married. Majority of the farmers i.e. 50 per cent, 43.33 per cent farmers from both irrigated and rainfed area, respectively had medium operational land holding (4-10 ha). Marginal farmers were found to be only 6.66 per cent in rainfed area where as 3.33 percent large farmers were present only in irrigated area. The percentage of farmers having semi-medium land holding (2-4 ha) in the irrigated and rainfed area were 33.33 and 36.66 per cent, respectively. The small land holdings (1-2 ha) were possessed by 13.33 per cent of the farmers in both irrigated and rainfed area.

Total area and production of wheat seeds in the study area under seed village programme is given in Table 2 which revealed that maximum area of 175.80 ha was found in irrigated belt whereas 124.80 ha area was under rainfed conditions of Jammu district with an overall area of 300.60 ha. It was also found that 7032 q and 3744 q of wheat seed was produced in irrigated and rainfed area of Jammu district, respectively with an overall production of 10,766q under seed village programme. Weather conditions of Jammu district is well suited for wheat production, but it was also noticed that area under wheat in seed village programme is decreasing over the years due to the unwillingness of the farmers to enroll themselves under the programme.

Table 3: Year wise seed issued under seed village programme

Year	Seed quantity(q)	Percent share (%)
2017-2018	871.80	53.33
2018-2019	452.60	27.70
2019-2020	310.00	18.97
Total	1634.40	100.00

Table 3 represents the year wise seed issued under seed village programme. The table further showed that maximum quantity of seed i.e. 871.80 q was issued during 2017-18 followed by 452.60q and 310 q during the year 2018-2019, 2019-20, respectively. 53.33 per cent of the total seed issued during the year 2017-2018 and 27.70 per cent seed was issued during 2018-19 only 18.97 percent seed was issued during 2019-20 respectively. It was noticed that there was decrease in the quantity of seed issued under seed village programme from the last three years. The main reason for the reduction may be due to the less involvement of the farmers towards seed village programme.

Table 4 depicts the formal and informal sources of wheat seed in Jammu district. Department of Agriculture, Private dealers comes under formal sources and maximum per cent share of wheat seed i.e. 98.57 was sold through this channel whereas only 1.43 per cent seed was sold through informal source i.e. farmer owned seed. The study revealed that formal sources had maximum per cent share of wheat seed 59.90 and 38.67 respectively. 1.43 percent informal wheat seed sources were there in the district.

Requirement and availability of wheat seed is shown in Table 5. The total requirement of wheat seed in Jammu district was found to be 71,000 q for the

Table 2: Area and production of wheat seed in study area under seed village programme for the year 2019-20

Particulars	Irrigated farmers (n=30)	Rainfed farmers (n=30)	Total (n=60)
Area (ha)	175.80	124.80	300.60
	(58.48)	(41.52)	(100)
Seed produced (q)	7032.00	3744.00	10766.00
	(65.31)	(34.77)	(100)

Note: Figures in parenthesis are percentage of total

Table 4: Formal and informal sources of wheat seed in Jammu district

Source of seed	Particulars	Wheat seed (q)	Percent share (%)
Formal source	Department of Agriculture	18517.00	59.90
	Private dealers	11951.00	38.67
Informal source	Farmer owned seed	442.47	1.43
	Total	30,910.47	100.00

Table 5: Requirement and availability of the wheat seed

Particulars	Quantity (q)
Requirement of seed for Rabi (2019-2020)	71,000
Seed available from all sources	30,910.47
Deficit	40,089.53

Table 6: Quantity of seed sold by Private dealers through different channels (q)

Channels	Department of Agriculture, Jammu	Wholesaler (n=6)	Dealer (n=10)	Retailer (n=40)	Seed purchased by the farmers	Contribution of different supply chains	Percent share
Channel 1	0	11951.00	11423.00	9633.00	9633.00	9633.00	31.62
Channel 2	0			0	1790.00	1790.00	5.88
Channel 3	0		0	528.00	528.00	528.00	1.73
Channel 4	18517.00	0	0	0	18517.00	18517.00	60.77
Total seed sold						30468.00	100.00

year 2019-2020 and the wheat seed available from all sources was 30,910.47 q which shows that 40,089.53 q of seed was deficit in the district.

Table 6 depicts the quantity of seed sold by the private dealers through different channels in q. The study revealed that channel 4 (Department of agriculture to farmer) contributed maximum seed (60.77%), 31.62 by channel 1 (wholesaler to dealer to retailer to farmer) and least contribution 1.73 was made by channel 3.

CONCLUSION

In the present study it was found that 40,532 quintals of wheat seed found deficit in the Jammu district as their total requirement was 71,000 quintals with a supply of 30,910.47 quintals. HD-2967, HD-3086, PBW644, WH-1080 were the predominantly grown wheat varieties in the sample area. Department of Agriculture, Jammu was responsible for maximum supply of wheat seed to the farmers of Jammu at 18517 quintals with per cent share of 60.77 followed by the supply chain of 'Wholesaler-Dealer-Retailer-Farmer with the per cent share of 31.62. There is a need of the training programme regarding seed production technology by the Department of Agriculture for the farmers before the commencement of the season so that they the chances of rejection of sample will decrease. In the study it is found that 38.67% of the seed was supplied by private dealers therefore they must be promoted to reduce the deficit. To fill the gap there is need to start farmer participatory seed programme under the guidance of SKUAST Jammu so that the farmers can produce seed for themselves and for other also.

REFERENCES

APEDA. 2002. Scenario of cereals in India. Agricultural and Processed Food Products Export Development Authority at: http://apeda.gov.in/apedawebsite/six_head_ product/cereal.htm. Accessed on 30 August, 2021.

DOA, Jammu. Department of Agriculture Production & Farmer's Welfare, Jammu 2020-21. Government of Jammu and Kashmir.

Morris, M.L.; R.P. Singh, and S. Pal. 1998. India's maize seed industry in transition: changing roles for the public and private sectors. *Food Policy*, 23(1): 55-71.

Singh, R. 1975. Optimum stratification for proportional allocation. SANKHYA, 37: 109-115.

Swaminathan, M.S. 1968. The Evolution and Significance of Jounti Seed Village, *Indian Farming*.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 361-367

Evaluation of Extension Contact of Rice Growers under Seed Village Programme in District Baramulla (J&K)

K. Naresh[1]*, Mushtaq Ahmad Dar[2], S.S. Kubrevi[3] and Noor Ul Islam Wani[4] and Puja Meenia[5]
[1&5]Research Scholar, [2] Professor and Head, [3]Assistant Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Shalimar-190025, J&K
[4]Agricultural Extension Officer, Agriculture Production Department, Jammu and Kashmir-192122

ABSTRACT

Innovative techniques and technologies are being developed at different research stations for the enhancement of rice production. But due to poor extension contact with credible agencies, the same technology has not been fully utilised by the growers at their farms. The study was conducted in five divisions of Baramulla district selected purposively with multistage sampling; having maximum area under the seed village programme of rice cultivation. The study used focus well structured interview schedule. The majority of the rice growers from all the five sub-divisions were a medium level of extension contact and a majority of the medium level of extension contact rice growers were found in sub-division Baramulla (75.34%), followed by sub-division Tangmarg (66.66%), followed by sub-division Pattan (64.28%), and followed by sub-division Rohamma (60.00%) and least was found in sub-division Sopore (56.30%). However, for the overall extension contact of the rice growers from all the five sub-divisions, it was observed that (63.23%) of the rice growers were a medium level of extension contact.

Keywords: Evaluation, Extension contact, Growers, Rice, Seed Village, Technology

INTRODUCTION

Rice is life, for most people of Asia. Rice has shaped the cultures, diets and economies of thousands of millions of people. It is central to the Asian way of life; deeply embedded in the cultural heritage, spirituality, traditions and norms (Ram, 2015). In Asia alone, more than 2,000 million people obtain 60 to 70 per cent of their calories from rice and its products. Recognizing the importance of this crop, the United Nations General Assembly declared 2004 as the "International Year of Rice" (IYR).

Almost one fifth of the world's population depends on rice cultivation for their livelihoods. In Asia, where about 90 per cent of rice is grown, has more than 200 million rice farms, most of whom cultivate rice on less than one hectare. Rice based farming is the main economic activity for hundreds of millions of rural poor in this region. Rice is the most important food crop of India covering about one-fourth of the total cropped area and providing food to about half of the Indian population (Ram, 2015).

According to World Bank (1997) agriculture has already reached the limits of land and water, thus in future food production must exploit biological yield on the existing land. Hence these challenges are putting tremendous pressure on agriculture to change from the way it is used to be practiced earlier and practiced even today.

Global rice output was 493.79 million tonnes in 2019-2020, according to the United States Department of Agriculture (USDA), with an increase of 8.17 million tonnes to 501.96 million tonnes in 2020-21 (USDA) (Anonymous, 2020b). India will produce 112 million tonnes of rice from 44 million hectares in 2019-20, making it the second-largest rice producer in the world (Anonymous, 2020a). During 2017-18, rice was planted on 0.273 million hectares in Jammu and Kashmir, yielding 6.641 lakh tonnes and an average

*Corresponding author email id: nareshboova@gmail.com

yield of 24.27 qts/ha and on 1.35 lakh hectares in Kashmir valley, yielding 3.390 lakh tonnes and an average yield of 24.97 qts/ha. In 2017-18, the Baramulla District of J&K (UT) has 20567 hectares under rice production (Anonymous, 2020).

MATERIALS AND METHODS

The research design utilised in this study was ex-post-facto because phenomena had already occurred. The current research was conducted in the Kashmir valleys district of Baramulla, which was selected for a seed village programme under rice from 2018 to 2020. In District Baramulla, totally six Agricultural Sub Divisions, out of which five Agricultural Sub Divisions namely Baramulla, Pattan, Sopore, Rohamma and Tangmarg from the twelve selected agricultural zones in twenty five villages of District Baramulla. The study had a total of 310 growers that were part of the Seed Village Program. The data was collected on a well-organized schedule, and the findings were analysed using per centage, frequency, mean, and standard deviation methods.

Extension contact was operationalized as the degree to which an individual maintained contact with the personnel of formal or informal sources for the purpose of getting information on the scientific technologies related to rice crop. The variable was quantified using schedule developed by Aparna (2014) with suitable modifications.

RESULTS AND DISCUSSION

According to Table 1, the majority of rice growers in sub-division Pattan (64.28%) had medium level of extension contact, followed by 22.86 per cent of the rice growers having high level of extension contact and only 12.86 per cent of the rice growers had low level of extension contact. In sub-division Sopore, a majority (56.30%) of the rice growers had medium level of extension contact, followed by 31.85 per cent of the rice growers having high level of extension contact and only 11.85 per cent of the rice growers had low level of extension contact. in sub-division Tangmarg, a majority (66.66%) of the rice growers had medium level of extension contact, followed by 16.67 per cent of the rice growers each having high and low level of extension contact. In sub-division Baramulla, a majority (75.34%) of the rice growers had medium level of extension contact, followed by 15.06 per cent of the rice growers having high level of extension contact and only 09.60 per cent of the rice growers had low level of extension contact. While as, in case of sub-division Rohamma, a majority (60.00%) of the rice growers had medium level of extension contact, followed by 30.00 per cent of the rice growers having high level of extension contact and only 10.00 per cent of the rice growers had low level of extension contact. However, in case of overall extension contact of rice growers from all the five sub-divisions, it was observed, that a majority (63.23%) of the rice growers had medium level of extension contact, followed by 25.16 per cent of the rice growers having high level of extension contact and only 11.61 per cent of the rice growers had low level of extension contact. So, it is clear from the data that majority of the rice growers had medium level of extension contact. The possible reasons could be, conducting of such activities by the concerned departments either more innovative, have good educational status and economic condition more frequently or with more popularity. The more interest on the part of the rice growers could also be the reason for the present findings.

Further perusal of the data from the Table 2, it was observed, that in sub-division Pattan, a majority (98.57%) of the rice growers had medium level of

Table 1: Distribution of rice growers according to their Extension Contact

Extension Contact	Pattan (n_1=70)	Sopore (n_2=135)	Tangmarg (n_3=12)	Baramulla (n_4=73)	Rohamma (n_5=20)	Total (N=310)
Low	09(12.86)	16(11.85)	02(16.67)	07(09.60)	02(10.00)	36(11.61)
Medium	45(64.28)	76(56.30)	08(66.66)	55(75.34)	12(60.00)	196(63.23)
High	16(22.86)	43(31.85)	02(16.67)	11(15.06)	06(30.00)	78(25.16)
Mean ± SD	12.79±1.62	13.64±1.74	13.42±1.31	12.89±1.79	12.30±1.72	13.01±1.64
Observed Range	8-17	9-18	11-15	9-19	9-15	8-19

Figures within parenthesis indicate respective per centage

Table 2: Distribution of rice growers according to their Extension Contact

Extension Contact	Pattan (n_1=70)	Sopore (n_2=135)	Tangmarg (n_3=12)	Baramulla (n_4=73)	Rohamma (n_5=20)	Total (N=310)
Assistant Agri. Extension officer						
Low	01(01.43)	04(02.97)	00(00.00)	00(00.00)	02(10.00)	07(02.56)
Medium	69(98.57)	131(97.03)	12(100.0)	73(100.0)	18(90.00)	303(97.74)
High	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)
Mean±S.D	2.99±0.12	2.97±0.17	3.0±0.0	3.0±0.0	2.90±0.30	2.97±0.12
Observed Range	2-3	2-3	3-3	3-3	2-3	2-3
Agricultural Extension officer						
Low	06(08.57)	01(00.74)	00(00.00)	04(05.48)	00(00.00)	11(03.55)
Medium	64(91.43)	134(99.26)	12(100.0)	69(94.52)	20(100.0)	299(96.45)
High	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)
Mean±S.D	2.64±0.63	2.77±0.43	2.17±0.38	2.53±0.60	2.60±0.50	2.54±0.51
Observed Range	1-3	1-3	2-3	1-3	2-3	1-3
Subject Matter Specialist						
Low	15(21.43)	32(23.70)	00(00.00)	00(00.00)	00(00.00)	47(15.16)
Medium	55(78.57)	99(73.33)	12(100.0)	70(95.90)	20(100.0)	256(82.58)
High	00(00.00)	04(02.97)	00(00.00)	03(04.10)	00(00.00)	07(02.26)
Mean±S.D	1.79±0.41	1.79±0.47	2.0±0.0	1.49±0.58	1.60±0.50	1.73±0.39
Observed Range	1-2	1-3	2-3	1-3	1-2	1-3
Sub-Divisional Agricultural officer						
Low	00(00.00)	18(13.33)	02(16.67)	20(27.40)	06(30.00)	46(14.84)
Medium	69(98.57)	114(84.44)	10(83.33)	50(68.50)	14(70.00)	257(82.90)
High	01(01.43)	03(02.22)	00(00.00)	03(04.10)	00(00.00)	07(02.26)
Mean±S.D	1.83±0.41	1.89±0.38	1.83±0.38	1.77±0.51	1.70±0.47	1.80±0.43
Observed Range	1-2	1-3	1-2	1-3	1-2	1-3
District Agricultural officer						
Low	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)
Medium	70(100.0)	135(100.0)	12(100.0)	73(100.0)	0(100.0)	310(100.0)
High	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)
Mean±S.D	1.19±0.39	1.42±0.49	1.58±0.51	1.16±0.37	1.05±0.22	1.28±0.40
Observed Range	1-2	1-2	1-2	1-2	1-2	1-2
Scientists of RARS / KVK						
Low	00(00.00)	67(49.63)	04(33.33)	22(30.14)	00(00.00)	93(30.00)
Medium	70(100.0)	67(49.63)	08(66.67)	51(69.86)	20(100.0)	216(69.98)
High	00(00.00)	01(00.74)	00(00.00)	00(00.00)	00(00.00)	01(00.32)
Mean±S.D	1.26±0.44	1.51±0.51	1.67±0.49	1.70±0.46	1.45±0.51	1.52±0.48
Observed Range	1-2	1-3	1-2	1-2	1-2	1-3
Private extension agencies (Input dealers)						
Low	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)	00(00.00)
Medium	67(95.71)	133(98.52)	12(100.0)	67(91.78)	20(100.0)	299(96.45)
High	03(04.29)	02(01.48)	00(00.00)	06(08.22)	00(00.00)	11(03.55)
Mean±S.D	1.16±0.47	1.33±0.50	1.17±0.38	1.23±0.59	1±0.1	1.18±0.41
Observed Range	1-3	1-3	1-2	1-3	1-1	1-3

Figures within parenthesis indicate respective per centage contact with the Assistant Agri. Extension officer, followed by 01.43 per cent of rice growers having low level of contact. In sub-division Sopore, a majority (97.03%) of the rice growers had medium level of contact with the Assistant Agri. Extension officer, followed by 02.97 per cent of rice growers having low level of contact. In sub-division Tangmarg, all the rice growers (100.00%) had medium level of contact with the Assistant Agri. Extension officer. In sub-division Baramulla, all the rice growers (100.00%) had medium level of contact with the Assistant Agri. Extension officer. While as, in sub-division Rohamma, a majority (90.00%) of the rice growers had medium level of contact with the Assistant Agri. Extension officer, followed by 10.00 per cent of rice growers having low level of contact. However, in case of overall extension contact of rice growers from all the five sub-divisions with the Assistant Agri. Extension officer, it was revealed, that a majority (97.74%) of the rice growers had medium level of extension contact with the Assistant Agri. Extension officer, followed by 02.56 per cent of the rice growers having low level of extension contact with the Assistant Agri. Extension officer. So, it is clear from the data that majority of the rice growers had medium level of extension contact with the Assistant Agri. Extension officer. The possible reason for a medium level of extension contact with the Assistant Agri. Extension officers can be attributed to the fact that Assistant Agri. Extension Officers are the main source of agriculture technology dissemination who are always in touch with the farmers.

In case of extension contact of rice growers with the Agricultural Extension officers, it was revealed from the data, that in sub-division Pattan, a majority (91.43%) of the rice growers had medium level of contact with the Agricultural Extension officers, followed by 08.57 per cent of rice growers having low level of contact. In sub-division Sopore, a majority (99.26%) of the rice growers had medium level of contact with the Agricultural Extension officers, followed by 00.74 per cent of rice growers having low level of contact. In sub-division Tangmarg, all the rice growers (100.00%) had medium level of contact with the Agricultural Extension officers. In sub-division Baramulla, a majority (94.52%) of the rice growers had medium level of contact with the Agricultural Extension officers, followed by 05.48 per cent of rice growers having low level of contact. While as, in sub-division Rohamma, all the rice growers (100.00%) had medium level of contact with the Agricultural Extension officers. However, in case of overall extension contact of rice growers from all the five sub-divisions with the Agricultural Extension officers, it was revealed, that a majority (96.45%) of the rice growers had medium level of extension contact with the Agricultural Extension officers, followed by 03.55 per cent of the rice growers having high level of extension contact with the Agricultural Extension officers. So, it is clear from the data that majority of the rice growers had medium level of extension contact with the Agricultural Extension officers. The possible reason for a high level of extension contact with the agricultural extension officer could be the reason for encouraging farmers to adopt new, improved methods of farming. Organizing awareness camps for farmers, 'farmer days' and demonstrations.

In case of extension contact of rice growers with the Subject Matter Specialists, it was revealed from the data, that in sub-division Pattan, a majority (78.57%) of the rice growers had medium level of contact with the Subject Matter Specialists, followed by 21.43 per cent of rice growers having low level of contact. In sub-division Sopore, a majority (73.33%) of the rice growers had medium level of contact with the Subject Matter Specialists, followed by 23.70 per cent of rice growers having low level of contact and only 02.97 per cent of rice growers had high level of contact with the Subject Matter Specialists. In sub-division Tangmarg, all the rice growers (100.00%) had medium level of contact with the Subject Matter Specialists. In sub-division Baramulla, a majority (95.90%) of the rice growers had medium level of contact with the Subject Matter Specialists, followed by 04.10 per cent of rice growers having high level of contact. While as, in sub-division Rohamma, all the rice growers (100.00%) had medium level of contact with the Subject Matter Specialists. However, in case of overall extension contact of rice growers from all the five sub-divisions with the Subject Matter Specialists, it was find, that a majority (82.58%) of the rice growers had medium level of extension contact with the Subject Matter Specialists, followed by 15.16 per cent of the rice growers having low level of extension contact with the Subject Matter Specialists and only 02.26 per cent of the rice growers had high level of extension contact with the Subject Matter Specialists. So, it is clear from the data that majority of the rice growers had medium level of extension contact with the Subject Matter Specialists. The possible reason for medium level of extension contact with the subject matter specialists could be due to imparting trainings to field extension staff, making field visits.

In case of extension contact of rice growers with the Sub-divisional Agricultural officer, it was revealed from the data, that in sub-division Pattan, a majority (98.57%) of the rice growers had medium level of contact with the Sub-divisional Agricultural officer, followed by 01.43 per cent of rice growers having high level of contact. In sub-division Sopore, a majority (84.44%) of the rice growers had medium level of contact with the Sub-divisional Agricultural officer, followed by 13.33 per cent of rice growers having low level of contact and only 02.22 per cent of rice growers had high level of contact with the Sub-divisional Agricultural officer. in sub-division Tangmarg, a majority (83.33%) of the rice growers had medium level of contact with the Sub-divisional Agricultural officer, followed by 16.67 per cent of rice growers having low level of contact with the Sub-divisional Agricultural officer. In sub-division Baramulla, a majority (68.50%) of the rice growers had medium level of contact with the Sub-divisional Agricultural officer, followed by 27.40 per cent of rice growers having low level of contact and only 04.10 per cent of rice growers had high level of contact with the Sub-divisional Agricultural officer. While as, in sub-division Rohamma, a majority (70.00%) of the rice growers had medium level of contact with the Sub-divisional Agricultural officer, followed by 30.00 per cent of rice growers having low level of contact with the Sub-divisional Agricultural officer. However, in case of overall extension contact of rice growers from all the five sub-divisions with the Sub-divisional Agricultural officer, it was revealed, that a majority (82.90%) of the rice growers had medium level of extension contact with the Sub-divisional Agricultural officer, followed by 14.84 per cent of the rice growers having low level of extension contact with the Sub-divisional Agricultural officer and only 02.26 per cent of the rice growers had high level of extension contact with the Sub-divisional Agricultural officer. So, it is clear from the data that majority of the rice growers had medium level of extension contact with the Sub-divisional Agricultural officer. The possible reason for a medium level of extension contact with the Sub-divisional Agricultural officer could be the reason for occasional contact with growers and holding various meetings.

In case of extension contact of rice growers with the District Agricultural officer, it was revealed from the data, that in sub-division Pattan, all the rice growers (100.00%) had medium level of contact with the District Agricultural officer. In sub-division Sopore, all the rice growers (100.00%) had medium level of contact with the District Agricultural officer. In sub-division Tangmarg, all the rice growers (100.00%) had medium level of contact with the District Agricultural officer. In sub-division Baramulla, all the rice growers (100.00%) had medium level of contact with the District Agricultural officer. While as, in sub-division Rohamma, all the rice growers (100.00%) had medium level of contact with the District Agricultural officer. However, in case of overall extension contact of rice growers from all the five sub-divisions with the District Agricultural officer, it was revealed, that all the rice growers (100.00%) had medium level of extension contact with the District Agricultural officer. So, it is clear from the data that complete rice growers had medium level of extension contact with the District Agricultural officer. The possible reason for a medium level of extension contact with the district agricultural officer could be the due to occasional visit of district agriculture officer to fields and farm visit to officer office.

In case of extension contact of rice growers with the Scientists of RARS/KVK, it was revealed from the data, that in sub-division Pattan, all the rice growers (100.00%) had medium level of contact with the Scientists of RARS/KVK. In sub-division Sopore, a majority (49.63%) of the rice growers had low and medium level of contact with the Scientists of RARS/KVK, followed by 00.74 per cent of rice growers having high level of contact with the Scientists of RARS/KVK. In sub-division Tangmarg, a majority (66.67%) of the rice growers had medium level of contact with the Scientists of RARS/KVK, followed by 33.33 per cent of rice growers having low level of contact with the Scientists of RARS/KVK. In sub-division Baramulla, a majority (69.86%) of the rice growers had medium level of contact with the Scientists of RARS/KVK, followed by 30.14 per cent of rice growers having low level of contact. While as, in sub-division Rohamma, all the rice growers (100.00%) had medium level of contact with the Scientists of RARS/KVK. However, in case of overall extension contact of rice growers from all the five sub-divisions with the Scientists of RARS/KVK, it was revealed, that a majority (69.68%) of the rice growers had medium level of extension contact with the Scientists of RARS/KVK, followed by 30.00 per cent of the rice growers having low level of extension contact with the Scientists of RARS/KVK and only 00.32 per cent of the rice growers had high level of extension contact with the Scientists of RARS/KVK. So, it is clear from the data that majority of the rice growers had medium level of extension contact with the Scientists of RARS/KVK. The possible reason for a medium level of extension contact with the Scientists of RARS/KVKs could be due the scientists visit to farm fields, conducting various trainings and laying FLD on various technologies.

In case of extension contact of rice growers with the Private extension agencies (Input dealers), it was revealed from the data, that in sub-division Pattan, a majority (95.71%) of the rice growers had medium level of contact with the Private extension agencies (Input dealers), followed by 04.29 per cent of rice growers having high level of contact. In sub-division Sopore, a majority (98.52%) of the rice growers had medium level of contact with the Private extension agencies (Input dealers), followed by 01.48 per cent of rice growers having high level of contact. In sub-division Tangmarg, all the rice growers (100.00%) had medium level of contact with the Private extension agencies (Input dealers). In sub-division Baramulla, a majority (91.78%) of the rice growers had medium level of contact with the Private extension agencies (Input dealers), followed by 08.22 per cent of rice growers having high level of contact. While as, in sub-division Rohamma, all the rice growers (100.00%) had medium level of contact with the Private extension agencies (Input dealers). However, in case of overall extension contact of rice growers from all the five sub-divisions with the Private extension agencies (Input dealers), it was revealed, that a majority (96.45%) of the rice growers had medium level of extension contact with the Private extension agencies (Input dealers), followed by 03.55 per cent of the rice growers having high level of extension contact with the Private extension agencies (Input dealers). So, it is clear from the data that majority of the rice growers had medium level of extension contact with the Private extension agencies (Input dealers). The possible reason for medium level of contact with the Private extension agencies (Input dealers) could be due to fact that farmers do purchase most of the inputs from their private extension agencies (Input dealers), so remain in touch with them. These findings are in line with Kumari (2014), Mahatab Ali (2010), Ramanna *et al.* (2000); Satish (2010) and Sharma *et al.* (2015).

CONCLUSION

It can be concluded that majority of the rice growers were having medium level of extension contact with different extension functionaries. The government sponsored extension agencies need to involve young and energetic brainpower and should be nurtured into the field by involving different schemes and projects for rice growers. More efforts are necessary by these agencies to update the knowledge of rice growers about recommended rice production technology and to motivate the growers for their proper use to obtain higher yields. Extension agencies need to adopt pragmatic approach for demonstration of potentially improved technologies at farmer's field. Different methods need to be employed while disseminating the farm advisory services to the rice growers.

REFERENCES

Anonymous. 2020. Digest of Statistics, Directorate of Economics and Statistics, Jammu and Kashmir: pp. 194-198.

Anonymous. 2020a. https://www.indiainfoline.com

Anonymous. 2020b. https:// www.worldagricultural-production.com.

Kumari, K.B. 2014. A study on farmers' perception and adaptability of the farmers towards climate variability in Kurnool district of Andhra Pradesh: *M.Sc. (Ag.) Thesis*, *submitted* to Acharya N.G. Ranga Agriculture University, Hyderabad.

Mahatab Ali, K.M. 2010. A study on knowledge and adoption of aerobic rice growers in eastern dry zone of Karnataka state: *M.Sc. (Ag.) Thesis*, *submitted* to University of Agricultural Sciences, Bangalore.

Ram, K.T. 2015. A Study on Technological Gap in Adoption of Recommended Cultivation Practices by the Rice Farmers in Kurnool District of Andhra Pradesh. Acharya N.G. Ranga Agriculture University, Hyderabad.

Ramanna, K.N.; K. Chandrakandan and C. Karthikeyan. 2000.Motivation factors and constraints of hybrid sunflower seed growers: *Journal of Extension Education* 11(3): 2840 -2844.

Satish, H.S. 2010. Farmer's perceptions, preferences and utilization of SRI and traditional paddy straw for livestock: *M.Sc.(Ag.) Thesis*, *submitted* to University of Agricultural Sciences, Dharwad, India.

Sharma, K.; N.S. Dhaliwal and A. Kumar. 2015. Analysis of Adoption and Constraints Perceived by Small Paddy Growers in Rice Production Technologies in Muktsar District of Punjab State, India. *Indian Research Journal of Extension Education,* 15(2): 20-23.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 368-374

Perceptions of the B.Sc. (Ag.) Hons Final Year Students towards Rural Agricultural Work Experience in Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati

Arulmanikandan B.[1], Anindita Saha[1], Pravin Kumar Tiwari[2]* and Ravi Kumar Gupta[1]
[1]Department of Agricultural Extension, PSB, Visva-Bharati, Sriniketan-731236, West Bengal
[2]Department of Agricultural Extension, College of Horticulture and Research Station, IGKV, Jagadalpur, Bastar-494001, Chhattisgarh

ABSTRACT

The Rural Agriculture Work Experience (RAWE) programme is for providing quality, practical, and production-oriented education to agriculture degree students. The Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati has launched the RAWE programme for VIII Semester B.Sc. (Ag.) Hons. Students who have successfully completed the RAWE programme during the 2018-19 and 2019-20 academic years were selected purposively for the study. A well-structured questionnaire was designed, which included all of the items, keeping the objectives and variables in mind. Due to the COVID-19 pandemic situation, the mail survey technique was employed in this study, which entailed mailing the questionnaire to the total of 74 fourth-year B.Sc. (Ag.) students in order to gather the data. The results of the study found that, a large proportion of respondents (73.0%) had a medium perception towards the RAWE programme. The correlation of Perception towards the RAWE among the 15 independent variables; only seven variables viz. orientation given on RAWE, course content, inter and intra group relationships, knowledge and skills gained, scientific information sharing, credit load and class room study showed the positively significant relationship and the regression analysis showed that all the 15 independent variables jointly explained 61.00 per cent of variation in the perception towards RAWE. It can be stated that the RAWE curriculum was intended to meet virtually all of the students' demands.

Keywords: RAWE, Student's perception, Correlation, Regression and Experiential Learning

INTRODUCTION

The Rural Agricultural Work Experience (RAWE) is a mandatory course offered to B.Sc. (Hons.) Agriculture students in the vital semester with the goal of better understanding rural situations, the state of agricultural technologies used by the farmers, prioritising farmers' problems, and developing skills and attitudes for working with farm families for all-round development in rural areas (Khare and Naberia, 2017).

In 1947, the Government of India formed the Commission on Higher Education chaired by Dr. Radhakrishnan, who identified agricultural education as the main theme and recommended the establishment of "Rural Universities". Therefore, agricultural education must be in a rural setting so that it includes direct participation and experience in agriculture life and practice. (Anonymous, 1948).

The Randhawa Committee (1992) in India suggested the Rur Agriculture Work Experience (RAWE) programme for providing quality, practical, and production-oriented education to agriculture degree students. This programme gives valuable hands-on experience in the acquisition of information and skills and the students are exposed to the natural setting of village situations, interact with farm families, analyse their difficulties, and use various extension techniques to impart the latest agricultural technologies. In 1980-1981, Acharya N.G. Ranga Agricultural University

*Corresponding author email id: tewaripk73@gmail.com

launched the Rural Work Experience Program. It is a well-organized system in which staff and farmers collaborate with the goal of offering practical training to final year B.Sc. students by allowing them to live and work with farmers in the village for one crop season (Anonymous, 1999).

The ICAR Fourth Dean's Committee recommended that the programme should be restructured to cover the majority of courses by the sixth semester, with the seventh and eight semesters devoted solely to providing professional skills in a selected combination of subjects and Rural Agricultural Work Experience (Anonymous, 2006).

The Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati has also launched the RAWE programme for VIII-th Semester B.Sc. (Ag.) Hons. Students in order to provide them with real-life experience. This programme is a follow-up to the recommendations given by the ICAR-created 'Randhawa Committee'. During the last semester, the Rural Agricultural Work Experience (RAWE) programme is a highlight activity for final year B.Sc. (Ag.) students. The main goal of ICAR's introduction of RAWE at the undergraduate level is to boost agricultural graduates' self-confidence by polishing their professional abilities. As a result, a semester-long curriculum has been developed (Saha, 2019).

As per the recommendations of ICAR one full semester has been adopted in Palli Siksha Bhavana (Institute of Agriculture) with the subsequent main objectives: i. To make them understand the rural community life and the prevailing situation and familiarize with the rural socio-economic conditions and have practical training in crop production. ii. To improve communication skills among the students using extension teaching methods in transfer of technology and sensitize them regarding agricultural technologies, used by farmers and to organize alternate farm plans in keeping with the local situation in consultation with the farmers. To develop confidence and competence in students for handling professional problems and acquaint them with on-going thrust on rural development programmes. iv. To make the students understand the changed role of men and women in agricultural and allied fields and explore the high-tech agricultural technology and the factors affecting the adoption of modern methods of agriculture. v. To raise student knowledge, understanding, and abilities in the areas of crop husbandry, horticulture, agroforestry, animal husbandry, fisheries, poultry, dairying, agro-based industries, processing, and marketing, with a focus on the scientific model of "Integrated Development of Agriculture". vi. To know the techniques / know how to prepare and develop the package through collection of data from grass root level. vii. To expose them to the research methodologies e.g. experimental techniques, management, collection and processing of experimental data.

It is to note that the aim of Extension Education discipline is to prepare students who will have practical skills of their discipline so that they can contribute significantly in agricultural development (Mahra *et al.*, 2020).

MATERIALS AND METHODS

Students who have successfully completed the RAWE programme in Palli Siksha Bhavana (Institute of Agriculture), Visva-Bharati during the 2018-19 and 2019-20 academic years were selected purposively for the study.

The study included a total of 74 fourth-year B.Sc. (Ag.) students (48 Boys and 26 Girls) who have worked and experienced about rural and agricultural scenario in about 15 different villages under seven Gram Panchayats (GPs) of Bolpur-Sriniketan, Illambazar and Nanur blocks of Birbhum district of West Bengal.

Due to the fact that RAWE had already been implemented and data was collected from the students based on their experiences, an ex-post facto research design (Ray and Mondal, 2011) was used in this study. Due to the COVID-19 pandemic situation, the mail survey technique was employed in this study, which entailed mailing the questionnaire to all of the respondents (74) in order to gather the data.

In the present study, 15 independent variables viz. Age, Gender, Accommodation, Medium of Instruction – High School, Medium of Instruction – Higher Secondary, Prior Exposure to Rural Life, OGPA, orientation given on RAWE, course content, inter and intra group relations, scientific information sharing, knowledge and skill gained, Credit Load, Monitoring and Evaluation, Class room study and various types of limitations felt by the students during RAWE were all given careful consideration. With the help of SPSS version 26.0 software, the data on perception was calculated and the relation between the dependent and independent variables was evaluated using the statistic tools such as mean, frequency, percentage, simple correlation, regression. The information was subsequently tabulated, analysed, and interpreted.

RESULTS AND DISCUSSION

Table 1 shows the profile of the RAWE respondents and its relationship with their perception.

Age: Majority (39.2%) of the RAWE respondents belonged to the age of 22 years followed by 31.1 per cent of respondents were in the age of 23 years.

Gender: More than half of the respondents (64.9%) are male, with 35.1 per cent being female. The results are in similar with Prakash (2010); Hase and Deshmukh (2012); Lakhamwad (2019).

Accommodation: Majority (82.4%) of the respondents were hostellers and only 17.6 per cent of the respondents belonged to day scholar. The results are in conformity with Badavath (2012) and Singh (2016).

Medium of Instruction - High School: Majority of RAWE respondents (77.0%) used Bengali as a medium of instruction in high school.

Medium of Instruction - Higher Secondary: Majority (75.7%) of RAWE respondents studied their higher secondary in Bengali.

Prior exposure to rural life: Majority of respondents (68.9%) had prior exposure to rural living before participating in the RAWE programme.

OGPA: Majority of students (71.6%), got a medium OGPA (7.5- 8.5), followed by a high OGPA (18.9%) i.e., 8.5 and above. The results are in similar with Sanjeev and Gowda (2013), Sharma, A. (2018), Lakhamwad (2019).

Course content: Majority of the students (66.2%) had a medium level of perception on course content. The results are in agreement with Soujanya and Khare (2019).

Table 1: Profile of the RAWE respondents and its relationship with their Perception

Category	Frequency	Percent
Age		
21	16	21.6
22	29	39.2
23	23	31.1
24	6	8.1
Gender		
Male	48	64.9
Female	26	35.1
Accommodation		
Day scholar	13	17.6
Hosteller	61	82.4
Medium of Instruction – High School Standard		
English	17	23.0
Bengali	57	77.0
Medium of Instruction – Higher Secondary		
English	18	24.3
Bengali	56	75.7
Prior exposure to rural life		
Yes	51	68.9
No	23	31.1
OGPA		
6 - 7.4	7	9.5
7.5 - 8.5	53	71.6
8.5 and above	14	18.9
Orientation given on RAWE		
Low	9	12.2
Medium	53	71.6
High	12	16.2
Course Content		
Low	14	18.9
Medium	49	66.2
High	11	14.9
Inter and Intra Group Relationship		
Low	12	16.2
Medium	51	68.9
High	11	14.9
Knowledge and Skills gained during RAWE		
Low	11	14.9
Medium	54	73.0
High	9	12.2

Table 1 contd...

Category	Frequency	Percent
Scientific Information Sharing		
Low	14	18.9
Medium	48	64.9
High	12	16.2
Credit Load		
Low	8	10.8
Medium	56	75.7
High	10	13.5
Monitoring and Evaluation		
Low	13	17.6
Medium	47	63.5
High	14	18.9
Class room study		
Low	8	10.8
Medium	58	78.4
High	8	10.8

Inter and Intra group relationship: Majority (68.9%) of the students had medium inter and intra group relationships.

Knowledge and Skills gained: Majority (73.0%) of the respondents considered the RAWE programme was moderately useful in terms of knowledge and skills gained throughout the programme's duration and it is similar with Soujanya and Khare (2019) and Verma *et al.* (2019).

Scientific and Information sharing: More than half of the RAWE respondents (64.9%) had a medium level of scientific information sharing.

Credit load: Only 10.8 per cent of the students believed that their credit load was low, while majority (75.7%) of the students were moderately pleased with their credit load.

Monitoring and Evaluation: Monitoring and evaluation method was moderately satisfactory to the majority (63.5%) of the RAWE respondents. The results are in agreement with Verma Madhuri *et al.* (2017).

Class room study: Majority of the respondents (78.4%) were moderately satisfied with the class room study.

The distribution of RAWE respondents' perception towards RAWE programme were presented in Table 2. According to the data, only 12.2 per cent of the respondents had a high perception towards RAWE programme. It is worth noting that a large proportion of respondents (73.0%) had a medium perception towards the RAWE programme, followed by a low perception (14.9%). The results are in conformity with Khatri (2019).

Table 2: Distribution of RAWE respondents on Perception towards RAWE

Categories	Frequency	Percentage
Low	11	14.9
Medium	54	73.0
High	9	12.2
Total	74	100.0

The perception index was created by computing the mean for each statement and assigning a rank to it.

Table 3 shows that the Rank I was assigned to get familiar with rural life, with a mean score of 4.47, suggesting that majority of the respondents was acquainted with the rural people through the RAWE programme. With a mean score of 4.36, Rank II was assigned to understand village situations. Following that, with a mean score of 4.33, Rank III was assigned to understand farmers problems. With a mean score of 4.30, Rank IV was assigned to understand socio-economic conditions of the farmers. As the mean score was 4.28, Rank V was assigned to improve the communication skills. With a mean score of 4.19, Rank VI was assigned to farming systems and farming. As the mean score was 4.14, Rank VII was assigned to understand rural institutions. With a mean score of 4.07, Rank VIII was assigned to understand the adoption patterns and adoption gaps of the farmers and to get exposure and increased confidence in various elements of agriculture. With a mean score of 4.05, Rank IX was assigned to develop diagnostic skills. As the mean score was 3.86, Rank X was assigned to provide practical training in crop production. With a mean score of 3.72, Rank XI was assigned to development of professional competence to solve field problems and with a mean score of 3.70, and XV, with mean scores of 3.66, 3.58, and 3.49 respectively.

Table 3: Perception of Respondents Towards RAWE Programme

S. No.	Role of RAWE programme	Mean Score	Rank
1	To get familiar with rural life	4.47	I
2	To understand village situations	4.36	II
3	To understand farmers problem	4.33	III
4	To understand socio-economic conditions of the farmers	4.3	IV
5	To improve communication skills	4.28	V
6	To understand farming systems and farming	4.19	VI
7	To understand rural institutions	4.14	VII
8	To understand adoption patterns and adoption gaps of the farmers	4.07	VIII
9	To get exposure and increased my confidence	4.07	VIII
10	To improve diagnostic skills	4.05	IX
11	Provided practical training in crop production	3.86	X
12	To develop professional competence to solve field problems	3.72	XI
13	To improve leadership qualities	3.7	XII
14	To develop competency to prepare farm plans for individual farm families	3.66	XIII
15	To get acquainted with on-going TOT programmes in agriculture	3.58	XIV
16	To get acquainted with poverty alleviation programmes	3.49	XV

Table 4: Correlation of the Independent variables with Perception towards RAWE as perceived by the respondents

Variables	Mean	Std. Deviation	Pearson Correlation (r)
Age (X1)	22.26	0.892	0.137
Gender (X2)	1.35	0.481	0.043
Accommodation (X3)	1.82	0.383	0.053
Medium of Instruction - High School (X4)	2.77	0.424	-0.118
Medium of Instruction - Higher Secondary (X5)	2.76	0.432	-0.13
Prior exposure to Rural life (X6)	1.31	0.466	0.106
OGPA (X7)	2.09	0.528	0.101
Orientation given on RAWE (X8)	44.07	5.518	0.453**
Course Content (X9)	79.2	13.622	0.654**
Inter and Intra group relationships (X10)	45.04	7.925	0.591**
Knowledge and Skills gained (X11)	325.7	60.91	0.692**
Scientific Information Sharing (X12)	36.54	11.341	0.472**
Credit Load (X13)	35.65	8.635	0.152
Monitoring and Evaluation (X14)	18.28	3.458	0.428**
Class room study (X15)	49.14	6.141	0.577**

** Significant at 1% level of significance

It was found from Table 4 that among 15 independent variables the Perception of RAWE is positively related with only seven variables viz., Orientation given on RAWE, Course content, Inter and Intra group relationships, Knowledge and Skills gained, Scientific information sharing, Credit load and Class room study at the 1% level of significance. It discovered that perception of RAWE has no significant relationship with the age, gender, accommodation, medium of instruction in high school and higher secondary, prior exposure to rural life, OGPA and monitoring and evaluation system.

Accordingly, the null hypothesis was rejected and the empirical hypothesis was accepted with respect to the following seven variables i.e., orientation given on RAWE, course content, inter and intra group relationships, knowledge and skills gained, scientific information sharing, credit load and class room study, whereas the remain eight variables i.e., age, gender, accommodation, medium of instruction in high school and higher secondary, prior exposure to rural life, OGPA and monitoring and evaluation system were accepted for the null hypothesis.

Multiple regression was used to determine the amount to which the independent variables, alone or in combination, might predict or contribute to the dependent variables and the Table 5 revealed the regression coefficient (b) values and 't' values. The interpretation of the Table 5 was briefly as follows:

1. R^2 was observed to be statistically significant as the computed 'F' value (6.017) was significant at the 0.05 level of probability.
2. The 15 independent variables jointly explained 61.00 per cent (0.609 x 100) of variation in the perception towards RAWE (Dependent variable).
3. Out of 15 independent variables, one variable (X_{15}) contributed significantly to the prediction of the dependent variable (which have been shown in the Table 5).

As a result, the null hypothesis was rejected by adopting the empirical hypothesis, which found that all 15 independent factors altogether caused significant variation in perception towards RAWE to the extent of 61.00 per cent.

CONCLUSION

The study concluded that a large proportion of respondents (73.0%) had a medium perception towards the RAWE programme, followed by a low perception (14.9%). As a result, it can be stated that the RAWE curriculum was intended to meet virtually all of the students' demands. The relationship between various profile characteristics of the respondents, among fifteen independent variables only seven variables viz., Orientation given on RAWE, Course content, Inter and Intra group relationships, Knowledge and Skills gained, Scientific information sharing, Credit load and Class room study were found to be positive and significant relationship with the perception of respondents towards RAWE programme. From regression analysis findings, it is showed that the Class room study of RAWE respondents as independent variable contributed significantly to the prediction of the

Table 5: Multiple regression analysis of Perception towards RAWE on the Independent variables

Variables	Mean	Std. Deviation	Beta value	t -value
Age (X1)	22.26	0.892	-0.039	-0.411
Gender (X2)	1.35	0.481	0.125	1.215
Accommodation (X3)	1.82	0.383	0.021	0.232
Medium of Instruction - High School (X4)	2.77	0.424	0.501	1.253
Medium of Instruction - Higher Secondary (X5)	2.76	0.432	-0.578	-1.459
Prior exposure to Rural life (X6)	1.31	0.466	0.034	0.35
OGPA (X7)	2.09	0.528	-0.068	-0.657
Orientation given on RAWE (X8)	44.07	5.518	0.042	0.33
Course Content (X9)	79.2	13.622	0.24	1.232
Inter and Intra group relationships (X10)	45.04	7.925	0.135	1
Knowledge and Skills gained (X11)	325.7	60.91	0.153	0.717
Scientific Information Sharing (X12)	36.54	11.341	0.115	0.87
Credit Load (X13)	35.65	8.635	-0.117	-1.084
Monitoring and Evaluation (X14)	18.28	3.458	0.095	0.776
Class room study (X15)	49.14	6.141	0.269	2.057*

* Significant at 5% level of significance; $R^2 = 0.609$ (with 15 independent variables); F= 6.017

dependent variable at the 0.01% significance level and also found that all fifteen independent factors altogether caused significant variation in perception towards RAWE to the extent of 61.00 per cent. It is therefore, a learner-centered approach, such as RAWE, has been shown to be important in developing human resources in the field of agricultural education, research, and extension in the country and guides students in developing their knowledge, attitude, and skill in order for them to graduate as experts and contribute to the holistic growth of agriculture.

REFERENCES

Anonymous. 1948. The report of University Education commission, Vol. I, Ministry of Education and Culture, New Delhi: GOI.

Anonymous. 1992. The Report of the Indian Council of Agricultural Research Committee on Rural Agriculture Works Experience programme implementation in SAUs of India.

Anonymous. 1999. Rural Agricultural Work Experience Programme. Manual Acharya N G Ranga Agricultural University, Rajendranagar, Hyderabad.

Anonymous. 2006. The Report of the Fourth Dean's committee on Agriculture Education in India, New Delhi: ICAR.

Badavath, P. 2012. An Exploratory Study on the use of Information Communication Technologies among teachers and students of ANGRAU, M.H.Sc. thesis, ANGRAU, Hyderabad (AP), 31p.

Hase, R.S. and P.R. Deshmuk. 2012. Utility perception about extension education courses by the undergraduates' studies. *Agriculture Update,* 7(3&4): 410-413.

Khare, N.K. and N. Seema. 2017. Manual for Rural Agricultural Work Experience (RAWE) & Agro-Industrial Attachment (AIA) (2017). Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur M.P. 66p.

Khatri, M. 2019. Perception of students on Rural Agricultural Work Experience (RAWE) programme in College of Agriculture Tikamgarh (MP) (Doctoral dissertation, (Tikamgarh) Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur).

Lakhamwad, N.B. 2019. Utility perception of students towards rural agricultural work experience programme (Doctoral dissertation, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani).

Mahra, G.S.; S.K. Kashyap; N. Bhardwaj and V.L.V. Kameswari. 2020. A study on relationship of instructional skills and immediacy behaviour of teachers on teaching effectiveness of extension teaching in agricultural universities. *Journal of Community Mobilization and Sustainable Development*, 15(1): 69-74.

Prakash, K.P. 2010. Participation of Agricultural Students in Co-curricular Activities, M.Sc. Thesis, Marathwada Krishi Vidyapeeth Parabhani Maharashtra, pp. 46-47.

Ray, G.L. and S. Mondal. 2011. Research methods in social sciences and extension education. Ludhiana: Kalyani Publishers.

Saha, A. 2019. RAWE 2019. Department of Agricultural Extension, Palli Siksha Bhavana, Visva-Bharati, Sriniketan. 32p.

Sanjeev, M.V. and K.N. Gowda. 2013. Perceptions on experiential learning: a study of agriculture students. *Indian Research Journal of Extension Education*, 13(1): 48-55p.

Sharma, A. 2018. Rural Agriculture Work Experience Programme in Agriculture College: A Study in Tarai Region of Uttarakhand. *Journal of Education, Society and Behavioural Science*, pp. 1-8.

Singh, S. 2016. Opinion of students and teachers regarding rural agricultural work experience and experiential learning programme of PAU, Ludhiana, M.Sc. thesis Ludhiana Punjab 30p.

Soujanya, K. and N.K. Khare. 2019. Need and necessity to upgrade Rural Agriculture Work Experience. *IOSR Journal of Humanities and Social Science*, 24(8): 42-45.

Verma, M.; N. Seema and V.K. Pyasi. 2017. Perception of Agriculture Students towards the Rural Agricultural Work Experience (RAWE) Programme. *International Journal of Current Microbiology and Applied Sciences,* 6(10): 3420-3423.

Verma, M.; S. Naberia and V.K. Pyasi. 2019. Utility of RAWE programme for undergraduate students of JNKVV Jabalpur. *The Pharma Innovation Journal,* 8(7): 250-251.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 375-382

Village Agricultural Development Action Plan Through Participatory Rural Appraisal Techniques: A Case Study of Santa Village, Morena, Madhya Pradesh, India

Rahul Devidas Damale[1], N.L. Kushwaha[1], Jitendra Rajput[1], Papa Rao Vaikuntapu[1], Chandan Kumar Deb[1], Rajneesh Sharma[1], Bharat S. Sontaki[1], Ch. Srinivasa Rao[1], R.A. Marathe[2], K. Dhinesh Babu[2] and Rabeesh Kumar Verma[3]

[1]ICAR-NAARM, Hyderabad-500030, Telangana
[2]ICAR-NRC on Pomegranate, Solapur-413255, Maharashtra
[3]C.C.R (P.G.) College, Muzaffarnagar-251001, Uttar Pradesh

ABSTRACT

Participatory Rural Appraisal (PRA) approach has been extensively employed by researcher/development practitioners to enable effective interaction and planning with communities. The rapid acceptance of Participatory Rural Appraisal (PRA) approaches to facilitate the understanding of problems among rural people, and the acknowledged priority for such studies to be sensitive to local conditions, has sometimes meant that such approaches have overlooked opportunities for appropriate application of relevant techniques. PRA and its forebears have for some time incorporated quantification or classification techniques such as matrix ordering or ranking (with considerable success), but with only limited incorporation of more complex analytical tools. This case study conducted by the multidisciplinary team members during the Field Experience Training (FET) attempts to focus upon the application of PRA techniques to investigate, analyse and evaluate constraints and opportunities and to formulate research plan to address the problems. The complexities of problem involved in agriculture can be understood through PRA and hence, it is a system approach for systematic and rapid collection of information. The Santa village has very rich tradition in cattle farming. There is huge scope for the adoption of improved breeds of cow, cattle with high milk production capacity. Development of nutrient enriched feed for cattle had a great opportunity to make the crop and animal production, a much profitable venture. With this there is huge scope in orchard establishment for horticultural crops like pomegranate, custard apple, etc.

Keywords: Participatory rural appraisal, Techniques, Morena, Field experience training

INTRODUCTION

Currently, India holds the second largest agriculture land (179.9 million hectares) in the world. The journey of Indian agriculture system is glorifying since the inception of planning commission in 1951. We faced nightmare of absolute shortage of food grain supplies in the 1960s. At the time of independence, the first Prime Minister Shri Jawaharlal Nehru said, *"everything else can wait, but not agriculture*." There have been several policy statements for agriculture during the last sixty years. Thanks to the Green Revolution, India attained self-sufficiency in food grains in the 1970s and emerged as an exporter of food grains to other countries. Presently, India ranks second worldwide in farm output. Agriculture sector accounts 13.7% of the GDP. The contribution of agriculture and allied sector to the GDP has fallen from 61 to 13.7% in the last 60 years (Tripathi and Prasad, 2009).

Due to increasing demand of land for housing, rising level of urbanization and industrialization, fertile agricultural land is being shifted to non-agricultural uses. India's food, nutritional, livelihood and economic

*Corresponding author email id: rahul.damale@icar.gov.in

security continues to be predicated upon the growth of agriculture sector and the situation will remain the same in the near future also. Now, nearly 72 per cent of our population live in rural areas where poverty is predominant phenomenon. Approximately 60 per cent them are engaged in agriculture for their livelihood either directly or indirectly. Increased productivity in agricultural sector helps in poverty alleviation, employment generation and increase the nation's economic growth. The productivity and growth of India's agriculture is in decelerating pace now owing to many reasons such as reduction in soil fertility, excessive use of fertilizers and imbalance of nutrient content in the soil, problems related to biomass availability, genetic erosion, water logging and salinization, depletion of groundwater table, imbalances in nutrient availability because of changes in cropping patterns and contamination of water bodies and soil by pesticides and fertilizers.

Participatory rural appraisal (PRA) has been defined as "*family of participatory approaches and methods which emphasize local knowledge and enable local people to do their own appraisal, analysis and planning. PRA uses group animation and exercises to facilitate information sharing, analysis and action among stakeholders*" (David *et al.*, 2002). To improve the agricultural scenario, the need based, less time consuming, location specific problem identification and solution is very important. Participatory Rural Appraisal (PRA) tool makes the farmer themselves as a solution agent and also provides the accurate information about the study area. PRA helps the farmer to identify their own livelihood issues and helps the trainee scientists to understand the problems of the farmer from farmers. PRA is an exercise that deals with temporal and spatial issues in agricultural activities. Spatial information supplies the database about soil type, water resources, land use, land pattern and topography of different life support system. Temporal data helps in seasonal analysis, adoption and awareness about the new technologies and human dimension helps in knowing the facts about participation, gender issues, disaggregation, cultural values and ethics of the people of that locality.

MATERIALS AND METHODS

Field Experience Training (FET) is to provide an opportunity to the scientist trainees to focus research efforts on field realities and needs of stakeholders by employing participatory rural appraisal methodology (NAARM, 2020). A multidisciplinary team of six scientists were constituted and posted in the, Zonal Agricultural Research Station, Morena, RVSKVV, Madhya Pradesh, identified as FET centre by the expert group from the ICAR- National Academy of Agricultural Research Management (ICAR-NAARM). With the help of experts of FET centre, Santa village of Joura Tehsil in Morena District, Madhya Pradesh, India was selected for FET study. A series of activities were carried out in the selected village to gather diverse information required for preparation of village development action plan through PRA.

The Participatory Rural Appraisal (Mascarenhas et al., 1991; Chambers,1994b) is a research technique developed in early 1980s as an alternative and complement to conventional sample survey. PRA is a way of learning from and with farmers to investigate, analyse and evaluate constraints and opportunities and to formulate research plan to address the problems. In the present study, PRA tools and techniques were used in the identified village with active involvement of villagers under the facilitation of multidisciplinary team of scientist trainees during the period of February-March, 2020. The selected PRA tools and techniques were employed to collect the information of the selected village and problems related to farming from villagers by conducting various activities like, survey and transect walk, mappings, group meetings, village assembly, problem priority chart seasonal calendars, trend and change analysis, and preparation of VDAP. The village social workers with panchayat secretary conducted the PRA study of 18 days in the said village. In addition, 40 randomly selected households of the village were surveyed and census data on village demographics were collected through local Gram Panchayat office and official government websites.

After detailed analysis of PRA tools and formal discussion with the farmers, ten most important problems were listed and forty farm households were surveyed for its prioritisation using Rank Based Quotient (RBQ) and Value Based Index (VBI) method.

After detailed PRA study, a village focus group discussion (village seminar) was carried out for cross validation (triangulation) of obtained information on identified agricultural problems with farmers and other stakeholders in the village. After village focus group discussion, a team of trainee scientists presented results in FET centre for discussion with experts from various ICAR institutes and other KVK Subject Matter Specialists and valuable suggestions received were incorporated in final village development action plan (VDAP).

RESULTS AND DISCUSSION

The village total population is about 2640 out of which about 1479 (56.02%) are male and 1161 (43.97%) are female. The village has a total of 314 farm families in which, 44 (14%) are large, 157 (50%) are medium, 98 (31.21%) are small and 15 (4.77%) are landless agricultural farmers and main occupation of villagers is farming. Basic information of the study village shown in Table1.The major crops grown in the village are Bajra, Guar, Arhar in Kharif season and Wheat, Mustard, Potato in Rabi Season. The livestock of the village serves as an important source of income for all classes of the family. Buffalo is a major livestock in the village with average 2-3 buffalo in every household.

The main motive of this PRA activity was to understand and study the major land uses, topographical pattern, water resources, crops, natural vegetation, livestock and different ecological zones by observing, interacting and discussing with the key informants, while walking in the decided direction. The discussion included topics like land use pattern, land slope, soil type, soil fertility status, water recourses, agro-ecological zones, crops, weeds, trees and lives stock. During the transect walk in the village it has been observed that farming is practised with all the modern equipment and implements like tractor, seed drill, disk plough, subsoiler, power tiller, grader, knapsack sprayer, rotavator, milking machine, thrasher, cultivator and power sprayer. The availability of water for agriculture is sufficient and major source is tube wells. The livestock population of the village consists of cows, goats, buffalos, poultry birds and bullocks.

Different PRA activities were conducted for analysis of situation in the village and accordingly social map, resource map, agro-ecosystem analysis, technology map, time line and trend analysis, health map and mobility map were prepared with help of villagers to understand the existing situation of the village to prepare village development action plan.

Table 1: Basic resource information of Santa village of Madhya Pradesh

Particulars Details	Details
Demographic pattern	
Total Population	2640
Male	1479 (56.0%)
Female	1161 (43.97%)
Families pattern	
Total household	314
Nuclear family	45 (14.33%)
Joint family	269 (85.66%)
Land holding classification	
Large farmers (>10 ha.)	44 (14.0.%)
Medium farmers (5-10 ha.)	157 (50.0%)
Small farmers (< 5 ha.)	98 (31.21%)
Landless farmers	15 (4.77%)
Total farmers	314 (100%)
Geographical Area (in ha)	
Total geographical area	343.07
Total cultivated area	317.75
Total irrigated area	303.75
Water Resources	
Seasonal pond	2
Bore wells 76 (functional)	112
Major crops and Cropping season	
Kharif: Bajra (main crop), Guar and Arhar, Sorghum	
Rabi: Wheat (main crop), Mustard, Potato, Berseem (Fodder crop)	
Livestock details	
Buffalo (Murrah, Niliravi and Local)	980
Cow (Holstein Friesian, Gir, Sahiwal and Marwari and local breed)	185
Goat (Jamnapari)	12
Poultry (Kadaknath)	23

The climatic and environmental condition with relation to the agricultural practices were represented in the agro ecological map. It also depicts the subsystem and component of the agroecological system. It helps in better understanding of the interaction between the agriculture and the environment around agriculture. Agro-ecological resource map of the village Santa was drawn to identify the various agro ecological condition present in the village. The farmers (Key informants) were encouraged to draw the agro ecological map themselves marking the important landmarks. Special emphasis was given to mark the various topographical areas, cropping systems and crops, soil types, water bodies, weeds, water sources and irrigation system, livestock, trees and other aspects related to agro ecology as shown in Figure 1. The study village *Santa* village basically has a crop-based cropping system. Most of the farmers are cultivating the crops like Wheat, Mustard, Potato, Bajra, Guar. Complete cultivation is done in irrigated area with sandy loam soil type. The normal annual rainfall is 753.7 mm and relative humidity is around 40-55 percent with mean annual minimum and maximum temperature is about 31°C and 43°C respectively. The residential area of the village mainly consisted of houses and all the livestock *i.e.* cattle, present in this area. The soil is sandy loam. Two ponds are available Main water source of water is bore wells (all time) also supply water for various purposes. Trees like Mango, Bael, Wood apple, Teak, Babul, and Eucalyptus are present in some parts of the residential area. Neem trees are available in large number in the residential areas also. Commonly available weeds in this village are Bathua (*Chenopodium album*), Mama Ghass

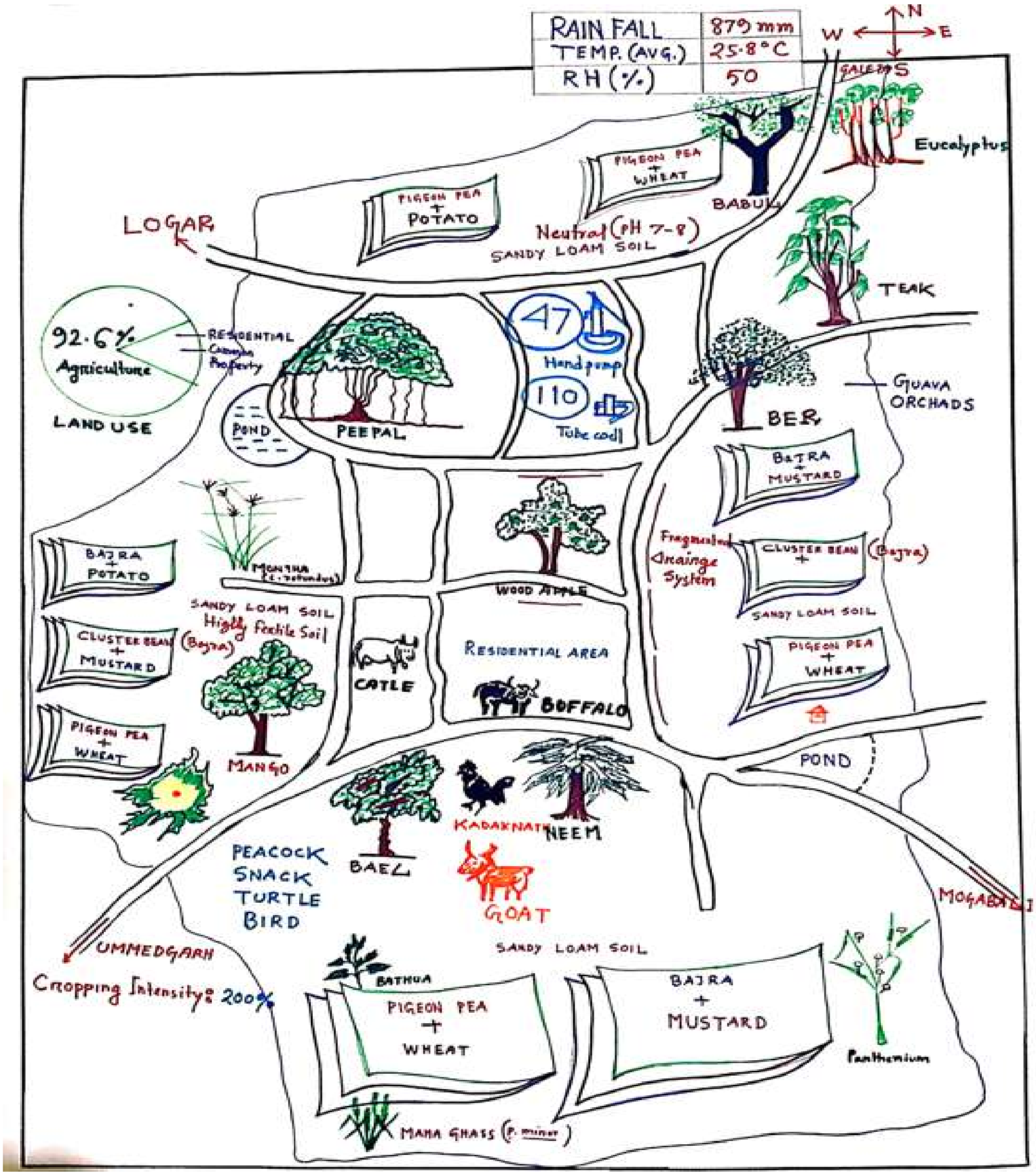


Figure 2: Agro-ecology map of Santa village of Madhya Pradesh

(*Phalaris minor*), Congress grass (*Parthenium hysterophorus*), Montha (*Cyperus rotundus*) and *Argemone mexicana*.

Seasonal calendar depicts month wise agricultural activities followed in a year. The main activities, followed in the study village *Santa* were identified by using seasonal calendar. It depicted time-to-time crop related operations being carried out in the village to maximize utilization of agricultural land across seasons. The common crop seasons in the village were *Kharif* and *Rabi*. Bajra, Guar, Arhar were the major crops of the village during *Kharif* season. Wheat, mustard and potato are the major crops grown during rabi season. In summer season there are no significant crop cultivation happens in this village. Livestock sector also had continuous activities. Animals were feeding in the home.

The technology map providing details related to decision behaviour of the farmers towards technology in terms of adoption, over adoption, reinvention, rejection and discontinuance with reference to the agricultural farm implements and structures, crops, vegetables, live stocks. The detailed information on adoption, discontinuance, rejection and over adoption of farm technologies were presented and their reasons are elucidated (Figure 2, Table 3). The major outcome of this technology map includes passive rejection of improved cross breed poultry due to dominance of religious values. Further, discontinuance of several crops also elucidated. It also observed that farmers are adopting new technologies and crops were observed. Overall, the village is receptive to adopt new technologies.

This is an analytical technique of exploring behaviours, decisions and coping strategies of households with different socio-economic backgrounds because study about socio-economic status of different scale farmers is helpful for designing and implementing government development programs (Pandey and Upadhayay, 2012). The livelihood analysis is drawn from each categories of farm family. The livelihood analysis of Santa village indicates that agriculture and allied is the major source of income for large, medium and small class families. The small and to some extent, the medium class depends on employment in agriculture and other labor work. Since maximum income comes from agriculture, majority of the expenditure are used for the same. Majority of the farm equipment's and livestock present in the village belongs to the farmer placed in the large and medium category.

Participatory Rural Appraisal (PRA) is the most helpful, desirable and advisable method to identify prevailing problems of farmer communities of the village. The problems faced by the farmers in either agriculture or livestock production were identified by participatory approach. For this purpose, forty (40) farmers were approached from the village representing all the sections (including small, marginal and rich famers) of the village using snowball technique. One by one all 40 farmers were asked to rank the problems based upon the severity and percentage of loss they are personally facing by the problem (the date collected from top 30 progressive farmers took for consideration to calculate Rank Based Quotient (RBQ) and Value Based Index (VBI)). Farmers were hinted about 9 major problems in different crops/ livestock sectors and given the ranks (ranking from 1 to 10) for each problem. Highest the VBI tells the severity of the

Table 2: Gender disaggregated seasonal calendar for major crops

Crop	Jan	Feb	Mar	April	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Wheat	I(M)	I, PP, FE(M)	I, PP (M)	H (M+F)							LP	S,I, FE(M)
Potato	I, PP (M)	I(M)	H(M)							LP, Tr, FE(M)		I(M)
Bajra						LP(M)	S(M)		H(M)	I(M)	PP(M)	H(M+F)
Mustard			H(M+F)							LP, S(M)		I, FE(M)
Pigeon Pea							LP, S(M)	PP, (M)	FE (M)		H(M+F)	
Guar							LP, S(M)	PP(M)		H(M+F)		

(*Note:* LP-land preparation, N- Nursery, S-Sowing, Tr- Transplanting, FE- Fertilizer Application, I-Irrigation, PP-plant protection, H-Harvesting, M-Male, F-Female)

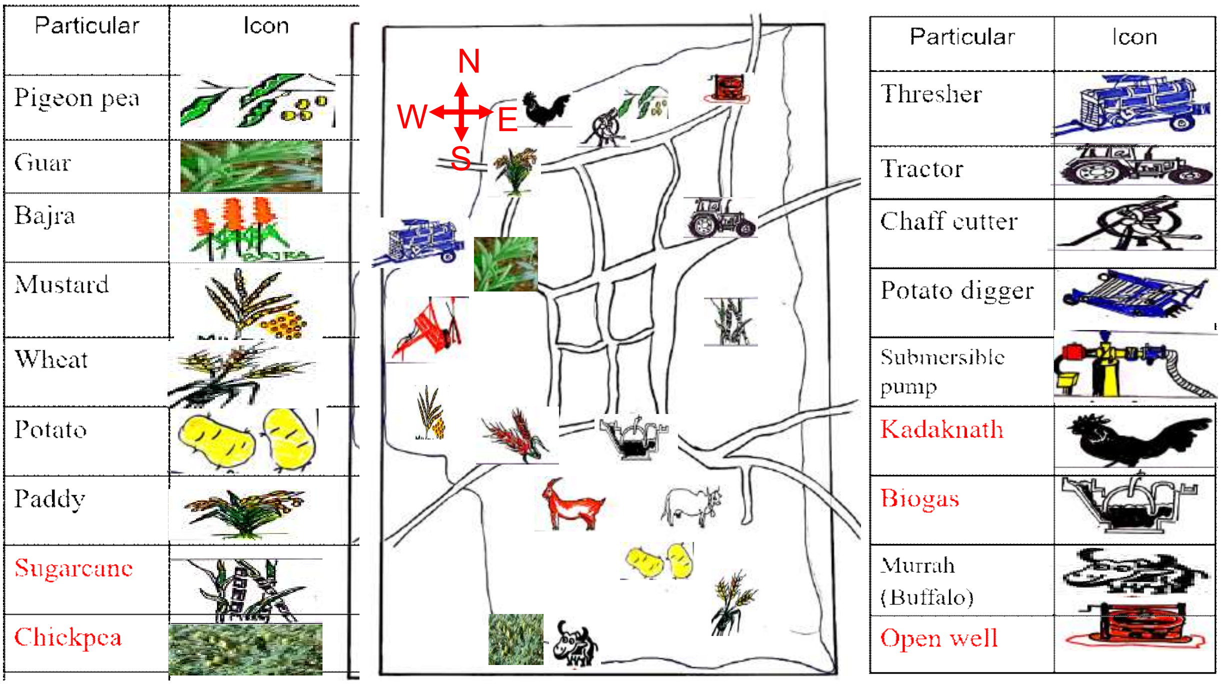


Figure 2: Agro-technology map of the study village

Table 3: Adoption behaviour of the farmers towards various farming technologies

Category	Technology	Status	Reasons
Machinery and implement	Country plough	Discontinued	Due to introduction of new technology
	Tractor	Adopted	Labour and time saving
	Knapsack sprayer	Adopted	Reduction due to introduction of power sprayer
	Power sprayer	Adopted	Reduction in drudgery
	Potato digger	Adopted	Time efficient
	Potato transplanter	Adopted	Timeliness in operation and saving of time
	Tractor	Adopted	Labour and time saving
	Knapsack sprayer	Adopted	Reduction due to introduction of power sprayer
	Thresher	Adopted	Shortage of labour, Time efficient
	Combine harvester	Adopted	Shortage of labour
	Laser land leveller	Recently adopted	Introduction of advanced technology
Irrigation Source	Tube well	Over Adoption	To irrigate high water consuming crops and poor water conservation and recharge measures
Crops	Potato Kufri Bahar (3797)	Adopted	Environmentally friendly, sunlight resistance, consumer preference and high profit
	Sugarcane Merathiya	Discontinued	Closing of kalarash sugar mill
Animals	Goat	Passive rejection	Social status and religious values
	Poultry	Passive rejection	Social status and religious values

problem. Quantification of data was done by ranking the problems based on the responses collected from the farmers. On the basis of RBQ and VBI, it was found that weed (local name: Barru) in bajra (Pearl millet; *Pennisetum glaucum*) with VBI of 7012.8 is a major threat to bajra causing highest damage to the crop with average loss of 72% followed by stem rot (causative agent- *Sclerotinia sclerotiorum*) of Indian mustard (*Brassica juncea*) with VBI of 6580 and average loss of 70%. We also categorised the problems based on the possible type of solutions. Since majority of the farmers of Santa village has the buffalos, Low fertility in buffalo observed as a third problem. Late blight of potato, Foot and mouth disease (FMD) of cattle, Premature delivery of cattle, Mimicking weed in wheat, Loos smut of wheat, and White rust of mustard observed as other major problems faced in the village (Table 4).

A comprehensive village development action plan was prepared after a month-long participatory exercise. The results were analysed and maps were drawn in participation with Santa villagers. Major problems were also discussed with the Zonal Agriculture Research Station (ZARS) and Krishi Vigyan Kendra (KVK) scientists and extension experts of Morena in our institute seminar. This has indicated scope and point of intervention by research institutes, extension workers through integration approach to mitigate the problem. The detailed action plan includes what is the identified problem, why problem is persisting, to whom the problem is concerned, how to tackle or solve the problem and what are the expected outcome from the solution. The major problem identified as the mimicking weed in Bajra (*Pennisetum glaucum*) and stem rot of mustard (also known as *Sclerotinia* stem rot). The mimicking weed was identified as a *Pennisetum purpureum* (Since there are no plant taxonomists in our group, we identified the weed name through internet based on morphological characters of weed; Scientists in RVSKVK, Morena claimed it as Pennisetum helpans). The action plant suggested that uproot weed plants before shading of seeds and burn them to reduce spread of seed bank. The second problem i.e. stem rot of mustard is caused by *Sclerotinia sclerotiorum.* The solution suggested as Use proper field sanitation practices, use certified seeds of resistant/tolerant varieties, Crop rotation with nonhost crops like, rice and maize and Preparation of compost pits to avoid pest transfer through raw cow dung. There is a need for focus on ground water recharge through adoption of on-farm water conservation techniques, demonstration and training on seed technology and all these solutions can be a strong output generator if training in special area provided to farmers (Landge & Tripathi, 2006). To tackle marketing issues, need to bring both APMC and cocoon market in nearby study village under e-NAM platform to create competition, demand and high price to the farmers produce were also recommended.

CONCLUSION

To understand the dynamics of agriculture undercurrent scenario, multidisciplinary approach is crucial for the development of agrarian economy like India. To tackle different problems of agricultural research village development action plan was prepared by multidisciplinary team of scientist with participation of all the stakeholders. The methods used in this study seem to have been successful in assessing farmers' priorities and preferences in variety choice, and have yielded hierarchy of the factors determining such choices. Therefore, this field experience training is unique module serve village as a social laboratory for effective

Table 4: Problem identification and prioritization

Problems	Individual Ranks										RBQ	Average economic loss (%/ Annum)	VBI	Rank
	1	2	3	4	5	6	7	8	9	10				
Mimicking weed in Bajra	22	8	-	-	-	-	-	-	-	-	**97.4**	**72**	**7012.8**	**1**
Late blight of potato	12	6	5	5	2			-	-	-	93.4	44	4109.6	4
Low fertility in buffalo	15	12	3		-			-	-	-	97.7	60	5862	3
FMD of cattle	15	10	5					-	-	-	87.1	52	4529.2	5
Stem rot of mustard	24	5	1					-	-	-	**94**	**70**	**6580**	**2**
Premature delivery of cattle	2	3	10	8	7			-	-	-	75.1	53	3980.3	6
Mimicking weed in wheat	3	3	8					-	-	-	84.3	30	2529	7
Loos smut of wheat	3	2	7					-	-	-	86.7	21	1820.7	8
White rust of mustard	4	2	7	2	5			-	-	-	79	20	1580	9

problem identification under actual field situation for further research and development. Further development of village development action plan using bricolage concept, will guide the local organizations to focus on developmental issues for betterment of agriculture in the village.

REFERENCES

Chambers, R. 1994a. The origins and practice of participatory rural appraisal. *World Development,* 22(7): 953-969.

David Brown, Mick Howes, Karim Hussein, Catherine Longley and Ken Swindell. 2002. participatory methodologies and participatory practices: assessing pra use in the gambia, ODI- Agricultural Research and Extension Network, AgREN- *Network Paper,* 124: 1-15.

Landge, S. and H. Tripathi. 2006. Training needs of kisan mitras in agriculture and allied areas. *Indian Research Journal of Extension Education*, 6(3): 54-58.

Mascarenhas, J.; P. Shah; S. Joseph; R. Jayakaran; J. Devavaram; V. Ramachandran; A. Fernandez; R. Chambers and J. Pretty. 1991. Participatory rural appraisal: proceedings of the February 1991 Bangalore PRA trainers' workshop. In RRA notes. IIED and MYRADA, Bangalore.

NAARM. 2020. Field Experience Training (FET) guidelines, National Academy of Agricultural Research Management, Hyderabad.

Pandey, D.K. and A.D. Upadhayay. 2012. Socio-economic profile of fish farmers of an adopted model aquaculture village: Kulubari, West Tripura. *Indian Research Journal of Extension Education*, 2: 55-58.

Tripathi, A. and A.R. Prasad. 2009. Agricultural D Development in India since Independence: A Study on Progress, Performance, and Determinants. *Journal of Emerging Knowledge on Emerging Markets*, 1(1): 63-92.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 383-386

Impacts of Changing Climate and Climate Variability on Seed Production under ICAR Seed project at SKUAST Jammu

Vishal Raina*, Magdeshwar Sharma, Anjani Kumar Singh, Amrish Vaid, Narinder Pannotra[1] and Rakesh Kuar[2]
Mega Seed Project, Directorate of Research, SKUAST-Jammu, J&K
[1]OFRC-Chatha, [2]RRSS-Raya, SKUAST-Jammu, J&K

ABSTRACT

Agriculture is extremely sensitive to climate and weather conditions. The resilience of our crop production systems to changes in climate can be enhanced by improved understanding impacts and responses of crops to changing climates. Seed is a basic input in agriculture to increase crop yields per unit area. Therefore the quality seed should have high genetic purity, high physical purity, high germination percentage, high vigour, higher field establishment, free from pest and disease, in good shape, size, colour etc., according to the specification of variety, high longevity / shelf life, optimum moisture content for storage and high market value. To achieve the same quality seeds of Paddy and Wheat were produced and supplied to the Department of Agriculture/farmers and a series of one day HRD Training programmes, were conducted by Mega Seed Project-SKUAST-Jammu in the year 2019-20. The seeds were produced to cater for different agroclimatic zones viz. temperate climate, intermediate zone and sub-tropical zone. The farmers and Officers of the alien departments were benefitted for improving the quality seed production.

Keywords: HRD, TSP, Quality seed production

INTRODUCTION

Several countries in Asia and Africa are at the risk of losing about 280 million tons of potential cereal production as a result of climate change factor, particularly increasing temperatures and prolonged dry periods. The most significant negative changes for developing countries in Asia, where agricultural production declines of about -4% to -10% are anticipated under different socioeconomic and climate change scenarios. Rising temperatures will reduce the amount of fertile farmland, and by 2050, the amount of maize grown is expected to decline by 6–23% and wheat by 40–45%. The majority of the world's food supply comes from the consumption of seeds from grain crops (wheat, rice, maize, soybean, barley, and sorghum), which are most vulnerable to changing climates. The growth in food production is lower than the population growth; therefore, there will be challenges of food security. Major impacts of climate change will be on rain-fed crops that account for nearly 60% of cropland area. It provides high-quality seeds of high-yielding varieties in adequate quantities at the right time and right place. Climate change influences the population dynamics of insects, emergence of new pests, changing status of pest and disease development, and evolution of new races of pests. Quality seed production is also affected by crop/weed interactions, loss of pollinator biodiversity, and genetic diversity. The seed crop is also affected by climate change regarding change in crop phenology, reproduction, flowering, anthesis/pollen viability, and pollination/fertilization, length of seed-filling duration, seed setting, seed size, seed dormancy, seed yield, and ultimately seed quality.

Importance of Seed in Crop Production: The importance of seed in crop production is known to human being since Vedic period. There is clear mention in ancient literature Yajarveda "May the seed viable,

*Corresponding author email id: vishalrainajammu@gmail.com

may the rains plentiful and may the grains ripe days and nights" The green revolution was only possible with production of generally pure seeds possessing other qualities namely high generation, high vigours high physical purity and sound health. Hence green revolution is in fact seed revolution. Among the inputs used by farmers seed in the cheapest input.

The major seed quality characters are summarized as below.

1. Physical Quality: It is the cleanliness of seed from other seeds, debris, inert matter, diseased seed and insect damaged seed. This quality character could be obtained with seed lots by proper cleaning and grading of seed (processing).
2. Genetic purity: It is the true to type nature of the seed. i.e., the seedling / plant / tree from the seed should resemble its mother in all aspects. This quality character is important for achieving the desired goal of raising the crop yield or for desired quality factors.
3. Physiological Quality: It is the actual expression of seed in further generation / multiplication. Physiological quality characters of seed comprises of seed germination and seed vigour.
4. Seed Health - Health status of seed is nothing but the absence of insect infestation and fungal infection, in or on the seed. Seed should not be infected with fungi or infested with insect pests as these will reduce the physiological quality of the seed and also the physical quality of the seed in long term storage.

Benefits of Using Quality Seeds: The good quality seed has high return per unit area as the genetic potentiality of the crop can be fully exploited. Less infestation of land with weed seed/other crop seeds. Less disease and insect problem. The quality seed respond well to the applied fertilizers and nutrients. Uniform in plant population and maturity. Crop raised with quality seed are aesthetically pleasing. Good seed prolongs life of a variety. Yield prediction is very easy. Handling in post-harvest operation will be easy. Preparations of finished products are also better.

MATERIAL AND METHODS

Capacity building and technology dissemination is required to reach to the masses/farmers and make them aware about the quality seed. The Various Seed Producing components of SKUAST –Jammu: Stations/Farms/Div./KVK's etc. contributed for providing the quality seed/Planting material for processing/distributing to the Dept. of Agriculture/ Farmers. Trainings are organized for the farmers and Officers of Agriculture/Allied departments.

RESULTS AND DISCUSSION

Training programmes on Quality seed production of various crops were conducted for generating awareness among farmers. The detail of seed production during 2019-20 (Table 1 & 2) and the training programmes

Table 1: Rabi 2019-20: Seed Production undertaken in Institute/university farm (Quintals

Crop / Variety	Breeder seed Production	Foundation seed Production	Certified seed Production
Wheat			
HPW 349	2.80	0.00	0.00
WH 1105	40.00	0.00	0.00
WH 1080	25.00	112.00	0.00
WH 1021	0.00	8.00	0.00
DBW 173	0.80	0.00	0.00
JAUW 584	3.10	0.00	0.00
WB 02	1.00	0.00	0.00
HD 3237	0.00	30.00	0.00
HD 3086	0.00	200.00	100.00
Total	72.70	350.00	100.00

Table 2: Kharif/Summer/spring 2020: Seed Production undertaken in Institute/university farm (quintals)

Crop/ Variety	Breeder seed Production	Foundation seed Production
Paddy		
Giza 14	15.00	300.00
Basmati 370	27.00	300.00
JB 129	0.34	0.00
PB1121	0.00	47.00
PB 1718	1.00	1.00
PB 1728	1.00	1.00
K 39	3.00	0.00
K 448	3.00	0.00
Total	50.34	649.00

(Table 3) conducted by Mega Seed Project, SKUAST-Jammu emphasizes the use of good quality and latest variety of seeds. The HRD trainings were undertaken with the objective to make aware the farmers and Officers/Personnel from Dept. of Agriculture about the importance of quality seed production. By increasing the seed replacement rate using high quality seed material the economy of the farmers will be enhanced (Pardeep Wali *et al.,* 2015-16; Dadlani *et al.,* 2009; Yadav *et al.,* 2014; Mondal and Goswami, 2020).

In *rabi* 2019-20, total 522.70 qtls. of quality seed was produced. In wheat variety HPW 349 for hill areas : 2.80 qtls. of breeder seed was produced, in WH 1105:40.00 qtls. of breeder seed was produced, in WH 1080 a variety for rainfed areas: 25.00 qtls. of breeder seed and 112.00 qtls. of foundation seed was produced, in WH 1021 suitable for irrigated areas (late sown): 8.00 qtls. of foundation seed was produced, in DBW 173 a late sown variety: 0.80 qtls. of breeder seed was produced, in JAUW 584: 3.10 qtls. of breeder seed was produced, In WB 02 zinc fortified variety for irrigatedareas: 1.00 qtl. of breeder seed was produced, in HD 3237 suitable for rainfed areas: 30 qtls. of foundation seed was produced, in HD 3086:200 qtls. of foundation seed and 100.00 qtls. of certified seed was produced.

In Kharif 2020, total 699.34 qtls. of quality seed of Paddy was produced. In paddy variety Giza14 suitable for hill areas: 15.00 qtls. of breeder seed and 300.00 qtls. of foundation seed was produced in Basmati 370: 27.00 qtls. of breeder seed and 300.00 qtls. Of foundation seed was produced, in JB 129: 0.34 qtls. of breeder seed was produced, in PB 1121: 47.00 qtls. of foundation seed was produced, in PB 1718: 1.00 qtl. of breeder seed and 1.00 qtl. of foundation seed was produced, in PB 1728: 1.00 qtl. of breeder seed and 1.00 qtl. of foundation seed was produced, In K 39: 3.00 qtls. of breeder seed was produced, in K 448: 3.00 qtls. of breeder seed was produced.

Under capacity building and technology dissemination eight HRD trainings were conducted namely- on Quality seed production of *rabi* oil seed at Purmandal on 04-10-2019 for 54 farmers, on Quality seed production of *rabi* Oats at Bhaderwah on 23-10-2019 for 40 farmers, on Production tech. for subtropical fruits at Raya on 16-03-2020 for 50 farmers,

Table 3: Capacity building / technology dissemination under ICAR Seed Project – Seed Production in Agricultural Crops during 2019-20

Title	Date	Kind of Stakeholders	Number of Beneficiaries
Training			
Quality seed production of *rabi* oil seed at Purmandal	4.10.2019	Farmers	54
Quality seed production of *rabi* Oats at Bhaderwah	23.10.2019	Farmers	40
Production tech. for subtropical fruits at Raya	16.03.2020	Farmers	50
Production tech. for temperate fruits at Bhaderwah	23.03.2020	Farmers	50
HRD			
Quality seed production of *rabi* crops at Samba	17.03.2020	Field functionaries	30
Production tech. for summer vegetables KVK, Sarnoo, Rajouri	19.03.2020	Farmers	50
Production tech. for summer vegetables KVK, Sunderbani, Rajouri	20.03.2020	Farmers	50
Quality seed production of *rab*i crops, Kathua	24.03.2020	Field functionaries	30
TSP			
Quality seed production of wheat crop under rainfed hilly condition	22.11.2019	Farmers	26
Fodder and seed production of dual purpose oats crop variety Sabzar under rainfed hilly condition wheat crop under rainfed hilly condition	25.11.2019	Farmers	26
Field day/ Seed days			
Basmati workshop	07.6.2019	Farmers	243
Vegetable day	05.03.2020	Farmers	70

on Production tech. for temperate fruits at Bhaderwah on 23-03-2020 for 50 farmers, on Quality seed production of *rabi* crops at Samba on 17-03-2020 for 30 field functionaries, on Production tech. for summer vegetables KVK, Sarnoo, Rajouri on 19-03-2020 for 50 farmers, on Production tech. for summer vegetables KVK, Sunderbani, Rajouri on 20-03-2020 for 50 farmers and on Quality seed production of *rab*i crops, Kathua on 24-03-2020 for 30 farmers. Under Tribal sub Plan two trainings were conducted at Rajouri / Poonch. One Basmati workshop for farmers was conducted for 243 farmers and Vegetable day was organied for 70 farmers. The HRD trainings conducted will also help in disseminating the latest trends and enhance the knowledge of farmers. Thus the quality seed production catering to different agro climatic regions were produced for Department of Agriculture and farmers to enhance the economy of the farmers.

REFERENCES

Dadlani, M.; S.K. Chakrabarty and S. Basu. 2009. Impact of climate change and IP regime on the production and availability of quality seed. *Indian Journal of Genetics and Plant Breeding,* 69(Spl. Issue): 325-330.

Mondal, R. and S. Goswami. 2020. Quality Seed Production A paradigm shift towards. *Sustainable Agriculture Research Today,* 2(5): 106-109.

Yadav, R.K.; S.S. Verma and S.S Dhankhar. 2014. Training manual on Quality seed production of field crops and seed health and quality. CCS Haryana Agricultural University, Hisar.

Wali, P.; A.K. Singh; M. Sharma and V. Raina. 2015-16. Annual Report : 2015-16, ICAR-Seed Project "Seed production in Agricultural Crops".

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 387-392

Adoption Status of Various Rice Residue Management Technologies in Sri Muktsar Sahib District of Punjab

Karamjit Sharma*, Mahekpreet Kaur and Gurmail Singh
Krishi Vigyan Kendra, Sri Muktsar Sahib, Punjab, India

ABSTRACT

Rice residue burning has been the major sustainability issue and a most debatable issue among different stakeholders. Rice residue burning in Punjab (north-western India) has emerged as most serious problem with ~23 million tons being produced annually, and ~80 per cent of being burnt in open fields before wheat establishment. Over the years, several rice residue management (RRM) technologies were developed and tested on large scale in entire north-western India. Agricultural machinery such as happy seeder, super seeder, zero drill, etc. have gained ground for RRM and wheat establishment. Therefore, the present study was undertaken to investigate the importance of different *in-situ* RRM technologies adopted after partial and complete residue management to study the current status of rice residue management in north-western India. The data was collected from randomly selected 200 farmers covering all the administrative blocks of Shri Muktsar Sahib district of Punjab. The results of the study revealed that ~35 per cent of the farmers fully burnt the loose rice straw on ~30 per cent of total area covered under study. Of the total, ~56.8 per cent area was fully managed by farmers using various technologies viz. happy seeder, super seeder, baler, zero drill, dry and wet ploughing *etc.* The rice residue was partially managed by ~3.4 per cent of the respondents on 4.64 per cent of the total area using happy seeder, while ~13 per cent of the respondents on an area of 14.5 per cent fully managed rice straw using super seeder technology. The previous experience in use of crop residue machinery and subsidy availed on machinery were factors that favored adoption of crop residue management. The attack of pink stem borer, lack of SMS fitted combine harvesters and lack of technical knowledge were the hindering factors in adoption of rice residue management. It was concluded that improved technical skill and know-how through trainings and hands-on exposure and access to machinery for crop residue management at cheap hiring price can lead to enhanced adoption of rice residue management.

Keywords: Baler, Happy seeder, Muktsar, Rice residue management, Super seeder

INTRODUCTION

Rice-wheat cropping system has given assured income to the farmers of Punjab (India) and about 3.14-million hectare area is under rice in the state. The area under rice crop increased continuously during last five decades. Farmers have rapidly adopted rice wheat cropping system on large areas due to assured marketing and high returns in comparison to other crops. However, presently, the major problem is that the farmers after combine harvesting of paddy fields resort to in-situ loose straw burning in order to clear fields for sowing of wheat crop (Erenstein, 2011).

Straw burning is considered as easiest and cheapest way to dispose of straw by farmers and also saves time for field preparation. Sometimes the straw burning is also linked to eliminate sources of pests, diseases and rat infestation. However, the practice of open-field burning is polluting air with a various gas especially carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); and fine particles which further effecting global climate and also impacting human in form of respiratory ailments (Singh *et al.,* 2008).

Large number of sensitization programs is being organized to make the farmers aware of the

*Corresponding author email id: sharmakaramjit@pau.edu

consequences of open field burning, but despite all the farmers giving preferences to open field burning. In recent years, farmers have been compelled to burn crop residues due to high cost of removing the crop residues by conventional methods; lack of machine availability; lack of combines with Super SMS attached for harvesting crops. The standing stubbles and loose straw in paddy harvested fields need to either incorporated into soil for enhancing soil fertility or removed from the field for other uses. Various technologies suggested by research scientists for straw in situ incorporation. In-situ management of loose rice straw using different technologies like fitting of straw management system (SMS) on combine harvesters, zero till drill (ZTD), happy seeder (HS), super seeder (SS), reversible mould board plough (RMBP), rotavator tillage (RT), rice straw chopper/mulcher and cutter-cum-shredder, etc. are being adopted by farmers (Singh *et al.*, 2020). In situ rice straw incorporation as an alternate to burning has been adopted by only a few farmers because of high incorporation costs and energy and time intensive (Singh and Sidhu, 2014). Further solution can be collection and removal of paddy straw from field by using rake and baler and utilizing it for paper industry, used as mulch in various crops, feed for animals, mushroom production and electricity generation in biomass power plants. The present study was conducted with an aim to assess the adoption status of different RRM technologies, their contribution towards the management of total rice residue produced.

MATERIALS AND METHODS

Sri Muktsar Sahib district in south-western Punjab has four administrative blocks viz. Muktsar, Gidderbaha, Malout and Lambi having 236 villages. Muktsar district lies in the south western part of the Punjab and lies between North Latitude 29°54' 20" and 30°40' 20" and East Longitude 74°15' and 74°19' and covers a geographical area of 2640 km^2. The district has a population of 9,01,896 with rural population of 72.04 per cent as per 2011 census with the population density of 348 person per km^2.The climate of the district is dry sub humid with grass land type of vegetation. Rice-wheat and cotton-wheat are the two major cropping systems prevalent in the district. Wheat dominates the cereal acreage with ~214 thousand ha area, while rice occupied 190 thousand ha area in the district during 2019 (Anonymous, 2020). The data were collected from randomly selected 200 farmers, during the year 2020-21. The data were collected using stratified random sampling from all four administrative blocks of the district. Within each administrative block, five villages were selected and within each village ten farmers were randomly selected. For the purpose of data collection, an open ended interview schedule was developed. The data regarding area under various RRM techniques during current 2020-21 was collected. The rice area under different RRM techniques viz. HS, SS, RT, ZTD, Baler technology, and RMBP was recorded during these interviews. The results were analyzed using frequencies, percentages, mean and standard deviation.

RESULTS AND DISCUSSION

The results of the study revealed that a total of 1483.2±5.6 ha area was under rice cultivation in the selected villages under study (Table 1). Among the different blocks maximum area under RRM was in Lambi block (308.0 ha), followed by Malout (209.6ha), Muktsar (196.8) and Gidderbaha (128.4ha). Area under partial burning was maximum in Muktsar block while area under fully residue burning was maximum in Gidderbaha block of Sri Muktsar sahib district.

Among different villages, maximum area under fully managed rice residue was 92.0±6.1 ha in village

Table 1: Area under different management techniques in different blocks of Sri Muktsar Sahib

Block	Fully Managed (ha)	Partially managed (ha)	Full crop residue burned (ha)	Total (ha)
Gidderbaha	128.4	66.8	133.6	328.8
Muktsar	196.8	74.8	124.0	395.6
Lambi	308.0	8.8	84.8	401.6
Malout	209.6	37.6	110.0	357.2
Total	842.8	188.0	452.4	1483.2

Mehna of Lambi block followed by 88.4±11.3 ha in Baloch Khera village of Lambi block. However, maximum proportion of area was in village Mehna (95.8%) of Lambi block followed by Virk Khera village (90.0%) of Malout block, Bloach khera village (85.3%) of Lambi block and Sarai Naga village (84.9%) of Muktsar, respectively. However, minimum area under RRM (15.6±1.8) was in Rakhala village of Gidderbaha block. Maximum proportion of area under partial burning was in Bhullar village of Muktsar block (40%) followed by ~28% area in Madhir village of block Gidderbaha.

Thus, a total of 842.8±5.2 ha *i.e.* 56.8 per cent of the total area under rice cultivation was fully managed using different CRM practices viz; happy seeder, super seeder and removal of straw using baler followed by conventional and zero drill sowing during 2019-20, while rice straw on 188.0±2.95 ha area (12.7%) was partially managed for wheat sowing in the district (Table 2). Rice straw on 452.4±2.68 ha i.e. 30.5% of the total are under rice was fully burnt in order to prepare field for wheat sowing. Similarly, 52.0 % of the farmers adopted CRM using different technologies followed by 34.7% of the farmers who resorted to complete burning and 13.7% partial burning of the rice residue (Figure 1).

Among the various RRM practices, the highest proportion of rice residue was managed through manual removal or mechanical removal using rectangular baler technology (Figure 2). Singh *et al.* (2017) concluded baler technology has social and economical viability and is can be adopted for removal

Table 2: Adoption status of rice residue management (RRM) in different blocks of Sri Muktsar Sahib district of Punjab

Admin block	No. of villages	Total sampled area under rice cultivation (ha)	Total area with open field burning (ha)	Total area under RRM (ha)	
				Partially managed	Fully managed
Gidderbaha	Madhir	60.8±2.28*	24.0±2.73	27.2±2.39	19.6±1.84
	Gurusar	83.6±3.83	24.4±3.08	20.4±4.41	38.8±4.02
	Rakhala	56.8±2.18	36.0±2.24	5.2±1.28	15.6±1.77
	Chotian	66.0±2.89	36.4±2.56	4.8±1.03	24.8±3.69
	Kotli Ablu	61.6±3.90	12.8±1.75	19.2±4.38	29.6±5.02
Muktsar	Chak Duhe Wala	114.4±5.65	32.4±4.37	0±0	82.0±6.78
	Ramgarh Chunga	76.0±3.09	31.6±3.20	12.8±2.71	31.6±3.26
	Vadayi	60.8±2.79	24.4±3.22	15.6±1.64	20.8±3.39
	Sarai Naga	42.4±2.54	2.8±0.65	3.6±0.81	36.0±3.44
	Bhullar	102.0±5.36	32.8±2.51	42.8±8.78	26.4±2.75
Lambi	Manikhera	36.0±1.93	6.8±0.89	7.2±1.52	22.0±2.68
	Kakhawali	81.6±3.65	18.4±2.02	0±0	63.2±3.93
	Baloch khera	103.6±7.58	15.2±2.75	0±0	88.4±11.32
	Tapakhera	84.4±3.73	40.4±3.44	1.6±0.51	42.4±4.57
	Mehna	96.0±5.55	4.0±1.26	0±0	92.0±6.13
Malout	Fulewala	90.8±4.21	48.0±3.39	26.8±4.90	16.0±3.96
	Virk Khera	96.4±5.46	4.4±0.93	5.2±1.64	86.8±6.53
	Kolian Wali	43.6±1.56	21.6±1.49	3.6±0.76	18.4±1.72
	Lakhmire Wala	61.2±2.58	24.4±1.57	0±0	36.8±3.34
	Gurusar Jodha	65.5±3.55	11.6±1.29	2.0±0.63	51.6±4.81
District	—	1483.2±5.58	452.4±2.68	188.0±2.95	842.8±5.2

* standard deviation

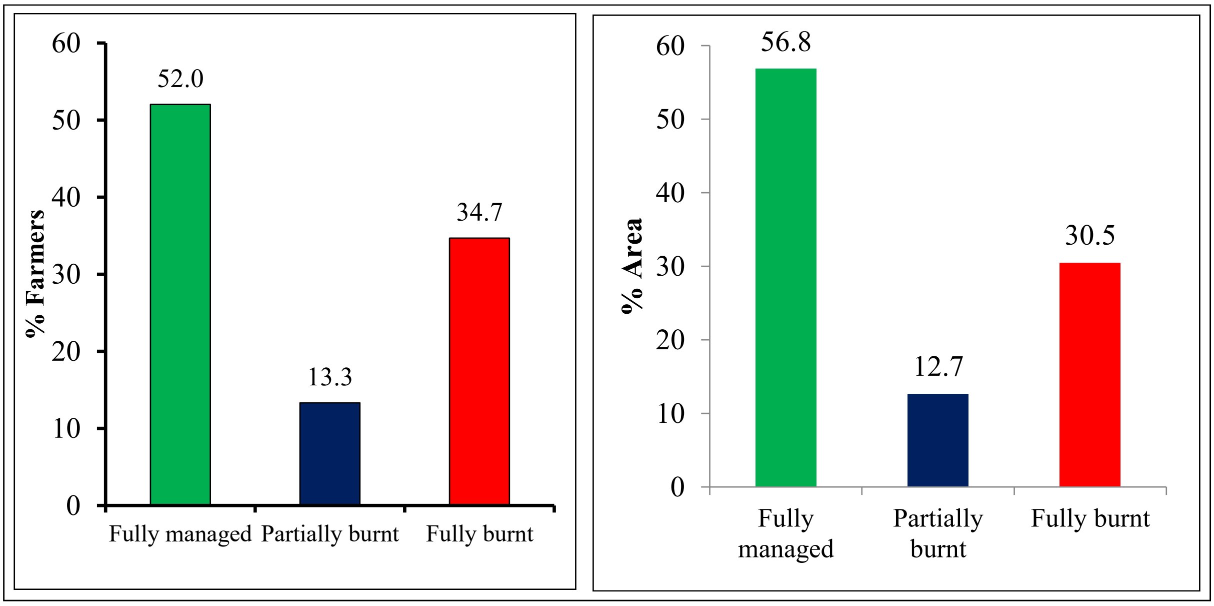


Figure 1: Distribution of respondents and area under rice residue management

of loose rice straw from the combine harvested fields. The majority of area under fully managed rice residue was done using baler technology was 59.7 per cent. This was followed by super seeder technology used for complete incorporation of loose straw and crop residue at the time of sowing on approximately 25.8 per cent area. Farmers adopted happy seeder technology (HST) on 5.6% of the sampled area and full load of rice residue was managed using this technology or in partial burnt rice straw fields where HST was adopted on 36.06 per cent of the total area under partial management of rice straw. About 2.9 per cent of the fully managed area was sown using conventional tillage (CT) and area managed with manual removal of straw was only 0.9 per cent. The incorporation of loose straw (wet mulching) using rotavator (after pre-sowing irrigation) was only 1.4 per cent and by dry mulching (by using mulcher, MB Plough and rotavator) was 3.0 per cent of the fully managed area. This technology is less adopted by farmers as the incorporation enhanced cost of cultivation due to high diesel fuel consumption on extra tillage operations required to incorporate heavy paddy straw load. Earlier, Singh *et al.* (2021) had reported that in Punjab ~25 per cent of farmers had to perform more than five tillage operations for incorporation of rice residues.

HS and SS technologies require chopping and uniform spread of loose straw for their enhanced efficiency and proper germination of the wheat crop. Fitting of straw management system (SMS) on combine harvesters has been recommended for chopping and uniform spread of straw. However, none of the farmers had sown wheat using HS after operation of SMS fitted combine harvester. Total 47.6 ha area i.e. 5.6 per cent of fully managed area was sown using happy seeder without using combines having super SMS attachment. Gupta *et al.* (2021) reported that happy seeder technology for wheat sowing ensures timely sowing, economic gains, enhanced water use efficiency and decrease in weed problem along with sustained wheat grain yields. Only 2.8 ha area i.e. 0.3 per cent of fully managed area was sown using SS after operation of SMS fitted combines. While, 214.4 ha area i.e. 25.4 per cent of fully managed area was sown using SS without using combine having super SMS attachment. Majority of the combine harvester did not adopt SMS technology due to decrease in efficiency of combine after installation of SMS and due to improper functioning of super SMS if installed from local market.

Hence the area managed using Happy seeder, super seeder, baler and incorporation is approximately 3.2, 14.7, 33.9 and 2.5 per cent, respectively of the total sampled area. Area managed through manual collection of loose straw for using it as fodder for animals or for bedding of animals was only 0.4 per cent of the total sampled area. In case of partial management of rice straw using happy seeder and zero till drill were

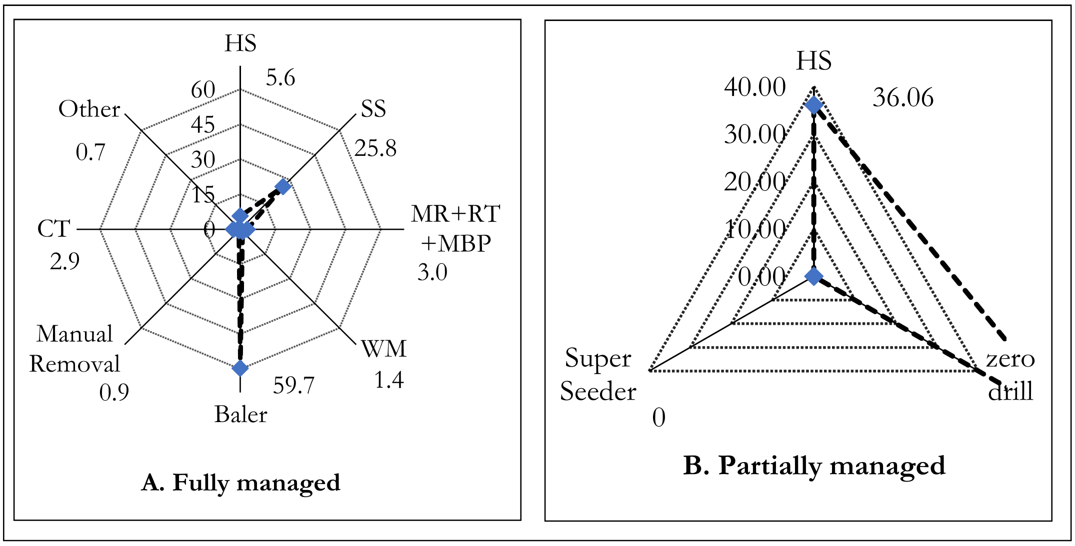


Figure 2: Percentage of area under different RRM techniques under fully and partially managed fields

Table 3: Area under different RRM technologies used for in situ management in Sri Muktsar Sahib district of Punjab

Particulars	Happy Seeder		Super Seeder		Incorporation		Removal of residue		Mixing with CT	Any other
	After SMS	Without SMS	With SMS	Without SMS	MR+ RMBP +RT	Dry/ Wet mixing	Baler	Zero Drill		
Fully managed										
Area managed (ha)	-	47.6	2.8	214.4	25.2	11.6	502.8	8.0	24.4	6.0
% of total	-	5.6	0.3	25.4	3.0	1.4	59.7	0.95	2.9	0.7
% of GT	-	3.2	0.2	14.5	1.7	0.8	33.9	0.5	1.65	0.4
Partial burning										
Area managed (ha)	-	68.8	-	-	-	-	-	119.2	-	-
% of total	-	36.6	-	-	-	-	-	63.4	-	-
% of GT	-	4.6	-	-	-	-	-	8.04	-	-

approximately 4.6% and 8.04% of the total sampled area, respectively.

Based on number of farmers who managed straw, it was found that 4.6 per cent of the farmers fully managed loose straw using happy and 3.4 per cent managed loose straw using happy seeder after partial burning. Similarly, 13 per cent of the farmers fully managed rice straw using super seeder followed by 1.6% who adopted incorporation (Table 4). A total of 88 farmers (27.2%) managed rice straw through collection and removal using rake and baler. Sowing of wheat in partial burnt fields using zero drill was adopted by 9.9 per cent of the farmers. Dry or wet mixing was adopted by 2.2 per cent of the farmers for management of rice residue. Thus, a total of 52.0 per cent of the farmers fully managed loose straw using different straw management technologies, 13.3 per cent of the farmers who resorted to partial burning and 34.7 per cent of the farmers fully burnt the rice straw.

CONCLUSION

There is immense need to check the open field burning of paddy straw to check environmental pollution, soil degradation, health problems and adverse impacts. Short window for sowing of next season crop, risk to human lives, environmental pollution and soil health are the sensitive issues for farmers. Thus, farmers should have different alternative to manage rice residue.

Table 4: Number of respondents adopted different CRM techniques in Sri Muktsar Sahib District of Punjab

Technology		Partial burning		Fully managed		Fully burnt	
		f	% of GT	f	% of GT	f	% of GT
A.	HS	11	3.4	15	4.6	-	-
B.	SS	-	-	42	13.0	-	-
C.	MR+RMBP +RT	-	-	5	1.6	-	-
D.	Removal	-	-			-	-
	i) Baler	-	-	88	27.2	-	-
	ii) Zero Drill	32	9.9	4	1.2	-	-
E.	Dry/wet mixing	-	-	4	1.2	-	-
F.	Mixing with CT	-	-	7	2.2		
G.	Any other	-	-	3	0.9	-	-
H.	Total	43	13.3	168	52.0	112	34.7

Incorporation and removal of straw using different machines has helped in solving the problem of rice residue burning. Farmers have adopted happy seeder, super seeder and other straw incorporation technologies however on small scale. Zero drill has been mainly adopted by farmers in partially burnt fields (9.9%) and where straw has been removed using baler technology. Most of the farmers prefer removal of loose straw by using rake and baler i.e. 27.2 per cent farmers to clear field for sowing of wheat. However, the baler technology is economically viable within few kilometers' radius of the demand area, but it is mandatory that there should be proper market for bulk purchase of paddy straw. Also, farmers face problems like lack of picking of bails by companies in case of wet rice straw and also baler owner charges farmers for making and picking of bails. From the data collected it was found that the use combines with super SMS is not much apparent because of reduced efficiency of combines. Hence, we can conclude that in Muktsar district the ex-situ technology ie. Baler is more evident rather than other technologies.

REFERENCES

Erenstein, O. 2011. Cropping systems and crop residue management in the Trans-Gangetic Plains: Issues and challenges for conservation agriculture from village surveys. *Agricultural Systems,* 104: 54-62. Available at: https://ideas.repec.org/a/eee/agisys/v104y2011i1p54-62.html.

Gupta, A.; P. Singh; G. Singh; B.S. Sekhon and G.P.S. Sodhi. 2021. On Farm Testing of Rice Residue Management Techniques for Wheat (*Triticum aestivum* L.) Establishment in Punjab. *Indian Journal of Extension Education*, 57 (4): 1-4.

Singh, B.; Y.H. Shan; S.E. Johnson-Beebout; Y. Singh and R.J. Buresh. 2008. Crop residue management for lowland rice-based cropping systems in Asia. *Advances in Agronomy*, 98: 117-187.

Singh, G.; A. Sharma and D. Tiwari. 2017. Socio-economic viability of baler for baling paddy straw: A Case Study. *Agricultural Engineering*, XLII (3): 1-8.

Singh, G.; P. Singh; G.P.S. Sodhi and D. Tiwari. 2020. Adoption status of rice residue management technologies in south-western Punjab. *Indian Journal of Extension Education*, 56(3): 76-82.

Singh, T.; M. Kaur and G. Singh. 2021. Extent of Adoption of Happy Seeder Technology among the Farmers of Punjab (India). *Indian Journal of Extension Education*, 57(4): 75-79.

Singh, Y. and H.S. Sidhu. 2014. Management of Cereal Crop Residues for Sustainable Rice-wheat Production System in the Indo-Gangetic Plains of India. *Proceeding of Indian National Science Academy,* 80(1): 95-114.

Received on April 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 393-397

Scheme for Promotion of Innovation, Rural Industry and Entrepreneurship (ASPIRE): An Initiative Towards Start up

Jamyang Lahmo[1]* and Poonam Parihar[2]
[1]Ph.D Scholar and [2]Assistant Professor Division of Agricultural Extension Education, SKUAST- Jammu, J&K

ABSTRACT

India has a particularly large agricultural sector even now, majority of India's population is over-reliant on agriculture business. Despite the fact the government has implemented number of creative programs; poverty and unemployment continue to exist in the country. To withstand this, the government launched the ASPIRE scheme, which aims to create jobs and business in the agricultural sector. The scheme is promoted by the Ministry of Micro, Small and Medium Enterprise (MoMSE). A scheme for promotion of innovation, Rural Industries and Entpreneurship (ASPIRE) is an initiative by the government of India on 16th March 2015. ASPIRE was established to establish a network of technology centres and incubation centres in order to accelerate entrepreneurship and support start ups in the agricultural business. The various benefits of ASPIRE scheme are Adding value to agricultural and forest products, Agricultural techniques and operations that are related to them are being automated, Agricultural pre/post harvest waste recycling, off-farm yet farm-connected animal husbandry and so on, Business models that create local jobs in rural locations as well as business concepts that have a social impact.

Keywords: Entrepreneurship, Innovation, Agricultural business, Start up and unemployment

INTRODUCTION

India's most valuable asset is the youth population which is the largest inn the world. As youth population is the key factor that is expected to propel economic growth, there has been a greater push to develop skills and improve livelihood opportunities. The government through several measures has been focusing on empowering and skilling youth. With the constantly rising influence of globalization, India has immense opportunities to establish its distinctive position in the world due to its young work force. If, the youth of India given an opportunity to show their metal through educating them in some skills, it will deciding progress. With 20 agri-climatic regions, all the 15 major climates in the world exist in India. The country also has 46 of the 60 soil types in the world. India is the largest producer of spices, pulses, milk, tea, cashew, and jute, and the second largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton, and oilseeds. Further, India is second in the global production of fruits and vegetables and is the largest producer of mango and banana. In India, the majority of the population is dependent on the agriculture industry even to this day. The Government introduced many schemes with innovative initiatives, yet poverty and unemployment problems prevail across the country. To curb this, the Government launched this scheme to generate employment and set up enterprises in the agriculture industry.

ASPIRE –SCHEME FOR PROMOTION OF INNOVATION, RURAL INDUSTRIES AND ENTRPRENEURSHIP

ASPIRE (Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship) was launched in 2015 to provide knowledge to the entrepreneurs for starting up their businesses and becoming job providers. It is major scheme under MSME. It was introduced to create new jobs and promote start-up enterprises for innovation in rural areas and traditional agro-industries. ASPIRE is an initiative of Government of India and

*Corresponding author email id: lamojamyang@gmail.com

promoted by the Ministry of Micro, Small and Medium Enterprises (MSME). It was launched to set up incubation centres and network of technology centres for enhancing entrepreneurship across India. It seeks to promote start-ups for innovation in the agro-industry. It was established to establish a network of technology centers and incubation centers in order to accelerate entrepreneurship and support start-ups in the agricultural business. He also proposed putting in place a program to facilitate forward and backward linkages with multiple manufacturing and service delivery chains. Furthermore, he also proposed to launch a nationwide "District level Incubation and Accelerator Program". The intent of these initiatives will be to incubate new ideas and provide necessary support for accelerating entrepreneurship. ASPIRE is aimed to give the required skill set for entrepreneurs to start businesses, as well as to enable market linkages and provide hand holding for a key period to achieve self-sustainability.

OBJECTIVES OF THE SCHEME

1. To organize the traditional industries and artisans into clusters in order to make them competitive and provide support for their long term sustainability.
2. To provide sustained employment for traditional industry artisans and rural entrepreneurs
3. To enhance marketability of products of such clusters by providing support for new products , design intervention and improved packaging and also the improvement of marketing infrastructures.
4. To equip traditional artisans of the associated clusters with the improved skills and capabilities through training and exposure visits.
5. Promoting of entrepreneurship culture in India
6. Facilitating innovative business solutions for meeting the social needs of the people.

COMPONENTS OF ASPIRE SCHME

Livelihood Business Incubators (LBI): The main aim/objective of LBIs is to create job opportunities at the local level & reduce the unemployment rate by creating a favorable ecosystem for entrepreneurship in our country. The primary focus area under LBI is to take up those commercial activities that are need-based and help create enterprises in the country's rural areas

The most crucial component is to establish Livelihood Business Incubators (LBI). The LBI will be established within the National Small Industries Corporation (NSIC), KVIC or Coir Board, or any other GOI or State Govt. institution or agency. These agencies will replicate the successful "Rapid Incubation Model" of the NSIC. The rapid incubation methodology combines "entrepreneurship promotion and skill development" with the creation of actual "demo projects. Hackett and Dilts (2004) define an incubator as 'a shared office space facility that seeks to provide its incubates with a strategic, value adding intervention system (i.e. business incubation) of monitor. The International Business Incubation Association (InBIA), the global association of incubators, defines incubation as, 'a business support process that accelerates the successful development of startup and fledgling companies by providing entrepreneurs with an array of targeted resources and services...a business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding.

The institutions, namely: NSIC, KVIC, or Coir Board, or any other institution/agency of the GOI/ State Govt., can also set up livelihood incubation centres under the PPP mode. The establishment under PPP mode will be with the institutions, namely: NSIC, KVIC, or Coir Board, or any other institution/agency of the GOI/State Govt.

Objectives of Livelihood Business Incubators (LBI) under ASPIRE Scheme

1. To establish business incubators where qualified kids can be effectively trained in various professions and given the opportunity to start their own businesses;
2. To provide youngsters with entrepreneurship and skill development courses.
3. To give coaching and support, as well as finance facilitation, in order to empower people to start their own businesses.
4. To encourage the development of new low-end-technology/livelihood-based businesses.

Technology Business Incubators (TBI): The next important component under the ASPIRE Scheme is to establish Technology Business Incubators (TBI). The

Technology Business Incubators (TBI) must be established at two levels.

The first level will be set-up to support existing incubation centers currently operated under various agencies. Such agencies are Ministries and Departments of the Government of India or Institutions including National/ Regional level institutions of the GOI / State Governments. These centers will be dedicated to incubation and enterprise creation in the area of Agro-based Industries.

The second level will be the set-up of a new incubation centre. This centre will be set up by e-Government. Incubation Centers will be promoted based on region, crop, product, process, and industry vertical.

Objectives of Technology Business Incubators (TBI) Under ASPIRE Scheme

- In order to incubate creative ideas or technology in the agro-based industry, technology-based incubators will be established.
- Technology Commercialization: to establish a platform for the rapid commercialization of innovations developed at the host institution or at any other academic or R&D institution in the country.
- Interfacing and Networking: to connect academics, business, and financial institutions through networking.
- Value Addition: Provide incubates with value-added services such as legal, financial, technical, IPR, and so on.
- To encourage the formation of innovative technology or knowledge-based businesses.

Small Industries Development Bank of India (SIDBI): The final important component under the ASPIRE Scheme is to establish a framework for Start-up Promotion through the Small Industries Development Bank of India (SIDBI). This must be done by utilizing innovative forms of finance such as equity, quasi-equity, angel funds, venture capital funds, impact funds, challenge funds, and others. The aim must be to enable ideas or innovations with creativity and scalability to emerge. Such ideas must be converted into commercial enterprise outcomes within a set time frame. SIDBI would establish a fund of funds for the purpose, with Rs. 60 crore set aside.

Objectives of Small Industries Development Bank of India (SIDBI) Under ASPIRE Scheme

1. Small Industries Development Bank of India (SIDBI) has used new instruments which support Angel funds and other venture capital funds. Such instruments are equity, quasi-equity, mezzanine debt, and other debt instruments. These instruments are both directly and indirectly through its fund of fund activities,
2. The SIDBI standards for the funds focus on adding value to the rural economy and creating jobs through social impact funding. With SIDBI's aid, ideas or innovations with inventiveness and scalability can come to the fore. Additionally, entrepreneurs can turn these ideas into commercial enterprises with precise objectives and deadlines.
3. In terms of timetables for SIDBI to set up a fund of funds, it would be prudent to consider a timeline of 7-9 years. Such a timeline will allow the SIDBI to adequately leverage the Funds.

The SIDBI standards for the funds focus on adding value to the rural economy and creating jobs through social impact funding. Along with 'quasi-equity' and 'convertible-equity,''venture debt' might be one of the essential components of the fund of funds for this plan. SIDBI money can truly boost the rural sector to fill the gap because there is so much room for mechanization in the rural economy.

Annual Report 2021-22 revealed: Till 31.12.2021, 102 LBIs and 22 TBIS have been approved, of which 54 LBIs and 9 TBIs are already functional.

- 50,572 persons have been trained in LBIs, of whom 14428 persons are self-employed and 8236 persons have been employed in other units.
- 5 LBIs are proposed to be approved in 2021-22

***Role of ASPIRE Scheme in Agricultural Entrepreneurship*:** ASPIRE Scheme acts as a driving factor for the Agriculture sector reforms. The agriculture sector provides food for approximately 1.3 million people in India and supports over 60 percent of their daily living. The Agricultural industry plays an essential role in the sustainable growth of the country's economy. Initially, agriculture got looked down on as a low-tech industry with limited dynamics, primarily controlled by many small families. Over the years, it paid attention to improving crop yield rather than looking at it as a money-making module.

Due to the prime importance of the Agricultural sector in our Nation, there is a need to bring transformation by efficient schemes and tools. They need to consider their agriculture as their businesses. Entrepreneurship must be encouraged in agriculture as innovation would help farmers improve crop productivity and create new avenues for rural youth.

Entrepreneurship under ASPIRE scheme involves entrepreneurial skills, models, and innovative ideas. The scheme mitigates issues in the farm sector and increases its profitability with sustainable, community-oriented, legitimate farm practices. It is not just an opportunity but an imperative to achieve the Government's target of doubling agriculture income by 2022 by integrating the latest technology & innovation.

Agriculture entrepreneurship can help face information dissemination, farm management, capital availability, mechanization of farms, and the agriculture supply chain. There are some successful examples of transforming agriculture practices with technology in the US, China, and Israel.

Agri-tech start-ups have many opportunities to solve critical farm-related challenges. These opportunities range from availing a fair price to the farmer to many other yield estimation mechanisms. The Agricultural Entrepreneurship is useful for farmers to boost productivity by removing inefficiencies.

Agricultural entrepreneurship acts as a stepping stone to success for small entrepreneurs. The ASPIRE scheme plays an active role in motivating many rural people to take up Agricultural entrepreneurship considering its scope. The Global Innovation Index 2021 ranks India 46 out of 132 countries in innovation performance. India performs better in innovation outputs than innovation inputs in 2021, accelerating entrepreneurship based on innovation is crucial for India.

Eligibility for ASPIRE Scheme

1. Any entrepreneur who intends to set up start-ups.
2 Any technical/university/research institutes including those in the field of rural and agro-based industry.
3 All MSMEs with Entrepreneurs Memorandum Registration.

Any institute/agency under the Government of India or any State Government in the field of technology, business management, rural development and entrepreneur development or anybody corporate under Public-Private Partnership (PPP) mode can set up Livelihood Business Incubation (LBI).

Any existing incubation centres operating under different Ministries and Departments of Government of India and institutions which include National/Regional level institutions of Government of India or any State Government for setting up centres dedicated to incubation and enterprise creation in the area of agro-based industries. SIDBI, in cooperation with the Ministry, will establish a competent monitoring mechanism for the Fund's operation and administration.

Benefits of the ASPIRE Scheme

- Agricultural techniques and operations that are related to them are being automated.
- Adding value to agricultural and forest products
- Agricultural pre/post-harvest waste recycling, off-farm yet farm-connected animal husbandry, and so on,
- Rural-relevant business models for aggregation and value addition

Business models that create local jobs in rural locations, as well as business concepts that have a social impact

CONCLUSION

There is more need of government intervention and policies to encourage these kind of schemes in various sectors and raise the employability through various short term, long term and vocational courses. Although the need for entrepreneurship development initiative is understood and realized by many sectors still there are few sectors where awareness needs to be created. The age group available to Indian economy is more influenced toward the learning traditional concept, if skilled can contribute to make the economy stronger instead of becoming the liability.

REFERENCES

Annual Report MSME 2021-22, Ministry of Micro, Small Medium enterprise, government of India.

Global Innovation Index 2021. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2021/in.pdf

https://aspire.msme.gov.in/ASPIRE/AFHome.aspx

www.msme.gov.in

www.msmedatabank.in

www.udyogaadhar.gov.in

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 398-407

Climate Change Threatens the Blue Economy, Food Millions of People Rely On?

Akhil Gupta[1]*, Prem Kumar[2] and J.P. Sharma[3]
[1]Associate Professor (Fisheries), Fisheries Unit, SKUAST Jammu, Chatha, UT of J&K
[2]Scientist, KVK Jammu, R S Pura, SKUAST Jammu, UT of J&K
[3]Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha, J&K

ABSTRACT

The world's already overtaxed fisheries are being stressed to their limits by climate change, putting at risk a critical component of the world's diet. As temperatures rise, fish populations are projected to plummet and disappear in some regions, especially in the tropics. More than 3 billion people depend on fish as a major source of protein. By the end of the century, a quarter of the sustainable fish catch could be gone (Gustin Georgina, 2019). In a major report published Sept. 25, 2019 by the United Nations' Intergovernmental Panel on Climate Change, scientists examined the interconnected web of the planet's oceans and icy landscapes, delivering a series of grim projections on the chaotic impact of climate change on super-charged storms, rising seas and the ecosystems that sea life depends on. They also looked at the consequences for global diets and the role oceans play in feeding the world. Fisheries are often overlooked when researchers and policymakers focus on land-based agriculture as the primary food source for a growing global population, yet fish are an essential protein source for 3.2 billion people and provide 17 percent of the world's animal protein. They're especially important in some developing tropical countries that rely on fish for 70 percent of their nutrition (Gustin Georgina 2019). The changes in the oceans will have direct impacts on people who are depending on these systems for food. The scientists determined that the sustainable fish catch—the amount of fish that can be caught without decimating populations—could drop by as much as a quarter by the end of the century if greenhouse gas emissions continue on their current trajectory.

Keywords: Blue economy, Climate change, Food millions, Threatens

INTRODUCTION

Climate change is no longer simply a potential threat but it is unavoidable and is a consequence of 200 years of excessive greenhouse gas (GHG) emissions from fossil fuel combustion in energy generation, transport and industry, deforestation and intensive agriculture (IPCC, 2007a). Small-scale fisheries and aquaculture have contributed little to the causes of climate change but will be amongst the first sectors to feel its impacts. Some anticipated consequences include falling productivity, species migration and localized extinctions, as well as conflict over use of scarce resources and increased risks associated with more extreme climatic events such as hurricanes. These result from direct impacts on fish themselves as well as from impacts on the ecosystems on which they depend, such as coral reefs. In general, the consequences of climate change will be negative for fishers at low latitudes. In contrast, fish farmers may benefit from expansion of the areas where aquaculture is viable due to increased temperatures and rising sea levels. However, these benefits may be tempered by reduced water quality and availability, increased disease incidence and damage to freshwater aquaculture by salinization of groundwater. The precise and localized impacts of climate change on fisheries are, however, still poorly understood (FAO, 2008a; Stern, 2007).

Global Fisheries Scenario

Fisheries play a critical role in local and global **aquatic food systems**. From seaweeds and sea cucumbers to

*Corresponding author email id: drakhilgupta777@gmail.com

crustaceans and fish, the vast range of **aquatic foods** harvested from fisheries contributes to resilient, sustainable, and diverse diets and income streams from the associated trading and processing activities of the value chain. Globally, the sector employs **120 million people**. Of these, 97 percent live in developing countries, and 90 percent work in small-scale fisheries. According of the State of World Fisheries and Aquaculture (FAO 2020), total world fisheries and aquaculture production has reached to 178.5 million metric ton (mt) collectively including 96.4 mt from capture fisheries and 82.1 mt from aquaculture (Figure 1) during 2018.

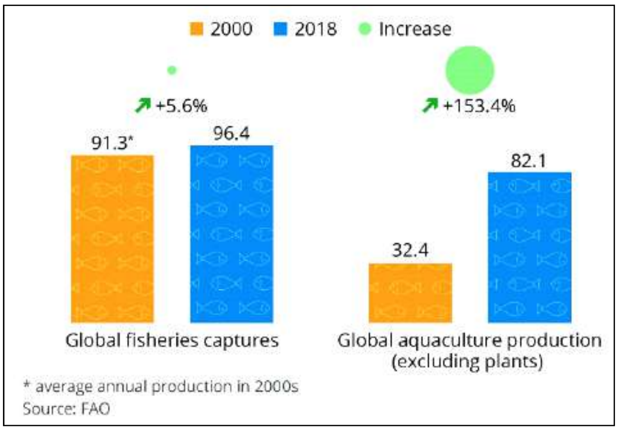


Figure 1: World fisheries and aquaculture production (in million tonnes)

However, the diverse, dispersed, and often informal nature of their work makes measuring these contributions difficult. We need to make sure the voices of fishers are heard and recognized. Currently, fishing communities around the world are dealing with the impacts of the COVID-19 pandemic such as market disruptions and shut-downs that severely impact incomes, food availability, and affordability and thus affecting the entire food system and the livelihoods it supports. The fisheries scientists, with the support of State and Union government through different projects, schemes and extension work, are making efforts to understand and create solutions to improve the productivity, resilience, and sustainability of small-scale fisheries.

Indian Fisheries Scenario

In India, owing to its massive coastline of over 8,000 km and a vast network of rivers, fisheries have always played a significant role in India's economy. Currently,

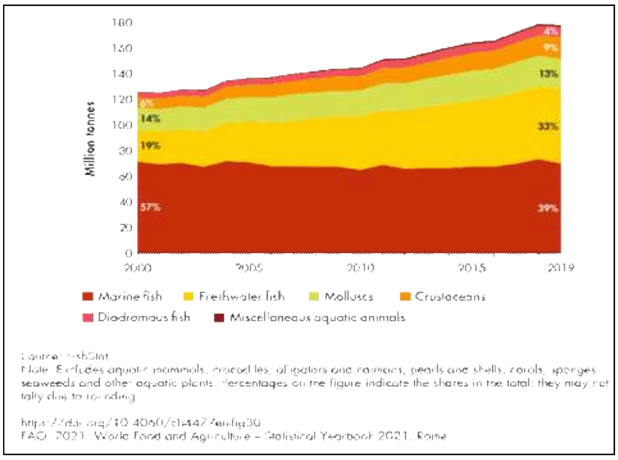


Figure 2: World Capture fisheries and aquaculture production by species group

this sector provides livelihood to more than 2.8 crore people within the country. Nevertheless, this is a sector with untapped potential. The Economic Survey of India, 2019-20 estimated that, only 58% of the country's inland potential has been tapped so far. The present budget has taken effective steps towards addressing the challenges and optimizing the potential of this sector. Despite challenges pertaining to infrastructure, the measures by the Central government in the past six years ensured that fisheries sector continued to register an annual growth rate of more than10 percent. In 2019-20, with an overall production of 142 lakh tons, India produced 8% of the global share (Figure 3 & 4). During the same time period, India's fisheries exports stood at Rs 46,662 crore, constituting about 18% of India's agricultural exports. In keeping with our Sustainable Development Goals (SDG)-effective governance of 'Blue Economy' would mean striking a balance between effectively utilizing fisheries to meet consumer demands and sustain livelihoods of fishing communities on one hand and preserving the ecosystem on the other. The Centre through its schemes envisions leveraging an investment of more than Rs. 50,000 crore in the next five years that includes contributions from states, beneficiaries, and financial institutions.

The recently concluded Blue Revolution Scheme launched in 2015-16 with Rs 3000 crore outlay, for over five years, made vital contributions towards the sector's development. To address the critical gaps in fisheries infrastructure, the government created the Fisheries and Aquaculture Infrastructure Development Fund in 2018-19 with an outlay of Rs. 7,522 crore.

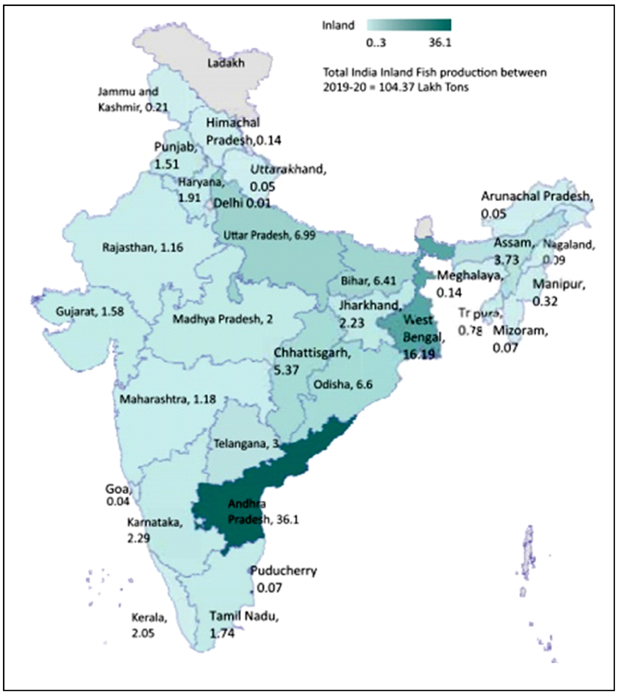


Figure 3: Inland fish production State wise during 2019-20 (in lakh tonnes)

(*Source*: Department of Fisheries, Union Ministry of Fisheries, Animal Husbandry and Dairying)

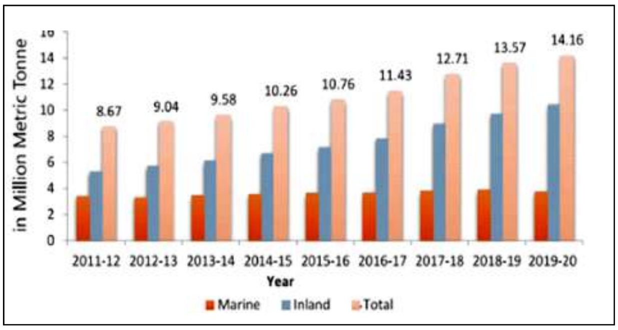


Figure 4: Fish production of India during 2019-20

The Covid-19 pandemic has resulted in a looming crisis for the global and Indian economies. The ongoing pandemic has created a prolonged health crisis. Economic activity was slowing prior to the pandemic. Three COVID-19 waves have resulted in a deep and broad-based economic downturn with the potential for a longer lasting impact. One of the most serious impacts is expected to be on food security.

Importance of Fisheries and Aquaculture

Livelihood: The livelihoods of 520 million people depend on fisheries and aquaculture (FAO, 2009a), 98% of whom live in developing countries (World Bank, 2005). FAO data reported by the World Bank (2005) indicates that the number of fishers in the world has grown by 400% since 1950, compared with a 35% increase in the number of agricultural workers over the same period. Most of the growth has been in small-scale fisheries in the developing world. It is likely that more poor people will turn to fishing and other common-pool resources in future as a result of the negative impacts of climate change on agriculture and other sectors.

Trade: Fish is the most widely traded foodstuff in the world: 37% of fish produced (live weight equivalent) is traded internationally (FAO, 2009a). In 2006 exports of fish were worth a total of $85.9 billion (FAO, 2009a), more than half of which originated in developing countries (Paquotte and Lem, 2008). In 2002, net exports of fish generated more foreign exchange earnings for developing countries than rice, coffee, sugar, and tea combined (World Bank, 2005). Aquaculture has grown by 6.9% per annum since 1970 (FAO, 2009a) and now provides half of global fish supply (Naylor *et al.*, 2009). As global demand continues to grow, there are opportunities for poverty reduction within the sector if supplies of wild fish can be maintained and aquaculture expanded sustainably.

Health and nutrition: One third of the world's population rely on fish and other aquatic products for at least 20% of their protein intake (Dulvy and Allison, 2009) and fish provides more than 50% of all the protein and minerals consumed by 400 million of the world's poorest people (MAB, 2009) and is also an important source of other nutrients such as vitamins A, B and D, calcium, iron and iodine (FAO, 2005). Even in small quantities, fish can have a positive effect on nutritional status by providing essential amino acids that are deficient in staple foods such as rice or cassava. Fish accounts for 30% of animal protein consumed in Asia, 20% in Africa and 10% in Latin America and the Caribbean (Prein and Ahmed, 2000). It is thus central to the food security of many of the world's poor, especially in coastal areas and small Island developing states.

Impact of Climate Change on Fisheries

The links between fisheries and their ecosystems are deeper and more significant than those that exist in mainstream agriculture (FAO, 2008b). The productivity of a fishery is tied to the health and functioning of the ecosystems on which it depends for food, habitat and even seed dispersal (MAB, 2009); generally, the only control humans can exert over a fishery's productivity is adjustment of fishing effort (Brander, 2007). Estuaries, mangroves, coral reefs and seagrass beds are particularly significant in the provision of ecosystem services, especially as nurseries for young fish, and are also amongst the most sensitive and highly exposed to the negative impacts of coastal development, pollution, sedimentation, destructive fishing practices and climate change. Fish also tend to live near their tolerance limits of a range of factors; as a result, increased temperature and acidity, lower dissolved oxygen and changes to salinity can have deleterious effects (Roessig *et al.*, 2004). Particular characteristics of the aquatic environment which will be affected by climate change are temperature and primary production.

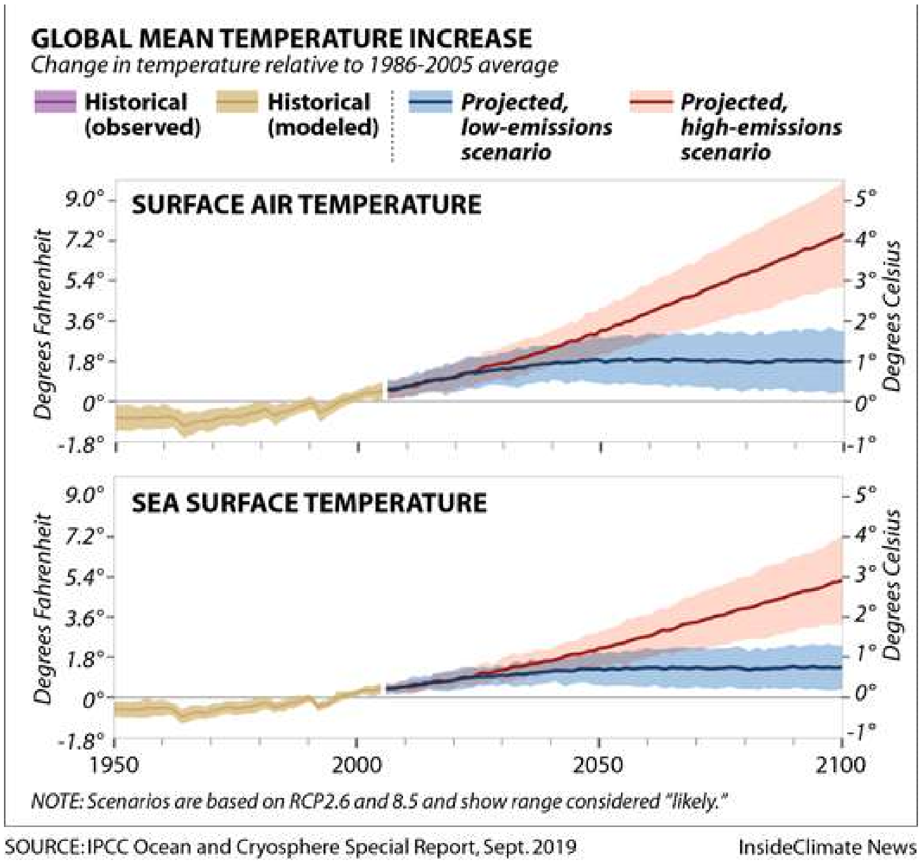
***Change in temperature of fish environment*:** All marine and aquatic invertebrates (molluscs, crustaceans, worms etc.) and fish are poikilotherms; their internal temperature varies directly with that of their environment. This makes them very sensitive to changes in the temperature of their surrounding environment. When changes do occur they move to areas where the external temperature allows them to regain their preferred internal temperature. This "behavioural thermoregulation" (Roessig *et al.*, 2004) is resulting in rapid migrations poleward or into cooler bodies of water (FAO, 2008a), corresponding to the poleward shift of climatic zones. As a result, benefits are likely to accrue at higher latitudes and losses will be experienced in the tropics. Some species will also shift from shallow coastal waters and semi-enclosed areas, where temperatures will increase fastest, into deeper cooler waters (Cheung *et al.*, 2009a). Recent predictions suggest this migration alone could reduce maximum catch potential in some areas of the tropics by up to 40% (Cheung *et al.*, 2010), but this may be a conservative estimate as it does not take into account predicted negative effects of climate change on coral reefs or the impact of ocean acidification (Cheung *et al.*, 2009b). Recruitment is also strongly affected by climate variability (Walther *et al.*, 2002) and some stocks may become vulnerable to overfishing at levels of fishing effort that had previously been sustainable (Easterling *et al.*, 2007).

Where fish continue to inhabit warming bodies of water the increases in temperature will increase their metabolic rate slowing growth and reducing maximum size (Roessig *et al.*, 2004). There are likely to be local extinctions of fish species at the edges of their ranges, especially among freshwater and diadromous species (IPCC, 2007a). However, overall extinction rates for marine species are lower than those predicted for terrestrial species (15–37%), in part due to their higher potential for migration (Cheung *et al.*, 2009b). As mentioned above, a 1–3°C temperature rise (Fig 5) relative to 1990–2000 would result in the bleaching and possible death of most of the world's coral reefs (IPCC, 2007a). This would have serious negative effects on coastal reef fisheries. It would also increase the risk of Ciguatera, a form of poisoning contracted by eating fish that have grazed on the toxic algae that grow on dead coral reefs (IPCC, 2007a).

Temperature increase reduces oxygen content: Ocean warming as a consequence of climate change is no longer a hypothesis but can now be considered a reality. The average temperature of the world's oceans at the surface rose by 0.7° C in the second half of the nineteenth century. Because relatively warmer water can absorb less oxygen climatic warming also reduces the oxygen concentration in the open sea. Based on calculations by climate researchers the oxygen content of the oceans could decrease by one to seven per cent by the end of this century – depending on the region. The effects on marine ecosystems and local species communities are at present difficult to predict. There could be spatial population shifts which would alter or destroy traditional food chains. If oxygen is lacking at the water's surface this also affects communities living at greater depths. During recent decades, the number and extent of low-oxygen zones on the seabed has increased. A reduced oxygen concentration within the water can already have a detrimental effect on fishing yields because oxygen dependent species usually leave such areas quickly (http://eurofish.dk). The remaining species that are more tolerant of oxygen deficiencies and can cope better with the changed conditions are then often subject to greater pressure from predators and are depleted at an above average rate.

Acidification a threat to the development of organisms: It is particularly worrying that the speed of the acidification process is today over one hundred

Figure 5: Global average air and sea surface temperature (Source: IPCC Ocean and Cryosphere Special Report, 2019)



times faster than in the last 65 million years. Since the beginning of the industrial age the pH value of the oceans has fallen by 0.1 units which is approximately equivalent to a 30% increase in the degree of acidity (pH value is a logarithmic measure). Due to the acidification of the seas it is increasingly difficult for calcareous organisms such as corals, mussels, crabs or numerous plankton species to build up robust skeletal structures (http://eurofish.dk). The ecological consequences of acidification are alarming. It endangers not only the continuity and growth of the coral reefs, the most species-rich ecosystems of the oceans, but also the survival of numerous plankton organisms, many of which are calcareous species. And with that an important element in the marine food web which serves as the first food for many fish larvae is in danger of being lost. Fishes, particularly during earlier development stages, can also be damaged directly by acidification which can, for example, cause tissue damage in cod larvae.

Climate change shifts the distribution boundaries of fish species: The impact of climate change on fish stocks is already noticeable in some regions, usually as a shift in distribution boundaries when for example a species that likes warmth suddenly moves into temperate latitudes. The rise in water temperature causes fish species that one would otherwise sooner expect to find in more southern marine regions to migrate to the North Sea. Examples of this are striped red mullet, gurnard or Norway lobster. Some species do not only migrate there for the summer but can now even live permanently in the North Sea because the winters there are milder than in the past. Climate change does not only shift distribution boundaries of individual fish species, however, but also influences the drifting of fish larvae, growth and survival rates, and the linking of regional populations. Some species communities and ecosystems could benefit because the immigration of new species will raise biological diversity in the short term. Others will perhaps be harmed because the competitive conditions between the different species will change. It is almost impossible to predict all the consequences of climate related structural changes within the marine food webs (http://eurofish.dk).

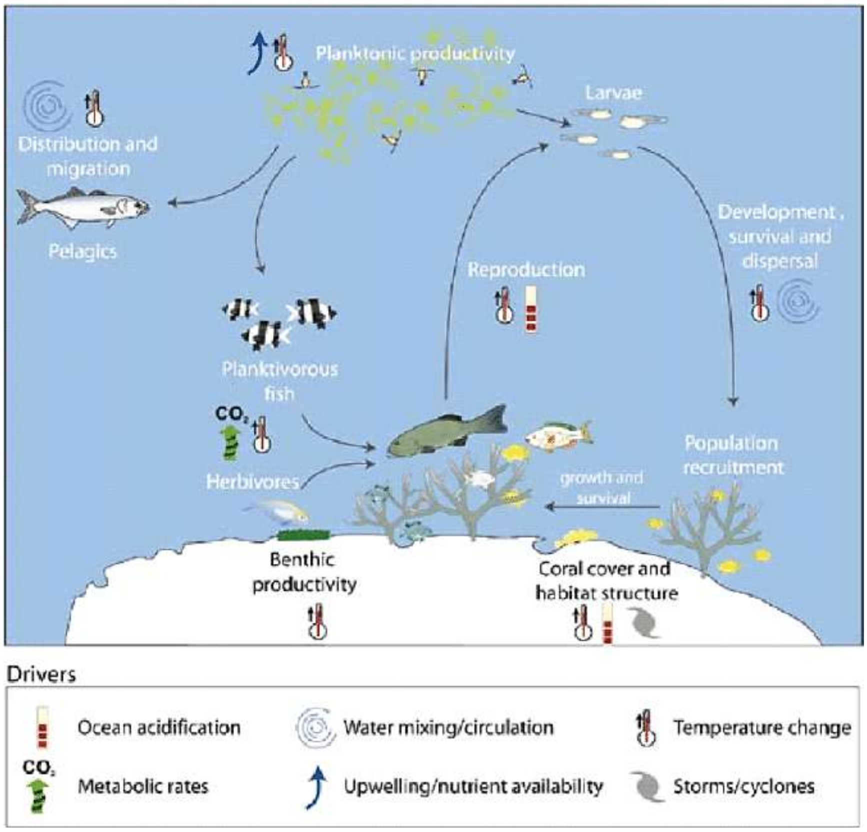
Climate change effect on primary production: Primary productivity is affected by availability of nutrients in the water, which in turn depends on freshwater run-off and ocean mixing as well as levels of light and temperature. In some areas reduced precipitation could lead to reduced run-off from land, starving wetlands and mangroves of nutrients and damaging local fisheries. In other areas increased precipitation or increased extreme weather events, including flooding, will lead to excessive nutrient levels in rivers, lakes and coastal waters as sewage and fertilizer is washed into water bodies causing harmful algal blooms, also known as red tides (Roessig *et al.*, 2004; Epstein, 2000). With climate change primary productivity is predicted to decline at lower latitudes (FAO, 2008a), where the majority of the world's small-scale fisheries are located, reducing the productivity of the fisheries.

Direct and indirect effects of climate change on distribution, productivity, and extinction: Climate change has both direct and indirect impacts on fish stocks that are exploited commercially. Direct effects act on physiology and behaviour and alter growth, development, reproductive capacity, mortality, and distribution (Figure 6). Indirect effects alter the productivity, structure, and composition of the ecosystems on which fish depend for food and shelter. The effects of increasing temperature on marine and freshwater ecosystems are already evident, with rapid poleward shifts in distributions of fish and plankton in regions such as the North East Atlantic, where temperature change has been rapid. Further changes in distribution and productivity are expected due to continuing warming and freshening of the Arctic. Some of the changes are expected to have positive consequences for fish production, but in other cases reproductive capacity is reduced and stocks become vulnerable to levels of fishing that had previously been sustainable. Local extinctions are occurring at the edges of current ranges, particularly in freshwater and diadromous species such as salmon and sturgeon.

Threats to Inland Fisheries and Aquaculture

Many inland fisheries are threatened by alterations to water regimes that, in extreme cases, cause whole lakes and waterways to disappear. Climate change has direct effects, through reduced precipitation and greater evaporation, and indirect effects when more water is used for irrigation to offset reduced precipitation.

Figure 6: Image showing different ways climate change can influence fish populations and communities through a range of direct and indirect effects on different life stages
(*Source:* Geoffrey P Jones et al 2007; https://www.researchgate.net/publication/239535156)



Threats to aquaculture arise from

- stress due to increased temperature and oxygen demand and decreased pH,
- uncertain future water supply,
- extreme weather events,
- increased frequency of diseases and toxic events,
- sea level rise and conflict of interest with coastal defences, and
- an uncertain future supply of fishmeal and oils from capture fisheries.

Aquaculture poses some additional threats to capture fisheries, and the development of aquaculture could affect the resilience of capture fisheries in the face of climate change. There will also be some positive effects due to increased growth rates and food conversion efficiencies, longer growing season, range expansion, and the use of new areas as a result of decrease in ice cover.

Future Fish Production

The quantity of future fish production depends on changes in NPP and on what proportion is transferred through the marine ecosystem to human consumption. Because there are considerable uncertainties about both of these factors, very low confidence can be placed in current predictions of future fish production. Regional and local forecasts may be more reliable than the global forecast because of special factors (such as loss of ice cover in high latitudes, which will allow greater light penetration). Some recent observation-based studies found that NPP has been declining, particularly in low latitudes, because of increased warming of the surface layers, which increases stratification and reduces nutrient mixing from depth. The scientific base is improving rapidly, as is evident from the very recent dating of key publications cited here, but we are some way from achieving a reliable consensus.

The examples of observed climate impacts cited above show changes in distribution and abundance of particular species, but because species are often replaced by functionally similar species, the net effect on trophic structure and fish production may be small. It is generally difficult to predict the changes in trophic structure and composition of ecosystems, therefore one simplifying assumption is that such functional replacement always occurs and that fish production is proportional to NPP. A second possible approach is to study the impacts of climate on fish communities rather than at the individual-species level. The rising proportion of aquaculture in global fisheries production will increasingly determine the trophic structure of fisheries; however, aquaculture is likely to remain dependent on capture fisheries for its food supply.

CONCLUSION

The effects of climate change are still only beginning to be felt in the fishing and aquaculture sectors. However, the rapid changes in chemical, physical and biological conditions in the aquatic environments will probably become more and more apparent in the coming years. A general forecast is currently difficult but, according to experts, from a global viewpoint the impact on fisheries and aquaculture is likely to be negative, and regionally, perhaps even severe. Even if it is possible to limit global warming to 2 degrees above the preindustrial level by 2050 (which many climate experts in the meantime doubt) based on calculations of the Intergovernmental Panel on Climate Change (IPCC) annual losses of 17 to 41 billion US dollars can be expected. There are at present no visible signs of any determination to halt climate change by means of resolute, uniform action. And so, it is all the more urgent that we prepare for the consequences of the coming changes and push forward the transition to sustainable fishing. While better monitoring and management of fish stocks do not stop climate change, they can at least limit some of the non-climatic problems facing the seas. The problem of climate change is additionally exacerbated by other anthropogenic factors such as increasing habitat loss, marine pollution, and overfishing. And there is not much time left for decisive action.

At low latitudes these are likely to be largely negative for fisheries, damaging important ecosystems such as coral reefs and mangroves and causing reductions in fish stocks due to rising water temperatures and reduced primary production. This could have significant effects on food security and employment in areas dependent on fisheries that are particularly vulnerable to the impacts of climate change; these include reef fisheries, fisheries in shallow lakes or wetlands and fisheries in other enclosed or semi-enclosed bodies of water. However, some areas may experience localized increases in fish stocks due to in-migration of species from other areas and rising primary production. Brackish and saltwater aquaculture could benefit from rising sea levels and freshwater aquaculture in cooler regions could benefit from increased feed efficiency and reduced cold water mortality, though reductions in availability of wild fish for feed and seed, increased spread of disease and reduced water quality pose threats. Responses to these changes must centre on boosting adaptive capacity and resilience both of communities and the ecosystems on which they depend. The heavy dependency of small scale fishers and fish-farmers in developing countries on ecosystem services must be recognized and measures taken to increase the health of these ecosystems by reducing other stresses such as over-exploitation and pollution. Communities themselves must be strengthened through provision of services such as insurance and weather warnings to reduce risk, support for participatory natural resource management and sustainable fishing operations, and assistance in post-harvest processing and preservation to maximize value-added and employment and minimize waste from both fisheries and aquaculture.

Adaptation in the fisheries sector need not be restricted to altering catch size and effort (Easterling *et al.* 2007). Numerous options are available, many focusing on building adaptive capacity and resilience, and many also contributing to additional goals of improved fisheries management and poverty reduction, improving the livelihoods of those poor rural people most at risk from the effects of climate change.

REFERENCES

Allison, E.H. and Ellis, F. (2001) The livelihoods approach and management of small-scale fisheries. Marine Policy 25, 377–388.

Allison, E.H., Andrew, N.L. and Oliver, J. (2007) Enhancing the resilience of inland fisheries and aquaculture systems to climate change. Journal of Semi-Arid Tropical Agricultural Research 4(1).

Allison, E.H., Perry, A.L., Badjeck, M.-C.*et al.* (2009) Vulnerability of national economies to the impacts of climate change on fisheries. Fish and Fisheries 10(2), 173–196.

Brander, K.M. (2007) Global fish production and climate change. Proceedings of the National Academy of Sciences 104(50), 19704–19714.

Cheung, W.W.L., Lam, V.W.Y, Sarmiento, J.L., Kearney, K., Watson, R. and Pauly, D. (2009b) Projecting global marine biodiversity impacts under climate change scenarios. Fish and Fisheries 10, 235–251.

Cheung, W.W.L., Lam, V.W.Y., Sarmiento, J. L., Kearney, K., Watson, R., Zeller, D. and Pauly, D. (2009a) Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. Global Change Biology 16, 24–35.

Cheung, W.W.L., Lam, V.W.Y., Sarmiento, J. L., Kearney, K., Watson, R., Zeller, D. and Pauly, D. (2010) Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. Global Change Biology 16, 24–35.

Cruz, R.V., Harasawa, M., Lal, S. *et al.* (2007) Asia. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds. Cambridge University Press, Cambridge, UK, pp. 471–506.

Das, D.N. (2002) Fish farming in rice environments of north eastern India. Aquaculture Asia, 7(2): 43–47.

Diersing, N. (2009) Phytoplankton Blooms: The Basics. Florida Keys National Marine Sanctuary, Key West, Florida, USA, 2 pp.

Dulvy, N. and Allison, E. (2009) A place at the table? Nature Reports Climate Change 3, 68–70.

Eakin, M.C., Kleypas, J. and Hoegh-Guldberg, O. (2008) Global climate change and coral reefs: rising temperatures, acidification and the need for resilient reefs. In: Status of Coral Reefs of the World: 2008 (C. Wilkinson, ed.). Global Coral Reef Monitoring Network and Reef and Rainforest Research Centre, Townsville, Australia, pp. 29–40.

Easterling, W.E., Aggarwal, P.K., Batima, P. *et al.* (2007) Food, fibre and forest products. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds.). Cambridge University Press, Cambridge, UK, pp. 273–313.

Epstein, P.R. (2000) Is global warming harmful to health? Scientific American, August 2000, 50–57.

FAO (2004) Fisheries in irrigation systems of arid Asia. FAO Fisheries Technical Paper No. 430.FAO, Rome, Italy, 150 pp.

FAO (2005) Nutritional elements of fish [web page]. Fisheries and Aquaculture Department, FAO, Rome, Italy.

FAO (2007) Building adaptive capacity to climate change: policies to sustain livelihoods and fisheries. New Directions in Fisheries – A Series of Policy Briefs on Development Issues No. 8. FAO Rome, Italy, 16 pp.

FAO (2008a) Climate change implications for fisheries and aquaculture. In: The State of Fisheries and Aquaculture 2008. FAO, Rome, Italy, pp. 87–91.

FAO (2008b) Climate change for fisheries and aquaculture. Technical background document from the Expert Consultation, 7 to 9 April 2008, FAO, Rome. Paper presented at 'Climate Change, Energy and Food', High-level Conference on Food Security: The challenges of climate change and bioenergy, 3–5 June 2008. Rome, Italy.

FAO (2008c) Options for decision makers. Workshop on Climate Change and Fisheries and Aquaculture, FAO Headquarters, Rome, 7–9 April 2008. FAO, Rome, Italy, 5 pp.

FAO (2009a) The State of World Fisheries and Aquaculture 2008. FAO, Rome, Italy, 176 pp.

FAO (2009b) Climate change implications for fisheries and aquaculture: overview of current scientific knowledge (K. Cochrane, C. De Young, D. Soto and T. Bahri, eds.). FAO Fisheries and Aquaculture Technical Paper No. 530. FAO, Rome, Italy, 212 pp.

Geoffrey P Jones et al 2007; https://www.researchgate.net/publication/239535156

Gustin Georgina 2019. https://insideclimatenews.org/news/29092019/ocean-fish-diet-climate-change-impact-food-ipcc-report-cryosphere/

Hamilton, C. (2009) Is it too late to prevent catastrophic climate change? Lecture to a meeting of the Royal Society of the Arts, Sydney, 21 October 2009. 19 pp.

Haroon, A.K.Y. and Pittman, K.A. (1996) Rice-fish culture: feeding, growth and yield of two size classes of PuntiusgonionotusBleeker and Oreochromis spp. in Bangladesh. Aquaculture 154(3–4), 261–281.

Hoegh-Guldberg, O., Mumby, P.J., Hooten, A.J. *et al.* (2007). Coral reefs under rapid climate change and ocean acidification. Science 318 (5857), 1737–1742.

https://www.eurofishmagazine.com/sections/fisheries/item/106-climate-change-threatens-fisheries-with-immense-losses

IFAD (2007) IFAD Strategic Framework 2007–2010. IFAD, Rome, Italy, 35 pp.

IFAD (2008) Climate Change: A Development Challenge. IFAD, Rome, Italy, 4 pp.

IPCC (2007a) Climate Change 2007: Synthesis Report – Contribution of Working Groups I, II, and III to the Fourth Intergovernmental Panel on Climate Change. Core Writing Team: R.K. Pauchauri and A. Reisinger, eds. IPCC, Geneva, Switzerland, 8 pp.

IPCC (2007b) Summary for policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of the Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (S. Solomon, D. Qin, M. Manning *et al.*, eds.). Cambridge University Press, Cambridge, UK, 22 pp.

MAB (Multi-Agency Brief) (2009). Fisheries and Aquaculture in a Changing Climate. FAO, Rome, Italy, 6 pp.

Magrin, G., Gay García, C., Cruz Choque, D. *et al.* (2007) Latin America. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds.). Cambridge University Press, Cambridge, UK.

Naylor, R.L., Goldburg, R.J., Primavera, J.H. *et al.* (2000). Effect of aquaculture on world fish supplies. Nature 405, 1017–1024.

Naylor, R.L., Hardy, R.W., Bureau, D.P. *et al.* (2009) Feeding aquaculture in an era of finite resources. Proceedings of the National Academy of Sciences 106, 15103–15110.

Neiland, A. E., Madakan, S. P. and Béné, C. 2005. Traditional management systems, poverty and change in the arid zone fisheries of northern Nigeria. Journal of Agrarian Change 5, 117–148.

Nellemann, C., Hain, S. and Alder, J., eds. (2008). In Dead Water: Merging of climate change with pollution, over-harvest, and infestations in the world's fishing grounds. UNEP, Grid-Arendal, Norway, 63 pp.

Nicholls, R.J., Wong, P.P., Burkett, V.R. *et al.* (2007) Coastal systems and low-lying areas. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds.). Cambridge University Press, Cambridge, UK, pp. 315–356.

Paquotte, P. and Lem, A. (2008) Seafood markets and trade: A global perspective and an overview of EU Mediterranean countries. Options Méditerranéenes, Series B 62, 43–55.

PEW. (2009) Redistribution of Fish Catch by Climate Change: A Summary of a New Scientific Analysis: Cheung, W.W.L., Lam, V.W.Y., Sarmiento, J. L., Kearney, K., Watson, R., Zeller, D. and Pauly, D. 2009.

Prein, M. and Ahmed, M. (2000) Integration of aquaculture into smallholder farming systems for improved food security and household nutrition. Food and Nutrition Bulletin 21(4), 466–471.

Prowse, M., Grist, N. and Sourang, C. (2009) Closing the gap between climate adaptation and poverty reduction frameworks. Project Briefing No. 21. Overseas Development Institute, London, UK, 4 pp.

Roessig, J.M., Woodley, C.M., Cech, J.J. and Hansen, L.J. (2004) Effects of global climate change on marine and estuarine fishes and fisheries. Reviews in Fish Biology and Fisheries 14, 251–275.

Rosenzweig, C., Casassa, G., Karoly, D.J. *et al.* (2007) Assessment of observed changes and responses in natural and managed systems. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, eds.). Cambridge University Press, Cambridge, UK, pp. 79–131.

Rothuis, A. (1998) Rice-fish culture in the Mekong delta, Vietnam: constraint analysis and adaptive research. Doctoral Thesis, Katholieke Universiteit Leuven, Leuven, Belgium, 127 pp.

Stern, N. 2007. The Economics of Climate Change.The Stern Review. Cambridge University Press, Cambridge, UK, 712 pp.

TEEB (2008). The Economics of Ecosystems and Biodiversity: An interim report. UNEP, Bonn, Germany, 66 pp.

UNEP. 2008. In Dead Water: Merging of Climate Change with pollution, Over-Harvest, and Infestations in the World's Fishing Grounds. UNEP: Grid-Arendal, Norway.

UNEP/GRID-Arendal. 2009. Fish protein world consumption. UNEP/GRID-Arendal Maps and Graphics Library.

UNEP-WCMC (2006) In the Front Line: Shoreline protection and other ecosystem services from mangroves and coral reefs. UNEP-WCMC, Cambridge, UK, 33 pp.

Vergara, W., Deeb, A.M., Mira-Salama, D. and Toba, N. (2009) The consequences of climate induced coral loss in the Caribbean by 2050–80. In: Environment Matters 2008. The World Bank, Washington, DC, USA, pp. 20–22.

Walther, G., Post, E. Convey, P. *et al.* (2002) Ecological responses to recent climate change. Nature 416, 389–395.

World Bank (2005) Turning the Tide. Saving fish and fishers: Building sustainable and equitable fisheries governance. The World Bank, Washington, DC, USA, 20 pp.

World Bank (2010) World Development Report 2010: Development and Climate Change. The World Bank, Washington, DC, USA, 424 pp.

World Fish Center (2007a) Fisheries and aquaculture can provide solutions to cope with climate change. Issues Brief No.1701.World Fish Center, Penang, Malaysia, 4 pp.

World Fish Center (2007b) The threat to fisheries and aquaculture from climate change. Policy Brief. World Fish Center, Penang, Malaysia, 8 pp.

World Fish Center (2009a) Climate change: Research to meet the challenges facing fisheries and aquaculture. Issues Brief No. 1915. World Fish Center, Penang, Malaysia, 6 pp.

World Fish Center (2009b) Don't let fish slip through the climate change net [online].

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 408-415

Evaluation of Drought Stress Tolerance based on Selection Indices in Common Bean (*Phaseolus vulgaris* L.) Varieties Exposed to Water Stress

Asmat Ara[1], P.A. Sofi[1]*, M.A. Rather[1], Z.A. Dar[2], Khalid Rehman[1], Musharib Gull[1] and Rehana Mohiuddin[3]

[1]Division of Genetics and Plant Breeding, Wadura, Sopore, 193201
[2]Dryland (Karewa) Agriculture Research Station, Budgam
[3]Division of Agronomy, Wadura, Sopore, 193201

ABSTRACT

Drought stress indices are quantitative measures that characterize water stress response by yield data from one or several environments based on timing, duration and intensity of stress. Such an index is more readily useable than raw yield data. Since drought resistance is a yield based trait, selection could vary depending on which index is chosen by the breeder. Where differential yield reduction (Yp-Yd) due to stress has been used as a basis for selecting cultivars with resistance to water stress, the strategy can be counterproductive because of the likelihood of selecting low yielding cultivars with a small yield differential. In the present study a number of drought response indices such as stress susceptibility index (SSI), tolerance index (TOL), mean productivity (MP), geometric mean productivity (GMP) and stress tolerance index (STI) were used to identify genotypes that have higher productive potential and resilience to water stress. It is proposed that such indices provide insight to genotypic response to water stress as compared to raw yield data which invariably fails to remove discrepancies on account of overlapping values of grain yield and define genotypic response in terms of productivity and resilience. However in view of some inherent limitation of indices and to create and validate more robust indices that could effectively discriminate genotypic response, two new indices resilience and production capacity indices were used to elucidate differential genotypic response in terms of adaptability stress and non-stress environments and were found to be efficient in genotypic screening based on resilience and productivity.

Keywords: Productivity, Resilience, Water stress

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) known as rajmash is the most important summer season pulse crop of Kashmir valley. The crop is consumed principally for its dry (mature) beans, shell beans (seeds at physiological maturity) and green pods. It is an indispensable component of the diets as well as the farming system. In the Jammu & Kashmir state, it enjoys a niche status among the crops on account of its being a cheap source of protein, minerals and nutraceuticals.

Given that abiotic stresses (such as drought and high temperatures) are pervasive, often strong, and occur practically every year, they are reported to cause larger yield decreases (Wortmann *et al.*, 1998). Abiotic stress is especially relevant in low-input agricultural systems found in developing nations (Beebe *et al.*, 2010). Drought stress is a major barrier to common bean output over the world (Teran and Singh, 2002). Long-term drought, whether early season, intermittent, or terminal, which is exacerbated by heat and low air relative moisture, is the most detrimental to beans, resulting in an increase in barren plants and incomplete seed set. Water stress during the flowering and grain filling periods has been shown to reduce seed output and seed weight, as well as expedite dry bean maturity (Singh, 1995).

*Corresponding author email id: parvazesofi@gmail.com

Breeding for water stress tolerance is very difficult as the stress conditions created in experimental set up and actual field conditions, invariably, have poor correspondence. In fact the translation of greenhouse and laboratory observations to myriad of diverse patterns and processes observed in the field is a huge challenge, even in case of experiments where seemingly fair amount of control is expected (Poorter *et al.,* 2016). Even in case of experiments where similar traits are studied under different screening systems, the correspondence is not fairly straightforward. Yield has been the primary breeding objective in production breeding and has been improved by targeting yield *per se* as well as yield components based on correlated response. One major problem that is encountered by researchers while dealing with the yield data is that yield under stress per se as well as yield differences under non-stress and stress conditions (Yp-Yd) cannot effectively discriminate the genotypes into tolerant and susceptible as well cannot account for the range of response exhibited by genotypes under stress. Historically the plant breeding programmes have mainly focussed on selecting genotypes that exhibit higher yield under yield nonstress conditions followed by testing under stress conditions of various severities (mild/severe) and applying stress at various stages (early season, intermittent and terminal stress) on the assumption is that a genotype with high yield potential will perform comparably well under most environments (Blum 2005). There are evidences that higher yield potential under non-stress conditions may correspondingly comp arable under mild stress but a lower yield and higher resilience under severe stress may be desirable (Panthuwan *et al.* 2002).

Because traditional plant breeding relies exclusively on physical markers, phenotypic features that represent genotype are required. Drought indices have been used to screen drought-tolerant genotypes because they provide a measure of drought based on yield loss under drought conditions compared to normal conditions. As a selection criterion, scientists have created various drought tolerance index approaches (Table 1). Bouslama and Schapaugh (1984) proposed the Yield Stability Index (YSI) to assess the stability of cultivars under stress and non-stress circumstances.

Fischer and Maurer (1978) suggested a cultivar-specific stress susceptibility index (SSI). Stress tolerance (TOL) is defined by Rosielle and Hamblin (1981)as the difference in yield between stress (Ys) and nonstress (Yp) situations, whereas mean productivity (MP) is defined as the average yield of Ys and Yp. Two novel indices designated as resilience and production capacity indices (Thiry *et al.* 2016) were utilised to eliminate the uncertainty surrounding the reliable genotypic response to stress conditions utilising the yield per se and the five stress indices (SSI, TOL, MP, GMP, and STI). Thiry *et al.* (2016) described the discriminatory power of the resilience capacity index (RCI) in terms of the genotypes' yield decrease under stress within a population, as compared to yield potential (non-stress) conditions; and the production capacity index (PCI) in terms of the genotypes' mean production under both stressed and non-stressed conditions within a population. They emphasised the need of combining the five indices (SSI, TOL, MP, GMP, and STI), as well as the two new indices (RCI and PCI).

MATERIALS AND METHODS

Location of the experiment: The present study was conducted during 2017-2019 at the Division of Genetics & Plant Breeding, Faculty of Agriculture Wadura, SKUAST-K, Sopore. The study area is located in the northmost part of India. The area has a varied geology with diverse rock types. The altitude of the study area varied from 1295 to 2500 meters above sea level with various landforms including plains, valleys, hills, and mountains. The various land uses of the study area include agriculture, horticulture, forest, urban bodies, vegetation, and snow are given below (Figure 1). The climate of the study area is temperate, with temperatures ranging from 8-35^{o}C, and in the winter months, the temperature goes below zero, and the area experiences moderate to heavy snow. The average rainfall varies from 800 to 1100 mm, with March being the wettest month. The area has a mesic soil temperature and a udic soil moisture regime. The study area has Asia's largest freshwater lake: Wular Lake on the Northwest side.

Plant material: Twenty genotypes of common bean were evaluated in the present study. The genotypes used were selected on the basis of their performance in the yield screening trials and represented diverse market classes in terms of use category, growth habits and seed characteristics. The material comprised of 20

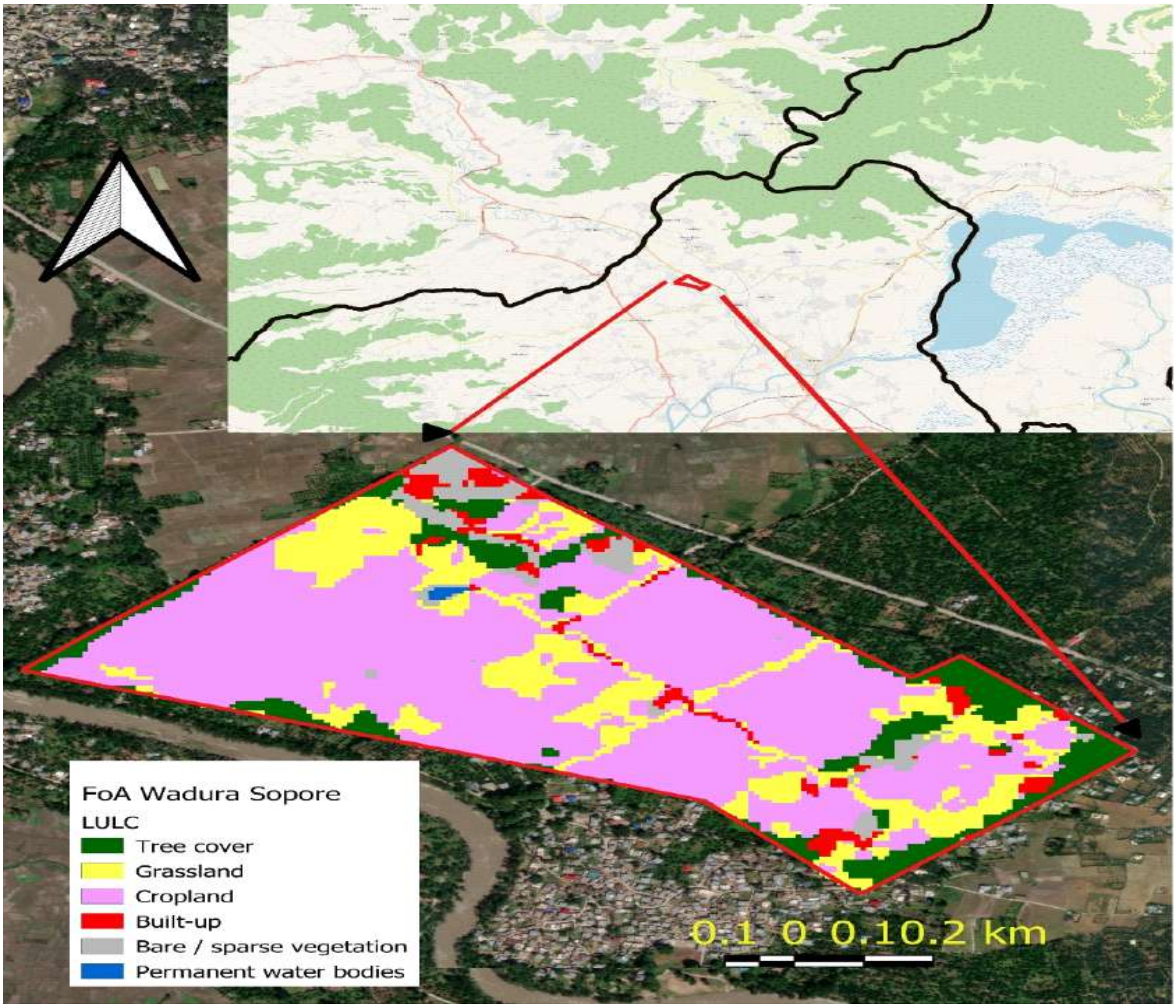


Figure 1: Land use and land cover map of the NWH for the year 2018

breeding lines including three released varieties namely SR-1, SFB-1 and Arka Anoop. While the SR-1 and SFB-1 have been released by SKUAST-Kashmir, Arka Anoop has been released by IIHR, Bengaluru.

Experimental design: Each genotype was represented by two rows of four meter length, with spacing of 40 cm x 15 cm, with two replications each for drought and irrigated treatments. Plants were irrigated regularly until the first fully opened trifoliate leaf and irrigation was withdrawn thereafter in water stressed treatment whereas the plants in irrigated treatment were watered regularly. A randomized block design with two replications for drought and irrigated treatments each was followed to conduct the experiment. Data was analysed using XLSTAT software.

Drought tolerance indices: Seed yield was calculated as the mean of all the plants in each replication. Various drought tolerance indices were calculated based on the values of seed yield per plant under irrigated and drought conditions to discriminate genotypes on the basis of drought response in terms of grain yield (Table 1).

RESULTS AND DISCUSSION

Five indices were used to determine genotypic response to moisture stress: SSI, TOL, MP, GMP, and STI (Table 2). All of the indices had varying ranks, emphasizing the need to create a more relevant index. The MP and GMP rankings, on the other hand, were generally similar. WB-1634, WB-341, SFB-1, and WB-451 were found as attractive genotypes with a decent

Table 1: Various stress screening indices based on seed yield

Index	Formula	Reference
Percent reduction in yield (PRY)	$\{(Y_{NS}-Y_S)/Y_{NS}\}$ x 100	-
Stress susceptibility index (SSI)	$\{1-(Y_S / Y_{NS})\}/\{1-(X_S / X_{NS}\}$	Fisher & Maurer (1978)
Tolerance index (TOL)	$Y_{NS} - Y_S$	Rosielle & Hamblin (1981)
Geometric mean productivity (GMP)	$\sqrt{(Y_{NS} \times Y_S)}$	Fernandez (1992)
Stress Tolerance Index (STI)	$(Y_S \times Y_{NS}) / X^2_{NS}$	Fernandez (1992)
Harmonic mean (HM)	$(2\ Y_{S\ X} Y_{NS})/ Y_S + Y_{NS}$	Jafari *et. al.* (2009)
Relative drought index (RDI)	$(Y_{S\,-} / Y_{NS}) / (X_{S\,-} / X_{NS})$	Fischer and Wood (1999)
Drought resistance index	$Ys \times (Y_S/Y_{NS}) / XS$	Lan (1998)
Coefficient of Drought Resistance	Y_S/ Y_{NS}	Bouslama and Schapaugh (1984)

amount of yield stability under water stress, while WB-6, WB-1587, WB-1492, and WB-112 had the lowest rankings based on the mean rankings of all indices. Two genotypes shared the ranks 5, 7, and 11 correspondingly (WB-956 and SFB-1; WB-185 and WB-1446; and WB-83 and Arka Anoop respectively). Due to overlaps in a small group, ranks are shared.

STI (0.848) had the highest correlation between the total rank and the individual ranks of indices, followed by GMP (0.836), SSI (0.821), MP (0.801), and TOL (0.801). (0.388). Porch (2006) used the GM, heat susceptibility index (STI in this case), and heat tolerance index (STI in this case) to screen for heat tolerance in common bean, finding that the GM and HTI were the most useful indices for evaluating genotypic performance under heat stress, and that they were highly correlated. HTI, GM and HSI were all correlated with yield under heat stress, whereas HTI and GM were more highly correlated with yield under low-stress conditions. Similarly, high correlation between low yield potential and low SSI scores has been reported in drought stress in bean (White and Singh, 1991). However, in both these and other reported cases, these indices have been used separately to rank the genotypes for relative tolerance to stress environments. However, it has been suggested that a combination of stress indices (tolerance and susceptibility indices) might provide a more useful criterion for improving drought stress tolerance selection in common bean and heat stress tolerance selection in maize (Thiry *et al.,* 2016). The correlation coefficient between the score stress susceptibility index (SSIs) and the score tolerance index (TOLs) values and their original index values (SSI and TOL) is highly negative (ranging from "0.801 to "0.993), as the score scale has been inverted in order to create a scale showing resilience instead of susceptibility. On the other hand, the Pearson correlation coefficients between the original values for MP, GMP and STI and the score indices MPs, GMPs and STIs are highly significant. These high Pearson correlation coefficient values demonstrate that the score indices can be used as a surrogate of their original index value as suggested by Thiry *et al.,* (2016).

We calculated the linear regression and coefficient of determination of the different score indices v/s yield under non-stress and heat stress environments on 20 genotypes to find the best combination of indices (Figure 2), which showed that no single index could clearly identify high yielding genotypes independent of the environment. This finding is consistent with the findings of Khayatnezhad *et al.*, (2010) and Thiry *et al.*, (2016), who conducted studies with 22 and 294 wheat genotypes, respectively. The SSI and STI had the closest connection with yield under water stress (R= 0.383 and 0.938, respectively) in each class of index (susceptibility and tolerance). TOL and MP, on the other hand, have a strong association with yield potential (non-stress). The current study's findings support the hypothesis that combining the score indices from each class would increase the association between the indices and grain yield. Thiry *et al.*, (2016) introduced two new indices (RCI and PCI) that are based on a mixture of score indices. They demonstrated the utility of the new indices using data from ten wheat genotypes, and they proposed that the indices might be used to evaluate germplasm sets of any size. Table 3 shows the score indices based on grain yield data from 20 genotypes. In each of the 20 genotypes, Table 5 shows the

Table 2: Yield under stress and non-stress and five indices in 20 common bean genotypes

Genotype	Yield (NS)	Yield (S)	SSI	Rank	TOL	Rank	MP	Rank	GMP	Rank	STI	Rank	Mean rank
WB-6	19.55	8.78	1.75	20	10.77	16	14.16	18	13.10	19	0.27	19	17
WB-22	29.32	14.35	1.62	18	14.97	20	21.83	8	20.51	9	0.67	10	12
WB-83	24.67	16.33	1.07	14	8.34	13	20.50	12	20.07	11	0.64	12	11
WB-112	26.06	14.97	1.35	17	11.09	17	20.51	11	19.75	12	0.62	13	14
WB-185	34.44	21.74	1.17	15	12.7	18	28.09	4	27.36	4	1.19	4	7
WB-216	16.28	12.17	0.80	6	4.11	4	14.22	14	14.07	16	0.32	17	9
WB-222	31.1	21.23	1.01	11	9.87	14	26.16	5	25.69	5	1.05	5	6
WB-257	25.38	17.41	1.01	12	7.97	12	21.39	10	21.02	8	0.70	9	8
WB-341	33.18	27.24	0.57	3	5.94	8	30.21	2	30.06	2	1.44	2	2
WB-401	15.10	11.68	0.72	5	3.42	1	13.39	19	13.28	18	0.28	18	10
WB-451	33.72	23.17	0.99	10	10.55	15	28.44	3	27.95	3	1.24	3	4
WB-956	25.41	18.61	0.85	7	6.80	10	22.01	7	21.74	7	0.75	7	5
WB-1446	24.96	17.84	0.91	8	7.12	11	21.40	9	21.10	9	0.71	8	7
WB-1492	27.35	13.16	1.65	19	14.19	19	20.25	14	18.97	13	0.57	14	15
WB-1587	13.5	8.26	1.23	16	5.24	7	10.88	20	10.55	20	0.18	20	16
WB-1634	36.05	31.96	0.36	1	4.09	3	34.00	1	33.94	1	1.83	1	1
WB-1643	25.52	20.69	0.60	4	4.83	5	23.10	6	22.97	6	0.84	6	3
SR1	20.18	13.43	1.06	13	6.75	9	16.80	15	16.46	14	0.43	15	13
SFB-1	22.11	18.57	0.51	2	3.54	2	20.34	13	20.26	10	0.65	11	5
AA	17.69	12.50	0.93	9	5.19	6	15.09	16	14.87	15	0.35	16	11

SSI= stress susceptibility index, TOL= tolerance index, MP= mean productivity index, STI= stress tolerance index

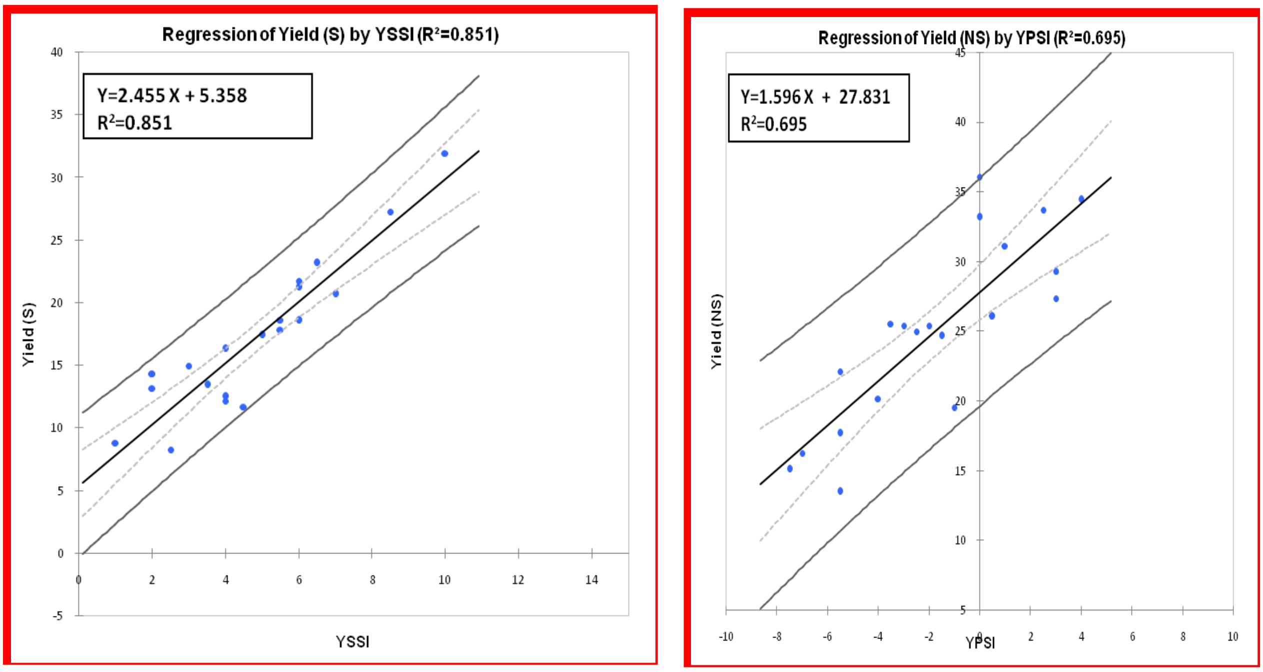


Figure 2: Linear regression and coefficient of determination (R2) between yield under stress and YSSI and yield under non-stress and YPSI

association between the indices within each class of indices. The most notable finding from the association between index scores and original indices in this study, as well as Thiry *et al.*, (2016), is that the values are nearly identical within each class. As a result, the Pearson correlation coefficient (Table 2) and the score values (Table 2) support the hypothesis that SSI and TOL are connected with class 1 and MP, GMP, and STI are associated with class 2. These two classes were utilised to create two new indices that represented two different aspects of plant response, namely, resilience capacity and production capacity.

However, such genotypes may experience smaller yield declines under stress, resulting in more resilience, as measured by a higher RCI value. As a result, rather than per se yield values, the score indices can be used to analyse differential genotypic adaptability to stress in terms of RCI and PCI values. Table 4 displays seed yield statistics for 20 popular bean genotypes. In terms of RCI and PCI, we can detect some unusual genotypic scores. The genotypes WB-22 and WB-1492 exhibited identical YSSI (2.0) and YPSI (3.00) values, indicating that they had equivalent productivity and resilience capacities. WB-956 and WB-1446, on the other hand, have a similar relationship. WB-451 and WB-1643, on the other hand, have comparable YSSI values. However, the YPSI readings are practically opposite. Similarly, although having identical YSSI values, WB-185 and SFB-1 had nearly opposite YPSI values, demonstrating that genotypes differed in their productive and resilient characteristics.

With the exception of the drought susceptibility index, which was negatively correlated with all other indices used in the study, the correlation matrix among drought tolerance indices (Table 4) revealed that most of the indices were significantly and positively

Table 3: Score indices based on grain yield for five tolerance indices (SSI. TOL, MP, GMP, STI) in 20 common bean genotypes

Genotypes	Seed yield (g)		Class 1		Class 2			Mean	Mean
	Stress	Non-stress	SSI score	TOL score	MP Score	GMP Score	STI Score	score index	genotypic Rank
WB-6	19.55	8.78	1	4	2	2	1	2.0	19
WB-22	29.32	14.35	1	1	5	5	3	3.0	17
WB-83	24.67	16.33	5	6	5	5	3	4.8	11
WB-112	26.06	14.97	3	4	5	4	3	3.8	15
WB-185	34.44	21.74	5	2	8	8	7	6.0	7
WB-216	16.28	12.17	7	10	2	2	1	4.4	13
WB-222	31.1	21.23	6	5	7	7	6	6.2	6
WB-257	25.38	17.41	6	7	5	5	4	5.4	10
WB-341	33.18	27.24	9	8	9	9	8	8.6	2
WB-401	15.10	11.68	8	10	2	2	1	4.6	12
WB-451	33.72	23.17	6	4	8	8	7	6.6	4
WB-956	25.41	18.61	7	8	5	5	4	5.8	8
WB-1446	24.96	17.84	7	7	5	5	4	5.6	9
WB-1492	27.35	13.16	1	1	5	4	3	2.8	18
WB-1587	13.5	8.26	4	9	1	1	1	3.2	16
WB-1634	36.05	31.96	10	10	10	10	10	10.0	1
WB-1643	25.52	20.69	9	9	6	6	5	7.0	3
SR-1	20.18	13.43	5	8	3	3	2	4.2	14
SFB-1	22.11	18.57	9	10	5	5	3	6.4	5
AA	17.69	12.50	6	9	2	2	2	4.2	14

SSI= stress susceptibility index, TOL= tolerance index, MP= mean productivity index, STI= stress tolerance index

Table 4 : Values of RCI and PCI and their combination into YSSI and YPSI

Genotype	RCI	PCI	YSSI	YPSI
WB-6	1	1	1.00	-1.00
WB-22	1	3	2.00	3.00
WB-83	5	3	4.00	-1.50
WB-112	3	3	3.00	0.50
WB-185	5	7	6.00	4.00
WB-216	7	1	4.00	-7.00
WB-222	6	6	6.00	1.00
WB-257	6	4	5.00	-2.00
WB-341	9	8	8.50	0.00
WB-401	8	1	4.50	-7.50
WB-451	6	7	6.50	2.50
WB-956	7	4	5.50	-3.00
WB-1446	7	4	5.50	-2.50
WB-1492	1	3	2.00	3.00
WB-1587	4	1	2.50	-5.50
WB-1634	10	10	10.00	0.00
WB-1643	9	5	7.00	-3.50
SR-1	5	2	3.50	-4.00
SFB-1	9	3	6.00	-5.50
AA	6	2	4.00	-5.50

RCI= Resilience capacity index, PCI= Production capacity index, YSSI= Yield stress susceptibility index

correlated with each other, indicating fair correspondence between these indices. GM was also found to be adversely linked with DSI. Except for the drought susceptibility index, all of the drought tolerance indices were positively linked with seed yield under drought (DSI). The fact that these indices have a positive correlation suggests that they can be used in conjunction with other indirect selection criteria to discover drought-tolerant genotypes rather than selection based on yield alone. Similar results in common bean have been reported by Foster *et al (*1995), Scheneder *et al* (1997), and Habibi (2011). Drought stress indicators are numerical metrics that quantify water stress responses by yielding data from one or more settings based on stress timing, duration, and intensity. Raw yield data is more difficult to utilise than an index like this. Drought resistance is a yield-based characteristic, hence selection may differ depending on which index the breeder chooses (Sofi *et al.*, 2018). Porch (2006) employed the heat tolerance index, stress tolerance index, and GM

Table 5: Pearson correlation coefficient between the score indices (SSIs, TOLs, MPs, GMPs and STIs) and their original indices (SSI, TOL, MP, GMP and STI)

TRAIT	SSI	TOL	MP	GMP	STI
Class 1					
SSIs	-0.993*	-0.805*	0.374	0.430	0.458
TOLs	-0.801*	-0.994*	-0.207	-0.148	-0.082
Class 2					
MPs	-0.357	0.197	0.995*	0.992*	0.974*
GMPs	-0.408	0.140	0.992*	0.994*	0.981*
STIs	-0.442	0.068	0.975*	0.981*	0.99

to screen for heat tolerance in common bean, reporting that superior genotypes for heat tolerance could be identified based on their stress indices because the indicators were connected. The heat tolerance index and GM were shown to be the most helpful indices for assessing genotypic performance in hot environments.

CONCLUSION

In the present study a number of drought response indices such as stress susceptibility index (SSI), tolerance index (TOL), mean productivity (MP), geometric mean productivity (GMP) and stress tolerance index (STI) were used to identify genotypes that have higher productive potential and resilience to water stress. It is proposed that such indices provide insight to genotypic response to water stress as compared to raw yield data which invariably fails to remove discrepancies on account of overlapping values of grain yield and define genotypic response in terms of productivity and resilience. However in view of some inherent limitation of indices and to create and validate more robust indices that could effectively discriminate genotypic response, two new indices resilience and production capacity indices were used to elucidate differential genotypic response in terms of adaptability stress and non-stress environments.

REFERENCES

Beebe, S, Rao, I, Blair, M and Butare, L. 2010. Breeding for Abiotic Stress Tolerance in Common Bean: Present and Future Challenges. FAO.

Blum, A. 2005. Effective use of water (EUW) and not water-use efficiency (WUE) is the target of crop yield improvement under drought stress. *Field Crops Research* 112: 119-123.

Bouslama, M., Schapaugh, W.T. 1984. Stress tolerance in soybean. Part 1: Evaluation of three screening techniques for heat and drought tolerance. *Crop Sci.*, 24: 933–937.

Fischer, R. A. and Maurer, R. 1978. Drought resistance in spring wheat cultivars. I. Grain yield responses. *Crop and Pasture Science* 29: 897-912.

Fischer, R. A., and Wood, J. T. 1979. Drought resistance in spring wheat cultivars. III. Yield associations with morpho- physiological traits. *Australian Journal of Agricultural Research*, 30(6), 1001-1020.

Fernandez, G. C. 1992. Effective selection criteria for assessing plant stress tolerance. In: Proceeding of a symposium on adaptation of vegetables and other food crops in temperature and water stress, Taiwan pp. 257-327.

Habibi, L. 2011. Influence of drought on yield and yield components in white bean. *International Journal of Biological, Agricultural, Food and Biotechnological Engineering* 5: 380-389.

Jafari, A., Paknejada, F. and Ahmadi, J. A. 2009, Evaluation of selection indices for drought tolerance of corn (*Zea mays* L.) hybrids.*Int. J. Plant Prod.*, 3(4): 33-38.

Lan, J. 1998. Comparison of evaluating methods for agronomic drought resistance in crops. *Acta Agr Bor-Occid Sinic.* 7: 85- 87.

Poorter, H, Fabio F., Peiruschka R., Tobias W., Puten W., Kleyer M., Schuur U., and Postma J. 2016. Pampered inside, pestered outside? Differences and similarities between plants growing in controlled conditions and in the ûeld. *New Phytologist* 212:838–855.

Porch, T. G. 2006. Application of stress indices for heat tolerance screening of common bean. *Journal of Agronomy and Crop Science* 192: 390-394.

Rosielle, A. A. and Hamblin, J. 1981. Theoretical aspects of selection for yield in stress and non-stress environments. *Crop Science* 21: 943-946.

Schneider, K. A., Rosales-Serna, R., Ibarra-Perez, B., Cazares-Enriquez, J., Acosta-Gallego, Ramirez-Vallejo, P., Wassimi, N. and Kelly, J. D. 1997. Improving common bean performance under drought stress. *Crop Sci*ence 37: 43-50.

Singh, S.P. 1995. Selection for water stress tolerance in interracial populations of common bean. *Crop Science* 35: 118–124

Sofi, P. A., Rehman, K., Ara, A. and Gull, M. 2018. Stress tolerance indices based on yield, phenology and biomass partitioning: A review. *Agricultural Reviews* 39(4): 292-299.

Teran, H. and Singh, S. P. 2002. Comparison of sources and lines selected for drought resistance in common bean. *Crop Science* 42: 64–70.

Thiry, A., Perla, N., Chavez, D., Reynolds, M. P. and Davies, W. J. 2016. How can we improve crop genotypes to increase stress resilience and productivity in a future climate? A new crop screening method based on productivity and resistance to abiotic stress. *Journal of Experimental Botany* doi: 10. 1093/jxb/erw330.

Wortmann, C. S., Kirkby, R. A., Eledu, C. A. and Allen, D. J. 1998. Atlas of Common Bean (*Phaseolus vulgaris* L.) Production in Africa, CIAT, Cali, Colombia.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 416-421

Promoting Nutrition – Sensitive Agriculture Through Extension and Advisory Services

Poonam Abrol* and Ritu Mittal Gupta
Punjab Agricultural University, Ludhiana, Punjab

ABSTRACT

More than half of the world's population is malnourished. Hunger, micronutrient deficiencies, overweight, and obesity frequently co-exist. India is one of 88 nations that will fail to achieve the global nutrition targets on four nutritional parameters in 2025. India was also named as the worst-performing country in case of disparities in stunting and ranked 101st out of 116 countries in the 2021 Global Hunger Index. Micronutrient malnutrition also known as "hidden hunger," affects people and can result in poor physical growth and development. This review paper highlights the main causes of poor nutritional status in India and helps examine the various strategies such as improving the production and availability of diverse and nutritious food, promoting kitchen gardens, bio-fortification of crops, promoting fortified products, reducing post-harvest losses through value addition and processing, empowering rural women, diffusion and adoption of nutritional recipes and practices, convergence of public, private and government sectors etc by extension and advisory services to overcome the problem of nutrition in India. To promote nutritional awareness among rural communities, it is essential to leverage agriculture sector with nutrition in an effective way using extension mechanism.

Keywords: Nutri-sensitive agriculture, Nutritional security, Nutrition targets, Extension, Advisory services

INTRODUCTION

According to the Food and Agriculture Organization of the United Nations, 2020, India is one of the world's leading producers of milk and pulses, as well as the second-largest producer of rice, wheat, sugarcane, groundnut, vegetables, fruits, and cotton (FAO, 2020). Despite this, India ranks 101st out of 116 countries in the 2021 Global Hunger Index (WHO, 2020). The nature and causes of malnutrition are complex, and additional problems such as switching demand for agricultural products, environmental issues, and natural resource extraction further complicate the situation.

Nutritional insecurity is a problem caused by the "nutrition gap," which is the difference between what foods are consumed and what foods are required for good nutrition such as protein and micro-nutrients like iron, iodine, zinc, and vitamin A. Micronutrient malnutrition (also known as "hidden hunger") affects people and can result in poor physical growth and development, reduced mental capacity, lower productivity, impaired immune systems and other nutritional deficiency problems. Even if food is available and accessible, there is no assurance of adequate absorption of nutrition, since nutrition is dependent on many other factors such as pregnant women's health, breastfeeding, illness, cleanliness, drinking water, sanitation, and so on. As a result, access to nutritious meals is a crucial component of nutrition security. (FAO, 2011).

MATERIALS AND METHODS

This review paper highlights the main causes of poor nutritional status in India and helps to examine the various strategies that should be adopted by extension and advisory services to promote nutrition sensitive agriculture. In order to achieve the objectives a mixed method approach was used. A systematic review of literature to seek out relevant information about nutritional status of India, nutritional diets and the

*Corresponding author email id: poonamabrol22@gmail.com

inclusion of nutrition as a part of their existing mandate and strategies adopted by agriculture extension and advisory services. For this various national and international reports and research publications from 2003 to 2020 year was reviewed and data was compiled.

RESULTS AND DISCUSSION

The result of the study summarizes the findings from the systematic review of literature. The results are categorized in four main headings viz. status of nutrition in India, causes underlined the problem of malnutrition, advantages of EAS over other types of community workers and various strategies that should be adopted by extension agents to leverage nutrition with agriculture extension services.

Nutritional Status of India: Concerned about the growing global problem of malnutrition, in 2012 the World Health Assembly approved and specified a set the six global nutrition targets to be achieved by 2025 i.e. reduce anaemia in women by 50%, reduce stunting in children under the age of five by 40%, reduce the number of underweight births by 30%, to get childhood wasting down to less than 5%. ensuring no increase in childhood obesity. rate of exclusive breastfeeding in the first 6 months to at least 50% should be increased.

According to the 'The State of Food Security and Nutrition in the World, 2020' report, 14 percent of the Indian population is undernourished. India is one of 88 nations that will fail to achieve the global nutrition targets on four nutritional parameters in 2025. In addition, domestic inequalities are very high in India, particularly in terms of malnutrition. India was also named as the worst-performing country in case of disparities in stunting. Reports highlighted that India is succeeded to achieve only two of the set target and the situation for the rest was reported to worsen even further. The targets which were observed on the track are Stunting percentage for children below the age of 5 year and Under-5 overweight.

But no progress was made for other targets or the conditions worsened further included; Anemia in Women reproductive age, Wasting Under-5 and Obesity and diabetes in adults, both males and females. As per the report, 189.2 million people in India are malnourished, and 34.7 per cent of children under the age of five are stunted, 20% of India's children under the age of five are wasting, which means their weight is too low for their height (WHO, 2020).

Causes of malnutrition: Traditionally, agricultural development has concentrated on raising productivity and increasing cereals production. In this context, farmers and farming systems around the world have achieved significant progress in multiplying cereal production by many times higher in the last half-century. Hunger, malnutrition, and poor health, however, continue to be prevalent and persistent issues. This simply proves that neither higher agricultural production nor increased economic growth has been successful in ensuring the country's nutritional security (FAO, 2017). Various Government, non-government, and commercial organizations have made a number of initiatives to achieve family health and nutritional education, particularly in the rural areas but the problems remain the same. The main causes are: Poverty, lack of education, lack of knowledge about nutritional foods, Stress on consumption of staple food, Maternal and infant malnutrition-related illnesses and diseases, Changing dietary patterns and physical activity behaviour, Lack of Breastfeeding practices, Intra household food distribution, Household delivery practices, Deficiencies due to poor intake of vitamins and minerals such as vitamin A, zinc, iron, and calcium etc., Environmental and climate conditions affecting agriculture resulting food unavailability (FAO, 2011).

Need to integrate agriculture and nutrition: Agriculture is not only crucial for generating income, but also for improving the food and nutrition security of rural people. The unavailability of nutritious food is the root cause of nutritional insecurity. The majority of Indian lives in rural areas and engages in agriculture and allied occupations. It is essential to promote nutritive-sensitive agriculture and advisory systems in order to overcome such nutritional issues (FAO 2013a, b; Herforth *et al,* 2012). During the post-2015 agenda discussions of the United Nations, sustainable development goals (SDGs) are being drafted. The term nutrition-sensitive agriculture has been introduced (Balz *et al,* 2015).

Defining Nutrition- Sensitive Agriculture: It is a multi-sectoral intervention that address malnutrition's determinants Nutrition-sensitive approaches that incorporate nutrition into other sectors to improve nutrition outcomes. It seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner. Nutrition requires taking action at all stages of the food chain. From production, processing, retail to consumption needs a broader focus which encompasses the entire food system. (FAO, 2017).

Nutrition-sensitive agriculture can also be defined as "A food-based strategy to agricultural development that puts nutritionally rich foods, dietary diversity, and food fortification at the heart of combating malnutrition and micro-nutrient deficiencies. The overall goal of nutrition-sensitive agriculture is to improve the global food system's ability to produce good nutritional outcomes" (Ruel and Alderman, 2013). Agriculture is essential for human nutrition, which has traditionally been viewed mainly as a health issue. Agri-food systems should do more than just produce enough food; they should also: provide a diverse, safe, and nutritious diet, improve rural incomes and resilience, increasing access to healthy diets, Start making food products that lead to healthy diets available and accessible at national and local levels.

To achieve this, we must strengthen the capacities of farmers, agricultural extensionists, consumers, and others, as well as promote innovations, investment and enabling policies and address gender issues. (Ruel and Alderman, 2013).

Advantages of EAS over other types of community workers: Extension workers (public, private, and non-governmental organizations (NGOs) are often regarded as a promising platform for the transfer of nutrition knowledge and practices in order to improve the nutritional health of rural communities because they reach and interact closely with farmers in local settings (Davis and Heemskerk 2012). Building farmers' capacities through agricultural extension and advisory service (EAS) providers is an excellent gateway for sharing nutrition knowledge and fostering healthy nutrition attitudes and practices among farmers in a culturally sensitive way (Callens and Gallagher, 2003). The most important reasons that nutrition should be integrated into Extension Advisory Service are: It has established infrastructure, Wider coverage (Satarupa *et al,* 2018), strong community trust, awareness about community culture (GFRAS, 2012), empathy and understanding and based on family approach (Fanzo *et al*, 2015).

Strategies for promoting nutrition-sensitive agriculture: The World Bank's Secure Nutrition Knowledge Platform and the Global Forum for Rural Advisory Services (GFRAS) (GFRAS, 2012). outline the integration and linkages of nutrition within the extension and advisory services (EAS).

1. Improve availability of diverse and nutritious food: Agricultural extension services (AES) focus on implementing robust programmes to increase food availability and access. Historically, food security has been measured to satisfy hunger and agriculture policies and services focused on increasing national production of starchy staples (e.g., maize, rice, etc.). But now we should also consider whether the foods available meet dietary requirements. Promoting the production of fruits, vegetables, poultry, and fish rearing practices allows people to include macro and micronutrients in their diet on a regular basis while also earning a good living (Pingali and Sunder, 2017).

2. Proper utilization of nutrients: To achieve optimal nutritional status, the body must be able to extract and utilize nutrients from food. This applies to several categories of EAS activity, including care and feeding practices, food preparation, and intra-household food distribution (FAO, 2009). The knowledge related to the enhancement of nutritive value of food must be imparted to the rural women (de Pee and Bloem 2009). Food safety, complementary feeding, sanitation and hygiene and other important issues should also be discussed with the rural people.

3. Homestead/ kitchen gardens: Promoting a Home garden is a common strategy for increasing the production and availability of micronutrient- rich vegetable and horticultural crops (Schreinemachers *et al*, 2016). By adapting backyard gardens and poultry, significantly enhances the intake of fresh vegetables, green leafy vegetables, eggs, and milk. It may lead to a reduction in nutrient deficiencies such as anaemia in women and children under the age of five (Arimond *et al,* 2011).

4. Bio-fortification: Bio-fortification of tested and approved crops provides an easy entry point for nutrition to be integrated into agricultural extension and rural advisory services. It has great potential for combating micronutrient deficiencies as it targets 75% of the rural population and poor people, who consume large amounts of staple food on a daily basis. Crop breeders should focus on breeding vegetables and staple food crops that are high in nutrients like zinc, iron and vitamin A (Bouis and Saltzman, 2017) and are resilient to climate, pests, weeds and disease.

5. Reduce post-harvest loss through value addition and processing: To reduce post-harvest loss of fruits and vegetables, value addition and processing should be encouraged. The processing and storage of nutritious crop harvests increase food availability even during the off/dry season and increases the intake of nutritious food in the diet throughout the year (Wild, 2007). This also enables farmers to earn a good living by selling processed food items in the local market.

6. Empower rural women: Rural women are the strongest link between agriculture, nutrition, and health. As a result, both nutrition and gender inequities must be addressed at the field level through the design of agricultural development programmes. Rural women's empowerment and nutritional security have a strong positive relationship (Olney *et al*, 2015). In many countries, they do the majority of farm labour and food processing. They prepare food and care for sick children and elder members at home. In many cases, they do so without the benefit of credit; access to healthcare and childcare; secure rights to land and water; sound information about agricultural production, health, and nutrition and access to well-functioning markets. Increasing women's access to resources and control over household income can significantly improve the health and nutrition of the family, and particularly of women and children (IFPRI, 2011).

7. Integrating nutrition into the curricula of agriculture education institutions: Increasing human capacity to promote nutrition-conscious agriculture. One of the identified challenges, according to the Global Forum for Food Security and Nutrition, is that in order to emphasize the linkages with the food system, it is important to mainstream nutrition into learning institution curricula. A focus should be given to ensuring that the nutrition component is not fragmented and diluted in agriculture-specific training.

8. Information and communication technology (ICT) application: The use of ICTs to backstop and support providers of extension and rural advisory services is getting popular, particularly among non-governmental organizations (NGOs) experimenting with new ways to deliver messages (Fanzo *et al*, 2015). SMS, apps, and voice messages have been used on mobile platforms for some years. Digital Green is an organization that is starting to investigate the use of ICTs to deliver nutrition messages via extension agents. Radio can play an important role in reinforcing and supplementing EAS nutrition messages.

9. The farmer field school and farm school: The farmer field school (FFS) approach is a participatory, group-based method of adult education that teaches farmers how to experiment and solve problems independently. The FFS model and farmer associations can be viewed as an opportunity for extension and rural advisory services to disseminate nutrition education (Davis *et al.,* 2011). It allows for the effective delivery of nutrition-sensitive agriculture without some of the transportation and training challenges faced by some extension agents.

10. Integrating gender and nutrition with agricultural extension and rural advisory services: Integrating Gender and Nutrition into the Agricultural Extension System empowers families, assists women in contributing to household income, increases productivity and reduces gender gaps in agriculture, and improves farming nutrition outcomes) (Rukmini *et al.,* 2019). There is a need for widespread acceptance of gender integration in agricultural research and development processes. As it becomes more important and recognized fact that gender equity and agricultural development are mutually beneficial, most international development funding agencies now require gender integration (Me-Nsope, 2015).

11. Home economics/ community science extension agents: Nutrition specialists, particularly female extension agents should be recruited for the promotion of nutrition-related information in the rural areas (Rivera, 2013). In various parts of country some traditional families don't like their females to talk or to participate in social gatherings where male are present. In this situation female extension agents can easily reach rural women in their local set up as compared to male extension workers.

12. Convergence: Bringing together different actors working in agricultural and allied sector (public, private, and non-governmental organizations) for information exchange at the grassroots level. Strengthen links between the agriculture, nutrition and health sectors interventions to improve diets and nutrition levels should combine public health, nutrition education, and dietary strategies (Fanzo *et al.*, 2015).

13. Extending participatory methodologies through participation: Many countries have found that people become more dynamic when they make decisions about their own affairs, take responsibility for, and are assisted in carrying out projects in their own areas. Increasing participation of people in their own programme from planning to implementation phase is very much important.

CONCLUSION

Although there has been lot of work done and initiatives taken by our government to combat malnutrition and promote nutritional awareness among rural people, but the situation is still critical in some areas. The programmes implemented by various sectors viz., Govt. Organizations, NGOs and private organizations needs to be refined. To promote nutritional awareness among rural communities, it is essential to leverage agriculture sector with nutrition in an effective way using extension mechanism. It is important because the extension system already has well developed infrastructure and acceptable by the rural communities. Agriculture and its allied sector is a strong channel to achieve food and nutritional security as the occupation of most of the population is dependent on agriculture. So, there is a clear need to promote agricultural extension and other intervention programmes more nutrition-sensitive in order to achieve better agriculture-nutrition integration. This involves an awareness of the knowledge flow channels from the national to the community and household levels, as well as the demand and opportunities for knowledge-based intervention through these channels. Future agriculture policies should be established in line with national nutritional objectives to ensure optimal nutritional integration in agriculture (Jaenicke and Virchow, 2013). Nutrition sensitive agriculture and the integration of nutrition in Extension and advisory services seems to be a viable action for policymakers in order to attain the nutritional targets of the Sustainable Development Goals on Zero Hunger and Optimum Nutrition.

REFERENCES

Arimond M, Hawkes C, Ruel M T, Sifri Z, Berti P R, Leroy J L, Low J W, Brown L R and Frongillo E A (2011) Agricultural interventions and nutrition: Lessons from the past and new evidence. *Combating micronutrient deficiencies: Food-based approaches. Pp* 41-75. FAO and CABI, Rome, Italy

Balz A G, Heil E A and Jordan I (2015) Nutrition-sensitive agriculture: new term or new concept? *Agric Food Sec* 4: 1-16.

Bouis H E and Saltzman A (2017). Improving nutrition through biofortification: a review of evidence from Harvest Plus, 2003 through 2016. Glob. Food Secur. 12; 49–58. http:// dx.doi.org/10.1016/ j.gfs.2017.01.009.

Callens K and Gallagher K (2003) Incorporating nutrition in farmer field schools. *In FAO Document Repository*. Retrieved from FAO: www.fao.org/docrep/005/ y8346m/y8346m08.html

Das M, Sharma A and Babu S C (2018) Pathways from agriculture-to-nutrition in India: implications for sustainable development goals. *Food Security* 10: 1561–76.

Davis, K., Nkonya, E., Kato, E., Mekonnen, D.A., Odendo, M., Miiro, R. and Nkuba, J. (2011) Impact of farmer field schools on agricultural productivity and poverty in East. Africa. World Development 40(2): 402-413.

De Pee, S and Bloem M. (2009) Current and potential role of specially formulated foods and food supplements for preventing malnutrition among 6- to 23-month-old children and for treating moderate malnutrition among 6- to 59-month-old children. FNB. 30(3 Suppl): S434-63.

Fanzo J, Marshall Q, Dobermann D, Wong J, Merchan R I, Jaber M I, Souza A, Verjee N, and Davis K (2015) Integration of nutrition into extension and advisory Services: A synthesis of experiences, lessons, and recommendations. *Food Nutr Bull* 36: 120-37.

FAO (2009) Declaration of the World Food Summit on food security, Food and Agriculture Organization United Nations, Rome, Italy. Retrieved from https:// www.fao.org/wsfs/wsfs-list-documents/en/

FAO (2011) The State of Food and Agriculture: Women in agriculture, closing the gender gap for development. Rome, Italy. Retrieved from https://www.fao.org/3/i2050e/i2050e00.htm

FAO (2013a) Synthesis of Guiding Principles on Agriculture Programming for Nutrition. FAO. Rome, Italy.

FAO (2013b) State of Food and Agriculture (SOFA). FAO, Rome.

FAO (2017) Nutrition-sensitive agriculture and food systems in practice. Retrieved from https://www.fao.org/3/I7848E/I7848E.pdf

FAO (2020) Food and agriculture organization of the United States. *India at a Glance*. Retrieved from https://www.fao.org/india/fao-in-india/india-at-a-glance/en/

GFRAS (2012) Fact Sheet on Extension Services. GFRAS. Lindau, Switzerland.

Herforth, A, Jones, A and Pinstrup Andersen P (2012) Prioritizing Nutrition in Agriculture and Rural Develoment: Guiding Principles for Operational Investments. The International Bank for Reconstruction and Development / The World Bank, Washington, DC.

IFPRI (2011) Leveraging agriculture for improving nutrition and health: *Highlights from an International Conference*. Washington, DC. Retrieved from https://www.ifpri.org/publication/leveraging-agriculture-improving-nutrition-and-health

Jaenicke H and Virchow D (2013) Entry points into a nutrition-sensitive agriculture. Food Secur. 5; 679–92. http://dx.doi.org/10.1007/s12571-013-0293-5.

Kachelriess M, Annemarie M, Stancher A, Asare B, and Afoakwa E O (2016) Promoting nutrition-sensitive extension advisory services. Retrieved from https://www.g-fras.org/en/download.html?download=877:what-works-in-rural-advisory-service

Me-Nsope N (2015) Guidelines for integrating gender into Agriculture Share. *Ag Share Project* 1-22. Retrieved from https://www.manage.gov.in/publications/discussion%20papers/MANAGE-Discussion%20Paper-2.pdf

Olney D K, Pedehombga A, Ruel MT, Dillon A, (2015) A 2-year integrated agriculture and Nutrition and Health Behavior Change Communication Program targeted to women in Burkina Faso reduces anemia, wasting, and Diarrhea in children 3 – 12.9 months of age at baseline: a cluster-randomized controlled tri. J. Nutr. 1–8. http://dx. doi.org/10.3945/jn.114.203539.1

Pingali P and Sunder N (2017) Transitioning toward nutrition-sensitive food systems in developing countries. *Annu Rev Resour Econ* 9. Retrieved from http://dx.doi.org/10.1146/annurev-resource-100516-053552

Rivera, W (2013) University of Maryland. Personal Interview. 8 March 2013.

Ruel M T and Alderman H (2013) Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? Lancet (382): 536–51. Retrieved from http://dx.doi.org/10.1016/S0140-6736 (13)60843-0.

Rukmani R, Gopinath R, Anuradha G, R Sanjeev and Yadav V K (2019) Women as drivers of change for nutrition-sensitive agriculture: Case study of a novel extension approach in Wardha, India *Agric Res* 8:523–30.

Satarupa M, Suchiradipta, B and Saravanan R (2018) Integrating gender and nutrition in agriculture and advisory services. *MANAGE*, Hyderabad, India. Retrieved from https://www.manage.gov.in/publications/discussion%20papers/MANAGE-Discussion%20Paper-2.pdf

Schreinemachers P, Patalagsa M A, Uddin N, (2016). Impact and cost-effectiveness of women's training in home gardening and nutrition in Bangladesh. J. Dev. Eff. 8:473–488. http://dx.doi.org/10.1080/19439342.2016.1231704.

WHO (2020) Global Nutrition Report. Retrieved from https://globalnutritionreport.org/0fb38d

Wild C P (2007). Aflatoxin exposure in developing countries: The critical interface of agriculture and health. Food and Nutrition Bulletin, vol. 28, no. 2 (supplement)

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 422-427

Kitchen Garden: A Sustainable Alternative for Food and Nutritional Security

Sheetal Badyal[1], Ravneet Kour[2], Neerja Sharma[3], Puneet Choudhary[4], Prem Kumar[5], Muneeshwar Sharma[6] and Amitesh Sharma[7]

[1]SMS Home Science, KVK Jammu; [2]SMS Horticulture, KVK Jammu; [3]SMS Horticulture, KVK Samba; [4]Senior Scientist, KVK Jammu; [5]SMS Fisheries, KVK Jammu; [6]SMS Plant Pathology, KVK Jammu; [7]SMS Plant Breeding, KVK Jammu

ABSTRACT

Kitchen Gardening is an integral part of farming system from which fresh vegetables can be obtained. Vegetables and fruits are sources of carbohydrates, proteins and minerals (micronutrients), the lack of which in daily diet has been a primary cause of malnutrition and under nutrition. The promotion of vegetable cultivation among small farm holders can be a source of significant supplementary income and contribute in elevating under nutrition, enhance economic growth and alternate livelihood creation as well as empowerment of women in long run. Women in our country are largely engaged in day to day cooking activities in rural households, which makes their role more crucial in kitchen gardening activities for procurement of fresh vegetables, fruits, herbs etc. in sufficient amounts. Present study was carried out to determine food and nutrition security of the family through kitchen gardening. It was conducted in two villages, Kattal Battal and Premachak from Nagrota and R.S. Pura tehsils of Jammu district of J&K UT. The results revealed 350sqm nutrition garden model to be appropriate for a family comprising of 4-6 members. Analysis further indicates that average vegetable production from 250 sqm area was 120 kgs and from 350 sqm was 166 kgs. Based on the findings it was concluded that although kitchen garden model with 250 sqm area is sufficient to fulfill the recommended dietary allowance requirement for vegetables (300gms /head/day) for a family of 4 members but for a small land holder 350 sqm. Kitchen garden model was ideal as it could provide sufficient amount of nutrition for a family comprising of 4-6 members. The total vegetable production and consumption were found to increase by 100 percent and 47 percent respectively, after implementation of demonstrations. Thus, additional nutrient intake and surplus production lead to income generation as well as income supplementation, improved livelihoods, household economic welfare and direct access to daily, fresh and safe food through self reliance.

Keywords: Homestead gardens, Nutation garden, Nutritional diversity

INTRODUCTION

The shift in Agriculture focusing on a market driven economy where cash crops have taken precedence, has its toll; households needs for a range of cereals, pulses and vegetables are not met from farm but purchased from the market. One of the easiest ways of ensuring access to healthy diet that contains adequate macro and micronutrients is to produce many different kinds of foods in home garden. This is especially important in rural areas where people have limited income, earning opportunities and less access to market. Vegetables occupy important place in a daily life as they are the only source to increase not the nutritive value of foods, but also their palatability. For a balanced diet, and adult should have an intake of 85 gm of fruits and 300 gm of vegetables per day according to the dietary recommendations. However the present level of production of vegetables in our country can permit a per capita consumption of only 120 grams of vegetables per day. India ranked on102 number out of 117 countries in global hunger index in the year 2019, grappling with high rate of under nutrition and a challenging management task.

*Corresponding author email id: rakshitshantanu90@gmail.com

In recent years there has been growing interest to strengthen and intensify local food production to mitigate the adverse effects of global food shocks and fruit price volatility. Consequently, there is much focus towards home garden as a strategy to enhance household food and nutritional security. A well developed kitchen garden has the potential, when land and water is not major limitation, to supply most of non staple foods that a family needs everyday of the year including roots and tubers, vegetables and fruits, lagoons, herbs and spices, rich in energy, protein, fat, iron, and vitamins. Green leafy vegetables and yellow-orange colored fruits provide essential vitamins and minerals particularly folate and vitamin A.,E, & C. Household garden scientifically laid out have to meet 40% of the supply of vegetables and fruits, medicinal plants and herbs, significant percentage of recommended dietary allowance for protein (10 to 20%), iron (15 to 20%), calcium (10 to 20 %) vitamin A (70%), vitamin C (100%).(March and Talukder, 1994). Establishment of Kitchen garden is found to be a low cost sustainable approach for reducing malnutrition, increasing awareness of vegetable production, increasing working hours and achieving food, nutrition and economic security for rural families. (Nandal, 2012). Homestead garden can also be important source of supplementary income for poor rural and urban households around the world. Properly managed home gardens, thus improve rural people's livelihoods and quality of life and foster economic growth that can reduce poverty in the future on a sustainable basis. Research shows that gardening is a preferred form of exercise across age, gender, and ethnicity (Krems *et al.*, 2004). Increasing urbanization and food security are among the key issues of present era (FAO, 2011). In recent decades safe and regular access to nutritional food to many rural and poor urban households has become uncertain, creating concern of food security in many developing countries (Nkosi *et al.*, 2014). Therefore safe food production and secure food supply are critical issue for low income countries thus requiring to develop all possible methods for production and distribution of food (Shafkuat, 2012; Cameron and Wright, 2014). In order to preserve health and prevent malnutrition, we should develop a kitchen garden, grow fresh and clean vegetables and make them a part of our daily diet

Studies indicate that women are particularly aware of kitchen gardening. They are engaged growing of vegetables in due time with proper management and able to save time and money in terms of buying vegetables from market (Cheema 2011; Bajwa *et al.*, 2015). Similarly, in the study area, woman have actively participated in kitchen garden activity along with the men and children. Involving women in setting up integrated organic kitchen gardens would empower and train them on use of latest technologies related to farming. Kitchen gardening give women more access to use of vegetables and knowledge of the importance of vegetables and empower them both economically and socially with increasing civilization and western education. Kitchen gardens are being incorporated into modern houses for easy and quick access to fresh food produce and products (Sanogo, 2007). Kitchen garden can be grown in the empty space and backyards of the house or the group of women can come together, identify a common place or land and grow desired fruits and vegetables etc, that can benefit women and community as whole (Christensen, 2011). Nutrition awareness programs stress the need for inclusion of locally available fruits and vegetables like mango, guava, anola etc. along with leafy vegetables like knol khol in daily diet. Owing to overcoming severe malnutrition and multiple nutrient deficiency disorders prevalent in the area under study daily dietary patterns and promoting vegetable production in the area under study, KVK initiated various research activities in the area with the objective to develop an intensive system of production which could enable small and marginal families to procure sufficient nutritious vegetables.

MATERIALS AND METHODS

The present study was carried out to determine food security through kitchen garden. The study was conducted in two villages (Kattal Battal and Premachak) of Nagrota and R.S. Pura, Tehsils of Jammu district of UT of Jammu and Kashmir. These villages were selected by Krishi Vigyan Kendra Jammu in the year 2020 to 2021 for promoting establishment of Kitchen gardens. The villages were selected purposively for front line demonstration of vegetable mini kits, Saplings, plants and technologies for Rabi and Kharif seasons for achieving sustainable and supplementary source of food & income, Nutritional and environmental awareness and Ensuring Accessibility through Domestic production. For the purpose of study, a list of nutrition garden demonstrations laid in the study areas was prepared for selection of the sample for the study. From 80 listed farm women, 10 farm women were selected from both villages through random sampling technique. further for the study 10 women who had no kitchen gardens were also selected purposively for comparative analysis. The objective of this Frontline demonstration was to provide knowledge to the women regarding related technologies, so that they could suitably grow desired vegetables in kitchen gardens for easy, fresh, safe and quick access for daily home consumptions. The women in each village were supplied vegetable kits for both summer (Kharif) and winter (Rabi) seasons. The kits comprised of seeds of vegetables like Okra, Sponge gourd, Bottle gourd, Radish, Carrot, Spinach, Fenugreek, Coriander, Peas, Turnip, and Brinjal etc. Since large number of FLDs was conducted on kitchen gardening therefore the study was carried out to assess the impact of these FLDs with respect to income generation, improved livelihood and household economic welfare and social and nutritional benefit. Data was collected through well structured open ended interview schedule on their basic profile growing and liking pattern of the responding and their knowledge about different vegetables demonstrative under FLDs, nutritional value of different vegetables was calculated according to ICMR (2011) with the help of nutritional value index.

RESULTS AND DISCUSSIONS

As per recommended dietary allowance (RDA) 300gm vegetables should be consumed by an adult. On that basis requirements for vegetables for family having 4 to 6 members comes out to 36 to 54 kg per month and 108 to 162 kg for three months (season) as vegetable crops are of 90 to 120 days duration so three months was taken as standard for the study (Table 1). Analysis of the data in the table reveals that the average vegetable production from 250 sq. m was 120 kgs and 166 kgs from 350sq m. for summer season. Similarly, average production from 250 sq. m and 350 sq. m was 126 kgs and 166 kgs respectively in Kharif season. As per RDA daily vegetable consumption of an adult person should be around 300gms. Based on the findings it was concluded that although kitchen garden model with 250 sqm area is sufficient to fulfill the recommended dietary allowance requirement for vegetables (300 gms /head/day) for a family of 4 members but for a small land holder 350sqm. Kitchen garden model was ideal as it could provide sufficient amount of nutrition for a family comprising of 4-6 members The Respondents having no nutrition garden produced 0.0kg and respondents having Kitchen garden reported 1.84 kg of vegetables per day and consumption was 1.80 kgs of producers and 0.95kgs of non- producers respectively. It was observed that production and consumption was found to increase 100 percent and 47 percent respectively after demonstrations.

Therefore it can be concluded from the findings that 250 sq. m and 350 sq. m area is sufficient to feed and fulfill the minimum requirements of vegetables for a family of 4 to 6 members respectively, Consume their home grown vegetables and in case of surplus production as per family requirements at different times, surplus produce could be sold in local market fetching money or saving the money spent on purchasing the same from market. Table 6, depicting economic evaluation of 350Sqm kitchen garden gives an estimate of income from kitchen garden from an area of 350sqm in three months span (Rs 3050/) to women thus saving money otherwise spent on vegetables for family. Thus for achieving economic security of rural families from homestead gardens either area can be increased or yield potential could be further improved. As far as economic evaluation of Nutrition garden planned in said dimensions is concerned, it is evident from the data that kitchen gardens contribute to income generation as well as income supplementation, improved livelihoods, household

Table 1: Appropriate area required for Nutrition Garden for a family of 4-6 members

Crop	Vegetables (kg) – Kharif Season (3 months)									Total
Area	Bitter gourd	Okra	Cowpea	Sponge gourd	Bottle gourd	Tinda	Radish	Tomato	Brinjal	
250 Sqm	9	14.4	11	14.65	15.9	7.2	6.75	19	22.7	120.6
350 Sqm	12.5	20.0	14.1	21.1	22.9	10.0	9.5	25	29.9	166

economic welfare, entrepreneurship development and rural development. kitchen garden helped in increasing household income either by sale of food products grown in garden or by consumption of same food produce which the family would have otherwise purchased from markets using a significant portion of family income. Apart from income generation and household economic welfare, the savings from consuming home grown food products create an increased amount of disposable income for the beneficiary families, who invest surplus income to fulfill other domestic requirements including purchase of additional food items, greater investment in education of children etc. The average yield and economic returns and additional produce obtained from summer season vegetables produced by randomly selected farm women (Table 2) clearly indicate that vegetable production can be a profitable venture.

Further, the endeavor has helped in reducing hidden hunger and also likely to curb the possibility of suffering from diseases caused by micro-nutrient deficiency by ensuring small but continuous flow of subsistence food products in daily household diet. Adequate nutrition is not only dependent on quantity of food available, the seed kits provided by KVK ensured a range of essential micro-nutrients like vitamins, magnesium, iron, folate, manganese, zinc,

Table 2: Contribution of vegetables produced from Nutrition garden (350 sq meters) to food and nutrition security (3 months/ Summer season) for a family of 6 members

Name of the Vegetables	Average Production	Market Value (Rs /-)	Average Consumption	Average (RDA)	Nutritional Status
Bitter gourd, Okra, Cowpea, Sponge gourd, Bottle gourd, Tinda, Radish, Tomato, Brinjal	166kg	3030.3	166kg	162kg	4kg additional consumption

Table 3: Average per day vegetable production, consumption and percentage increase from Nutrition garden

Category	Production (kg/day)	Consumption (kg/day)
Nutrition garden establisher	1.84/ family of 6 persons	1.80 / family of 6 persons
Non-Nutrition garden establisher	0	0.95 / family of 6 persons
Differences	1.84/ family of 6 persons	0.85/ family of 6 persons
Percent increase	100 % increase	47% increase

Table 4: Average yield from summer season vegetables grown in the kitchen garden on 250 m^2 area, vegetable yields (kg)

S.No	Bitter gourd	Okra	Cowpea	Sponge gourd	Bottle gourd	Tinda	Radish	Tomato	Brinjal	Cumulative Yield (kg)
1	10	13	11.5	11	13	6	5	19	22.5	111
2	12	15	13.5	19	17	4.5	6	19.5	22	128.5
3	12	16	13	18.5	19	6.5	8	18.5	21.5	133
4	11.5	16	12	17.5	18	8	9	18	22	132
5	10	15	12	16	19.5	10	9	20	22.5	134
6	10	14.5	11	17	18.5	9	8	17.5	23.5	129
7	9	15	10.5	14.5	17.5	9	7.5	20.5	23.5	127
8	8	14	9.5	12.5	14.5	7	6	19	23	113.5
9	8	13	9	11	12	6	5	19.5	22.5	106
10	7.5	12.5	8	9.5	10	5	4	18.5	24	99
Total	90	144	110	146.5	159	72	67.5	190	227	1213
Avg	9.0	14.4	11.0	14.65	15.9	7.2	6.75	19	22.7	121.3

potassium, sodium, fibre etc. Therefore it is evident that kitchen gardens increased production and intake of micro-nutrient rich foods apart from diversifying the household diet and making them more appealing (Table 3).

Review of studies reveal that most fundamental benefit of nutrition /kitchen gardens can be accrued from their direct contribution to household food security by increasing availability, accessibility and utilization of food products (FAO, 2003). It was observed that Food items produced in kitchen gardens add to family nutrition substantially, which directly leads to reduction of food insecurity. Kitchen gardening helped women to develop proficiency in vegetable cultivation, which in turn helped them to become better home and environment managers and meet the needs of their families more easily and economically. This has enhanced their status within the family and society at large. Their contribution in household food production has increased manifold, at times even making them sole caretakers of these gardens. It was observed that with time, kitchen gardening activities commensurate with their daily household chores, subsequently generating hopes for their socio-economic enhancement (Table 4&5).

Food availability refers to the supply of food made available through domestic production. Accessibility is ensured when an individual is able to obtain food without any physical, social or economic barrier. Food adequacy or utilization is achieved through various biological and non biological process that ensures energy and nutrient intake (Table 6). Homestead vegetable production contributes to household security by providing direct access to food that can be harvested, prepared and feed to family members almost daily). Average vegetable production from nutrition garden was 166kg and families consumed their originally grown vegetables which helped to improve their nutrition and save their money spent on green leafy and other vegetables and also tends to taste better than the ones purchased from market similar observations were reported by Christensen in 2011.

Table 6: Economic evaluation of Nutrition Garden planned in 350 square meter area

Crop	Average Yield (kg)	Market Rate (Rs/kg)	Average Income
Bitter gourd	12.5	18	237.5
Okra	20.0	20	400
Cowpea	14.1	22	310.2
Sponge gourd	22.1	19	419.9
Bottle gourd	22.9	18	412.2
Tinda	10.0	15	150
Radish	9.5	16	152
Tomato	25	20	500
Brinjal	29.9	15	448.5
Total			3030.3

Table 5: Average yield from summer season vegetables grown in the kitchen garden on 350 m^2 area, vegetable yields (kg)

S.No	Bitter gourd	Okra	Cowpea	Sponge gourd	Bottle gourd	Tinda	Radish	Tomato	Brinjal	Cumulative yield (kg)
1	14	17	14	15	18	8	8	25	31	150
2	13	19	15	30	28	7	10	24	29	175
3	15	21	16	29	30	9	10	23	28	181
4	12	21	15	27	30	10	14	26	32	187
5	13	19	17	25	26	16	12	24	28	180
6	15	20	15	26	24	12	11	27	31	181
7	11	20	14	23	23	15	10	26	30	172
8	11	20	12	18	20	10	9	28	31	159
9	11	22	12	15	16	7	7	23	30	143
10	10	21	11	13	14	6	4	24	30	133
Total	125	200	141	221	229	100	95	250	299	1661
Avg	12.5	20.0	14.1	22.1	22.9	10.0	9.5	25	29.9	166

CONCLUSION

The 350 sq.m area was found to sufficiently support a family of 4-6 members which would provide daily vegetable requirements of family as well as some earning (for 4 members) to them. The average vegetable production in a cropping season(summer) was about 166 kg from kitchen garden of 350sq.m area. This has improved the calorie intake of members in the families. Analysis has revealed that homestead gardens can be a boon to small and marginal land holders in providing food security and nutritional diversity. Disposal of organic waste by producing organic manure for kitchen garden would help in solving a big problem. Therefore it is recommended that efforts to remove above listed bottlenecks would lead to successful adoption of kitchen gardening as the efforts by KVK had a positive impact in providing healthy and nutritious recommended diet to family comprising of both 4 to 6 members and also helped in reducing economic burden, procuring fresh, safe toxin free vegetables. In times of increasing food prices, kitchen gardening practice has the potential to directly address the area of nutrition and food diversity and food security, income generation, alternative livelihood creation for household as well as empowerment of women in long run. Thus, nutrition garden is one of the key intervention strategies that aims to provide direct access to poor to food through self reliance, rather than dependence on subsidies and supplementation schemes.

REFERENCES

Arshad, S. and A. Shafquat. 2012. Food security Indicators Distribution and Techniques for Agriculture sustainability in Pakistan. *International Journal of Applied Science & Technology,* 2: 137-147.

Cameron, J. and S. Wright. 2014. Researching Diverse Food initiatives: From Backyard and Community Gardens to International markets. *Local Environ,* 19: 1-9.

Cheema, K.J. 2011. Call to Promote Kitchen Gardening. The News.

Christensen, T.E. 2011. What is Kitchen Garden?. Kitchen gardening technology introduced in LCWU. *Pakistan Educational News Keiko,* 1(2): 319-327.

D, Sonogo. 2007. Africa's Food Status: Implications and challenges in a changing world in facing up food crisis in sub Saharan Africa. Proceedings of the 12th Annual Symposium of International Association of Research Scholars & fellows.

FAO. 2011. Food Agriculture and Cities-Challenges of Food and Nutrition Security, agriculture and Ecosystem Management in an urbanized world. cited 2015 feb.www.Fao.org/File/admin/templates/FCIT…/ Food Agri. cities pdf.

Global Hunger Index. 2019. Available on https:// www.globalhungerindex.org/results,html.

Halder, P. and S. Pati. 2011. A need for paradigm shift to improve supply chain management of fruits and vegetables in India. *Asian Journal of Agriculture of Rural Development,* 1: 1-20.

Krems, C.; P.M. Lehrmana and M.B. Neuhuser. 2004. Physical activity in Young and Elderly subjects. *Journal of Sports, Medicine & Physical Fitness,* 44(1): 71-76.

Marsh, R. and A. Talukder. 1994. Production and Consumption effects of the Introduction of Home Gardening on target, interaction and control groups : A case study of Bangladesh. Proceedings of International symposium on systems oriented research AFSR.

Nandal, U. 2016. Food security through Homestead vegetable production. *Indian Journal of Extension Education & Rural Development,* 24: 170-177.

Nkosi, S.; T. Gumbo; F. Kroll and M. Rudolph. 2014. Urban household Food and Income Supplements in African cities: Experiences in Hammanskrael, Pretoria. *Asian Policy Brief*, 112: 1-6.

Titiola, O.L.; A.O. Abraham and J.A. 2012.Food Consumption Pattern in Ogbomoso metropolis of Oyo state, Nigeria. *Journal of Agriculture and social science Research,* 12:74-83.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 428-431

A Study of Economics analysis of Hybrid Marigold Production in Jammu District of J&K

Raju Gupta, Prem Kumar, Punit Choudhary and Pawan Sharma

Sher-e-Kashmir University of Agriculture Science and Technology, Jammu-180009, J&K

ABSTRACT

Marigold is one of the important cash crops for the Indian farmers. It has gained popularity on account of its easy culture and wide adaptability, wide attractive colours, shape, size and good keeping quality and it is widely grown for their aesthetic, economic, religious and social value. Marigold oil acts as a repellent against files, ants and mosquitoes and also this essential oil is used in high grade perfumes and cosmetics industries in India. The present area under marigold is 55-89 thousands hectares with a production of 511.31 thousands million tones of loose flowers and +25 thousands million tonnes of cut flowers. It is cultivated commercially in most parts of India. Moreover Jammu and Kashmir has immense scope of floriculture as the state is blessed with some word famous religious shrines and tourists across the world visit to these spots. The floriculture is not getting the priority as it deserves in the state. In Jammu region, a total of 468.53 ha area was under flower cultivation with a total production of 13,680 ton loose flowers and 10.01 lakh number of cut flowers in 2014–2015, out of which, marigold flowers were cultivated on 467.33 ha, which yields total production of 13,680 ton. In floriculture income per hectare is much higher than many other agricultural sectors if it done in a specific way. The study showed that the variable cost and net return of hybrid marigold production was highest for marigold farms. This paper aims to conducting study on Economic Analysis of Hybrid Marigold Production in Jammu District of J&K.

Keyword: Economic, Hybrid, Marigold, Production

INTRODUCTION

Floriculture is considered as economically viable diversification option in the Indian agriculture and has captured the interest of many entrepreneurs due to the easiness of marketing directly and cash money. The floriculture business is growing with an annual rate of 7-10%. Cut flowers, loose flowers, products like dry flowers and foliages, essential oils, nutraceuticals, natural colour etc. are in very much demand. Tamil Nadu, Andhra Pradesh, Maharashtra and West Bengal are leading states in flower cultivation while it is estimated that 248.41 thousand ha area was under flower cultivation during 2014-15. The floriculture in J&K has increased tremendously, which is evident from the increase in area from 225 ha against only 80 ha in 1996. The state of Jammu and Kashmir has a great potential for commercialization of floriculture. Emerging trends of increase in area under flower crops due to the market demand shows the better prospects for flower cultivation in Jammu and Kashmir. The climatic conditions also favours the development of the floriculture industry in the state. The business of flowers is still in its in growth stage and it can be increased by the efforts made by government through various programmes, exhibitions, flowers shows and seminars. Marigold is the major floriculture crop of Jammu region, grown over an area of 240 acres. The present study had been conducted to assess the economics of hybrid marigold production along with the constrains perceived by marigold flower growers.

MATERIALS AND METHODS

The present study has been conducted in R.S. Pura block of Jammu district of Jammu and Kashmir UT. The majority of farmers have diversified their farms in this block by adopting floriculture as one of the major enterprises. In this study, two villages namely village Chouhala and village Dablehar were selected purposively as there are sufficient numbers of flower growers present. Thirty respondents from each village were interviewed through convenient sampling, thus making a total sample of sixty respondents for the present study. The responses of the respondents were recorded in a pre designed interview schedule. The statistical methods like percentage and frequency were employed for analyzing the data.

RESULT AND DISCUSSION

The detail item-wise cost of hybrid marigold in the study area has been present in Table 1. The total variable cost of hybrid marigold production was estimated to be Rs. 23680.28 Rs. 23276.24 and Rs. 23310.04 for marginal, small and large farms respectively. Similarly the total fixed cost of hybrid marigold production was estimated to be Rs. 4662.40 Rs. 4707.77 and Rs. 4725.43 for marginal small and large farms respectively. The total cost of hybrid marigold was found to be Rs. 28342.68 Rs 27981.01 and Rs. 28035.47 for marginal and small and large farms respectively. Among the total variable cost of hybrid marigold, cost of seed constituted the largest share, followed by cost of machinery labor, cost of fertilizers and cost of human labor. It can be concluded that the variable cost of hybrid marigold production was highest for marginal farmers followed by large and small farmers. The fixed cost increases with increase in size of holding. The total cost however does not show any specific pattern with increases in size of the farm.

The yield and return from hybrid marigold under three selected categories in the study area has been presented in Table 2. The yield of hybrid marigold varies from 9175.00 kg per acre in case of marginal farms to 9140.00 kgs per acres in case of small farms to 9255.00 kg per acre in case of large farms. The gross return was highest in case of marginal farms i.e. (Rs. 355990.00) followed by small farm i.e. (Rs. 352347.00) and large farms i.e. (348450.75). The net return was also highest in case of marginal farms (Rs. 327647.32) followed by small farms (Rs. 324365.90) and large farms (Rs. 320415.28). The B:C ratio was highest in case of small farms (12.59) followed by marginal farms (12.56) and large farms (Rs. 12.43). The overall yield of hybrid marigold was 9190.00 kg per acre and net return was Rs. 324142.86

The constraints in marigold production was identified and analyzed for the selected categories of farms. The Garret Ranking technique was used for

Table 1: Item-Wise Cost of Hybrid Marigold Production (Rs. acre)

Particulars	Size of land holding			Overall
	Marigold	Small	Large	
Seed	8840.00(31.19)	8840.00(31.59)	8960.00(31.96)	8880.00(31.58)
Machinery Labour	3835.00 (13.53)	3710.00(13.26)	3760.00(13.41)	3768.33(13.40)
Manure	1923.00(6.78)	2035.50(7.27)	1873.50(6.68)	1944.00(6.91)
Chemical fertilizer	3585.00(12.65)	3440.00(12.29)	3410.00(12.16)	3478.33(12.37)
Insecticides	1504.00(5.31)	1485.50(5.31)	1557.50(5.56)	1515.67(5.39)
Irrigation	130.00(0.46)	132.50(0.47)	127.50(0.45)	130.00(0.46)
Human labour	2950.50(10.42)	2737.50(9.78)	2725.00(9.72)	2805.00(9.98)
Interest on variable cost @ 12%	910.78(3.21)	895.24(3.20)	896.54(3.20)	900.85(3.20)
Total Variable Cost	23680.28(8.55)	23276.24(83.19)	23310.04(83.14)	23422.19(83.29)
Estimated Rented Value	3600(12.70)	3600(12.87)	3600(12.84)	3600.00(12.80)
	50(0.18)	50(0.18)	50(0.18)	50.00(0.18)
	862(3.04)	903(3.23)	923(3.29)	896.00(3.19)
	150.40(0.53)	151.77 (0.54)	152.43(0.54)	151.53(0.54)
Total fixed cost	4662.40(16.45)	4704.77(16.81)	4725.43(16.86)	4697.53(16.71)
Total Cost	2842.68(100.00)	27981.01(100.00)	28035.47(100.00)	28119.71(100.00)

Figures in parentheses represent percentages

Table 2. Yield and Economic Returns from Hybrid Marigold (per acre)

Particulars	Size of land holding			Overall
	Marigold	Small	Large	
Yield (kg)	9175.00	9140.00	9255.00	
Price (Rs.)	38.80	38.55	37.65	
Gross Return (Rs.)	355990.00	352347.00	348450.75	9190.00
Total Cost (Rs)	28342.68	27981.01	28035.47	
Net Return (Rs.)	327647.32	324365.99	320415.28	
B:C Ration	12.56	12.59	12.43	

Table 3: Constraints in Marigold Production

S. No.	Constraints	Marginal Farms		Small farms		Large farms		Overall	
		Garret's Mean Score	Ranking	Garret's Mean Score	Ranking	Garret's Mean Score	Ranking	Garret's Mean Score	Ranking
1	Un-availability of quality seed	68.05	II	72.50	I	73.00	I	71.18	I
2.	Un-availability of fertilizer	47.70	IV	56.40	III	62.10	III	55.40	III
3.	Lack of Irrigation facility	40.50	VII	42.30	V	70.10	II	50.97	IV
4.	Labour Problem	47.90	III	41.23	VI	30.05	VI	39.73	VII
5.	Price not good	41.80	VI	43.24	IV	36.10	V	40.38	VI
6.	Marketing problem	46.50	V	22.25	VIII	20.12	VIII	29.62	VIII
7.	Lack of new information	36.00	VIII	42.24	VII	50.00	IV	42.75	V
8.	Lack of finance	70.60	I	59.21	II	24.30	VII	59.21	II

identified the most crucial constraints in the marigold production in the study area and presented in Table 3. Observations indicate that the top three constraints in marigold production for marginal farmers were lack of finance, un-availability of quality seed and un-availability of fatigue respectively. The top three constraints for small farmers were un-availability of quality seed, lack of finance and un-availability of fertilizers respectively. Similarly, the top three constrains for large farmers were un-availability of quality seed, lack of irrigation facility and un-availability of fertilizers respectively.

CONCLUSION

The farm level cultivation of marigold flower is highly profitable because of its higher demand compared to its production. Its cultivation is also profitable compared to its competitive crops Jammu region is going to play a vital role in floriculture trade which may turn the economy of the state. Hence, the present study revealed that the variable cost of hybrid marigold production was height for marginal farmers followed by large and marginal farmers. The fixed cost increases with increase in size of holding. The total cost however does not show any specific pattern with increase in size of the farm. The net return was also highest in case of marginal farmers followed by small farmers and large farmers. The marigold farmers face various problems during production and marketing of their produces i.e. unavailability of quality seed, lack of finance and unavailability of fertilizers and lack of technical know-how.

REFERENCES

Anonymous, Annual Report 2007. National Horticulture Board, Jammu and Kashmir 2007.

Jehanzeb, Khan, A. and Hussain, A. 2015. The marketing and cost-benefit analysis of floriculture in the rural areas of Peshawar: A case study of Bazid Khel. *City University Research Journal,* 5(1): 49-63.

Manjula, N. 2003. A analysis of Krishniprashasthi awardee farmers and their influence on the neighbouring farmers. M.Sc. (Ag) Thesis, University of Agriculture Science, Dharwad Karnataka (India).

Omar, I Chowdhury, M.I & Islam, T. Islam, R. Islam, M. 2014. Marketing Efficiency and Post Harvest Loss of Flower in Bangladesh. *IOSR Journal of Business and Management,* 16(1): 45-51.

Sheikh MQ, Bhat ZA, Sidddique MAA, Singh KP, Saha TN. 2015. Present status and prospects of floriculture in Jammu and Kashmir. *Indian Council of Agriculture Research Directorate of Floriculture Research, Pune,* 13: 138.

Singh, K.P.; Lakhera, J.P. and Sharma, S.K. 2010. Communication behaviour of small farmers in relation to wheat production technology. Paper presented in Souvenir national seminar on role of extension education changing agriculture Scenario held on 6-8 march, 2010, Dipole, Kokan Krishi Vidya Peeth, Maharashtra; p-6.

www.aiph.org/2011 (International Statistics Flowers and Plants/statistical-year book).

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 432-436

Constraints Perceived by the Farmers Using Farm Mechanization Under Farm Machinery Banks (FMBs) in Jammu Division of Jammu and Kashmir

Ruhana Rafiq[1]*, Poonam Parihar[2] and Mohammad Monis Ansari[1]
[1]Ph.D. Scholar, [2]Assistant Professor, Division of Agriculture Extension Education, Faculty of Agriculture, SKUAST-J, J&K

ABSTRACT

Farm mechanization has become a necessity for boosting agricultural productivity, reducing drudgery and achieving agriculture's stable expansion in tandem with population increase. Due to the growing scarcity of agricultural labour, farmers need to have access to agricultural machinery at a reasonable cost for timely completion of their farming operations. Even though farm mechanization helps farmers in various ways, yet it's not adopted on a full scale. Hence the study was conducted to find the constraints perceived by the farmers using farm mechanization under Farm Machinery Banks (FMBs). The study was conducted in Jammu, Doda and Samba districts of Jammu & Kashmir. Multi stage sampling plan was followed for the selection of ultimate respondents. Three districts namely Jammu, Samba and Doda were selected purposively because of having maximum number of FMBs (11 in number) existing in these three selected districts. All FMB adopted villages from three selected districts were selected for the study. Each FMB comprises of 8-10 number of farmers. Hence making the sample size of 98 FMB adopted farmers. Whereas in case of non-FMB members, from each FMB adopted village, four non-FMB adopted farmers were selected randomly, thus making a sample size of 44 non-FMB adopted farmers. Thereby making a sample size of 142 respondents. Results of the study showed that major constraints perceived by the FMB members were more expenditures on maintenance followed by non-availability of spare parts in the local market, the undulating topography and terraced irregular shape fields make mechanization difficult with farm equipment available in the market, transportation problem, Non availability of work around the year, difficulties in getting payment for service, State share of subsidy not provided at proper time and high risk involved in the machineries. Whereas in case of non-FMB members, majority of the respondents reported that there was non-availability of machinery at proper time, small farmers do not prefer it and expensive to use.

Keywords: Farm mechanization, Farm machinery banks, Crop production, Emergence, Constraints and topography

INTRODUCTION

Increased demand for enhanced agricultural productivity and profitability from limited land resources, in a globally competitive manner in India, needs large scale mechanization (Roy and Bezbaruah, 2002; Mishra, 2006; Sharma *et al.,* 2010). Farm Mechanization is the process of developing machines and substituting this machine power for human and animal power in agriculture and allied production practices. Farm mechanization has become a requirement for boosting agricultural productivity and achieving agriculture's stable expansion in tandem with population increase. Due to the growing scarcity of agricultural labour, farmers must have access to agricultural machinery at the appropriate time and at a reasonable cost. Furthermore, through improving input usage efficiency and judicious use of inputs, the use of appropriate agricultural machinery lowers the unit cost of output. Farm mechanization improves crop yield by making agricultural processes and inputs more efficient. However, in India, over 85% of agricultural holdings are tiny, and owning farm machinery is neither

*Corresponding author email id: ruhanarafiq624@gmail.com

possible nor economical. In this circumstance, the most rational and suitable institutional solution proposed in recent years appears to be bespoke hiring of agricultural machinery (Reddy and Rani, 2021). Farm mechanization in India is about 40-45 percent which is comparatively very low as compared to countries like USA (95 per cent), Brazil (75 per cent) and China (57 per cent) (Barman *et al.*, 2019). The usage of animal and human power in farm-related tasks has decreased significantly in India's agriculture industry. A variety of agricultural equipment have benefited from the trend. Many of these are powered by fossil fuel vehicles, such as tractors and diesel engines. As a result, the old agricultural process has given way to a more automated one. The importance of tractors in Indian agriculture shows the country's rising tractorization trend (Singh and Sahni, 2019). The level of farm mechanization in India stands at about 40-45% with states such as UP, Haryana and Punjab having very high mechanization levels, but north-eastern states having negligible mechanization. (NABARD, 2018). The Government has paid much attention towards mechanization by providing subsidy to the farmers on useful implements/ machines. The Ministry of Agriculture and Farmers Welfare launched a scheme Sub-Mission on Agricultural Mechanization (SMAM) for promotion of farm mechanization during the year 2014-15. The Government has introduced several schemes and policies that support greater mechanization of Indian Agriculture, in the light of its commitment to transform the agriculture sector and double farmers' income by 2022-23. Union territory of Jammu and Kashmir is one of the north-western mountainous regions with total geographical area of 2417 thousand ha, out of which net sown area is about 757 thousand ha (39.32%), forest land is 659 thousand ha (27.26%), area not available for cultivation is 562 thousand ha (23.25%), other uncultivable land is 315 thousand ha (13.03%) and fallow land is 121 thousand ha (5.01%) (DOS, 2016-17). Agriculture and its related industries provide around 36% of the country's GDP and employ roughly 80% of the people. The major source of farm power is draught animals. For land preparation, animal-drawn equipment such as the Indigenous, Tawi, Hill, and Soil Stirring Plough are used. Farmers in plain topography utilize tractors and equipment for tillage and transportation, whereas small and marginal farmers still use manual tillage instruments like spades, shovels, sickles, and hand forks. (Dixit et. al., 2006; Sharma, 2010). At present, the availability of farm power is 0.78 kW/ha in the state (gross cropped area basis). There is great variability in unit farm power availability within state i.e., it is as high as 3.06 kW/ha in RS Pura and Bishnah and as low as 0.47kW/ha in Ramnagar areas of Jammu region of the state (Sharma, 2009, Sharma, 2010). In the erstwhile state of Jammu& Kashmir, SMAM was introduced in the year 2014-2015 and the Farm machinery banks were established under SMAM. Therefore, keeping in view, the functioning and importance of SMAM scheme, the present study was conducted to find out the constraints perceived by the farmers using farm mechanization under Farm machinery banks.

MATERIALS AND METHODS

The study was conducted in Jammu, Doda and Samba districts of Jammu & Kashmir. Multi stage sampling plan was followed for the selection of ultimate respondents.

Stage-I. Selection of districts: Three districts namely Jammu, Samba and Doda were selected purposively because of having maximum number of FMB's. Eleven (11) number of FMB's existing in these three selected districts.

Stage-II. Selection of villages: All FMB adopted villages from three selected districts were selected for the study.

Stage-III. Selection of respondents: The respondents were further divided into two groups.

1) Treatment group: There are 11 numbers of FMBs existing in selected three districts and each FMB comprises of 8-10 number of farmers. Total 98 FMB's adopted farmers are existing in these 11 FMBs. Therefore, all the 98 FMB adopted farmers from three selected districts were selected for the study.

2) Control group: From each FMB adopted village, four non FMB adopted farmers were selected randomly, thereby making a sample size of 44 non FMB adopted farmers. Overall sample size consisted of 142 respondents.

RESULTS AND DISCUSSION

It is evident from the results that the average age of the FMB and Non- FMB members were 47.68 and

47.34 years respectively. Significant difference was also observed in young and middle age category with (z=5.304; p= 0.001) and (8.165; p= 0.001) respectively. This might be because the middle-aged group of people work actively, are more enthusiastic, having more work efficiency and are more responsible for maintaining their families. Similar results were obtained by Kumar (2014).

As per the education is concerned, it was found that majority of the FMB members were educated up to matriculation level. Whereas majority of non-FMB members were educated up-to middle level of education. However, proportion of highly educated persons engaged in farming was low in study area and this might be due to the fact that farming is labour intensive activity because of manual harvesting and threshing and the persons having higher education might not opted its cultivation and more over agriculture may not be their main occupation. These results are in conformity with the findings of Gudadur and Johanara (2017).

The data presented in Table 1 revealed that majority of the FMB members (91%) were head of the family whereas in case of non-FMB members only 66% of the respondents were head of the family. Nuclear families were dominant in the study area, and it may due to impact of urbanization and westernization in rural area which is resulting in disintegration of joint family system in farm family. The results in Table 1 related to operational land holding revealed that the

Table 1: Descriptive statistics regarding socio-economic status of the respondents (% respondents).

Parameters	FMB members (n= 98)	Non-FMB members (n= 44)	Diff.	Statistics (*p*- value)
Average age (years)	46.68±1.084	47.34±9.887	-0.66	$\|t\|$=0.355(0.771)
Age				
Young (22-42)	39(40)	17(39)		$\|z\|$=5.304**(0.001)
Middle (43-63)	50(51)	23(52)		$\|z\|$= 8.165**(0.001)
Old (Above 64)	9(9)	4(9)		$\|z\|$= 1.866(0.061)
Average education (schooling years completed)	10.04±2.917	8.77±2.794	1.27	t= 2.467(0.589)
Education				
Illiterate	2(2)	2(5)		$\|z\|$= 2.373*(0.017)
Primary	7(7)	3(7)		$\|z\|$= 1.620(0.105)
Middle	20(21)	17(39)		$\|z\|$= 7.497**(0.001)
Matriculate	41(42)	12(27)		$\|z\|$= 2.040*(0.041)
10+2	19(19)	10(22)		$\|z\|$= 3.722**(0.002)
Graduation and above	9(9)	0	-	—
Family (% respondents)				
Head of Family (% respondents)	89(91)	29(66)		z= 3.662**(0.002)
Family type (% respondents) Joint	18(18)	16(36)		z= 7.202** (0.001)
Nuclear	80(82)	28(64)		z= 2.323* (0.020)
Average operational land holding (ha)	1.03±0.545	0.69±0.287	0.34	t= 4.806**(0.001)
Farm size (% respondents)				
Marginal (<1 ha)	47(48)	34(77)		$\|z\|$=21.391**(0.001)
Small (1-2 ha)	41(42)	10(23)		$\|z\|$= 1.041(0.298)
Semi- medium	(2-4 ha)	10(10)	0	-
Average irrigated area	0.46±0.653	0.30±0.398	0.26	t= 1.808**(0.004)
Average unirrigated area	0.56±0.057	0.39±0.352	0.17	t= 2.248**(0.001)

average operational land holding of FMB and Non-FMB members were 1.03 (±0.545) ha and 0.69 (±0.287) ha respectively. Statistically there was significant difference between FMB members and non-FMB members in average operational land holding with (t=4.806; p= 0.001). Further in case of farm size of FMB members 48 percent of the respondents were marginal having landholding size of less than 1 hectare, 42 percent were small (1-2 ha), 10 percent were semi-medium (2-4 ha). Whereas in case of non-FMB members, 77 percent were marginal having landholding size of less than 1 hectare, 23 percent were small (1-2ha) and there was no respondent in semi-medium category. the studies also revealed that the average irrigated area of FMB members and non-FMB members were 0.46 (± 0.653) ha and 0.30 (± 0.398) ha respectively. The average unirrigated area of FMB members and non-FMB members were 0.56 (± 0.057) ha, and 0.39 (± 0.352) ha respectively. Statistically, there was a significant difference between FMB members and non-FMB members in average irrigated and unirrigated area with (t=1.808; p= 0.001) and (t= 2.248; p= 0.001) respectively. The average operational land holding of FMB members were 1.03 (±0.545) ha which is higher than the state average 0.67 hectare (Census of India, 2011). This may be due to the fact that only those people actively participated in FMB who had the sufficient land holding size. Statistically there was significant difference between FMB members and on-FMB members in average operational land holding (t=4.806; p= 0.001). The number of marginal farmers was dominant in the study area. The continuous fragmentation of land holdings and shrinkage of the agricultural land might be the reason for this situation.

It was operationalised as the degree to which the respondents face some difficulties or hindrances using farm mechanization under FMB. The result presented in Table 2 revealed that the major constraints perceived by the FMB members were more expenditures on maintenance followed by non-availability of spare parts in the local market, the undulating topography and terraced irregular shape fields make mechanization difficult with farm equipment available in the market, transportation problem, Non availability of work around the year, difficulties in getting payment for service, State share of subsidy not provided at proper time and high risk involved in the machineries. Whereas in case of non-FMB members, majority of the respondents reported that there was no availability of machinery at proper time, small farmers do not prefer it and expensive to use. More efforts need to be done for proper functioning of FMB under the scheme of SMAM. Subsidy should be provided on the priority

Table 2: Constraints encountered by farmers in using farm machinery from FMBs (% respondents)

Constraints	FMB members (n=98)	Rank	Non-FMB members (n=44)	Rank
More expenditures on maintenance.	50(51)	I	0	0
Non availability of spare parts in the local market.	41(42)	II	0	0
Transportation problem.	32(33)	IV	0	0
State share of Subsidy not provided at proper time.	18(18)	VIII	0	0
The undulating topography and terraced irregular shape fields make mechanization difficult with farm equipment available in the market.	40(41)	III	0	0
Non availability of work around the year	24(24)	VI	0	0
High risk involved in the machineries	13(13)	IX	0	0
Difficulties in getting payment for service	19(19)	VII	0	0
Small farmer does not prefer mechanization	27(27)	V	0	0
Non availability of Machinery at proper time	0	0	31(70)	I
Expensive to use	0	0	12(27)	III
Small farmer does not prefer	0	0	15(34)	II

**Multiple responses

base and some subsidy should also be provided for the maintenance of farm machineries which will encourage the farming community. Similar finding was also found by Dixit *et al.* (2014).

CONCLUSION

It is concluded on the basis of major findings that proportion of highly educated persons engaged in farming was low in study area. Statistically there was significant difference between FMB members and non-FMB members in average operational land holding, average irrigated and unirrigated area. Major constraints faced by the FMB members were more expenditures on maintenance followed by non-availability of spare parts in the local market, the undulating topography and terraced irregular shape fields make mechanization difficult with farm equipment available in the market, transportation problem, non-availability of work around the year, difficulties in getting payment for service, State share of subsidy not provided at proper time and high risk involved in the machineries. More efforts need to be done for proper functioning of FMB under the scheme of SMAM. Knowledge level of farmers about agricultural machinery should be enhanced by the use of mass media, arranging exhibitions and conducting field demonstrations. State share of subsidy should be provided timely for better livelihood of the farmers and spare parts of the machinery should be made available in their nearest markets in order to avoid the transportation problems.

REFERENCES

Anonymous. 2018. Government of India. 2018-19. Annual report, National Bank for Agriculture and Rural Development.

Barman, S.; N. Deka and P. Deka. 2019. Factors affecting farm mechanization - A case study in Assam, India. *Asian Journal of Agricultural Extension, Economics and Sociology,* 32(1): 1-7.

Census of India. 2011. Census of India. Details available at http://Censusindia.gov.in/2011census/hio/data_sheet/india/HLO_indicator.xlx.

Dixit, J.; A.S. Jeena; N.C. Shahi and T. Wahid. 2006. Potential of farm mechanization in Jammu and Kashmir State of India-A review. *Agricultural Mechanization in Asia, Africa and Latin America,* 37(4): 9-14.

Dixit, J.; S. Sharma and M. Ali. 2014. Present status, potential and future needs for mechanization of agricultural operations in Jammu and Kashmir state of India. *Agricultural Engineering International,* 16(3): 87-96.

Gudadur, K. and Jahanara. 2017. A Study on Adoption level of farm mechanization on Paddy grower in Uttarakhand, Karnataka. *International Journal of Pure and Applied Bioscience,* 5(6): 1640-1644.

Kumar, M.S. 2014. A study on the Agricultural Mechanization in Karimnagar District of Andhra Pradesh. M.Sc. Dissertation, Acharya N.G. Ranga Agricultural University, Hyderabad.

Mishra, S.K. 2006. Sustainable growth of agriculture in India. CABI Abstract.

Reddy, S.Y. and V.S. Rani. 2021. Custom Hiring Centres – A Mechanization Innovation for sustainable Agriculture in India. *6th National Youth Convention,* 80-93.

Roy, N. and M.P. Bezbaruah. 2002. Agricultural Growth and Regional Economic Development (A Study of Barak Valley). Mittal Publications, New Delhi.

Sharma, S. 2009. Status of farm power availability in the selected villages of Jammu District (J&K State). *Agricultural Mechanization in Asia, Africa and Latin America,* 40(10): 41-45.

Sharma, S. 2010. Status of farm power availability in the selected villages of Udhampur District (J&K State). *Journal of Dryland Agriculture Research & Development,* 25(1): 70-73.

Sharma, V.K.; K. Singh and B.S. Panesar. 2010. Custom hiring of agricultural machinery and its future scope. Status of farm mechanization in India, DOAC, Government of India, pp 127-132.

Singh, R.S. and R.K. Sahni. 2019. Transformation of Indian Agriculture through Mechanization. *Economic Affairs*, 64(2): 297-303.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 437-442

Intensification of Existing Rice-Wheat Cropping System with Inclusion of Legume Crops to Enhance System Productivity, Profitability, Energetic and Soil Fertility Under Assured Irrigated Conditions of Jammu Region

N.P. Thakur, Parshotam Kumar*, A.K. Gupta, Vijay Khajuria, Archana, Manpreet Kour R.S. Bochalya, Deepak Kumar and Naveena
Sher-e-Kashmir University of Agricultural Science and Technology- Jammu, Chatha-180009, J&K

ABSTRACT

A field experiment was conducted at research farm FSR SKUAST– Jammu of AICRP-IFS during 2016-17 and 2017-18 to evaluate the performance of ten rice based different cropping systems viz. Rice-Wheat, Rice–Wheat-Green manuring, Rice-Berseem (F) – Berseem (Seed), Rice–Knol Khol–Capsicum, Rice–Pea-Cowpea, Rice–cauliflower-Cucumber, Rice-Barley + Chickpea-Green gram, Rice-Broccoli-Mash, Rice- Oat(F) - Oat (Seed) and Rice – Potato- Bhindi under assured irrigated conditions of Jammu region in randomized block design with four replications. Among the cropping systems, the highest system productivity in terms of rice equivalent yield (REY), net returns and B:C ratio (142.75q/ha, Rs.220078/ha and 2.34) was realized in Rice (B-1509)-Broccoli (Ever green)-Mash (NUL-7) cropping system followed by Rice (B-1509)–Potato (Kufri Sindhuri)-Bhindi (lady luck) cropping system (142.6q/ha, Rs.186466/ha and 1.46) and the lowest REY(70.2 q/ha) in Rice (B-1509)-Wheat (PBW-550) (Existing cropping system), net returns (Rs. 90609/ha) and B:C ratio (1.20) was recorded under Rice (B-1509)–Wheat (PBW-550) -Green manuring cropping system. The highest system profitability (Rs. 600/ha/day) and production efficiency (53.38 kg/ha/day) was observed under rice (B-1509)-broccoli (Ever green)- -mash (NUL-7) cropping system followed by rice (B-1509)-potato (KufriSindhuri) –bhindi (lady luck) (511/ha/day and 45.58 kg/ha/day) and Rice (B-1509)–cauliflower (snow wall)-Cucumber (local) (398/ha/day and 43.22 kg/ha/day) cropping system. The highest land use efficiency (90.68%) was observed under Rice (B-1509)–Wheat-Green manuring cropping system followed by Rice (B-1509)—Berseem (Mascavi)–Seed (90.54%) and Rice (B-1509)-Barley (Jyoti) + Chickpea (PBG-4)-Green gram (SML-818) (86.30%). Cropping system an appreciable content of soil organic carbon (SOC) was build up (18-20%) under Wheat-Green manuring. cropping system over their initial soil status (5.5g/kg).

Keywords: Rice, Wheat, Legume, REY, Profitability, Energy

INTRODUCTION

The Rice grain is termed as global grain and it is the most important food crop of India and second most important crop of the world. Among the rice growing countries India ranks first in area (36.95 mha) and second in production (120.6 mt). However, the average productivity of rice in India is only 3.26 t/ha against the global average of 4.37 t/ha FAO (2014).Wheat is the second most important crop after rice in India and it occupied approximately 28 million ha with production of 85.93 million ton. Country ranks second in wheat production after China. The wider adoption of rice-wheat cropping system is mainly due to its high productivity, stability and less risk. Although the system has sustained over year but the yield shows stagnation since early 1990's Gill *et al.* (2014) and factor productivity is declining year after year (Sharma *et al.*, 2014). The yield stagnation in rice-wheat cropping system may be due to deterioration of soil properties, formation of hard pan beanth plough layer,

*Corresponding author email id: parshotamagro@gmail.com

development of hardy and resistance weed increase in insect-pest and disease, exhaustive nature of both the crops. Crop intensification/diversification in areas, where continues cropping of cereal-cereal is in vogue have shown marked advantage over existing cropping systems. The introduction of new cropping systems or diversification of one or more crops in a system resulted in enhanced annual productivity ranging between 25 and 117 per cent over the existing cropping systems Sharma *et al.* (2002). Diversification of rice-wheat cropping system with legume crops is an efficient strategy which not only acts as insurance but also have many benefits such as stable yield, better use of resources, pest and disease reductions, build up available nutrients in soil and reduce the need of synthetic fertilizers. Yield of cereals following legumes are reported to be 30-35% higher than those following a cereal – cereal cropping sequence. Besides N fixation, legumes also help in solubilizations of phosphorous, increase in soil microbial activity, organic matter restoration and improvement of soil health Acharya and Bandyopadhyay (2002). Hence, two present investigation view under location to evaluate different rice based cropping system with inclusion of location specific legume crops in a cropping system to enhance productivity, profitability and maintain soil fertility.

MATERIALS AND METHODS

A field experiment was conducted at research farm FSR centre SKUAST– Jammu of (AICRP-IFS) Chatha located at 32° 40' N latitude and 74° 58'E longitude and an altitude of 356 meters above mean sea level under assured irrigated conditions during 2016-17 and 2017-18 to evaluate the performance often rice based cropping systems (Table 1) in randomized block design with four replications. The treatment detail is given as below.

The soil of experimental site was clay loam having pH 8.1, organic carbon 5.5 g/kg and available N,P and K 216.23 kg/ha, 23.00 kg/ha and 118.00 kg/ha, respectively. The different crops were raised with recommended package of practices. The supplementary information with respect to cropping system are given (Table 2). The yield obtained from *Rabi* and *summer* crops were converted into rice equivalent yield (REY).

RESULTS AND DISCUSSION

Average yield of different varieties of paddy tested in a system (Table 3) indicated that the highest grain yield of paddy was recorded from variety rice- B1509 under rice-oat-seed (39.6q/ha) cropping system followed by Rice-Barseem-seed-(38.23 q/ha) under the diversified cropping systems. However, significantly highest productivity in terms of rice equivalent yield (REY), which was calculated on the basis of prevailing unit cost of the produce of the crop with different genotypes (Table 3) was recorded under rice-broccoli-blackgram cropping system (142.75q/ha) followed by rice-potato-bhindi (142.6q/ha) under irrigated condition and the lowest REY of 70.12 q/ha was recorded in existing rice - wheat cropping system under assured irrigated conditions of Jammu. Similar findings were reported by (Kachroo *et al.*, 2014). The increase

Table 1: Detail of cropping system used

Kharif	Rabi	Summer
Rice (B-370)	Wheat (PBW-550)	-
Rice (B-370)	Wheat (PBW-550)	GM (Dhaincha)
Rice (B-1509)	Berseem (Mascavi) F	Seed
Rice (B-1509)	Knol Khol (G-40)	Cowpea (Pusa Komal)
Rice (B-1509)	Pea (Arkal)	Bottle Gourd (Santosh)
Rice (B-1509)	Cauliflower (Pusa snowball-16)	Cucumber (local desi)
Rice (B-1509)	Barley (Jyoti) + Chickpea (PBG-4)	Green gram (SML-818)
Rice (B-1509)	Broccoli (Evergreen)	Blackgram (NUL-7)
Rice (B-1509)	Oat (F kent)	Seed
Rice (B-1509)	Potato (K. Sindhuri)	Bhindi (lady luck)

Table 2: Schedule of operations under rice based cropping system

Cropping systems	Variety name and Fertilizer Dose (NPK)			Date of sowing/Transplanting			Date of harvesting		
	Kharif	***Rabi***	***Summer***	***Kharif***	***Rabi***	***Summer***	***Kharif***	***Rabi***	***summer***
Rice – Wheat-	B-370 (30:20:10)	PBW-550 (100:50:25)	-	14 July	*8 November*		15 November	20 April	
Rice – Wheat- Green Manuring	B-370 (30:20:10)	PBW-550 (100:50:25)	Dhaincha (20:0:0)	14 July	*8 November*	15 may	15 November	20 April	1 July
Rice – Berseem- Seed	B-1509 (100:50:25)	Mascavi (100:50:25)	Seed	7 July	28 October		25 October	-	16 June
Rice - KnolKhol- Cowpea	B-1509 (100:50:25)	G-40	Pusa Komal (50:30:30)	7 July	15 November	1 April	25 October	5 February	15 June
Rice – Pea- Bottle Gourd	B-1509 (100:50:25)	Arkal (40:60:50)	Santosh (200:100:100)	7 July	20 November	25 March	25 October	15 March	20 June
Rice – Cauliflower-Cucumber	B-1509 (100:50:25)	Pusa Snowball -16 (120:30:50)	Local desi (150:75:75)	7 July	2 November	25 Feb	25 October	15 Feb	10 June
Rice- Barley + Chickpea-Green gram	B-1509 (100:50:25)	Jyoti + PBG-4 (100:50:20)	SML-818 (15:40:0)	7 July	20 November	10 April	25 October	5 April	22 June
Rice – Broccoli- Blackgram	B-1509 (100:50:25)	Evergreen (120:30:50)	NUL-7 (15:40:0)	7 July	18 November	3 April	25 October	10 February	20 June
Rice- oat –Seed	B-1509 (100:50:25)	Kent (100:50:25)	-	7 July	1 November	-	25 October	10 January 1st cut	30 April
Rice–Potato-bhindi	B-1509 (100:50:25)	K. Sindhuri (150:80:120)	Lady luck (50:30:20)	7 July	1 November	1st March	25 October	20 Feb	5 July

in rice grain equivalent yield was mainly due to 300% cropping intensity in a system with inclusion of vegetable/legume crops in the crop sequences as well as higher market price of legumes and vegetable crops than that wheat similar results were reported by Rathika *et al.* (2014).

Moreover, choice of a cropping system in an area is mainly guided by the profitability of the farm. Among the different cropping system adopted, rice-broccoli-blackgram resulted highest system net returned of Rs. 220078/ha with a B: C ratio of 2.34 followed by rice-potato-bhindi (Rs.186466/ha and B: C ratio of 1.46) and rice-cauliflower-cucumber (net return of Rs. 145385/ha and B: C ratio of 1.26), respectively. While, a predominant existing cropping system with Rice (B-370) –wheat (PBW-550) realized lowest net return of Rs. 89251/ha with B:C ratio of 1.37 which was significantly differ among other cropping systems (Table 3). Earlier studies also indicated that multiple cropping systems offer special advantages and enhance the profitability per unit area. Rana *et al.* (2010), Rana *et al.* (2011) and Sharma *et al.* (2009).

The highest system profitability of Rs. 600/ha/day was observed under rice-broccoli-blackgram cropping system (Table 4) followed by rice-Potato-bhindi (Rs. 511/ha/day) and rice-cauliflower-cucumber (Rs. 398/ha/day), respectively, while lowest was recorded under existing rice wheat cropping system (Rs. 244/ha/day). It can be attributed mainly to broccoli which fetched higher prices in the market besides having good productivity.

The next in the order was rice-Pea-bottle gourd cropping sequence. Here, bottle gourd contributed most to enhance the equivalent yield due to its higher marketable yield. Barring the bottle gourd, it was the summer season crops which governed the REY of the systems, because rice being the base crop and contribution of post rainy season crops was not optimal. These results corroborate the findings of Singh *et al.* (2007) who reported rice-pea-okra followed by rice-pea-onion as the most productive cropping sequence for eastern Uttar Pradesh, India. Mishra *et al.* (2007) also reported higher productivity and profitability through inclusion of vegetables and pulses

Table 3: Grain yield, REY and economics of different rice based cropping system under crop diversification (mean data of 2016-17 and 2017-18)

Treatment	Economic yield (q/ha)			REY (q/ha)	System cost of cultiva-tion (Rs.)	System Gross return (Rs.)	Total net returns (Rs. /ha)	B:C Ratio
	Kharif	Rabi	Summer					
R-W	25.73(44.81)	35.31(45.72)	-	70.12	65055	154307	89251	1.37
R-W-GM	27.67(51.04)	37.81(47.91)	-	75.37	75227	165836	90609	1.20
R-B-Seed	38.23(53.65)	558.33	1.31	72.69	65159	159989	92292	1.45
R-k- Cowpea	36.56(53.54)	85.10	-	86.46	76979	190260	113282	1.47
R-Pea-bottle gourd	37.81(53.65)	65.73	76.14	118.25	119746	261083	141337	1.17
Rice – Cauliflower- Cucumber	37.08(51.56)	113.54	42.29	118.28	114890	260270	145385	1.26
R-barley+ Chickpea- Greengram	37.29(52.60)	237.5GF (27.84)	-	77.1	75471	169678	94207	1.24
R- Broccoli-Mash	36.77(50.94)	60.73	8.17	142.75	93501	313575	220078	2.34
Rice- oat –Seed	39.06(54.27)	304.58	23.64(13.75)	51.84	63771	186684	122913	1.92
Rice–Potato-bhindi	36.91(49.16)	165.10	62.70	142.6	127402	218197	186466	1.46
C.D (0.05)				3.45				
SEm(±)				1.21				

Rice basmati grain= 3500/q, Rice Pusa 1509 grain = 2500/q Rice straw= 100/q, Wheat grain = 1850/q, Wheat straw = 500/q, Berseem fodder 100/q, Berseem seed=10000/q, Bhindi = 1500/q, Broccoli = 2000/q, Mash = 8000/q, Pea=1000/q, Moong bean = 8000/q in rice-based cropping system. It clearly shows the importance of summer crops to raise the system productivity and sustainability. (Ben-Hammounda *et al.* (1995), Cheema, 1998 and Kim *et al.* (1993).

Moreover, highest production efficiency (53.38kg/ha/day) was realized under rice-broccoli-blackgram followed by rice-potato-bhindi (45.6kg/ha/day) in (Table 4) which was probably due to higher production and price of the produce viz., Potato, bhindi, broccoli and blackgram. Results corroborate the findings by Sharma *et al.* (2008) in a study of rice based crop sequences. Kumar and Negi (2015) also reported similar results in ricebased crop sequences.

The highest land use efficiency (LUE) (90.22%) was observed in rice-berseem- seed followed by rice-barley + chickpea-greengram (86.73%). Kachroo *et al.* (2014) also recorded higher land use efficiency in rice-pea- lady's finger might be due to longest duration of crop sequence. It is very much clear from the data presented in (Table 5) that crop intensification utilize land properly throughout the year which will not only enhance the profitability but also generates more employment to the farmer during lean period in the year. The soil pH did not show any significant among cropping system over the initial soil pH value after completion of three-year study (Table 5). Soil organic carbon content was build up upto 6.6 g/kg soil in

Table 4: System profitability, land use efficiency and production efficiency under rice based cropping sequences

Crop sequence	Duration of crops (days)	System profitability (Rs/ha/day)	Land use efficiency % (LUE)	Production Efficiency (kg/ha/day)
R-W	292	245	80.00	24.02
R-W-GM	331	248	90.68	22.77
R-B-Seed	330	260	90.54	22.29
R-k- - Cowpea	272	310	74.65	31.72
R-Pea- Bottle gourd	302	387	82.87	39.53
Rice – Cauliflower- Cucumber	275	398	76.18	43.22
R-barley+ Chickpea- Green gram	315	258	86.30	24.73
R- Broccoli-Mash	268	600	73.42	53.38
Rice- oat –Seed	258	336	70.68	33.24
Rice–Potato-bhindi	313	511	85.90	45.58

Table 5: Changes in soil properties over initial status after completion of crop cycle

Treatments	After Summer		Available nutrients (kg/ha)		
	Soil pH (1:2.5 H_2O)	Org. C (g/kg)	N	P	K
Rice –Wheat-	7.85	5.4	217	19.60	120
Rice–wheat-Green manuring	7.80	6.6	240	26.20	130
Rice–Berseem-Seed	7.95	6.5	232	24.70	134
R-k- - Cowpea	8.10	6.4	230	21.20	122
R-Pea- Bottle gourd	8.10	6.2	236	22.50	124
Rice – Cauliflower- Cucumber	8.0	6.0	228	22.80	128
R-barley+ Chickpea- Greengram	7.98	6.2	224	21.50	130
R- Broccoli-Mash	8.10	6.2	220	23.10	122
Rice- oat –Seed	8.20	6.0	212	23.40	127
Rice–Potato-bhindi	8.10	6.1	202	24.20	125
Initial status	8.10	5.5	216.23	23.00	118.98

rice-wheat-green manuring and 6.5g/kg soil in rice-berseem-seed cropping systems over their initial value of 5.5g/kg soil, which was 18-20% higher over initial level. Similarly available N and P were also recorded highest under rice-wheat-green manuring, while available K was higher under rice-berseem-seed cropping sequence which contributed 11, 13 and 12.6 percent higher over their initial level, respectively. These results are in agreement with Thakur *et al.* (2009) and Kachroo *et al.* (2014).

CONCLUSION

These results clearly indicated that intensification/ diversification of rice -wheat cropping system under subtropical Conditions of Jammu by substitution wheat with barley, green manuring, knolkhol, cowpea, Pea, Bottlegourd, Greengram, Blackgram, Broccoli not only enhance productivity and profitability per unit area but also improve the soil fertility in comparison to rice wheat cropping system. The crop sequences viz., R-Broccoli-Blackgram, Rice-knolkhol- cowpea and R-barley- chickpea- Greengram were found to be highly remunerative and recommended under irrigated condition of Jammu region for getting higher system productivity and profitability with appreciable improvement soil organic carbon as well as soil nutrient after completions of three year study.

REFERENCES

Acharya, C.L. and Bandyopadhyay. 2002. Efficient input management for sustainable agriculture production. *Indian Farming.*, 52:42-49.

Ben-Hammounda, M.; J.K. Robert. and C.M. Harry. 1995. Phytotoxicity of extracts from sorghum plant components on wheat seedlings. *Crop Sci.*, 35: 1652-1656.

Cheema ZA. 1998.Sorghum allelopathy – new weed control technology for enhancing wheat productivity. *Journal of Animal Plant Science.*, 8:19–21.

FAO. 2014. Food and agriculture organization of the United Nations, Available online at http://ww w.fao.org/ag/ ca6c.html.

Gill, M.S; Gangwar, B; Walia, S.S. and Dawan, A.K. 2014. Sustainability of rice-wheat efficient alternate cropping system of India. *Indian Journal of Ecology*, 41: 219-227.

Kachro, D.; Thakur, N.P; Kour, M; Kumar, P; Sharma, R. and Khajuria, V. 2014. Diversification of rice (*Oryza sativa)* – based cropping system for enhancing productivity and employment. *Indian Journal of Agronomy,* 59: 21-25.

Kim, S.Y., De Dutta, S.K., Robels, R.P., Kim, K.U., Lee, S.C. and Shin, D.H. 1993. Allelopathic effects of Evaluation of ricebased cropping sequences on cultivators' fields in Una district of Himachal Pradesh. *Himachal Journal of Agricultural Research,* 35: 171-175.

Kumar, Ashish and Negi, S. C. 2015 Crop Diversification for Increasing Productivity and Profitability under Mid-hill Sub-humid Conditions of Himachal Pradesh. *International Journal of Agriculture, Environment and Biotechnology.,* 8: 861-865.

Rana S.S; Sharma H.L; Subehia S.K; Negi S.C. and Sharma, S.K. 2011. Promising cropping system for mid hill agro-climatic conditions of Himachal Pradesh. *Himachal Journal of Agricultural Research.* 37: 138-148.

Rana, S.S.; Sharma, J.J; Sharma, H.L; Sharma, S.K. and Sharma, S.K. 2010. Production potential and economic feasibility of rice-based cropping sequences under mid hills of Himachal Pradesh. *Himachal Journal of Agricultural Research.,* 36: 7-12.

Rathika, S.; Velayudham, K; Thavaprakaash, N. and Ramesh, T. 2014. Biological Efficiency of Legume Inter crops in Baby Corn (*Zea Mays* L.). *International Journal of Agriculture, Environment and Biotechnology,*73: 627-633.

Sharma, A.R. and Singh, V.P. 2014. Integrated weed management in conservation agriculture systems. *Indian Journal of Weed Science,* 46: 23-30.

Sharma, B.R. 2002. Efficient conservation and management of water resources for sustainable agriculture. *Indian Farming*, 52: 51-57.

Sharma, S.K., Rana, S.S., Subehia, S.K., Sharma, H.L., Sharma, J.J. and Sanjay, K. Sharma, 2009. Evaluation of rice based cropping sequences on cultivators' fields in Una district of Himachal Pradesh. *Himachal Journal of Agricultural Research,* 35: 171-175.

Sharma, S.K.; Rana, S.S; Sharma, S; Subehia, S.K; Sharma, J.J. and Sharma, H.L. 2008. Production potential and economic feasibility of rice based cropping sequences on cultivator's fields under sub-mountain low-hills of Himachal Pradesh. *Himachal Journal of Agricultural Research.,* 34: 5-9.

Singh P; Singh JP; Gill, MS. and Singh Y. 2007. Alternate cropping systems to sugarcane-ratoon wheat in peri urban areas of Meerut. In: Extended summaries of the 3rd National Symposium on Integrated Farming Systems; 2007 Oct 26-28; Durgapura, India. Meerut (India): Project Directorate for Cropping System Research, Modipuram. sorghum extract and residues on selected crops and weeds. *Korean J Weed Sci.,* 14:34–41.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 443-448

Studies on Genetic Variation for Yield and its Attributing Characters in Taro (*Colocasia esculenta* var. *antiquorum* L. Schott)

G.P. Nag[1]*, Bhagwat Kumar[1], P.K. Tiwari[2], A.K. Thakur[3] and D.P. Singh[4]
[1,2&3]College of Horticulture and Research Station, Jagdalpur, Indira Gandhi Krishi Vishwavidyalaya, Raipur
[4]Shaheed Gundadhur College of Agriculture and Research Station, Jagdalpur, Indira Gandhi Krishi Vishwavidyalaya, Raipur

ABSTRACT

The present investigation was carried out to studies the genetic variation, heritability and genetic advance for important yield attributing traits involving 24 selected taro (including check) germplasms of colocasia in a complete randomized block design with three replication during summer season of 2018 and 2019. The estimation of genetic variation observed that there was significant genetic variation in the experiment. Among all the genotypes evaluated, genotype IGCOL-GB-17-1 was recorded highest cormels and corms yield ha^{-1} followed by IGCOL-LHDD-18-1 suitable to further crop improvement programme. Among the attributes studied, high PCV and GCV were observed for characters like number of suckers plant^{-1} (46.80 and 46.23 respectively), Leaf Area Index (43.90 and 42.70 respectively) and corm yield plant^{1} (43.04 and 42.66 respectively) indicating high variability available in the genotypes for these characters for further improvement. A high heritability (>60 %) coupled with high genetic advance was observed for LAI, number of suckers plant^{-1} and corm yield plant^{-1} which suggested that there may be presence of additive gene action and selection will be beneficial for improving of such characters.

Keywords: Genetic variation, Yield, PCV, GCV, LAI

INTRODUCTION

Colocasia (*Colocasia esculenta* var. *antiquorum* L. Schott) also known as '*Taro*' is one of the oldest known tuber crop and has been grown for more than 10,000 years ago in Tropical Asia (Lebot, 2009). It is a tropical tuber crop belongs to the monocotyledonous own family *Araceae* of the order *Arales* whose participants are called aroids (Henry, 2001). *Araceae* includes about 100 genera and 1500 widely distributed species. It has been probably originated as of the wet tropical place flanked by India and Indonesia (Matthews, 2004) and has been cultivated within the South Pacific for hundreds of years (FAO, 1992). Colocasia grows wild in tropical Asia, extending as far as east as New Guinea region near Indonesia and possibly Northern Australia. Taro serves as staple supply of diet for community in the region of the globe and it is the fourteenth mainly enthusiastic vegetable globally (Rao *et al.,* 2010). Worldwide taro is grown in an area of approximately 1.35 M ha in the midst of a yearly production of 10.2 MT and average productivity of 6.82 t/ha. In Asia, average yields reach 12.6 t ha^{-1} (Anonymous, 2019).

Available literature expressed that, an insufficient systematic breeding effort for developing the quantifiable traits in taro has been concluded so a ways and a small number of indigenous cultivars are handy for its growing. Hence, a dire need had once felt for systematic breeding work for improvement of taro specifically in Chhattisgarh which is blessed with the adequate variety of taro. In view of this the knowledge of genetic variability, heritability and genetic advance of important economic characters and their genotypic and phenotypic correlation coefficients amongst themselves play a significant role in framing the breeding works of the any crops. The achievement of breeding work depends largely on the genetic variability, which is existing in the population. Hence, segregation of the phenotypic variance in to the genetic & environmental variance is essential. The amount of transmission of quantitative traits from parent to the

*Corresponding author email id: ganeshnag26@gmail.com

offspring depends upon the heritability (h^2b) of the particular traits. The value alone does no longer have much importance as it fails to account for the magnitude of absolute variability. It is therefore crucial to make use of heritability along with genetic improve whilst predicting for selection. A large amount of the agro-nomically essential traits inclusive of yield are poly genetically and are maximum effects by environmental factors. In view of the fact that yield is a complex trait dependent on several to huge number of component characters.

The same genotypes were raised during 2017-18 for another season evaluation and tubers were planted on 07th February 2019 with the same design and plot size and similar agronomic practices.

MATERIALS AND METHODS

The experiments were conducted at SG, College of Agriculture and Research Station, IGKV, Instructional cum Research Farm, Kumhrawand, Jagdalpur, Bastar, Chhattisgarh during the summer season from 1st year February to August 2018 and 2nd year during February to August 2019. The experiment was laid out in Randomized Complete Block Design (RCBD) with 24 genotypes of colocasia grown in three replications. The genotypes were grown randomly in each replication/block in a total of 72 plots at 3m x 3m spacing each containing 50 plants per plot at each locations.

RESULTS AND DISCUSSION

The analysis of variance of all the characters under study is presented in Table 1. This analysis of variance revealed that mean sum of squares due to genotypes was highly significant for all the characters over all the locations studied. This is an indication of existence of sufficient variability among the genotypes for yield and its components traits is in directive of applying various analyses in the material. Significant mean sum of squares due to yield and attributing characters revealed existence of considerable variability in materials studied for improvement for various traits. These findings are in general agreement with the findings of Chand *et al.* (1987), Mulualem and Weldemichael (2013), Tewodros (2013) and Bhanuprakash *et al.* (2019)

The environmental coefficients of variation (ECV), genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV), heritability, genetic advance and expected genetic advance as per cent of mean (GAM) for the different characters were studied and presented in Table 2. The estimates of phenotypic variance were greater than the corresponding estimates of genotypic variance for all the traits, indicating thereby, the influence of environment in the expression of these traits. The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) and environmental coefficient of variation (ECV) for all the traits under study.

Phenotypic variance was higher than the genotypic and environmental variances. Similarly, phenotypic coefficient of variation was higher in magnitude than the genotypic coefficient of variation also had higher genotypic coefficient of variation. In Table 1, the highest value of environmental coefficient of variation was recorded for leaf area index (9.46) followed by number of cormels plant^{-1} (9.05), girth of pseudo-stem (8.11), number of suckers plant^{-1} (7.45), cormel length (6.97), cormel weight g (5.86) and corm yield

Table 1: Analysis of variance for yield and its component characters in colocasia: during 2018 and 2019

Traits	Mean sums of square		
	Replicate	Treatments	Error
d.f.	2	23	46
Plant height (cm)	2.30	514.59**	7.23
No. of suckers Plant^{-1}	0.01	1.40**	0.01
Petiole length (cm)	6.72	197.36**	4.10
Girth of pseudo-stem (cm)	0.18	1.21**	0.09
LAI	0.00	0.54**	0.01
No. of cormels plant^{-1}	0.22	12.74**	0.57
Cormel length (cm)	0.12	2.15**	0.15
Cormel girth (cm)	0.07	0.18**	0.01
Cormel weight (g)	5.61	80.80**	2.17
Cormels yield Plant^{-1} (g)	51.52	10565.33**	55.74
Dry matter % of cormel	1.29	2.64*	1.21
Corm length (cm)	0.18	7.96**	0.09
Corm girth (cm)	0.14	1.03**	0.04
Corm yield plant^{-1}	55.85	6530.08**	39.04
Dry matter % of corm	4.05	12.55**	1.34
Corms & cormels yield ha^{-1}	37.55	8921.69**	23.67

* &** Significant at 5% & 1% respectively

plant^{-1} (5.73), whereas corms and cormels yield ha^{-1} had the lowest ECV (3.35). The highest value of PCV was found for number of suckers plant^{-1} (46.80) followed by leaf area index plant^{-1} (43.90), corm yield plant^{-1} (43.04), cormels yield plant^{-1} (39.17), corms & cormels yield plant^{-1} (37.66), corm length (26.31) and number of cormels plant^{-1} (25.68). The lowest PCV had recorded for dry matter per cent cormel (4.90). The highest value of GCV was recorded for number of suckers plant^{-1} (46.23) followed by leaf area index plant^{-1} (42.70), corm yield plant^{-1} (42.66), cormels yield plant^{-1} (38.86), corms & cormels yield ha^{-1} (37.51), corm length (cm) (25.88) and number of cormels plant^{-1} (24.04), whereas dry matter per cent of cormel had the lowest GCV (2.60).

The estimates of moderate PCV and GCV, high heritability coupled with high GAM were observed for this trait indicated the preponderance of additive gene action governing the inheritance of this character and offers the possibility of improvement through direct selection. These finding are in accordance with findings of Mukherjee *et al.* (2003) Pandey *et al.* (2009), Paul *et al.* (2011), Choudhary *et al.* (2011), Mulualem and Weldemichael (2013), Tewodros *et al.* (2013), Bhattacharjee *et al.* (2014), Poddar *et al.* (2015), Eze and Nwofia (2016a), Ashok *et al.* (2017) in sweet potato, Singh *et al.* (2017) and Narayan *et al.* (2018) in taro.

The estimates of PCV and GCV were low for this trait which is in accordance with the findings of Choudhary *et al.* (2011), Tewodros *et al.* (2013) and Mukherjee *et al.* (2016) in taro whereas, Alam *et al.* (2014) in greater yam. The high PCV and GCV for number of suckers plant^{-1} revealed that variation among the genotypes was also high. High PCV for this trait was in accordance with the findings of Chand *et al.* (1987). The results were in accordance with findings of Alam *et al.* (2014) in greater yam, Kumar *et al.* (2017), Yadav *et al.* (2017) in taro, Bhanuprakash (2018) in taro.

Heritability in broad sense was estimated for all the 16 traits under study and presented in Table 2. In the location-Jagdalpur the magnitude of heritability ranged from 28.11% to 99.21%. The corms & cormels yield ha^{-1} had the high heritability estimate (99.21%) followed by cormels yield plant^{-1} (98.43%), corm yield plant^{-1} (98.23%), number of suckers plant^{-1} (97.46%), corm length (96.73%), plant height (95.90%) leaf area index (95.35%) petiole length (94.01%) and cormel weight (92.34%). The moderate heritability was estimated in the characters *viz.*, corm girth (88.49%), number of cormels plant^{-1} (87.59%), cormel girth (84.44%), and dry matter per cent of corm (73.67%). The low heritability was estimated for character dry matter per cent of cormel (28.11%).

The heritability value alone however, provides no indication of the amount of genetic improvement that would result from selection of superior genotypes. The heritability estimates would be reliable; if it is limited in broad sense and h^2b along cannot give reliable gain. It indicates the preponderance of additive and non additive gene effect if accompanied with high genetic advance. To facilitate the comparison of progress in various characters of different genotypes genetic advance was calculated as percentage of mean.

High heritability in conjunction with high GAM was observed for corms & cormels yield ha^{-1} trait which indicated the role of additive gene action governing the inheritance of this trait and offers the best possibility of improvement through progeny selection or any modified selection procedures aiming to exploit the additive gene effects. These findings are in agreement with Mukherjee *et al.* (2003), Cheema *et al.* (2007), Choudhary *et al.* (2011), Paul *et al.* (2011), Devi *et al.* (2013), Bhattacharjee *et al.* (2014), Alam *et al.* (2014) in greater yam, Eze and Nwofia (2016a), Kumar *et al.* (2017) and Yadav *et al.* (2017) in taro cultivars.

Presence of moderate to high heritability is in agreement with Choudhary *et al.* (2011), Tewodros *et al.* (2013), Poddar *et al.* (2015), Kumar *et al.* (2017), and Yadav *et al.* (2017) in taro, Paul *et al.* (2011) in aqua edible aroids cultivars and Paul *et al.* (2011) in aqua edible aroids and Mulualem and Weldemichael (2013) in aerial yams.

The magnitude of genetic advance as percentage of mean ranged from 2.83% to 93.96% (Table 2) estimated for all 16 characters in colocasia. The character number of suckers plant^{-1} showed higher genetic advance (93.96%) followed by character *viz.*, corm yield plant^{-1} (87.10%), leaf area index (86.23%), cormels yield plant^{-1} (79.42%) and corms & cormels yield ha^{-1} (76.96%). Similarly moderate GA as percentage of mean was recorded for the characters corm length (52.43%), number of cormels plant^{-1} (46.34%), cormel weight (40.31%) plant height (35.68%), petiole length (32.93%) and girth of pseudo stem (31.61%). The rest of the characters exhibited low magnitude of genetic advance as per cent of mean were *viz.*, cormel length (27.99%), corm girth (20.11%), cormel girth (16.10%) and dry matter per cent of cormel had the lowest magnitude of GA in colocasia (2.83%).

The genetic advance is a useful measure to predict genetic gain at specified selection intensity, but when it is considered along with h^2 becomes more valuable from selection point of view and to predict response to selection. The heritability value alone, however, provides no indication of the amount of genetic improvement that would result from selecting the best individuals. Hence, genetic gain in quantitative traits can be predicted only when heritability and genetic advance over mean are considered together (Johnsen *et al.*, 1955)

High h^2 estimates coupled with high GAM was recorded for number of suckers plant^{-1} followed by corm yield plant^{-1} in location Jagdalpur and Kanker, while high GAM was recorded for corm yield plant^{-1} in location Dantewada. Thus, it is apparent from the present finding that, these traits being governed by additive gene and their effects could be exploited for improving corms and cormels yield and its attributes in colocasia. Also, early selection for these traits would be precious for accumulating desirable genes in selected genotypes. Similar finding had also been reported by Mukherjee *et al.* (2003), Choudhary *et al.* (2011) in taro, Paul *et al.* (2011), Devi *et al.* (2013), Bhattacharjee *et al.* (2014), Choudhary *et al.* (2011), Tewodros *et al.* (2013), Alam *et al.* (2014) in greater yam Bhattacherjee *et al.* (2014), Mukherjee *et al.* (2016), Kumar *et al.* (2017), Yadav *et al.* (2017) in taro genotypes.

Moderate to high GAM for this trait were in accordance with the findings of Singh et al. (2003), Alam *et al.* (2014) in greater yam, Kumar *et al.* (2017) and Ashok *et al.* (2017). The estimates of PCV and GCV were low for this dry matter per cent of cormel which is in accordance with the findings of Tewodros *et al.* (2013), Choudhary *et al.* (2011) and Mukherjee *et al.* (2016) in taro whereas, Alam *et al.* (2014) in greater

Table 2: Genetic parameters of variance for corms & cormels yield and its components characters: pooled mean of colocasia

Traits	Mean	Range		Coefficient of variation (%)			h^2 b	Genetic	GA as
		Min.	Max.	ECV	GCV	PCV	(Broad Sense)	Advan. cement 5%	% of mean 5%
Plant height (cm)	73.52	61.03	105.36	3.66	17.69	18.06	95.90	26.23	35.68
No. of suckers plant^{-1}	1.47	38.56	67.75	7.45	46.23	46.80	97.46	1.38	93.96
Petiole length (cm)	48.68	38.56	67.75	4.16	16.49	17.00	94.01	16.03	32.93
Girth of pseudo-stem (cm)	3.60	2.67	4.95	8.11	16.98	18.84	81.45	1.14	31.61
LAI	0.98	0.55	2.18	9.46	42.70	43.90	95.35	0.85	86.23
No. of cormels plant^{-1}	8.38	6.26	12.67	9.05	24.04	25.68	87.59	3.88	46.34
Cormel length (cm)	5.46	4.47	7.48	6.97	14.99	16.53	82.20	1.53	27.99
Cormel girth (cm)	2.78	2.33	3.22	3.65	8.50	9.26	84.44	0.45	16.10
Cormel weight (g)	25.14	15.97	35.80	5.86	20.36	21.19	92.34	10.13	40.31
Cormels yield plant^{-1} (g)	152.32	52.26	301.58	4.90	38.86	39.17	98.43	120.97	79.42
Dry matter% of cormel	26.55	25.39	28.32	4.15	2.60	4.90	28.11	0.75	2.83
Corm length (cm)	6.26	4.57	9.63	4.75	25.88	26.31	96.73	3.28	52.43
Corm girth (cm)	5.53	4.66	6.54	3.74	10.38	11.03	88.49	1.11	20.11
Corm yield plant^{-1}	109.04	63.23	200.37	5.73	42.66	43.04	98.23	94.97	87.10
Dry matter % of corm	25.23	22.33	28.46	4.58	7.66	8.93	73.67	3.42	13.55
Corms & cormels yield ha^{-1}	145.20	82.44	278.86	3.35	37.51	37.66	99.21	111.74	76.96

yam. High heritability in conjunction with moderate to high GAM was observed for this trait indicating the role of additive gene action governing the inheritance of the trait and offers the best possibility of improvement through progeny selection or any modified selection procedures aiming to exploit the additive gene effects. Presence of moderate to high heritability is in agreement with Cheema *et al.* (2007), Choudhary *et al.* (2011), Paul *et al.* (2011) in aqua edible aroids cultivars, Poddar *et al.* (2015) in yam, Ashok *et al.* (2017) in sweet potato and Yadav *et al.* (2017) in taro genotypes.

CONCLUSION

The data of ANOVA revealed the significant difference between the evaluated genotypes in almost all traits. The PCV evaluation was higher than GCV estimation for all the observed traits. The number of suckers plant $^{-1}$, LAI, corm yield plant^{-1} and cormels yield plant^{-1} revealed a wide range of PCV and GCV as well as high broad-sense heritability that indicated these characters to have additive gene effect and more reliable for successful selection. In a population, a population with a broad GCV is effective for selection to obtain superior variety. The 24 genotypes can be utilized in assembling varieties especially for traits which have a broad GCV value. Hence, these accessions may be finalized for further breeding programme.

REFERENCES

Alam, S., Shylla, E., Bora, P. and Saud, B.K. (2014). Genetic Variation in Different Cultivars of Greater Yam (*Dioscorea alata*). *Journal of Root Crops,* 40: 1-5.https:// doi: 10.1007/s12298-019-00691-3

Anonymous. (2019). Directorate Horticulture and Farm Forestry, Chhattisgarh (Department of Agricultural Development and Farmers Welfare and Biotechnology, Govt. of Chhattisgarh).

Badu, M. Ashok, P., Patro, T.S.K.K.K and Sasikala, K. (2017). Studies on genetic variability, heritability and genetic advance for growth, yield and quality parameters among orange flesh sweet potato [*Ipomoea batatas* (L.) Lam.] genotypes. *Int. J. Curr. Microbiol. App. Sci.,* 6(9): 1894-1903. https://doi.org/10.20546/ijcmas.2017.609.233.

Bhanuprakash G.C., Ramesh Babu B, Mamatha K., Snehalatha Rani A. and Umayjothi, K. (2019). Genetic divergence studies in colocasia [*Colocasia esculenta* (L.) Schott] germplasm. *Int. J. of Chemical Studies.* 7 (1): 998-1002.

Bhanuprakash G.C. (2018). Morphological, Biochemical and Molecular Characterization of Colocasia [*Colocasia esculenta* (L.) Schott] Germplasm. M.Sc. (Hort.) Thesis Dr. Y. S. R. Horticultural University, Andhra Pradesh.

Bhattacharjee, M., Tarafdar, J. and Sadhukhan, R. (2014). Assessment of Genetic Diversity of Some Indigenous Collections of Upland Taro [*Colocassia esculenta* var. *antiquorium* (L.) Schott] for Selection of Genotypes Aiming at Improvement in Breeding Programme. *IOSR J. of Agriculture and Veterinary Science,* 7: 31-43 .https:/ / DOI: 10.9790/2380-07713143

Burton, G.W. (1952). Quantitative inheritance in grasses. *Proceeding of the sixth International Grassland Congress,* 1: 277-83.

Burton, G.W. and Devane, E.H. (1953). Estimating the heritability in tall fescue (*Festuca arundinancea*) from replicated clonal material. *Agronomy J.,* 45: 478-81. https:/ /doi.org/10.2134/agronj1953.0002196200450010 0005x

Chand, B., Jaiawal, R.C. and Gautam, N.C. (1987). Genetic variability and correlation studies in Colocasia (Colocasia *esculenta* L.). *Haryana J. Hort. Sci.,* 16 (1-2):134-39.

Cheema, D.S., Singh, H., Dhatt, A.S., Sidhu, A.S. and Garg, N. (2007). Studies on genetic variability and correlation for yield and quality traits in arvi [*colocasia esculenta* (l.) schott]. Proceedings in Ist International Conference on Indigenous Vegetables and Legumes. Prospectus for Fighting Poverty, Hunger and Malnutrition. ISHS Acta Horticulturae, 752.

Choudhary, V.K., Kumar, S.P., George, J., Kanwat, M. and Saravanan, R. (2011). Genetic variability and character association in taro (*Colocasia esculenta* (L.) Schott.) under Mid-Hills of Arunachal Pradesh. *J. of Root Crops,* 37(2):155-161.

Choudhary, V.K., Kumar, S.P., George, J., Kanwat, M. and Saravanan, R. (2011). Genetic variability and character association in taro (*Colocasia esculenta* (L.) Schott.) under Mid-Hills of Arunachal Pradesh. *J. of Root Crops,* 37(2):155-161.

Devi, H. S., Singh, V., Duwey, R. K. and Chauhan, V.B.S. (2013). Assessment of genetic diversity in taro (*Colocasia esculent* L.) National conference on: Tuber crops (other than potato) for sustainable agriculture and livelihood security in climate change scenario AAU, Jorhat on April, 29: 53-54.

Eze, C.E. and Nwofia, G.E. (2016). Variability and Inter-Relationships between yield and associated traits in taro (*Colocasia esculenta* (L.) Schott). *J. of Experimental Agriculture International,* 14(2): 1-13.

FAO. 1992. Taro: A south Pacific specialty. Leaflet – revised. (1992). Community Health Services, South Pacific

Commission, B.P. D 5, Noumea, Cedex, New Caledonia.

Henry, R. J. (2001). Plant genotyping: The DNA fingerprinting of plants. CAB Publishing, Southern Cross University, Australia.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955a). Estimates of genetic and environmental variability in Soybeans. *Agronomy J.,* 47: 314 - 318.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955b). Genotypic and phenotypic correlation in soybean and their application in selection. *Agronomy J.,* 47: 477 - 482.

Kumar, A., Kushwaha, M. L., Ankit, P. and Priyanka, V. (2017). Studies on genetic variability in different genotypes of taro. *J. of Hill Agriculture,* 8(3): 274-78.

Lebot, V. (2009). Tropical Root and Tuber Crops: Cassava, Sweet Potato, Yam and Aroids. CABI, Wallngford, U K: 413-416.

Lush, J.L. (1949). Heritability of quantitative characters in farm animals. *Hereditas,* 35: 356–375.

Matthews, P. (2004). Genetic diversity in taro, and the preservation of culinary knowledge. Ethnobotany J., 2: 55–77.

Mukherjee, D., Chattopadhyay, A., Rao, L.L.T.P., Satapathy, M.R and Sen, H. (2003). Genetic variability and causal relationship in dashean taro (*Colocasia esculenta* var. *esculenta* L. Schott). *Annals of Agriculture Research,* 24(3): 593-597.

Mukherjee, D., Roquib, M.A., Das, N. D. and Mukherjee, S. (2016). A Study on Genetic Variability, Character Association and Path Co-Efficient Analysis on Morphological and Yield Attributing Characters of Taro [*Colocasia esculenta* (L.) Schott]. *American J. of Plant Sciences,* 7: 479-488.

Mulualem, T. and WeldeMichael, G. (2013). Agronomical evaluation of aerial Yam/ *dioscorea bulbifera* accessions collected from South and Southwest Ethiopia. *Greener J. of Agricultural Sciences,* 3(9): 693-704.

Narayan, A., Prasad, R., Singh, P.P., Kumar, A. and Singh, R.S. (2018). Genetic divergence and correlation of tuber characteristics in bunda germplasm (*Colocasia esculenta* var. *esculenta*) of Bihar. *Int. J. Curr. Microbiol. App. Sci.,* 7: 1022-30.

Pandey, V. S. Ojha, M. D. and Singh, P. K. (2009). Genetic variability and correlation studies in arvi (*Colocasia esculenta* var. *antiquorum*). *Vegetable Science,* 36(3): 431-434.

Panse, V. G. and Sukhatme, P. V. (1976). Statistical methods for agricultural workers. Indian council of Agricultural Research, New Delhi, p 381.

Paul, K. K. and Bari, M. A. (2011). Studies on direct and indirect effects of different plant characters on yield of taro (*Colocasia esculenta* L. Schott Var. *antiquorum*). *The Agriculturists,* 9(1-2): 89-98.

Poddar, A., Mukherjee, A., Sreekumar, J., Abraham, K., Naskar, S. K., Unnikrishnan, M. and Mukherjee, A. 2015. Phenotypic variability of among germplasm lines of elephant foot yam (*Amorphophallus paeonifolius*) and taro (*Colocasia esculenta*). *Int. J. of Tropical Agric.,* 33(2): 377-80.

Rao, R. V., Matthews, P., Eyzaguirre, P. B. and Hunter, D. (2010). The global diversity of *C. esculenta*: ethnobotany and conservation. Biodiversity International, Rome.

Singh, D. P. (2017). Stability parameters for varieties of finger millet multi environments trials. *Bulletin of Environment, Pharmacology and Life Sciences,* 6(4): 134-139.

Tewodros, M. B. (2013). Morpho-agronomical characterization of taro (*Colocasia esculenta*) accessions in Ethiopia. *Plant,* 1(1): 1-9.

Yadav, G.C., Vimlesh, K., Deepak, K.G and Akshay, J. (2017). Estimates of variability for growth and yield attributes in taro (*Colocasia esculenta* var. *Antiquorum* (L.) Schott). *Int. J. Curr.* Microbiol. *App. Sci.,* 6(8): 1282-86.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 449-455

Contamination of Groundwater with Heavy Metals and its Impact on Soil and Plants: A Review Paper

Humnabad Srikanth and Kamini Kumari*
Division of Soil Science and Agricultural Chemistry, Lovely Professional University, Punjab

ABSTRACT

Heavy metals are naturally occurring compounds elements that exist in many forms in the environment and the Earth's biosphere. It is any metallic chemical element with a high density that is hazardous or dangerous at tiny concentrations. Mercury (Hg), lead (Pb), arsenic (As), copper (Cu), and nickel are examples of heavy metals (Ni). These elements are mostly found in water and soil. These natural elements are created by the weathering of parent materials and should occur as a result of human actions. Heavy metal contamination is a severe issue due to its toxicity and ease of propagation in the biotic world. It also has serious consequences for animals, soils, crops, and humans. In this subject topic, we will primarily examine heavy metal contamination in groundwater and its impact on soil. These elements are beneficial to both plants and humans, but exceeding the safe limit generates pollution and has a negative impact on the ecosystem. Heavy metal contamination in soil degrades land and poses a risk to soil and plant growth.

Keywords: Effect on soil and plants, Environmental consequences, Heavy metal contamination in groundwater, Heavy metal evaluation index, Remediation of heavy metal contamination

INTRODUCTION

Heavy metals are a well-defined group of inorganic chemical dangers, and it is any metallic chemical element with a high density that is hazardous or dangerous at tiny concentrations. that are mostly encountered in contaminated areas. Lead (Pb), chromium (Cr), arsenic (As), zinc (Zn), cadmium (Cd), and mercury (Hg) are the elements. Groundwater is the most important natural water supply for both drinking and agriculture. Groundwater contamination is currently one of the most serious environmental challenges (Zürk *et al.,* 2008). Toxic pollutants are contaminating the environment and causing serious negative impacts on local consumers. Pollutants are regularly introduced into the aquatic environment, mostly as a consequence of enhanced industrial activity, technological growth, a growing human population, and abuse of natural resources, agriculture, and industrial and household waste run-off (Liu *et al.,* 2008). Heavy metals have been classified as one of the most dangerous contaminants due to their tendency, inclination, and toxicity to accumulate in organisms and penetrate the food chain, as well as their inability to degrade. Heavy metals are particularly hazardous to humans, causing harm to the cardiovascular and gastrointestinal tracts, as well as the central nervous system, endocrine glands, kidneys, liver, lungs, and bones (Kumar and Tripathi, 2010). Heavy metal contamination of soil may pose risks and hazards to humans and the ecosystem via direct ingestion or contact with contaminated soil, the food chain (soil-plant-human or soil-plant-animal-human), drinking contaminated groundwater, reduction in food quality through phytotoxicity, and reduction in land usability for agricultural production (Ling *et al.,* 2007). On the other hand, specific toxic metals, such as As, Ag, Hg, Cd, and Pb, have no biological value to plants and animals; rather, they are hazardous. These elements contaminate the environment at higher concentrations (Shanker *et al.,* 2005). Land and water are valuable natural resources that are essential to agriculture's long-term viability and humanity's civilization. Unfortunately, they have been over-exploited and have substantially deteriorated due to human activity and metals from melting down and mining. These heavy metals have a

*Corresponding author email id: kamini.25795@lpu.co.in

deleterious impact on ground water, soil and soil characteristics, soil chemical and physical properties, and plant germination (Schwartz *et al.,* 2003; Kozdrój, 2001).

Sources of heavy metals

Rapid worldwide industrial expansion has resulted in a greatly elevated danger of heavy metal pollution in the environment. Non-point sources include soluble salts (natural and artificial), insecticides and pesticides, disposal of industrial and municipal wastes in agriculture, and excessive use of fertiliser application. Point sources include emissions, effluents, and solid discharge from industries, vehicle depletion, and metals from melting down and mining. There is also rapid industrialization and disorderly urbanization, as well as the long-term use of enormous amounts of fertiliser and pesticides (Adler and Rascher, 2007). Chromium comes from the metallurgical, paint, and tanning industries; nickel comes primarily from the steel industry and the combustion of coal and liquid fuel; cadmium comes from metal (mostly zinc) smelters, with grease used in motor vehicles being another source of contamination along roads; and lead comes from the paint, metallurgical, and glass industries (Kumar *et al.,* 2015; Rodrigues *et al.,* 2017; D'amore and Al-Abed, 2004).

The effects of heavy metal contamination on soil, plants, and humans

These heavy metals and metalloids are highly poisonous, causing unwanted consequences and significant issues even at low metal concentrations. Heavy metals are more dangerous to people, animals, and other living beings on the planet. Metals are significant because they have the potential to reduce agricultural output owing to the possibility of bioaccumulation and biomagnification in the food chain and high impacts on groundwater pollution (Shiowatana *et al.,* 2001). There are more heavy metals accessible, particularly those Pb, Cr, As, Cd, and Hg are the elements (Mercury).

Lead (pb): Lead is a poisonous metal. even though it is present in small doses. It is found in paints as a powder and in high concentrations in mixed leaded petroleum products. Lead toxicity causes significant damage to the prefrontal hippocampus, cerebellum, and cerebral cortex of the brain, which can result in a variety of neurological disorders such as brain injury and more (Khan *et al.,* 2000, 2008). Lead poisoning inhibits ATP generation in plants, induces lipid peroxidation, and damages DNA through excessive ROS production. In addition, lead severely lowers seed germination, root elongation, seedling development, plant growth, transpiration, chlorophyll synthesis, and water and protein content (Pourrut *et al.,* 2011). Lead's destiny in soil is influenced by selective or exchange adsorption at mineral surfaces, precipitation of sparingly soluble solid phases, and the creation of relatively stable organo-metal complexes or chelates with organic materials. According to a WHO report issued by the Institute for Health Metrics and Evaluation (IHME), lead exposure caused 900,000 deaths worldwide in 2019 (WHO (World Health Organization, 2021).

Chromium (Cr): Chromium is the primary component in stainless steel. Adding anti-corrosive qualities by adding metallic chromium to make stainless steel was a significant advance in steel manufacturing (Coblentz, WW, and Stair 2008). Steel may be given a polished mirror appearance using chromium plating, and it is also possible to chromium plate plastics and household items, which are frequently used in bathroom fixtures (CRC Press/Taylor and Francis, 2015). Cr is mostly emitted as a result of human activity, with substantial emissions from industrial operations. Chromium causes multi-organ poisoning in humans, including asthma, allergy, kidney impairment, and respiratory cancer (Goyer *et al.,* 2001). If Cr dissolves into the soil and becomes poisonous in that location, no plant can live; if they do survive, Cr influences plant growth and development by modifying the germination process as well as the growth of roots, stems, and leaves, which may affect total dry matter production and yield. Under high Cr circumstances, Cr produces significant soil damage and is noticeable on wheat, oat, and sorghum plants by reducing the chance of seed and seedling germination (Journal of Hazardous Materials, 2009).

Arsenic (As): Arsenic is mostly used in lead alloys and is used in semiconductor electronic devices; arsenic is a frequent n-type dopant. It is mostly used to make pesticides, herbicides, and insecticides, so this metal is highly effective on agricultural soils and water (From Wikipedia). Arsenic has been shown to disrupt biochemical and metabolic processes, thus impairing nutritional absorption (Khalid *et al.,* 2017). The very negative impact and effect on photosynthetic apparatus, disturbance of plant water status, interaction with functional groups of enzymes, and substitution of critical ions from adenosine triphosphate (ATP) in plants growing in As-contaminated soils and also the When these heavy metals interact with soil and drain beneath the soil, they become extremely polluted (Winkel *et al.,* 2008; Rafiq *et al.,* 2017).

Cadmium (cd): Cadmium is a byproduct of zinc manufacturing and exists as a small component in most zinc ores. Cadmium has long been used as a corrosion-resistant coating on steel and telluride solar panels. Cadmium is a non-flammable metal that is insoluble in water (Prasad, 2003; Maret, Wolfgang, 2013; Dutta and Sarma, 2015; Soil Science 1993; Morrow, 2010). Even low Cd levels have a negative impact on plant development and metabolism. Cadmium is known to cause the production of reactive oxygen species, to obstruct the usage, absorption, and transport of vital nutrients and water, and to alter photosynthetic machinery, resulting in plant tissue death (Qadir *et al.,* 2014, http://www.osha.gov/cadmium/2021). When Cd is combined with soil and water, it causes infiltration into the soil, which then travels under the subsurface and becomes mixed with ground water. The impact of Cd toxicity is highly dose-specific and significantly correlated with soil nutrient status. (http://www.idph.state.il.us/cancer/factsheets/cadmium.htm)

Mercury (Hg): Mercury and the halogen bromine are the only elements that are liquid in nature. Mercury is used in thermometers, barometers, manometers, sphygmomanometers, etc. (Hammond *et al.,* 2005). Natural sources of mercury include volcanic eruptions, seawater discharges, and anthropogenic emissions from its usage in goods or industrial processes. Mercury inhibits the function of plasma membrane-localized aquaporins (AQP), which are water channel proteins that improve water penetration, resulting in a physical barrier to the water flow and a reduction in plant water uptake and transpiration rate (Sas-Nowosielska *et al.,* 2008; Clemens, 2013). mercury is when dissolved in soil it can suppress the plant growth and soil quality.

Groundwater pollution analysis: A total of twenty-five samples were collected from twenty-five different places in the same area or district. The samples are gathered in various regions from various locations, such as borewells, small farm ponds, agricultural fields, and surrounding industrial sites. Water quality criteria are determined by the Bureau of Indian Standards (BIS), Indian Standards (IS), and the World Health Organization (Nelson *et al.,* 2020).

Water quality index: The water quality index is the most effective instrument for monitoring both surface and groundwater contamination. This water quality indicator assigns a score between 0 and 100. We were aware of nine factors in this case. Calcium, Magnesium, Chloride and Total Dissolved Solids. The water quality scale runs from 1 to 5, with 1 being the least concerned and 5 being the most concerning. These all process are done in lab by seeing lab manual.

Heavy metal contamination treatment or remediation

There are various forms of heavy metal contamination remediation, however we will focus on some of them in order to address meta pollution in groundwater. To repair heavy metal-contaminated soil, water, and sediments, many techniques such as physical, chemical, and biological approaches are proposed. Thermal treatment, adsorption, chlorination, chemical extraction, ion exchange, membrane separation, electro kinetics, bioleaching, and other procedures fall within this category. Heavy metals may spread swiftly and easily after they have been disseminated in the soil.

Chemical-Biological Remediation: This technique of chemical–biological integrated treatment is regarded as a very cost-effective and environmentally sound method of treating heavy metal-containing wastewater. The use of this comprehensive therapy rather than individual chemical or biological treatments has been found to be beneficial and to provide considerable outcomes in heavy metal removal (Murthy *et al.,* 2005). Because of its efficacy and cost practicality, this sort of integrated system combines biological treatment followed by chemical treatment and vice versa, which works as a polishing phase.

Microbial Remediation Using Electro-Kinetic Energy: The soil is mostly made up of heavy metals that are insoluble. Because their removal rate was at its lowest, solubility could be attained by combining electrokinetic and other approaches. Another method we are aware of is that if the metal ion was in "soluble" form in the soil, the remediation rate would be maximised (Logan and Rabaey, 2012). In this case, we are using a modest quantity of electric current to eliminate the high permeability of heavy metals in the soil without disturbing the soil. When used exactly according to instructions, this approach is simple to use, cost-effective, and does not produce a lot of pollution. The bioleaching process was carried out first in this Bio-EK integrated remediation to convert the metal to a soluble form, which Favours a quicker and higher rate of remediation in the electrokinetic approach and this process in bioelectrokinetics. The addition of EDTA was found to play an important role in reducing heavy metal toxicity in soil, and this combined approach resulted in an 81.7 percent elimination of lead from the soil (GWRTAC Technical Report, 1997).

Immobilization: Organic and inorganic amendments are reduced during the immobilisation process when soil or metals are significantly mobilized. Using this method to limit the mobility of heavy metals is a smart concept (Google Scholar, 2006). The precise processes of immobilisation are unknown; however, they might involve precipitation, chemical adsorption and ion exchange, surface precipitation, creation of stable complexes with organic ligands, and redox reaction. The majority of immobilisation methods can be conducted either ex situ or in situ (Journal of Applied Ecology, 2009).

Vitrification: High-temperature (heating) treatment of the contaminated/polluted region results in the creation of vitreous material, generally an oxide solid, which reduces the high mobility of metal pollutants. This approach is extensively used and successful all around the world. It may be utilised in any weather condition (Farrell *et al.,* 2010). The temperature may rise throughout this process until the metals become volatile or until the organic pollutants in the region are destroyed (Lewis Publishers, 1995). As the melted soil generally offers more conductance for the current, the melt expands outward and downward. At a typical treatment rate of 3 to 6 tonnes per hour, a single melt may treat up to 1000 tonnes of contaminated soil to a depth of 20 feet. Vitrification is not a traditional immobilisation technology, but it is easily applicable to the reclamation of contaminated soils, and the use of these procedures can cause the qualification of contaminated metal to convert into normal form (USEPA Handbook, 1992).

Phytoremediation: It simply states that phytoremediation is the employment of green plants in the removal or recovery of pollutants from an area. The phytoremediation process is environmentally friendly, simple to implement, does not require any specific equipment, and results in re-usable land. The rhizosphere and environmental circumstances have a significant impact on the system's efficiency. Specifically, the soil must be suited to the demands of the plant in order for the plant to remove toxins from the soil. The most essential factor in phytoremediation is soil ph. The pH of the region must be between 5.8 and 6.5 in order for the nutrients to be absorbed (Tazi, Yüksek *et al.,* 2007). The absorption of nutrient elements occurs in three stages: (1) transportation of nutrients to the root circle and root surface; (2) absorption of nutrient ions into the roots; and (3) transportation of nutrient ions which entered the root to the essential portions via the transmission branches. The two major ideas for nutrition transfer to the root surface are "Carbonic Acid Theory" and "Intersection and Contact Change". (Adilolu *et al.,* 2012). Phytodegradation, rhizofiltration, phytoextraction, phytostabilization, phytovolatilization, and phytodegradation are the additional types of phytoremediation. These procedures are particularly successful in the sterilising of polluted medium-range regions. All the above-mentioned remediations are effective in treating polluted regions and soils. This procedure is incredibly easy, widely available, and widely used throughout the world (Lee *et al.,* 2009).

Fungal Phytoremediation: Many plants have merged with or are linked to mycorrhizal fungi, which enhance the surface area of plant roots and help with water and nutrient absorption (Kirk and Santos, 1999). Glomus mosseae, Glomus geosporum, and Glomus etunicatum are mycorrhizal fungi that have been detected in *Plantago lanceolata* L. and have been demonstrated to promote arsenic (As) development in a contaminated zone or region (Sylvia, Fuhrmann *et al.,* 2005; Orowska *et al.,* 2012).

Phytoremediation of Algae: We can develop the ability to grow both autotrophically and heterotrophically in this location. In this location, metallothionein and phytochelatin synthesis can develop (Hua and Traina, 1995). Heavy metal accumulation has been demonstrated in microalgae (e.g., Dunaliella salina), macroalgae (Ulva sp., Enteromorpha sp., Cladophora sp., and Chaetomorpha sp.), green algae (Enteromorpha, Cladophora), and brown algae (Fucus serratus) (Gosavi *et al.,* 2004). As a result, heavy metal pollution has an impact not only on the soil but also on the overall environment.

Future Prospects: Heavy metals are known to have major health consequences, including reproductive impairment and genetic, epigenetic, and metabolic changes in both the human body and the environment. Physical separation, isolation, immobilisation, toxicity reduction, and extraction are common remediation strategies. When compared to a single procedure, the usage of integrated remediation results in more successful remedial implementation. to determine the best corrective strategy for challenging in-situ operating situations such as site features (geographical location, pH levels, particle size, clay, soil type, depth, water content, climate, types of co-contaminants, etc.). In future study, more emphasis should be placed on assessment methodologies for measuring remediation efficacy while creating new remediation technologies. If the government properly followed all of the above directions, we would be able to minimize heavy metal pollution in ground water and see a significant reduction in the number of heavy metals in the environment.

CONCLUSION

This study explores the contamination process and its consequences on animals, plants, soils, humans, and the entire ecosystem, as well as a study of anthropogenic activities that cause severe pollution in groundwater and soil. We've already spoken about how the repair process can proceed. We discussed several different types of remediation techniques, and selecting an effective remedial option requires a thorough understanding of the sources of heavy metals, their chemistry, and the possible threats to the environment and individuals. We also came to the conclusion that integrated procedures comprising EK techniques and Phyto-remediation were more successful in regulating the polluted zone or region. There are several sorts of integrated therapy that should be explored, including chemical, physical, and biological treatments. We also determined that these integrated technologies have the potential to be extremely useful for in-situ operations in both emerging and industrialised countries where agriculture, urbanisation, and industrialisation are producing or releasing an inheritance of environmental degradation.

REFERENCES

Adler, R., and J. Rascher, (2007. A Strategy for the Management of Acid Mine Drainage from Gauteng Gold Mines. CSIR, Pretoria, South Africa.

Balakrishnan A., Ramu A. (2016). Evaluation of the heavy metal pollution index (HPI) of ground water in and around the coastal areas of the Gulf of Mannar Biosphere and Palk Strait. *J. Adv. Chem. Sci.,* 2: 331–333.

Coblentz, WW and Stair, R. (2018). Reflecting Power of Beryllium, Chromium, and several other metals. (PDF). *The National Institute of Standards and Technology* NIST Publications Retrieved on October 11, 2018.

D'amore, J. J., Al-Abed, S. R., Scheckel, K. G., and Ryan, J. A. (2005). Methods for the speciation of metals in soils, 34: 1707–1745,

Dutta D, Sarma HP (2015), Copper (Cu), Zinc (Zn) and Cadmium (Cd) Contamination of Groundwater in the Dirking River Basin, Paumpare District, Arunachal Pradesh, India. *Soil Science* 155: 376–384.

Farrell, M. Perkins, W. T. Hobbs, P. J. Griffith, G. W. and Jones D. L. (2010). Migration of heavy metals in soil as influenced by compost amendments. *Environmental Pollution*, 158(1): 55–64.

Gosavi, K., Sammut, J., Gifford, S., and Jankowski, J. (2004). Macroalgal bio monitors of trace metal contamination in acid sulphate soil aquaculture ponds. *doi: 10.1016/j.scitotenv.2003.11.002.*

Goyer RA (2001). Toxic effects of metals. In: Klaassen CD (Ed.), Cassarett and Doull's Toxicology: The Basic Science of Poisons. 811–867. McGraw-Hill Publisher, New York, USA, pp. 811–867.

Hammond, C. R. The Elements Lide, D. R., ed. (2005).The CRC Archived June 26, 2008 at the Wayback Machine *Handbook of Chemistry and Physics (86th ed.). Boca Raton, FL: CRC Press.*

Heavy metal intoxication, Mahajan PV. Nelson Textbook of Pediatrics, 21st ed. Philadelphia, PA: Elsevier; 2020: chap 738. Kliegman RM, St Geme JW, Blum NJ, Shah SS, Tasker RC, Wilson KM, eds.

Hua, C. X., Traina, S. J., Logan, T. J., Gustafson, T., Sayre, R. T., and Cai, X. H. (1995). Applications of eukaryotic algae for the removal of heavy metals from water. *Mol. Mar. Biol. Biotechnology,* 338–344.

Khalid S., Shahid M., Niazi N.K., Rafiq M., Bakhat H.F., Imran M., Abbas T., Bibi I., Dumat C. (2017). Improving Pollution Cleanup. Berlin, Germany: Springer, 2017. Arsenic behavior in soil-plant systems: biogeochemical reactions and chemical speciation influences, pp. 97–140.

Khan DA, Qayyum S, Saleem S, and Khan FA (2008). found that lead-induced oxidative stress has a negative impact on the health of occupational workers. *ToxicolInd Health,* 24(9): 611-618.

Kirk, G. J. D., Santos, E. E., and Findenegg, G. R. (1999). Phosphate solubilization by organic anion excretion from rice (*Oryza sativa L.*) growing in aerobic soil. *Plant Soil,* 211: 11–18.

Kozdrój J, van Elsas JD. (2001). Structural diversity of microbial communities in arable soils of a heavily industrialized area determined by PCR-DGGE finger printing and FAME profiling. *Appl Soil Ecol.* 17(1):31–42.

Kumar R, Tripathi RM, Gupta AK. International Journal of Current Microbiology and Applied Science 3(7): 945-949.

Kumar, N., Kumar, S., Bauddh, K., Dwivedi, N., Shukla, P., Singh, D. P., & Barman, S. C. (2015). Toxicity assessment and accumulation of metals in radish irrigated with battery manufacturing industry effluent. *International Journal of Vegetable Science,* 1–13.

Lee, K. Y., Yoon, I. H., Lee, B. T., Kim, S. O., and Kim, K. W. (2009). A novel combination of anaerobic bioleaching and electro kinetics for the removal of mine tailing soil. *Environ. Sci. Technol.* 43: 9354–9360.

Ling, W. Shen, Q. Gao, Y. Gu X., and Yang Z. (2007). Use of bentonite to control the release of copper from contaminated soils. *Australian Journal of Soil Research*, 45(8): 618–623.

Liu H, Li L, Yin C, Shan B (2008). Heavy metal percentage distribution and risk assessment in Moshui. *Lake sediments Journal of Environmental Sciences,* 20(4): 390–397.

Logan, B. E., and Rabaey, K. (2012). conversion of wastes into bioelectricity and chemicals by using microbial electrochemical technologies. *Science,* 337: 686–690.

Maret, Wolfgang (2013). Chapter 14 Zinc and the Zinc Proteome. In Banci, Lucia (ed.). *Metallomics and the Cell* Metal Ions in Life Sciences, Springer, pp. 479–501, 2012.

Morrow, H. (2010). Cadmium and Cadmium Alloys. *The Kirk-Othmer Encyclopedia of Chemical Technology*.

Obhanardakani S. (2016). Evaluation of water quality pollution indices for groundwater resources in the Ghahav and Plain, Hamadan Province, Western Iran. *Iran. J. Toxicol.* 10: 35–40.

Orowska, E., Godzik, B., and Turnau, K. (2012). Effect of various arbuscular mycorrhizal fungal isolates on growth and arsenic accumulation in *Plantago lanceolata* L. *Environ. Pollut.* 168: 121–130.

Pourrut B, Shahid M, Dumat C, Winterton P, Pinelli E. (2011). Lead uptake, toxicity, and detoxification in plants. *Rev Environ Contamination Toxicol.* 213: 113–36.

Prasad, AS (2003). Zinc deficiency: has been known about for 40 years but ignored by global health organisations. 326(7386): 409

Prasanna M.V., Praveena S.M., Chidambaram S., Nagarajan R., Elayaraja A. (2012). Evaluation of water quality pollution indices for heavy metal contamination monitoring: a case study from Curtin Lake in Miri, East Malaysia. Earth *Science,* 67:1987–2001, 2012.

Qadir S, Jamsheed S, Rasool S, Ashraf M, Akram NA, Ahmad P. (2014). Modulation of plant growth and metabolism in cadmium-enriched environments. *Rev Environ Contam Toxicol,* 229: 51–88.

Rafiq M., Shahid M., Shamshad S., Khalid S., Niazi N.K., Abbas G., Saeed M.F., Ali M., Murtaza B. (2017). A comparative study to evaluate the efficiency of EDTA and calcium in alleviating arsenic toxicity to germinating and young *Vicia Faba* L. seedlings. pp 1–11.

Rahman, P. K. S. M., and Murthy, M. A. V. (2005). Advances in S/S for Waste and Contaminated Land, eds. A. T. Abir and A. A. Stegemann (London: Balkema Publishers), 347–355.

Rodriguesa, A. A. Z., De Queiroz, M. E. L. R., Oliveira, A. F., Heleno, A. A. F. F., Zambolim, L., Freitasa, J. F., & Morais, E. H. C. (2017). Pesticide residue removal in classic domestic processing of tomato and its effects on product quality. *Journal of Environmental Science and Health. Part. B,* 52: 1-8.

Sas-Nowosielska *et al.* 2008. Mercury toxicity in plants. *The Botanical Review,* 66(3): 379-422

Schwartz C, Echevarria G, Morel JL. (2003). Phytoextraction of cadmium with *Thlaspi caerulescens*. *Plant Soil,* 249(1): 27–35.

Shashi Dubey (Reviewing Editor), Mohd Saleem, Athar Hussain, and Gauhar Mahmood (2016) Analysis of groundwater quality using the water quality index: A case study of greater Noida (Region), Uttar Pradesh (U.P), India, Cogent Engineering, 3:1.

Shiowatana, J., McLaren, R. G. Chanmekha N. and Samphao A. (2001). Fractionation of arsenic in soil by a continuous-flow sequential extraction method. *Journal of Environmental Quality,* 30(6): 1940–1949

Sylvia, D. M., Fuhrmann, J. J., Hartel, P. G., and Zuberer, D. A. (2005). Principles and Applications of Soil Microbiology.

The United States Government Accountability Office (USGAO) (2000). Health Effects of Lead in Drinking Water the U.S. General Accounting Office reports

Winkel, L., Berg, M., Amini, M., Hug, S. J., & Johnson, C. A. (2008). Predicting groundwater arsenic contamination in Southeast Asia from surface parameters *Nature Geoscience,* 1: 536–542.

Yankey R.K., Fianko J.R., Osae S., Ahialey E.K., Duncan A.E., Essuman D.K., Bentum J.K. (2013). Evaluation of the heavy metal pollution index of groundwater in the Tarkwa mining area, *Ghana.* 54: 12663–12667

Ztürk, M., Zözen, G., Minareci, O. and Minareci, E. (2009). Heavy metal determination in fish, water, and sediments from Turkey's Avsar Dam Lake. *Iranian Journal of Environmental Health Science and Engineering,* 6: 73-80.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 456-461

Impact of Paramparagat Krishi Vikas Yojana (PKVY) in Terms of Income Generation by the Beneficiaries

Krishna Yadav[1]* and J.P. Yadav[2]
[1]Ph.D. Student,[2]Professor, Department of Extension Education, SKN College of Agriculture, SKNAU, Jobner - 303329, Jaipur, Rajasthan

ABSTRACT

Under National Mission of Sustainable Agriculture (NMSA) the Paramparagat Krishi Vikas Yojana (PKVY) is a comprehensive scheme to promote and develop organic farming through a cluster approach along with Participatory Guarantee System (PGS) of certification. Rajasthan state comprises seven regions he study was conducted in Jaipur region of Rajasthan purposively. In Jaipur region, three pachayat samitees from each selected district Jaipur and Sikar and also two Gram panchayats from each selected Panchayat Samiti were selected randomly where, 25 respondents who benefitted under PKVY from each selected Gram Panchayat were selected randomly by making a sample size 300. Income generation referred to the total annual income earned by the beneficiaries through various activities carried out under PKVY. 10 (03.33 per cent) farmers had generated very high income (Rs. from 204601 to 248000) through agriculture development activities of PKVY, whereas, 32 (10.67 per cent) of PKVY farmers had high income (Rs. from 161201 to 204600), 66 (22.00 per cent) had medium (Rs. From 117801 to 161200), 90 (30.00 per cent) low (Rs. From 74401 to 117800) and 102 (34.00 per cent) had generated very low (Rs. from 31001 to 74400) income, respectively, by the farmers through agricultural development activities of PKVY. The knowledge was measured on five point continuum based on experts' opinion. The study shown that the majority (46.67 per cent) of farmers (140) had fair knowledge regarding agricultural development activities of PKVY whereas, 115 farmers (38.33 per cent) had excellent knowledge while 32 farmers (10.67 per cent) had good knowledge and 08 (02.67 per cent) had poor knowledge while a few number 05 farmers (01.66 per cent) had less knowledge about agricultural development activities carried out for farmers under PKVY.

Keywords: Impact, Income Generation, Krishi Vikas Yojana, Paramparagat

INTRODUCTION

The phenomenon of Green Revolution came into existence which allowed developing countries like India to overcome continual food scarcity by producing more food and other agricultural products by using high-yielding varieties of seeds, modifying farm equipments and substantially increasing use of chemical fertilizers. For optimum production of agriculture and to feed the growing population, application of chemical fertilizers and pesticides has become necessary. Such type of agriculture practices allowed growth and sustainability of food grains but at the same time have the negative impact on the environment, soil, animal and human health created many problems like pollutions, diseases, insect-pest, psycho-physical problems and physiological disorders in animal kingdom. Looking to these facts the existing potential of organic farming was given the priority and the future demand for organic produce, the Government is promoting organic farming across the country. The Paramparagat Krishi Vikas Yojana (PKVY) is a comprehensive scheme under National Mission of Sustainable Agriculture (NMSA) to promote organic farming through a cluster approach along with Participatory Guarantee System (PGS) of certification. This centrally sponsored scheme is being 'implemented by the states government on farmers' field. Farmers always hesitate to use the technology without having

*Corresponding author email id: krishnaext@gmail.com

the basic knowledge about the any scheme or programme. Therefore, the knowledge of PKVY farmers was measured for further improvement in the scheme. Keeping these facts in mind, an attempt has been made to measure the Knowledge level of farmers about agriculture development activities carried out under PKVY in Jaipur Region of Rajasthan.

MATERIALS AND METHODS

The study was conducted in Jaipur region of Rajasthan purposively. In Jaipur region, three pachayat samitees from each selected district Jaipur and Sikar were selected randomly. Two Gram panchayats from each selected Panchayat Samiti were selected randomly where as, 25 respondents who benefitted under PKVY from each selected Gram Panchayat were selected randomly by making a sample size 300.

Income generation referred to the total annual income earned by the beneficiaries through various activities carried out under PKVY which was measured by using of following formulae:

Net income = Gross income - gross expenses.

The impact of PKVY in terms of income generation by the beneficiaries was measured based on developed schedule. For this purpose the statements related to income generation were prepared based on PKVY guideline and related literature reviewed. These prepared statements were sent to 30 experts working at SKNAU, Jobner, MPUAT, Udaipur, SKRAU, Bikaner, AU Kota and Jodhpur, SMS of KVK Chomu of district Jaipur and Fatehpur of district Sikar and also experts of PKVY working at Directorate of agriculture, Pant Krishi Bhawan Jaipur. After obtaining the suggestions from the experts and in consultation with the members of advisory committee, the schedule was modified. Based on the attainable score and experts suggestions, the respondents were classified into five categories namely very low, low, medium, high and very high income by using arbitrary method.

To find out the difference between beneficiary farmers of district Jaipur and Sikar, following hypotheses were farmed and tested by employing 'Z' test for significance of difference between the two samples and results are presented in the Table 4.

***$NH_{04.4.}$* :** There is no significant difference between the PKVY farmers of district Jaipur and Sikar regarding income generated by them through agriculture development activities.

***RH_4* :** There is a significant difference between the PKVY farmers of districts Jaipur and Sikar regarding income generated by them through agriculture development activities.

RESULT AND DISCUSSION

The impact of PKVY activities on income generation of farmers through agriculture development activities were calculated by using the arbitrary method as per experts opinion and the data are presented in Table 1. The data given in Table 1 indicate that 10 (03.33 per cent) farmers had generated very high income (Rs. from 204601 to 248000) through agriculture development activities of PKVY, whereas, 32 (10.67 per cent) of PKVY farmers had high income (Rs. from 161201 to 204600), 66 (22.00 per cent) had medium (Rs. From 117801 to 161200), 90 (30.00 per cent) low (Rs. From 74401 to 117800) and 102 (34.00 per cent)

Table 1: Categorization of income generated by the beneficiary farmers through agriculture development activities of PKVY (n=300)

Income categories (Rupees)	District Jaipur (n_1=150)	District Sikar (n_1=150)	Overall (n=300)
Very high (Rs. from 204601 to 248000)	08(05.33)	02(01.33)	10(03.33)
High (Rs. from 161201 to 204600)	23(15.33)	09(06.00)	32(10.67)
Medium (Rs. from 117801 to 161200)	38(25.34)	28(18.67)	66(22.00)
Low (Rs. from 74401 to 117800)	39(26.00)	51(34.00)	90(30.00)
Very low (Rs. from 31001 to 7440)	42(28.00)	60(40.00)	102(34.00)
Total	150(100.00)	150(100.00)	300(100.00)

(Figures in the parentheses indicate percentage) had generated very low (Rs. from 31001 to 74400) income, respectively, by the farmers through agricultural development activities of PKVY. These findings are supported by the findings of Bhandari (2014) and Bori (2014).

The data given in Table 2 reveal that the highest net income generated by beneficiary farmers of PKVY was through Organic vegetable production (Rs. 11308) and the second highest net income generated through Organic pulses production (Rs.10442) followed by Organic crop production (Rs.10222), Organic oilseeds crops (Rs. 9859), Bio fertilizer/Bio-insecticide (Rs. 9220), Botanical extracts (Rs. 9203), Vermi-composting (Rs. 8863), Nursery raisings/seedlings/plantations (Rs. 7560), Compost production (Rs. 7105), Organic seed production (Rs. 6670), Traditional organic beejaamruth, jeevaamruth, panchgavya production (Rs. 5957) where as the lowest income generated by the beneficiary farmers was through Organic fruit production (Rs. 3000). These findings are in support with the findings of Dubey *et al.* (2011), Meena *et al.* (2017) and Satyajeet (2018)

District wise net income generated by the beneficiary farmers was also calculated. Therefore, the data given in Table 2 also indicate that in district Jaipur, the highest income generated by the beneficiary farmers of PKVY was through Organic vegetable production (Rs. 11240) and the second highest net income generated was through Organic oilseed crop production (Rs. 10897) followed by Organic crop production (Rs. 10451), Organic pulses (Rs. 9883), Bio fertilizer/Bio-insecticide (Rs. 9673), Botanical extracts (Rs. 9243), Vermi-compost (Rs. 9083), (Rs. 7403), Compost production (Rs. 7067), Organic seed production (Rs. 6323), Traditional organic beejaamruth, jeevaamruth, panchgavya (Rs. 5867) where as the lowest income generated by the beneficiary farmers was through Organic fruit production (Rs. 3073). Similarly in case of district Sikar, it was found that the highest income generated by the beneficiary farmers of PKVY was through Organic vegetable production (Rs. 11377) and the second highest net income generated was through Organic pluses production (Rs. 11000), followed by Organic crop production (Rs. 9993), Botanical extracts (Rs. 9163), Organic oilseed crop production (Rs. 8821), Bio-fertilizer/Bio-insecticide (Rs. 8767), Vermi-compost (Rs. 8643), Nursery raisings/seedlings/ plantations (Rs. 7717), Compost production (Rs. 7143), Organic seed production (Rs. 7017), Traditional organic beejaamruth, jeevaamruth, panchgavya (Rs. 6047) where as the lowest income generated by the beneficiary

Table 2: Extent of income generation of farmers through agriculture development activities of PKVY (Rs)

Income generating activities	Jaipur (n_1=150)			Sikar (n_2=150)			Overall (n=300)		
	Input (Rs.)	Output (Rs.)	Net income (Rs.)	Input (Rs.)	Output (Rs.)	Net income (Rs.)	Input (Rs.)	Output (Rs.)	Net income (Rs.)
Nursery seedlings/ plantations	8873	16277	7403	8507	16223	7717	8690	16250	7560
Organic seed production	5860	12183	6323	6200	13217	7017	6030	12700	6670
Compost production	4573	11640	7067	4720	11863	7143	4647	11752	7105
Organic crop production	8253	18705	10451	8530	18523	9993	8392	18614	10222
Organic fruit production	2300	5373	3073	1680	4607	2926	1990	4990	3000
Bio fertilizer/Bio-insecticide	7227	16900	9673	7080	15847	8767	7153	16374	9220
Organic vegetable production	7897	19137	11240	7207	18583	11377	7552	18860	11308
Vermicompost	3143	12227	9083	3483	12126	8643	3313	12176	8863
Organic oilseeds crops	5580	16477	10897	6206	15027	8821	5893	15752	9859
Organic pulses	5870	15753	9883	6201	17201	11000	6035	16477	10442
Traditional organic beejaamruth, jeevaamruth, panchgavya	2523	8390	5867	3330	9377	6047	2926	8883	5957
Botanical extracts	2593	11837	9243	2775	11937	9163	2684	11887	9203
Overall	64693	164898	100205	65918	164531	98613	65305	164714	99409

farmers was through Organic fruit production (Rs. 2926).

The inferences may be drawn from the findings that the maximum income was generated by beneficiary farmers of PKVY was Organic vegetable production, Organic pulses production, Organic crop production, Organic oilseeds crops, Bio-fertilizer/Bio-insecticide, Botanical extracts and Vermi-compost activities of PKVY where as less income was generated through the Nursery raisings/ seedlings/ plantations, Compost production, Organic seed production and Traditional organic beejaamruth, jeevaamruth, panchgavya production. Similar trends of results were also found in case of income generated by the beneficiary farmers of district Jaipur and Sikar. These results might be found due to the facts that the farmers might be interested to take the organic production of vegetables, food grains, oilseed and pulses by using of Bio-fertilizer/Bio-insecticide, Botanical extracts and Vermi-compost for their own crops and selling to nearby farmers on demand basis as given higher returns where as the demand of Nursery raisings/seedlings, Compost, Organic seed and Traditional organic Beejaamruth, Jeevaamruth, Panchgavya were production were very less due unawareness about these products. These findings are in support with the findings of Venkattakumar *et al.* (2012), Pandya *et al.* (2015).

Net income generated by the beneficiary farmers through various agriculture development activities of PKVY was also measured through analyzing of benefit: cost ratio (BCR) of each activity of PKVY. The BCR was calculated by dividing the proposed total gross income (Output) of particular activity of the project by the total cost/expenses (Input) incurred in total Production.

The data given in Table 3 indicates that the highest benefit cost ratio (BCR) was obtained from income generated by the beneficiary farmers from Botanical extracts (BCR) 4.42 hence ranked first. The second highest BCR (3.67) was found through income generated by the farmers of PKVY from production of vermi–compost, followed by Traditional organic beejaamruth, jeevaamruth, panchgavya (BCR 3.03), Organic pulses (BCR 2.73), Organic oilseeds crops (BCR 2.67), Compost production (BCR 2.52), Organic fruit production (BCR 2.50), Organic vegetable production (BCR 2.49), Bio fertilizer/Bio-insecticide (BCR 2.28), Organic crop production (BCR 2.21), Organic seed production (BCR 2.10) and III, IV, V, VI, VII, VIII, IX, X, XI ranks were assigned ,respectively. The lowest BCR (1.86) was obtained through Nursery seedlings/plantations activity of income generating carried out under PKVY which was assigned the lowest rank (XII).

The BCR of income generated under PKVY activity by the beneficiary farmers of districts Jaipur and Sikar was also analysed. The data given in Table 3 reveal that in case of district Jaipur, the highest benefit cost ratio (BCR) was obtained from income generated by the beneficiary farmers from Botanical extracts (BCR 4.56), hence ranked first. The second highest BCR was found through income generated by the farmers of PKVY from Vermi-compost production (BCR 3.89) followed by Traditional organic beejaamruth, jeevaamruth, panchgavya (BCR 3.32), Organic oilseeds crops (BCR 2.95), Organic pulses production (BCR 2.68), compost production (BCR 2.54), Organic vegetable production (BCR 2.42), Organic fruit production and Bio fertilizer/Bio-insecticide each (BCR 2.33), Organic crop production (BCR 2.26), Organic seed production (BCR 2.07) and III, IV, V, VI, VII, VIII, IX, X ranks were assigned, respectively. The lowest BCR (1.83) was obtained through Nursery seedlings/plantations activity of income generation carried out under PKVY by the beneficiary farmers; therefore, it was accorded lowest rank (XI).

In case of district Sikar, the highest benefit cost ratio (BCR) was obtained from income generated by the beneficiary farmers from Botanical extracts (BCR 4.30), hence ranked first. The second highest BCR was found through income generated by the farmers of PKVY from Vermi-compost production (BCR 3.48) followed by Traditional organic beejaamruth, jeevaamruth, panchgavya (BCR 2.81), Organic pulses production (BCR 2.77), Organic fruit production (BCR 2.74), Organic vegetable production (BCR 2.57),Compost production (BCR 2.51), Organic oilseeds crops (BCR 2.42), Bio fertilizer/Bio-insecticide each (BCR 2.23), Organic crop production (BCR 2.17) and Organic seed production (BCR 2.13) and III, IV, V, VI, VII, VIII, IX, X ranks were assigned, respectively. The lowest BCR (1.90) was obtained through Nursery seedlings/plantations activity of income generation

Table 3: Cost: Benefit analysis of income generated by the farmers through agriculture development activities of PKVY

Income Generation Activities	Benefit : Cost Ratio of input and out Put with rank					
	Jaipur (n_1=150)	Rank	Sikar (n_1=150)	Rank	Overall (n_1=300)	Over all Rank
Nursery seedlings/plantations	1.83	XI	1.90	XII	1.86	XII
Organic seed production	2.07	X	2.13	XI	2.10	XI
Compost production	2.54	VI	2.51	VII	2.52	VI
Organic crop production	2.26	IX	2.17	X	2.21	X
Organic fruit production	2.33	VIII	2.74	V	2.50	VII
Bio fertilizer/Bio-insecticide	2.33	VIII	2.23	IX	2.28	IX
Organic vegetable production	2.42	VII	2.57	VI	2.49	VIII
Vermi-compost production	3.89	II	3.48	II	3.67	II
Organic oilseeds crops	2.95	IV	2.42	VIII	2.67	V
Organic pulses production	2.68	V	2.77	IV	2.73	IV
Traditional organic beejaamruth, jeevaamruth, panchgavya	3.32	III	2.81	III	3.03	III
Botanical extracts	4.56	I	4.30	I	4.42	I
Overall	2.54		2.49		2.52	

carried out under PKVY by the beneficiary farmers, hence lowest rank XII was accorded. These findings are in support with the findings of Rani and Lal (2019).

It might be concluded from the above findings that the maximum BCR was obtained by the farmers of PKVY through income generating activities i.e. botanical extracts, Vermicompost, Traditional organic beejaamruth, jeevaamruth, panchgavya, Organic oilseeds crops, Organic pluses production, compost production, Organic vegetable production, Organic fruit production and Bio fertilizer/Bio-insecticide. These results might have obtained according to income generated by the beneficiary farmers through these activities. Although, it was found remarkable that BCR of Traditional organic beejaamruth, jeevaamruth, panchgavya was very high yet net income generated was very low. This might be due to the facts that there was very low cost technology was involved in preparation of Traditional organic Beejaamruth, Jeevaamruth, Panchgavya but this practice awareness might be created about benefits of this technology. More or less similar pattern of BCR was found in case of beneficiary farmers of district Jaipur and Sikar. These findings are in support with the findings of Dubey *et al.* (2011), Gautam *et al.* (2011) and Rajesh *et al.* (2011), Pathak (2017).

To find out the difference between beneficiary farmers of district Jaipur and Sikar, following hypotheses were farmed and tested by employing 'Z' test for significance of difference between the two samples and results are presented in the Table 4.

$NH_{04.4}$: There is no significant difference between the PKVY farmers of district Jaipur and Sikar regarding income generated by them through agriculture development activities.

RH_4 : There is a significant difference between the PKVY farmers of districts Jaipur and Sikar regarding income generated by them through agriculture development activities.

The data given in Table 4 reveal that the calculated 'Z' value was found less than the tabulated value which is statistically non-significant. Hence the null hypothesis

Table 4: Comparison between income generation of farmers of district Jaipur and Sikar through agriculture development activities (n=300)

Districts	Sample size	Mean score	S.D	'Z' Value
Jaipur	150	97558.67	39106.57	0.74^{NS}
Sikar	150	94016.00	43628.41	

NS= Non-significant

($NH_{04.3}$) "There is no significant difference between the PKVY farmers of district Jaipur and Sikar regarding income generated by them through agriculture development activities" was accepted and alternate hypothesis (RH_4) was rejected. It means that beneficiary farmers of both districts had generated more or less same income through different activities of PKVY. This might be due to the facts that farmers of both districts were equally benefited through PKVY activities in the study area. These findings are supported by the findings of Mahadik *et al.* (2018).

CONCLUSION

It was found that 03.33 per cent famers (10) had generated very high income (Rs. 204601 to 248000) through agriculture development activities of PKVY, whereas, 10.67 per cent of PKVY farmers (32) had high income (Rs. 161201 to 204600), 22.00 per cent (66) had medium (Rs. 117801 to 161200), 30.00 per cent (90) low (Rs. 74401 to 117800) and 34.00 per cent (102) had generated very low (Rs. 31001 to 74400) income, respectively, through agriculture development activities of PKVY. Out of the different agriculture development activities carried out under PKVY, the highest net income generated by beneficiary farmers of PKVY was through Organic vegetable production (Rs. 11308), Organic pluses production (Rs.10442) and Organic crop production (Rs.10222). Out of the different agriculture development activities of PKVY, the highest benefit cost ratio (BCR) was obtained from Botanical extracts (BCR) 4.42, followed by vermi–compost, (BCR 3.67) and Traditional organic beejaamruth, jeevaamruth, panchgavya (BCR 3.03). Non-significant difference between beneficiary farmers of district Jaipur and Sikar was found regarding their income generation through different activities of PKVY.

REFERENCES

Bhandari, S.D. 2014. Socio-economic impact of Mahatma Gandhi National Rural Employment Guarantee Act on the beneficiaries. M.Sc. (Agri.) Thesis, VNMKVP, Parbhani (Maharastra).

Bori, B. 2014. Impact of Swarnajayanti Gram Swarozgar Yojana (SGSY) on poverty alleviation in Golaghat District, Assam. *J. Humanities & Soc. Sci.* 19 (09): 53-56.

Dubey, Swapnil; Tripathy, Sarvesh; Singh, Pradyumn and Sharma, R.K. 2011. Impact of improved technology on soyabean productivity in frontline demonstration. *Ind. J. Ext. Edu.,* 47 (3 & 4): 100-103.

Gautam, U.S.; Paliwal, D.K. and Singh, S.R.K. 2011. Impact of frontline demonstration on productivity enhancement in chickpea. *Ind. J. Ext. Edu.,* 47, (3 & 4): 10-13.

Mahadik, R.P.; Punjabi, N.K.; Sharma, F.L. and Upadhyay, B. 2018. Adoption of eco-friendly management practices by mango orchardists. *Ind. J. Ext. Educ. & R.D.*, 26 : 21-24.

Meena, G.L.; Upadhyay, B. And Singh, H. 2017. Impact of livelihood and nutritional security project on socio-economic status of rural households in Udaipur district of Rajasthan. *Ind. J. Ext. Edu. & R.D.*, 25: 9-14.

Pandya, S.P.; Prajapati, M. R. and Thakar, K. P. 2015. Socio-economic impact of krishi mahotsav on beneficiary farmers of Gujarat. *Indian J. of Ext. Edu.* 51, 1 & 2: 75-77.

Pathak, Jagannath 2017. Impact of front line demonstrations on the yield and economics of black gram in Burhanpur District of Madhya Pradesh. Ind. J. Ext. Educ. & R.D., 25: 5-8.

Rajesh Singh; Gurjar, P. S.; Singh, Saurabh and Singh, A.K. 2011. Income generation through varietal selection of rabi onion in Kymore Plateau of Madhya Pradesh. *Ind. J. Ext. Edu.,* 47 (3 & 4): 96-99.

Rani, S. and Lal, M.2019). Effect of media on relationship between socio-personal and economic variables with knowledge and attitude of rural women regarding vegetables cultivation practices in Haryana. Indian J. of Ext. Edu., 55 (2): 52-57.

Satyajeet,; Yadav, V.P.S.; Yadav, S.P. and Rajender, Kumar 2018. Status and opportunities of organic farming for sustainable agriculture – successful cases of rural youths in Haryana. *Indian Res. J. Ext. Edu.*, 18 (4): 25-33.

Venkattakumar, R.; Padmaiah, M.; Sarada, C.; Mahajan, A.M.; Moon, M.K. and Deshmukh, S.N. 2012. Impact of sunflower frontline demonstrations in Akola District of Maharashtra. *Ind. J. of Extn. Edu.,* 48, (1 & 2): 6-11.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 462-467

Productivity and Economics of Fodder Oat (*Avena sativa* L.) Varieties under Integrated Management Techniques in Foot Hills of Jammu Region

Ali Ahmad Abdul Rahim Zai[1], Manpreet Kour[2], B.C. Sharma[3], N.P. Thakur[4], Rohit Sharma[5]*, P. Kumar[6] and Archana[7]

[1]MSc Student, [2]Assistant Professor, [3]Professor & Head, Division of Agronomy, SKUAST-Jammu
[4]Chief Scientist, [5]Technical Assistant, [6]Junior Scientist, ACRA, SKUAST-Jammu
[7]Research Scholar, FSR Centre, SKUAST-Jammu

ABSTRACT

An experimental trial was conducted at Research Farm of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, during *rabi* season of 2016-17. The soil of the experimental field was sandy clay loam in texture, slightly alkaline in reaction (7.60), low in organic carbon (0.47 per cent) and available nitrogen (210.80 kg /ha) but medium in available phosphorus (13.25 kg /ha) and potassium (110.5 kg /ha) with electrical conductivity in the safer range. The experiment consisting of three varieties and five integrated nutrient management treatments in three replications was laid out in Factorial Randomized Block Design. The integrated nutrient management treatments on soil test basis were recommended dose of fertilizers, RDF +25% RDN through FYM, 75% RDF + 25% RDN through FYM, 50% RDF +50% RDN through FYM and 25% RDF + 75% RDN through FYM with three varieties *viz*. Kent, *JHO*-851 and Palampur-1. Among nutrient management techniques. The experimental results revealed that among integrated nutrient management, the treatment where RDF was incorporated with 25% RDN through FYM proved superior in terms of growth, yield, and uptake although it was statistically at par with 100% RDF in terms of plant height and green biomass yield. The application of RDF +25% RDN through FYM increased the total forage yield to the tune of 6.73, 22.29, 32.21 and 55.33 per cent over 100% RDF, 75% RDF + 25% RDN through FYM, 50% RDF +50% RDN through FYM and 25% RDF + 75% RDN through FYM, respectively. However, the highest net returns (Rs 51092.86 /ha) and B: C ratio of 2.63 was obtained with 100% RDF followed by RDF +25% RDN through FYM with net returns of Rs 50005.53/ha and B: C ratio (1.98). Among the varieties, Kent out yielded other varieties by producing of 35.76 t^{-1} of total green biomass followed by Palampur-1 (30.77 t /ha) and JHO-851 (27.32 t /ha). The percentage increase of Kent was 16.21 and 30.87 per cent over Palampur-1 and JHO-851, respectively. In uptake studies also the Kent accumulated highest nitrogen, phosphorus and potassium uptake. Net returns (Rs 46494.93 /ha) and B: C ratio of 1.86 was also highest in variety Kent followed by Palampur-1 with net returns and B: C ratio of Rs 36516.93 and 1.46, respectively.

Keywords: Oats, Farm Yard Manure, Integrated Nutrient Management, Varieties

INTRODUCTION

India has the world's largest livestock population accounting for over 37.28 per cent of cattle, 21.23 per cent of buffalo, 26.40 per cent of goats and 12.17 per cent of sheep (Sonavale *et al.,* 2020). Whereas there is a gap between fodder demand and supply in the country. The country is deficient in dry fodder, green fodder and concentrates to the tune of 21, 26 and 34 per cent (Parmar and Misra, 2020). Similarly deficiency in fodders is also observed in Jammu and Kashmir, which is 27.31% deficit in dry fodder, 67% deficit in green fodder and 85% deficit in concentrates (Anonymous, 2021). Thus in order to make animal husbandry sector more viable and productive in the

*Corresponding author email id: rohit_agros@rediffmail.com

UT of Jammu and Kashmir, there is a great need to attain and maintain a balanced feed and fodder supply to animals. Among the fodder crops, oat (*Avena sativa* L.) is an important fast growing winter fodder crop with most important cultivated oat species of *Avena sativa*, which has been estimated to cover over 80% of the total area of the world due to its high yield potential, good palatability, softness and good nutritive value as rich in soluble carbohydrates, protein content of 10-12 per cent, 30-35 per cent dry matter and supply abundant quantity of vitamin A and important minerals like Ca and Fe in addition to energy for the animals (Kadam *et al.*, 2019; Kumawat *et al.*, 2017). Besides having multiple uses as green fodder, straw, hay or silage, concentrates and grains. But, it is an exhaustive crop considering its nutrient demand and puts heavy nutritional load on soil. A major constraint in realizing high genetic potential is the selection of well adopted variety to the particular agro climatic conditions as well as supply of adequate nutrients (Rawat and Agrawal, 2010).

As supply of heavy doses of inorganic fertilizers is not a sound management practice and creates many problems like declining trend in productivity, water pollution and soil degradation etc. Hence, emphasis should be given in the use of chemical fertilizers along with organic fertilizers to sustain the agricultural productivity (Dubey *et al.*, 2014), soil health and generate higher income to the farm family. Further, to increase productivity per unit area and bridge the gap between demand and supply there is a dire need to select superior varieties having higher yield potential and quality (Ahmad *et al.*, 2015). Hence, keeping this background the present study was undertaken to evaluate the performance of fodder oat (*Avena sativa* L.) varieties under integrated management techniques in irrigated sub- tropics of Jammu region.

MATERIALS AND METHODS

An experimental trial was conducted at Research Farm of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, during *rabi* season of 2016-17. Geographically, the experimental site is situated in the sub-tropical Shiwalik foothills of Jammu and Kashmir at 32°39′ N latitude and 74°53′ E longitude at an elevation of 332 meter above mean sea level. The climate is subtropical with hot and dry early summers followed by hot and humid summers and cold winters. The average annual rainfall is nearly 1174 mm, 75 per cent of it is contributed by south-west monsoon rains during June to September and remaining 25 per cent are received in few showers of cyclonic winter rains from December to March. The analysis of experimental soil revealed that soil was sandy clay loam in texture, slightly alkaline in reaction (7.60), low in organic carbon (0.47 per cent) and available nitrogen (210.80 kg /ha) but medium in available phosphorus (13.25 kg /ha) and potassium (110.5 kg /ha) with electrical conductivity in the safer range (0.21ds/m). The experiment comprising of fifteen treatment combinations of five integrated nutrient management techniques on soil test basis viz. Recommended dose of fertilizers (T_1), RDF +25% RDN through FYM (T_2), 75% RDF + 25% RDN through FYM (T_3), 50% RDF +50% RDN through FYM (T_4) and 25% RDF + 75% RDN through FYM (T_5) and three varieties *viz. Kent* (V_1) *JHO*-851 (V_2) and *Palampur*-1 (V_3) replicated thrice was conducted in Factorial Randomized Block Design. The crop was sown on 3rd November @ 100 kg seed rate for all varieties with kera method with row to row spacing maintained at 20 cm the fertiliser dose was given as per soil test basis and than accordingly there was increase on RDF. On soil test basis the dose calculated for variety kent and palampur-1 was 100:40:40 and for JHO-851 was 150:40:40.

In all treatments half dose of nitrogen and full dose of phosphorous and potassium was applied at the time of sowing. The remaining half dose of nitrogen was top dressed in two equal splits one each at after first and second cut, respectively. The FYM was applied two week earlier as per technical programme. Three irrigations were given to crop at pre-sowing (07 before sowing) through flooding method followed by two irrigations (5 cm depth) at 71 and 116 days after sowing. Three cuts were taken for all varieties. First cut was done at the appearance of the first node in all the treatments followed by second cut at 45 days after the first cut and third cut 45 days proceeding to second cut. The plants were cut at 10 cm above the ground to allow for the regeneration of the crop.

RESULTS AND DISCUSSION

Plant height (64.7 cm), number of tillers (469.1) (Table 1) were significantly higher where Integrated Nutrient Management treatment RDF +25% RDN through

FYM was applied followed by 100% RDF. It might be due to better availability of nutrients at higher dose where RDF was coupled with 25% more of RDN through FYM which resulted in greater cell division and cell elongation which ultimately produced more photosynthesis and this supplied food to growing parts and improved the growth characters like plant height, number of tillers fresh and dry weight. Similar findings were reported by Kumar and Karmakar (2015), Dabhi *et al.* (2017).

Among the varieties, *Kent* recorded significantly highest plant height (77.4 cm) whereas highest number of tillers to the tune of 479.6 tillers per m^2 was recorded by *JHO-851*. The variation in growth characters might be related to inherent differences and high vigour in plant height and number of tillers of varieties at different cuts. Growth characters are generally depending on genetically makeup of particular variety and adaptability of these varieties to different environmental conditions and also due to more growth characters of varieties there is more leaf formation and stable chlorophyll formation which increase interception, absorption of solar energy and thus accumulate more photosynthesis and more fresh and dry weight. Similar findings are observed by Singh *et al.* (2017), Godara *et al.* (2016) and Ratan *et al.* (2016).

The first node appearance was chosen as a criteria for taking first cut of fodder oat under different treatments. This stage was important to consider as the fodder crop cut at this stage had good recovery rate (Nagpal and Kaur, 2019). The treatments where 100% RDF was applied had early appearance of first node (66.4 days) and also took less days to complete its life cycle (156.4 days).

Among varieties JHO-851 took more number of days to attain first node appearance stage (75.6 days) as well as to attained maturity (165.6 days) which might be due to its slower growth rate as compare to other two varieties. However Kent at par with Palampur-1 took less number of days for attaining first node appearance (63.0) as well as number of days for maturity (153 days). This might be due to investigated characteristics related to the physiological aspect of different varieties. This findings are in corrobation with Nagpal and Kaur, 2019 (Table 1).

It was observed significantly higher green fodder biomass yield (37.65 t /ha) as well as total dry fodder yield (9.64 t /ha) was recorded in treatments where RDF +25% RDN through FYM was applied (Table

Table 1: Plant height (cm), No. of tillers per m^2, total days taken, total green and dry fodder yield (t /ha) of oat varieties under varying INM treatments

Treatments	Plant height (cm)	No. of tillers per m^2	Days taken to attain first node appearance	Total duration of fodder crops	Total green fodder yield (t /ha)	Total dry fodder yield (t /ha)
Integrated nutrient management						
T_1: (Recommended dose of fertilizers (RDF)	62.9	426.4	66.4	156.4	35.28	8.98
T_2: (RDF +25% RDN through FYM)	64.7	469.1	67.2	157.2	37.65	9.64
T_3: (75% RDF + 25% RDN through FYM)	55.2	406.9	67.6	157.6	30.79	7.92
T_4: (50% RDF +50% RDN through FYM)	51.1	397.3	67.8	157.8	28.48	7.26
T_5: (25% RDF + 75% RDN through FYM	45.9	355.6	68.3	158.3	24.24	6.20
Sem(±)	1.7	24.3	0.45		1.0	0.29
CD (5%)	4.9	70.3	N.S		2.9	0.84
Varieties						
V_1: (Kent)	77.4	330.7	63.0	153	35.76	8.96
V_2: (JH0-851)	32.7	479.6	75.6	165.6	27.32	7.10
V_3: (Palampur-1)	57.8	422.9	63.8	153.8	30.77	7.95
SEm(±)	1.3	18.8	0.34		0.80	0.26
CD (5%)	3.8	54.5	1.09		2.3	0.80

1). Further, the increase of total green forage yield in RDF +25% RDN through FYM was to the tune of 6.73, 22.29, 32.21 and 55.33 percent over 100% RDF, 75% RDF + 25% RDN through FYM, 50% RDF + 50% RDN through FYM, and 25% RDF + 75% RDN through FYM, treatments, respectively. Similar trend was observed under dry biomass yield with corresponding increase of 7.4, 21.7, 32.78 and 55.48 percent, respectively. This might be due to luxuriant vegetative growth in form of more plant height, number of tillers, and dry matter accumulation where RDF was applied along with 25% RDN through FYM. These findings are in conformity with Dhabi *et al.* (2017) and Devi *et al.* (2019).

Further it was evident from the Table 1 that there was significant effect of varieties on the fodder oat yield. Among varieties, *Kent* recorded the highest total green forage yield (35.76 t /ha) followed by Palampur-1 (30.77 t /ha) and JHO-851 (27.32 t /ha). The percentage increase of green biomass yield of Kent was 16.21 and 30.87 per cent over Palampur-1 and JHO-851 respectively. Similar trend was observed with regard to dry matter yield of different oat genotypes where kent excelled palampur-1 and JHO-851 with the tune of 12.70 and 26.20 percent, respectively. The variation in green total fodder yield and dry biomass yield might be related to inherent differences among varieties as improved yield from varieties could be attributed to improvement in growth parameters viz. plant height, number of tillers, dry matter accumulation of varieties at different cuts which lead to more fresh and dry weight and ultimately lead to more green and dry biomass yield. The results are in conformity with the findings of Mir *et al.* (2018) and Ratan *et al.* (2016).

There was significant improvement in uptake of N, P and K due to increase in nutrient content (Table 2). As the uptake in forage crops is product of nutrient content and yield so considerable increase in either of the component may increase the accumulation of uptake thus treatment where 100% RDF was incorporated along with 25% RDN through FYM accumulated highest total N (110.48 kg /ha), P (52.34 kg /ha). and K uptake (126.30 kg /ha). Higher nitrogen levels in this treatment might have resulted in increased availability of N, P and K in soil that results in better root prolification and also increased Cation-Exchange Capacity of roots which enhanced N, P and K absorption in plants. Similar results were reported by Sharma (2009).

Among varieties variations were observed with nutrient uptake. Uptake of N (101.02 kg /ha), P (48.67) kg /ha) and K (111.89 kg /ha) was significantly highest in variety Kent followed by palampur-1 and JHO-851. The cultivar wise differences in uptake pattern may be ascribed to increased fodder yield in Kent led to higher nutrient uptake. These results are in agreement with the findings of Prathyusha *et al.* (2014).

The application of RDF +25% RDN through FYM incurred highest gross returns (Rs 75,296.00 / ha) followed by 100% RDF (Rs 70,550 /ha).However due to increased cost of cultivation of 25% of extra

Table 2: Total uptake (kg/ha) and economics of fodder oat varieties under varying INM treatments

Treatments	Total N uptake kg /ha	Total P uptake kg /ha	Total K uptake kg /ha	Cost of cultivation (Rs /ha)	Gross Returns (Rs /ha)	Net returns (Rs /ha)	B:C ratio
Integrated nutrient management							
T_1: (Recommended dose of fertilizers (RDF)	100.91	48.48	110.24	19457.1	70550.0	51092.9	2.63
T_2: (RDF +25% RDN through FYM)	110.48	52.34	126.30	25290.5	75296.0	50005.5	1.98
T_3: (75% RDF + 25% RDN through FYM)	89.25	42.11	97.25	24208.7	61570.0	37361.3	1.54
T_4: (50% RDF +50% RDN through FYM)	78.98	39.37	86.99	28960.2	56952.0	27991.8	0.97
T_5: (25% RDF + 75% RDN through FYM	69.64	33.49	77.30	33710.7	48476.0	14765.3	0.44
Varieties							
V_1: (Kent)	101.02	48.67	111.89	25023.1	71518.0	46494.9	1.86
V_2: (JH0-851)	80.65	37.90	87.71	28930.2	54648.0	25717.8	0.89
V_3: (Palampur-1)	87.80	42.89	99.24	25023.1	61540.0	36516.9	1.46

use of RDN the highest net returns (Rs 51,092.86 /ha) and B:C ratio of 2.63 was obtained under 100% RDF followed by RDF +25% RDN through FYM having net returns of Rs 50,005.53 /ha and B: C ratio of 1.98 (Table 2). The possible reason could be better crop growth with low input requirements which generated higher economic returns in these treatments. This finding is in accordance with Deva *et al.* (2014).

Among the different varieties under taken for investigation Kent registered highest net returns (Rs. 46,494.93 /ha) as well as B: C ratio (1.86) followed by Palampur-1 with net returns of Rs 36,516.93 /ha and B: C ratio of 1.46 whereas the lowest net returns (Rs 25,717.76 /ha) and B: C ratio of 0.89 were recorded by JHO-851.Highest monetary values for Kent was ultimately the reflection of highest total green fodder yield of this cultivar. Dubey *et al.* (2013) also reported the variations in B: C ratio of different varieties where *OS-6* topped (2.77) with respect to B: C ratio being close to Kent (2.23) and JHO-822 (2.06) and JHO-851 (1.97).

CONCLUSION

Concluded that sowing of Kent variety along with integrated application of RDF with 25% RDN through FYM proved superior in terms of growth, yield, and uptake with highest net returns and B:C ratio.

REFERENCES

Ahmad, M.; Zaffar, G.; Mehraj, U.; Jehangir, I. A.; and Lone, A.A. 2015. Stability analysis for forge quality traits in oats (*Avena sativa* L.) over environments. *International Journal of Science and Nature,* 6: 590- 595.

Anonymous. 2021. Producing fodder. greater Kashnmir. https: // www. Greaterkashmir.com /news/opinion/ producing-fodder/

Cochran, G. and Cox, G.M. 1963. Experimental design. Asia Publishing House, Bombay, India.

Dabhi, M. S.; Patel, M. R.; Chaudhari, C. R.; Patel, V. N. and Patel, P. M. 2017. Response of oat (*Avena sativa* L.) varieties to methods of sowing and nitrogen levels on forage yield and quality. *International Journal of Chemical Studies*, 5(4): 683-686.

Deva, S.; Tandon, A. and Pandey, P. 2014. Effect of tillage practices and nutrient management on yield and economics of fodder oat. *Forage Research,* 40(1): 49-50.

Devi, R.; Sood, V.; Chaudhary, H.; Kumari, A and Sharma, A. 2019. Identification of promising and stable genotypes of oat (*Avena sativa* L.) for green fodder yield under varied climatic conditions of north-western Himalayas. *Range Management and Agroforestry*, 40. 67-76.

Dubey, A.; Rathi, G. S. and Sahu, R. (2013). Effect of nitrogen levels on green fodder yield of oat (Avena sativa) varieties. *Forage Research*, 39(1): 39-41.

Dubey, R.; Sharma, R.S. and Dubey, D. P. 2014. Effect of organic, inorganic and integrated nutrient management on crop productivity, water productivity and soil properties under various rice-based cropping systems in Madhya Pradesh, India. *International Journal of Current Microbiology and Applied Sciences,* 3(2): 381-389.

Godara, A. S.; Satpal Duhan, B. S. and Pahuja, S. K. 2016. Effect of different nitrogen levels on forage yield, quality and economics of oat (*Avena sativa* L.) genotypes. *Forage Research,* 41(4): 233-236.

Kadam, S.S.; Solanki, N.S.; Arif, M.; Dashora, L.N.; Mundra, S.L. and Upadhyay, B. 2019. Productivity and Quality of Fodder Oats (*Avena sativa* L.) as influenced by Sowing Time, Cutting Schedules and Nitrogen Levels. *Indian Journal of Animal Nutrition*, 36: 179. 10.5958/2231-6744.2019.00030.6.

Kumar, B. and Karmakar, S. 2015. Effect of tillage and nutrient management on fodder yield, economics and energetic of oat (*Avena sativa* L.). *Forage Research,* 41(1): 19-22.

Kumawat, S.M.; Kantwa, S. R.; Desai, D.H.; Arif Mohd and Khinchi, V. 2017. Responses of dual purpose oats (*Avena sativa* L.) to sowing date, method and level of zinc with or without thiourea in irrigated arid ecosystem. *Range Management and Agroforestry*, 38: 215-220.

Mir, N.; Ahmad, S.; Verma, D. K and Zaffar, G. 2018. Fodder yield and quality evaluation of some oat (*Avena sativa* L.) varieties in temperate conditions of Kashmir, India. *Range Management and Agroforestry*, 39: 232-236.

Nagpal, A.S. and Kaur, K. 2019. Harvesting dates effect. *International Research Journal of Engineering and Technology*, 6(12): 792-795.

Parmar, P. and Misra, H. 2020. Focus needed on fodder shortage in India. *The Hindu business line.com article*. 3143079.

Prathyusha, C.; Hemalatha, S.; Rao, P. V. and Jayasree, G. 2014. Nitrogen response, nutrient uptake by the crop and post-harvest soil fertility status in speciality corn as influenced by nitrogen fertilization under pongamia + maize agrisilvi system. *Journal of Science*, 4: 170-173.

Ratan, N.; Singh, U. N. and Pandey, H. C. 2016. Yield and quality of oat (*Avena sativa* L.) as influenced by nitrogen and varieties in Bundelkhand region (U.P.) *Indian Agricultural Science Research Journal*, 6(1): 27-30.

Rawat, A. and Agrawal, S. B. 2010. Effect of soil enrichment in conjunction with bio-organics and chemical fertilizers on yield and quality of fodder oat (*Avena sativa* L.). *Forage Research*, 35(4): 190-192.

Sharma, K. C. 2009. Integrated nitrogen management in fodder oats (*Avena sativa*) in hot arid ecosystem of Rajasthan. *Indian Journal of Agronomy,* 54(4): 459-464.

Singh, G.; Sharma, R. B.; and Singh, M. 2017. Green fodder production potential of oat cv. Kent under Semi-arid climatic conditions of Tonk-Rajasthan in frontline demonstration. *International Journal of Current Microbiology and Applied Science*, 6(3): 2228-2232.

Sonavale, K.; Shaikh, M.; Kadam, M. and Pokharkar, V. 2020. Livestock Sector in India: A Critical Analysis. *The Journal of Agricultural Education and Extension*, 38:51-62.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 468-473

Adoption Status of Various Rice Residue Management Technologies in Sri Muktsar Sahib District of Punjab

Karamjit Sharma*, Mahekpreet Kaur and Gurmail Singh
Krishi Vigyan Kendra, Sri Muktsar Sahib, Punjab

ABSTRACT

Rice residue burning has been the major sustainability issue and a most debatable issue among different stakeholders. Rice residue burning in Punjab (north-western India) has emerged as most serious problem with ~23 million tons being produced annually, and ~80% of being burnt in open fields before wheat establishment. Over the years, several rice residue management (RRM) technologies were developed and tested on large scale in entire north-western India. Agricultural machinery such as happy seeder, super seeder, zero drill, etc. have gained ground for RRM and wheat establishment. Therefore, the present study was undertaken to investigate the importance of different *in-situ* RRM technologies adopted after partial and complete residue management to study the current status of rice residue management in north-western India. The data was collected from randomly selected 200 farmers covering all the administrative blocks of Shri Muktsar Sahib district of Punjab. The results of the study revealed that ~35% of the farmers fully burnt the loose rice straw on ~30% of total area covered under study. Of the total, ~56.8% area was fully managed by farmers using various technologies viz. happy seeder, super seeder, baler, zero drill, dry and wet ploughing *etc*. The rice residue was partially managed by ~3.4% of the respondents on 4.64% of the total area using happy seeder, while ~13% of the respondents on an area of 14.5% fully managed rice straw using super seeder technology. The previous experience in use of crop residue machinery and subsidy availed on machinery were factors that favored adoption of crop residue management. The attack of pink stem borer, lack of SMS fitted combine harvesters and lack of technical knowledge were the hindering factors in adoption of rice residue management. It was concluded that improved technical skill and know-how through trainings and hands-on exposure and access to machinery for crop residue management at cheap hiring price can lead to enhanced adoption of rice residue management.

Keywords: Baler, Happy Seeder, Muktsar, Rice Residue Management, Super Seeder

INTRODUCTION

Rice-wheat cropping system has given assured income to the farmers of Punjab (India) and about 3.14-million hectare area is under rice in the state. The area under rice crop increased continuously during last five decades. Farmers have rapidly adopted rice wheat cropping system on large areas due to assured marketing and high returns in comparison to other crops. However, presently, the major problem is that the farmers after combine harvesting of paddy fields resort to in-situ loose straw burning in order to clear fields for sowing of wheat crop (Erenstein, 2011).

Straw burning is considered as easiest and cheapest way to dispose of straw by farmers and also saves time for field preparation. Sometimes the straw burning is also linked to eliminate sources of pests, diseases and rat infestation. However, the practice of open-field burning is polluting air with a various gas especially carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O); and fine particles which further effecting global climate and also impacting human in form of respiratory ailments (Singh *et al.,* 2008).

Large number of sensitization programs is being organized to make the farmers aware of the

*Corresponding author email id: sharmakaramjit@pau.edu

consequences of open field burning, but despite all the farmers giving preferences to open field burning. In recent years, farmers have been compelled to burn crop residues due to high cost of removing the crop residues by conventional methods; lack of machine availability; lack of combines with Super SMS attached for harvesting crops. The standing stubbles and loose straw in paddy harvested fields need to either incorporated into soil for enhancing soil fertility or removed from the field for other uses. Various technologies suggested by research scientists for straw in situ incorporation. In-situ management of loose rice straw using different technologies like fitting of straw management system (SMS) on combine harvesters, zero till drill (ZTD), happy seeder (HS), super seeder (SS), reversible mould board plough (RMBP), rotavator tillage (RT), rice straw chopper/mulcher and cutter-cum-shredder, etc. are being adopted by farmers (Singh *et al.*, 2020). In situ rice straw incorporation as an alternate to burning has been adopted by only a few farmers because of high incorporation costs and energy and time intensive (Singh and Sidhu, 2014). Further solution can be collection and removal of paddy straw from field by using rake and baler and utilizing it for paper industry, used as mulch in various crops, feed for animals, mushroom production and electricity generation in biomass power plants. The present study was conducted with an aim to assess the adoption status of different RRM technologies, their contribution towards the management of total rice residue produced.

MATERIALS AND METHODS

Sri Muktsar Sahib district in south-western Punjab has four administrative blocks viz. Muktsar, Gidderbaha, Malout and Lambi having 236 villages. Muktsar district lies in the south western part of the Punjab and lies between North Latitude 29 °54' 20" and 30°40' 20" and East Longitude 74 °15' and 74 °19' and covers a geographical area of 2640 km^2. The district has a population of 9,01,896 with rural population of 72.04% as per 2011 census with the population density of 348 person per km^2. The climate of the district is dry sub humid with grass land type of vegetation. Rice-wheat and cotton-wheat are the two major cropping systems prevalent in the district. Wheat dominates the cereal acreage with ~214 thousand ha area, while rice occupied 190 thousand ha area in the district during 2019 (Anonymous, 2020). The data were collected from randomly selected 200 farmers, during the year 2020-21. The data were collected using stratified random sampling from all four administrative blocks of the district. Within each administrative block, five villages were selected and within each village ten farmers were randomly selected. For the purpose of data collection, an open ended interview schedule was developed. The data regarding area under various RRM techniques during current 2020-21 was collected. The rice area under different RRM techniques viz. HS, SS, RT, ZTD, Baler technology, and RMBP was recorded during these interviews. The results were analyzed using frequencies, percentages, mean and standard deviation.

RESULTS AND DISCUSSION

The results of the study revealed that a total of 1483.2±5.6 ha area was under rice cultivation in the selected villages under study (Table 1). Among the different blocks maximum area under RRM was in Lambi block (308.0 ha), followed by Malout (209.6ha), Muktsar (196.8) and Gidderbaha (128.4ha). Area under partial burning was maximum in Muktsar block while area under fully residue burning was maximum in Gidderbaha block of Sri Muktsar sahib district.

Among different villages, maximum area under fully managed rice residue was 92.0±6.1 ha in village Mehna of Lambi block followed by 88.4±11.3 ha in Baloch Khera village of Lambi block. However, maximum proportion of area was in village Mehna (95.8%) of Lambi block followed by Virk Khera village (90.0%) of Malout block, Bloach khera village (85.3%) of Lambi block and Sarai Naga village (84.9%) of Muktsar, respectively. However, minimum area under RRM (15.6±1.8) was in Rakhala village of

Table 1: Area under different management techniques in different blocks of Sri Muktsar Sahib

Block	Fully Managed (ha)	Partially managed (ha)	Full crop residue burned (ha)	Total (ha)
Gidderbaha	128.4	66.8	133.6	328.8
Muktsar	196.8	74.8	124.0	395.6
Lambi	308.0	8.8	84.8	401.6
Malout	209.6	37.6	110.0	357.2
Total	842.8	188.0	452.4	1483.2

Gidderbaha block. Maximum proportion of area under partial burning was in Bhullar village of Muktsar block (40%) followed by ~28% area in Madhir village of block Gidderbaha.

Thus, a total of 842.8±5.2 ha *i.e.* 56.8 per cent of the total area under rice cultivation was fully managed using different CRM practices viz; happy seeder, super seeder and removal of straw using baler followed by conventional and zero drill sowing during 2019-20, while rice straw on 188.0±2.95 ha area (12.7%) was partially managed for wheat sowing in the district (Table 2). Rice straw on 452.4±2.68 ha i.e. 30.5% of the total are under rice was fully burnt in order to prepare field for wheat sowing. Similarly, 52.0% of the farmers adopted CRM using different technologies followed by 34.7% of the farmers who resorted to complete burning and 13.7% partial burning of the rice residue (Figure 1).

Among the various RRM practices, the highest proportion of rice residue was managed through manual removal or mechanical removal using rectangular baler technology (Figure 2). Singh *et al.* (2017) concluded baler technology has social and economical viability and is can be adopted for removal of loose rice straw from the combine harvested fields. The majority of area under fully managed rice residue was done using baler technology was 59.7%. This was followed by super seeder technology used for complete incorporation of loose straw and crop residue at the time of sowing on approximately 25.8% area. Farmers adopted happy seeder technology (HST) on 5.6% of the sampled area and full load of rice residue was

Table 2: Adoption status of rice residue management (RRM) in different blocks of Sri Muktsar Sahib district of Punjab

Admin block	No. of villages	Total sampled area under rice cultivation (ha)	Total area with open field burning (ha)	Total area under RRM (ha)	
				Partially managed	Fully managed
Gidderbaha	Madhir	60.8±2.28*	24.0±2.73	27.2±2.39	19.6±1.84
	Gurusar	83.6±3.83	24.4±3.08	20.4±4.41	38.8±4.02
	Rakhala	56.8±2.18	36.0±2.24	5.2±1.28	15.6±1.77
	Chotian	66.0±2.89	36.4±2.56	4.8±1.03	24.8±3.69
	Kotli Ablu	61.6±3.90	12.8±1.75	19.2±4.38	29.6±5.02
Muktsar	Chak Duhe Wala	114.4±5.65	32.4±4.37	0±0	82.0±6.78
	Ramgarh Chunga	76.0±3.09	31.6±3.20	12.8±2.71	31.6±3.26
	Vadayi	60.8±2.79	24.4±3.22	15.6±1.64	20.8±3.39
	Sarai Naga	42.4±2.54	2.8±0.65	3.6±0.81	36.0±3.44
	Bhullar	102.0±5.36	32.8±2.51	42.8±8.78	26.4±2.75
Lambi	Manikhera	36.0±1.93	6.8±0.89	7.2±1.52	22.0±2.68
	Kakhawali	81.6±3.65	18.4±2.02	0±0	63.2±3.93
	Baloch khera	103.6±7.58	15.2±2.75	0±0	88.4±11.32
	Tapakhera	84.4±3.73	40.4±3.44	1.6±0.51	42.4±4.57
	Mehna	96.0±5.55	4.0±1.26	0±0	92.0±6.13
Malout	Fulewala	90.8±4.21	48.0±3.39	26.8±4.90	16.0±3.96
	Virk Khera	96.4±5.46	4.4±0.93	5.2±1.64	86.8±6.53
	Kolian Wali	43.6±1.56	21.6±1.49	3.6±0.76	18.4±1.72
	Lakhmire Wala	61.2±2.58	24.4±1.57	0±0	36.8±3.34
	Gurusar Jodha	65.5±3.55	11.6±1.29	2.0±0.63	51.6±4.81
District	—	1483.2±5.58	452.4±2.68	188.0±2.95	842.8±5.2

* standard deviation

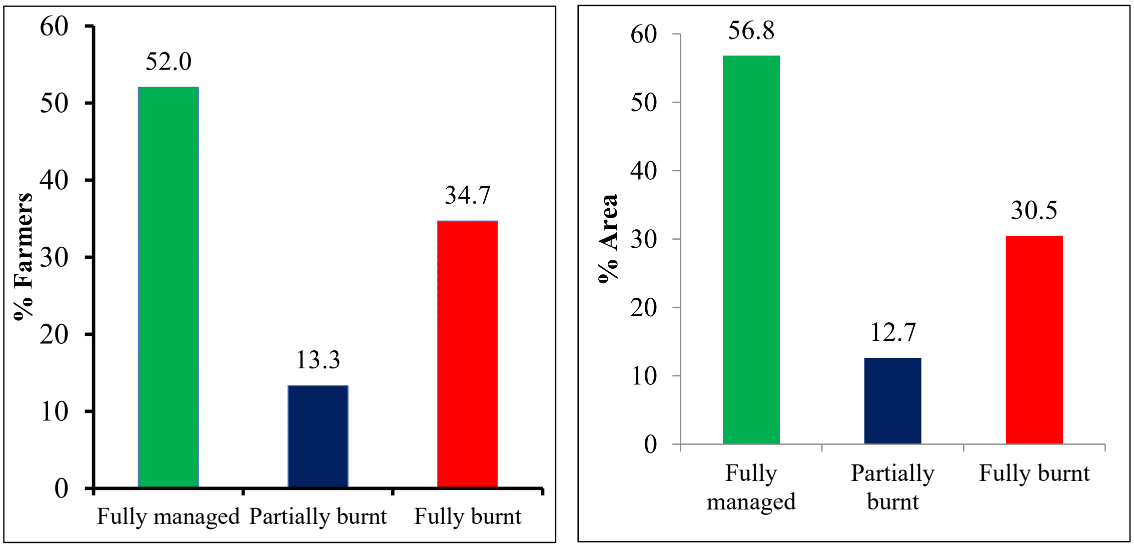


Figure 1: Distribution of respondents and area under rice residue management

managed using this technology or in partial burnt rice straw fields where HST was adopted on 36.06% of the total area under partial management of rice straw. About 2.9% of the fully managed area was sown using conventional tillage (CT) and area managed with manual removal of straw was only 0.9%. The incorporation of loose straw (wet mulching) using rotavator (after pre-sowing irrigation) was only 1.4 per cent and by dry mulching (by using mulcher, MB Plough and rotavator) was 3.0 % of the fully managed area. This technology is less adopted by farmers as the incorporation enhanced cost of cultivation due to high diesel fuel consumption on extra tillage operations required to incorporate heavy paddy straw load. Earlier, Singh *et al.* (2021) had reported that in Punjab ~25 per cent of farmers had to perform more than five tillage operations for incorporation of rice residues.

HS and SS technologies require chopping and uniform spread of loose straw for their enhanced efficiency and proper germination of the wheat crop. Fitting of straw management system (SMS) on combine harvesters has been recommended for chopping and uniform spread of straw. However, none of the farmers had sown wheat using HS after operation of SMS fitted combine harvester. Total 47.6 ha area i.e. 5.6% of fully managed area was sown using happy seeder without using combines having super SMS attachment. Gupta *et al.* (2021) reported that happy seeder technology for wheat sowing ensures

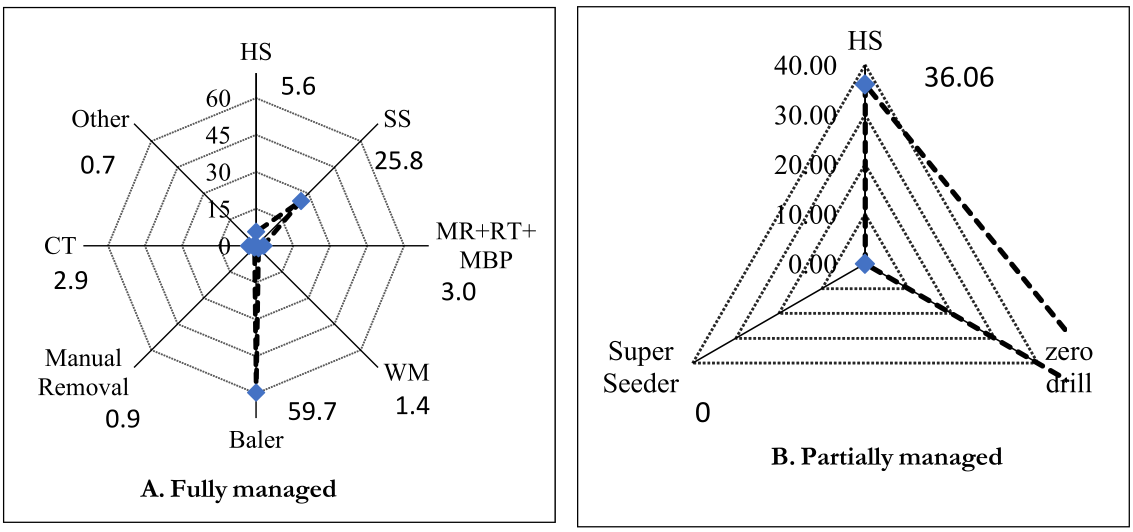


Figure 2: Percentage of area under different RRM techniques under fully and partially managed fields

timely sowing, economic gains, enhanced water use efficiency and decrease in weed problem along with sustained wheat grain yields. Only 2.8 ha area i.e. 0.3 % of fully managed area was sown using SS after operation of SMS fitted combines. While, 214.4 ha area i.e. 25.4% of fully managed area was sown using SS without using combine having super SMS attachment. Majority of the combine harvester did not adopt SMS technology due to decrease in efficiency of combine after installation of SMS and due to improper functioning of super SMS if installed from local market.

Hence the area managed using Happy seeder, super seeder, baler and incorporation is approximately 3.2%, 14.7%, 33.9% and 2.5%, respectively of the total sampled area. Area managed through manual collection of loose straw for using it as fodder for animals or for bedding of animals was only 0.4% of the total sampled area. In case of partial management of rice straw using happy seeder and zero till drill were approximately 4.6% and 8.04% of the total sampled area, respectively.

Based on number of farmers who managed straw, it was found that 4.6% of the farmers fully managed loose straw using happy and 3.4% managed loose straw using happy seeder after partial burning. Similarly, 13% of the farmers fully managed rice straw using super seeder followed by 1.6% who adopted incorporation (Table 4). A total of 88 farmers (27.2%) managed rice straw through collection and removal

Table 3: Area under different RRM technologies used for in situ management in Sri Muktsar Sahib district of Punjab

Particulars	Happy Seeder		Super Seeder		Incorporation		Removal of residue		Mixing with CT	Any other
	After SMS	Without SMS	With SMS	Without SMS	MR+ RMBP +RT	Dry/ Wet mixing	Baler	Zero Drill		
Fully managed										
Area managed (ha)	-	47.6	2.8	214.4	25.2	11.6	502.8	8.0	24.4	6.0
% of total	-	5.6	0.3	25.4	3.0	1.4	59.7	0.95	2.9	0.7
% of GT	-	3.2	0.2	14.5	1.7	0.8	33.9	0.5	1.65	0.4
Partial burning										
Area managed (ha)	-	68.8	-	-	-	-	-	119.2	-	-
% of total	-	36.6	-	-	-	-	-	63.4	-	-
% of GT	-	4.6	-	-	-	-	-	8.04	-	-

Table 4: Number of respondents adopted different CRM techniques in Sri Muktsar Sahib District of Punjab

Technology		Partial burning		Fully managed		Fully burnt	
		f	% of GT	f	% of GT	f	% of GT
A.	HS	11	3.4	15	4.6	-	-
B.	SS	-	-	42	13.0	-	-
C.	MR+RMBP +RT	-	-	5	1.6	-	-
D.	Removal	-	-			-	-
i)	Baler	-	-	88	27.2	-	-
ii)	Zero Drill	32	9.9	4	1.2	-	-
E.	Dry/wet mixing	-	-	4	1.2	-	-
F.	Mixing with CT	-	-	7	2.2		
G.	Any other	-	-	3	0.9	-	-
H.	Total	43	13.3	168	52.0	112	34.7

using rake and baler. Sowing of wheat in partial burnt fields using zero drill was adopted by 9.9% of the farmers. Dry or wet mixing was adopted by 2.2% of the farmers for management of rice residue. Thus, a total of 52.0% of the farmers fully managed loose straw using different straw management technologies, 13.3% of the farmers who resorted to partial burning and 34.7% of the farmers fully burnt the rice straw.

CONCLUSION

There is immense need to check the open field burning of paddy straw to check environmental pollution, soil degradation, health problems and adverse impacts. Short window for sowing of next season crop, risk to human lives, environmental pollution and soil health are the sensitive issues for farmers. Thus, farmers should have different alternative to manage rice residue. Incorporation and removal of straw using different machines has helped in solving the problem of rice residue burning. Farmers have adopted happy seeder, super seeder and other straw incorporation technologies however on small scale. Zero drill has been mainly adopted by farmers in partially burnt fields (9.9%) and where straw has been removed using baler technology. Most of the farmers prefer removal of loose straw by using rake and baler ie. 27.2% farmers to clear field for sowing of wheat. However, the baler technology is economically viable within few kilometers' radius of the demand area, but it is mandatory that there should be proper market for bulk purchase of paddy straw. Also, farmers face problems like lack of picking of bails by companies in case of wet rice straw and also baler owner charges farmers for making and picking of bails. From the data collected it was found that the use combines with super SMS is not much apparent because of reduced efficiency of combines. Hence, we can conclude that in Muktsar district the ex-situ technology ie. Baler is more evident rather than other technologies.

REFERENCES

Gupta A, Singh P, Singh G, Sekhon BS and Sodhi GPS (2021) On Farm Testing of Rice Residue Management Techniques for Wheat (*Triticum aestivum* L.) Establishment in Punjab. *Indian Journal of Extension Education*, 57(4): 1-4.

Singh, G., Singh, P., Sodhi, G. P. S. & Tiwari, D. (2020). Adoption status of rice residue management technologies in south-western Punjab. *Indian Journal of Extension Education*, 56(3): 76-82.

Singh T, Kaur M and Singh G (2021) Extent of Adoption of Happy Seeder Technology among the Farmers of Punjab (India). *Indian Journal of Extension Education*, 57(4): 75-79.

Singh G, Sharma A and Tiwari D (2017) Socio-economic viability of baler for baling paddy straw: A Case Study. *Agricultural Engineering*, XLII (3): 1-8.

Erenstein O (2011) Cropping systems and crop residue management in the Trans-Gangetic Plains: Issues and challenges for conservation agriculture from village surveys. Agricultural Systems, 104: 54-62.

Singh B, Shan Y H, Johnson-Beebout S E, Singh Y and Buresh R J (2008) Crop residue management for lowland rice-based cropping systems in Asia. *Advances in Agronomy*, 98: 117-187.

Singh Y, Sidhu H S (2014) Management of Cereal Crop Residues for Sustainable Rice-wheat Production System in the Indo-Gangetic Plains of India. Proceeding of Indian National Science Academy 80 (1): 95-114.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 474-484

Genotype x Environment Interaction Analysis for yield and yield Attributes in Urdbean (*Vigna mungo* L.) Under Irrigated and Rainfed Conditions of Jammu Region

Aman[1], Anjani Kumar Singh[1]*, Sanjeev Kumar[1], Manmohan Sharma[2] and Neeraj Gupta[3]
[1]Division of Plant Breeding & Genetics, [2]School of Biotechnology, [3]Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, J&K

ABSTRACT

The present investigation was conducted during *Kharif* 2020 at Research Farm, SKUASt-J, Chatha, Advanced Centre for Rainfed Agriculture, Rakhdhiansar and Pulses Research Sub-Station, Samba to carryout stability analysis of 20 diverse urdbean (*Vigna mungo* L.) genotypes under irrigated and rainfed conditions of Jammu region. Data with respect to 13 yield and yield contributing traits were recorded. Genotype and environment interactions were found to be significant for all the traits, suggesting that grain yield was inconsistent at different locations. The analysis of stability parameters for grain yield per plant in twenty genotypes implied that PLU499-52 and STTZ834 had higher means than general mean paired with regression coefficient greater than unity and non-significant S^2d_i values which demonstrated their stability and adaptation to certain favourable environment only. Mash 338 and PU 31 were observed to be the most stable genotypes across the environments for grain yield per plant, 1000 grain weight and number of clusters per plant. Genotype Mash 338 was found to be stable for number of primary branches per plant, number of pods per cluster and number of seeds per pod. These specified genotypes may be effectively used for future *Vigna mungo* breeding programmes.

Keywords: *Vigna mungo*, Stability, Genotype, Environment, G x E interactions, Grain yield

INTRODUCTION

Urdbean (*Vigna mungo* L., famously known as Urd/ Biri/ Mash, is one of the important nutritious grain legumes of the Indian subcontinent that is utilized in the diet, green fodder, soil conservation, integrated farming systems, reclaiming of degraded pastures and symbiotic nitrogen fixation. It is said to have originated in the Indian subcontinent (Vavilov, 1926) and was domesticated from *Vigna mungo var. sylvestris* (Lukoki *et al*., 1982) that is wildly cultivated there. India is the world's largest producer as well as consumer of urdbean. Being the third important pulse crop in India, it was cultivated over an area of 5.44 Mha (*Kharif*+*Rabi*) and recorded a production of 3.56 Mt at a productivity level of 655 kg/ha (Singh *et al*., 2021). It was farmed over acreage of 12.955 thousand hectares in the Jammu Division of the UT of J&K in 2016-17, yielding 57.077 thousand quintals (Anonymous, 2017).

Urdbean has a distinct prominence in rainfed agriculture due to its significant soil binding ability. It is an annual, upright or dragging type and rapid-growing herb with a profusely branching structure that reaches 0.3 to 1.0 meter in stature. Among various pulses, urdbean formulates a major source of dietary protein with its high protein quantity for the predominant vegetarian population of India. Its seeds contain carbohydrates (60%), fats (1.5%), fibers (0.9%), minerals (3.2%) and a variety of vitamins. The 100 g of seeds contain 24 mg of protein, 64 mg of Vitamin A (Retinol), 0.19 mg of Vitamin K, 0.41 mg of Vitamin B_1 (Thiamine), 0.37 mg of Vitamin B_2 (Riboflavin), 2 mg of Nicotinic acid, 206 mg of Choline, 90 mg of Inositol and 3.5 mg of Pantothenic acid. Per 100 g of urdbean seeds, there are 7.5 g of Biotin and 144 g of Folic acid. It also enlists a significant fraction of phosphorous (983 mg/100 g), calcium (138 mg/100 g) and iron (7.57 mg/100 g). It has high calorific value,

*Corresponding author email id: anjaniiari@yahoo.co.in

holding 347 calories per 100 g of seeds. It is a tremendous complement to rice in terms of equated human nutriment owing to its high proportion (7.2%) of lysine (Sakila and Pandiyan, 2018).

In contrast to other pulses, the production of urdbean is minimal. Hence, endeavors should be directed towards increasing production by developing high yielding stable cultivars. Grain yield being a quantitative trait is highly influenced by environment. This interplay effect of genetic and non-genetic components on performance of plants is termed as genotype x environment (G x E) interaction (Comstock and Moll, 1963). This effect of G x E interactions has always been defined as non-additive, implying that phenotypic performance is vastly influenced by the exterior environmental circumstances. Genotype-environment interactions are of major consequence to the breeders in the process of development of improved varieties. Several superior cultivars of urdbean have been developed, although due to G x E interactions, the majority of them exhibit uneven performance under varying environments. Cultivar performance must stay static across environments if the crop's productivity is to be enhanced. The aim of a breeding programme should, therefore, be to develop genotypes that can withstand unpredictable transient environmental fluctuations.

Eberhart and Russell (1966) established a better framework for assessing the consistency and suitability of cultivars in a variety of environments. As per this approach, the genotype x environment interactions are split into two sections: slope of the regression line (b_i) and departure from the regression line (S^2d_i). Regression coefficient is the static of responsiveness, while the deviation from regression is the metric of steadiness. As per this model, a stable genotype features unit regression through all environments (b_i=1.00) and minimum departure from the regression (S^2d_i=0). With the aforementioned concerns in mind, the present study was executed to determine which urdbean genotypes are appropriate for the urdbean growing areas of Jammu region.

MATERIALS AND METHODS

The present research was performed during *Kharif* 2020 under irrigated and rainfed conditions of Jammu region of UT of Jammu and Kashmir. Twenty urdbean genotypes namely DUS 19, PGRU99022, Mash 479, PLU499-52, Mash 338, UH82-14, PL4158, PU19, No. 40, IPU02-43, T9, UH86-4, STTZ834, Mash 114, SPS38, NKD4-2, IPU96-16, IPB96-6, PU 31 (C) and Uttara (C) constituted the experimental material that originated from diverse locations of the country. This experimental material was received from ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh and maintained at PRSS, Samba. Genotypes Mash 479, Mash 338 and Mash 114 were developed by PAU, Ludhiana, IPU02-43, IPU96-16 and Uttara were developed by IIPR, Kanpur, PU 19 and PU 31 were originated at GBPUA&T, Pantnagar. The genotypes were assessed in three environments, which were created by growing genotypes at three separate locations of Jammu Region. The experiment was carried out under irrigated condition at Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Chatha (E_1) which is situated at an elevation of 356 meters above sea level, with 32° 40'N latitude and 74° 54'E longitude. The experiments were conducted under rainfed conditions at two different locations, namely Advanced Centre for Rainfed Agriculture (ACRA), Rakhdhiansar (E_2) which is located at 32° 38'24.00"N latitude and 74° 55'48.00"E longitude and Pulse Research Sub-Station, Samba (E_3) which is situated at an elevation of 400 meters above sea level with 32° 34'N latitude and 70° 83'E longitude with yearly rainfall of 1073 mm. The experimental material evaluated in Randomized Complete Block Design and replicated three times with plot size of (2 × 1.20) m^2. Each plot was divided into four rows. The spacing of 30 cm between lines and 10 cm between plants was maintained. The seeds were placed by hand at a depth of around 5 cm beneath the soil surface. Recommended cultural and agronomic practices were followed to ensure a healthy crop.

Observations with respect to 13 morphological and physiological traits *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), number of primary branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length (cm), number of seeds per pod, 1000 grain weight (g), grain yield per plant (g), biological yield per plant (g) and harvest index (%) were recorded for the present study. Data were collected for such traits on five plants chosen at random in each plot of each replication as well as observations on days to 50 per cent flowering and days to maturity were recorded on a plot-by-plot basis. The pooled mean data were subjected to statistical analysis to analyse the variance and stability parameters employing INDOSTAT statistical package. Applying Bartlett's test for homogeneity, all three mean squares due to error obtained for each attribute were validated for homogeneity. The model of phenotypic stability proposed by Eberhart and Russell (1966) was used for the present study. The genotype x environment interactions observed for all the traits were utilized to compute phenotypic stability. Assessment of the regressing per genotype on an environmental index and a function of the squared deviations from the regression value were worked out.

RESULTS AND DISCUSSION

The analysis of variance per environment (Table 1) implied that the variance attributable to genotypes was highly significant for all of the considered traits demonstrating that performance of genotypes varied significantly. The environments were validated for homogeneity of variances using Bartlett's chi square test prior to pooled analysis. The non-significant χ^2 values ascertained that the variance owing to error was uniform throughout all thirteen yield attributing traits examined. Assessment of joint regression for thirteen morpho-physiological traits has been depicted in Table 2. Pooled analysis of variance across the environments indicated significant differences among genotypes for all thirteen traits. Except the number of primary branches per plant and number of pods per cluster, mean sum of squares due to environment were found to be significant for all the yield attributes. These observations are in accordance with the pooled analysis done by Kumar *et al.* (2015) and Desai *et al.* (2020). The presence of genotype × environment interactions was characterized by significant variance owing to G × E interactions. These findings are confirmed by Gambhire *et al.* (2017), Lal *et al.* (2019), Desai *et al.* (2020) and Kumar *et al.* 2020 in blackgram.

The mean sum of squares owing to pooled deviation were evaluated by comparing mean sum of squares to pooled error and considered to be significant throughout most of the traits considered in the study, except days to 50 per cent flowering, days to maturity, plant height and 1000 grain weight, inferring that genotypes differed significantly in terms of their stability for majority of the characters. For all attributes, mean sum of squares due to genotype × environment (linear) were found to be significant, and it could be concluded that genotype performance can be anticipated in nature since the difference in performance of genotype is related to genotype regression in environments. The same findings have been reported by previous researchers including Lal *et al.* (2019) and Kumar *et al.* (2020). Crop improvement measures are reliant primarily on the determination of excellent and steady genotypes that can be used in wide range of environments. A superior genotype has high yield potential under suitable environment, whereas a stable genotype performs adequately and has minimal environmental interactions. Data presented in Table 3 illustrate the stability parameters for grain yield and yield contributing traits, comprising mean (X), regression coefficient (b_i) and departure from linear regression (S^2d_i). A genotype with a high mean value, a unit regression coefficient ($b_i = 0$) and a dispersion not significantly different from zero (S^2d_i) is deemed to be stable according to the Eberhart and Russell (1966) model.

Results revealed that out of 20 genotypes, 18 genotypes depicted non-significant deviation from regression. Therefore, these genotypes were considered stable. Regression coefficient ranged from 0.03 (PU19) to 3.40 (No. 40). Genotypes Mash 479, PLU499-52, Mash 338, PU19, UH86-4, STTZ834, SPS38, NKD4-2, IPB96-6 and PU 31 had higher mean values than general mean. PLU499-52 showed higher mean than general mean coupled with regression coefficient close to unity and observed as the most stable and desirable genotype across the environments. Genotype PU 31 followed by UH86-4 were observed as stable ones under favourable environment as they exhibited higher mean than general mean with regression coefficient greater than unity. Similar findings were obtained by Kumar *et al.* (2015) and Sharma and Rao (2015) in blackgram. Genotypes T9 was the earliest to flower followed by Mash 114 with regression coefficient less than unity.

DUS 19, Mash 479, PLU499-52, Mash338, PU19, UH86-4, STTZ834, SPS38, NKD4-2, IPB96-6 and

Table 1: Environment wise analysis of variance for different morpho-physiological traits in Urdbean (*Vigna mungo* L.)

Env.	Source	d.f.	1	2	3	4	5	6	7	8	9	10	11	12	13
Research Farm, Chatha, SKUAST-Jammu (Irrigated)															
E I	Replication	2	0.17	30.22	38.93	0.03	0.36	0.03	1.36	0.10	0.18	0.69	0.02	0.20	0.76
	Genotype	19	51.46**	43.41**	107.74**	5.55**	15.66**	3.89**	306.93**	2.11**	2.24**	44.79**	1.57**	38.22**	36.04**
	Error	38	6.34	9.56	13.75	0.09	0.18	0.04	4.70	0.05	0.07	2.95	0.03	0.79	0.84
Experimental Farm, Advance Centre for Rainfed Agriculture, Dhiansar (Rainfed)															
E II	Replication	2	1.70	0.84	0.66	0.02	0.02	0.03	8.61	0.06	0.01	0.24	0.01	1.05	4.33
	Genotype	19	52.18**	84.13**	132.94**	5.19**	11.67**	4.27**	331.09**	2.03**	2.57**	41.84**	1.68**	41.00**	59.58**
	Error	38	3.70	6.96	10.84	0.05	0.17	0.05	4.53	0.05	0.05	2.27	0.05	1.07	1.48
Pulses Research Sub-Station, Samba (Rainfed)															
E III	Replication	2	3.16	0.98	25.13	0.09	0.96	0.16	5.50	0.02	0.02	1.69	0.07	2.36	1.80
	Genotype	19	76.79**	104.13**	112.66**	5.22**	14.04**	3.97**	331.05**	2.13**	2.56**	39.11**	1.60**	39.04**	51.03**
	Error	38	1.53	5.37	11.56	0.05	0.24	0.05	6.02	0.03	0.04	3.40	0.06	1.20	1.45

*, ** significant at 5 per cent and 1 per cent level, respectively

1. Days to 50% flowering; **2.** Days to maturity; **3.** Plant height (cm); **4.** No. of primary branches per plant; **5.** No. of clusters per plant; **6.** No. of pods per cluster; **7.** No. of pods per plant; **8.** Pod length (cm); **9.** Number of seeds per pod; **10.** 1000 grain weight (cm); **11.** Grain yield per plant (g); **12.** Biological yield per plant (g); **13.** Harvest index (%)

Table 2: Joint regression analysis of variance for grain yield and its contributing traits following Eberhart & Russell (1966) model

Source of variation	d.f.	1	2	3	4	5	6	7	8	9	10	11	12	13
Genotypes (G)	19	364.02**	415.71**	420.97**	24.28**	39.56**	12.60**	1079.75**	8.19**	9.04**	79.36**	8.99**	122.23**	112.88**
Environments (E)	2	114.01*	156.55*	239.00*	9.55	29.57*	7.38	792.58**	4.16**	5.61**	96.43**	3.38*	89.18**	112.73**
Genotype x Environment	38	33.21**	37.56**	57.16**	3.21**	5.90**	2.38**	88.25**	1.06**	0.88**	14.65**	0.74**	14.54**	16.96**
Env. + (Gen. x Env.)	40	16.58**	18.82**	25.12**	1.42**	2.53**	0.96*	45.94**	0.47**	0.43**	5.96**	0.38**	6.64**	7.25**
Environments (Lin.)	1	242.74**	277.26**	280.53**	16.18**	26.37**	8.40**	719.83**	5.46**	6.02**	52.89**	5.99**	81.50**	75.26**
Geno. x Env. (Lin.)	19	16.13**	17.80**	28.48**	1.63**	3.28**	1.22**	45.85**	0.60**	0.43*	7.57**	0.36**	7.17**	8.60**
Pooled Deviation	20	5.69	6.87	9.15	0.48**	0.63**	0.35**	12.32**	0.10**	0.15**	2.08	0.12**	2.39**	2.57**
Pooled Error	114	3.81	7.29	11.91	0.06	0.20	0.05	4.94	0.04	0.05	2.78	0.05	1.02	1.23

*, ** significant at 5 per cent and 1 per cent level, respectively

1. Days to 50% flowering; **2.** Days to maturity; **3.** Plant height (cm); **4.** No. of primary branches per plant; **5.** No. of clusters per plant; **6.** No. of pods per cluster; **7.** No. of pods per plant; **8.** Pod length (cm); **9.** Number of seeds per pod; **10.** 1000 grain weight (cm); **11.** Grain yield per plant (g); **12.** Biological yield per plant (g); **13.** Harvest index (%)

PU 31 depicted higher mean values than general mean with non-significant deviation from regression for days to maturity. Mash338 was found the most stable genotype as it had higher mean than general mean coupled with regression coefficient close to unity. Genotypes STTZ834 and UH86-4 had higher mean with regression coefficient greater than unity and recommended for specific environment only whereas genotypes PLU499-52 and NKD4-2 had higher mean with regression coefficient less than unity, were desirable under unfavorable environments. Similar results were reported by Rita *et al.* (2016) in black gram. IPU96-16 was observed as the earliest to mature with less than unity regression coefficient value. Stability of all genotypes for plant height was predictable as they showed non signification deviation from regression. Regression coefficient was ranged from 0.40 (PU19) to 3.47 (IPB96-6). Genotypes PLU499-52, PL4158, PU19, T9, STTZ834, Mash 114, SPS38, NKD4-2, IPB96-6, PU 31 and Uttara had higher mean than general mean. PL4158 was found the most stable and desirable genotype as it had higher mean than general mean coupled with regression coefficient closer to unity. Genotypes PU 31, PLU499-52 and T9 had higher mean than general mean with regression coefficient greater than one, were stable and suitable for high performance environments. Genotypes STTZ834 and NKD4-2 were adaptable under low performance environments as they exhibited higher mean than general mean but regression coefficient less than one. Similar results were obtained by Kumar *et al.* (2015) in blackgram.

Only 10 genotypes showed non-significant difference from regression signifying that such genotypes were predictable for number of primary branches per plant in varied environments. Genotypes Mash 479, PLU499-52, Mash 338, UH82-14, STTZ834, SPS38 and NKD4-2 had higher mean than general mean. Regression coefficient was found non-significant for most of the genotypes except Mash 479 and UH82-14. Mash 338 was found the most stable and desirable genotype as it had higher mean than general mean with regression coefficient approaching to one. Mash 479 and SPS38 were suitable under favourable environments as they exhibited higher mean than general mean with regression coefficient greater than unity while PLU499-52, NKD4-2 and STTZ834 were desirable under unfavourable environments as they showed higher mean than general mean with regression coefficient less than unity. Similar conclusions were made by Sharma and Rao (2015) in urdbean and Singh *et al.* (2020) in cowpea.

Regression coefficient ranged from 0.28 (DUS 19) to STTZ834 (4.34) for number of clusters per plant. Genotypes PGRU99022, Mash 479, Mash338, STTZ834, NKD4-2, IPB96-6 and PU 31 had higher mean than general mean. Regression coefficient was found non-significant for most of the genotypes except STTZ834, IPB96-6 and PU 31. PU 31 and Mash 338 were found the most stable and desirable genotypes as they had higher mean than general mean coupled with regression coefficient close to unity. NKD4-2, STTZ834 and PGRU99022 were suitable under high performing environments as they exhibited higher mean than general mean and regression coefficient greater than one. Singh *et al.* (2020) found the similar trend in cowpea.

Eight genotypes had a non-significant deviation from regression, implying that these genotypes were predictable for number of pods per cluster. Mash338 was found the most stable and desirable genotypes as it had higher mean than general mean coupled with regression coefficient close to unity. PLU499-52, PU 31 and STTZ834 were suitable under favourable environments as they exhibited higher mean than general mean with regression coefficient greater than one whereas NKD4-2 was suitable under favourable environment as it showed higher mean than general mean with regression coefficient less than unity. Similar results were obtained by Kumar and Peera (2012). Sixteen genotypes were denoted a non-significant deviation from regression, implying that number of pods per plant was predictable for these genotypes. Regression coefficient was ranged from 0.05 (No. 40) to 4.21 (IPB96-6). Regression coefficient was found non-significant except PLU499-52, PU 19, STTZ834 and IPU96-16. Genotypes DUS 19, PGRU99022, Mash 479, PLU499-52, UH82-14, PU19, STTZ834, NKD4-2 and PU 31 had higher mean than general mean. PGRU99022 and PU 31 were found the most stable and desirable genotypes as they had higher mean than general mean coupled with regression coefficient close to unity.

Regression coefficient ranged from 0.11 (UH82-14) to 4.65 (PLU499-52) for pod length. Regression coefficient was found non-significant for most of the genotypes except PLU499-52 and NKD4-2. NKD4-2 was found the most stable and desirable genotypes as it had higher mean than general mean coupled with regression coefficient approaching to unity. PLU499-52 and Mash 479 were suitable for high performing environments as they exhibited higher mean than general mean with regression coefficient greater than one whereas UH82-14 was suitable for low performing environments as it had higher mean than general mean with regression coefficient less than one. Similar findings were observed by Kumar *et al.* (2020). Out of twenty, fifteen genotypes showed non-significant deviation from regression so these genotypes were predictable for number of seeds per pod. Regression coefficient was ranged from 0.05 (Mash 114) to 4.12 (PGRU99022). Regression coefficient was found non-significant for most of the genotypes except Mash 338 and PU 31. PU 31 and Mash 338 were found the most stable and desirable genotypes as they had higher mean than general mean coupled with regression coefficient close to unity. STTZ834 and UH86-4 were suitable under high performing environments as they exhibited higher mean than general mean with regression coefficient greater than unity whereas NKD4-2 and PLU499-52 were suitable under low performing environments as they exhibited higher mean than general mean with regression coefficient less than one. Deviation from regression was non-significant for all the observed genotypes for 1000 grain weight. Regression coefficient was non-significant except PLU499-52, IPU2-43 and STTZ834. Genotypes PGRU99022, Mash 479, PLU499-52, Mash 338, UH82-14, PU19, UH86-4, STTZ834, NKD4-2 and PU 31 had higher mean than general mean. PU 31 and Mash 338 were found the most stable and desirable genotypes as they had higher mean than general mean coupled with regression coefficient approaching to unity. Kumar *et al.* (2020) arrived at the very same outcomes for 1000 grain weight and number of seeds per pod in urdbean amid rainfed environments of Jammu region. PLU499-52 was suitable under high performing environments as it had high mean than general mean with regression coefficient greater than one.

A non-significant deviation from regression was specified by sixteen genotypes so such genotypes were predictable for grain yield per plant. Mean grain yield per plant was differed from 3.53 g (NKD4-2) to 5.71 g (PU 31 and PLU499-52), with a regression coefficient of 0.16 (DUS 19) to 2.95 (IPB96-6). Regression coefficient was non-significant except DUS 19, Mash 479, PLU499-52, PU 31 and Uttara. Genotypes PGRU99022, Mash 479, PLU499-52, Mash 338, UH82-14, STTZ834, PU 31 and Uttara had higher mean yield than general mean. The most adaptable and preferable genotypes throughout the environments were PU 31 and Mash 338, which signified greater performance, nearer to unit regression coefficient associated with no significant deviation from linear regression. In the same way, constant performers were enlisted earlierby Rita *et al.*, 2016, Gambhire *et al.*, 2017, Manivannan *et al.* (2019) and Sidramappa *et al.*, 2021or this character in urdbean applying Eberhart and Russell (1966) model. PLU499-52 and STTZ834 were specified for high-performance environments, because they had a greater average paired with value and minimal S^2_{di} value. Kumar *et al.* (2020) came to the same conclusion for PLU499-52. The cultivars in urdbean have been proposed by Kumar *et al.* (2015) and Sharma and Rao (2015) for general adaptability in better-performing environmental conditions. Uttara was recognized the most adaptable genotypes in low-performing environments, since it had higher average compared to general mean combined with value along with least S^2_{di} value. Better performers under poor-environmental conditions were formerly enlisted by Kumar and Peera (2012) in urdbean crop.

Regression coefficient was non-significant for most of the genotypes except STTZ834 for biological yield per plant. PU 31 and STTZ834 were found the most stable and desirable genotypes as they had higher mean than general mean coupled with regression coefficient approaching unity. NKD4-2 and PLU499-52 were suitable in high performing environments as they had higher mean than general mean with regression coefficient greater than one whereas PU19 was suitable under low performing environments as it had higher mean than general mean with regression coefficient less than unity. Out of twenty, seventeen genotypes were showed non-signified deviation from regression so these genotypes were predictable for harvest index.

Table 3: Estimation of stability parameters of different morpho-physiological traits in Urdbean (*Vigna mungo* L.) following Eberhart & Russell (1966)

S.No.	Genotypes	Days to 50% flowering			Days to maturity			Plant height (cm)			No. of primary branches/ plant		
		X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i
1	DUS 19	52.56	0.85	-0.73	85.89	0.47	-2.42	69.96	-0.52	-3.13	3.93	0.49	0.00
2	PGRU99022	51.11	3.39	-0.27	83.89	3.76	8.73	57.87	1.57	-3.53	3.73	4.27	0.47**
3	Mash 479	53.44	0.48	-0.17	87.33	0.53*	-0.80	64.91	1.05	9.91	4.53	2.27*	0.03
4	PLU499-52	60.66	1.29	-0.71	92.78	-0.07	-1.29	73.47	1.56	15.93	6.25	0.39	0.09
5	Mash338	55.33	0.40	-1.20	88.78	0.97*	-2.42	63.89	1.91	-2.57	4.91	0.81	-0.01
6	UH82-14	52.00	0.80	-0.97	85.00	1.26	-0.35	61.92	1.60	0.83	4.58	-0.24**	-0.02
7	PL4158	50.22	0.59	-0.98	80.11	1.78	-0.02	69.13	0.91	0.89	3.71	0.75	0.09
8	PU19	54.22	-0.03	-0.78	86.89	0.25	6.55	66.69	0.40	-0.69	4.04	1.48	0.36**
9	No. 40	49.67	3.40	2.66	81.11	3.40	5.20	57.52	1.64	10.57	3.22	3.60	1.13**
10	IPU2-43	49.08	3.07	3.11	80.56	0.51	-2.26	61.20	1.76	6.28	3.29	2.15	0.49**
11	T9	46.22	0.27	22.81*	82.44	0.49	10.73	70.50	2.26	-2.04	3.91	0.39	0.00
12	UH86-4	54.11	1.62	-0.94	88.89	1.50	-1.44	61.91	1.28	34.35	5.51	1.94	1.47**
13	STTZ834	56.22	0.32	-1.15	90.22	1.79*	-2.41	73.31	0.53	0.72	5.80	0.27	-0.02
14	Mash 114	47.56	0.54	0.55	81.00	0.61	0.71	69.42	0.15*	-4.00	3.27	-1.27	0.87**
15	SPS38	53.56	0.59	1.96	87.11	0.55	0.09	67.81	2.16	-1.50	4.53	2.52	0.20
16	NKD4-2	58.11	-0.42	0.24	92.22	-0.41	-0.28	71.63	-0.79	2.67	6.13	0.09	0.09
17	IPU96-16	49.78	0.80	43.01**	79.78	0.65	15.17	59.62	-1.10	-0.50	3.04	-0.25	1.05**
18	IPB96-6	53.00	-0.79	8.05	86.89	2.11	9.04	66.63	3.47	12.81	4.49	-0.85	1.71**
19	PU 31 (C)	56.11	1.66	3.93	89.45	-0.70	11.61	73.99	2.69*	10.03	5.22	0.73	0.24**
20	Uttara (C)	51.00	1.16	9.88	80.56	0.57	34.53*	66.99	-2.54	15.72	2.87	0.45	0.96**
	General mean	52.70			85.54			66.42			4.35		
	SE±m	1.73	0.70		1.90	0.72		2.19	0.83		0.50	0.79	

X = Mean, b_i = Regression coefficient, S^2d_i = Deviation from regression *, ** significant at 5% and 1% level, respectively

Table 3 contd...

S.No.	Genotypes	No. of clusters per plant			No. of pods per cluster			No. of pods per plant			Pod length (cm)		
		X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i
1	DUS 19	6.96	-0.28	0.72	3.56	-0.46	0.00	45.40	1.22	2.63	3.99	2.16	0.07
2	PGRU99022	8.93	-2.53	0.05	4.30	-0.66	0.79**	57.07	1.10	-0.74	4.37	0.68	0.00
3	Mash 479	8.73	1.84	0.36	4.27	1.29*	-0.02	45.22	0.08	-1.68	4.46	0.24	0.05
4	PLU499-52	11.58	1.77	0.78*	5.94	2.28	0.10	51.71	0.87*	-1.69	5.65	4.65*	0.01
5	Mash338	9.84	1.17	0.57	4.81	-1.02	-0.01	47.58	1.02	50.57**	4.82	-0.37	0.18*
6	UH82-14	8.98	2.40	1.30**	4.59	2.13	0.25*	48.91	1.18	-0.01	4.73	0.11	0.06
7	PL4158	6.47	1.09	-0.01	2.84	0.79	0.38**	35.11	0.70	-1.69	4.24	0.71	-0.02
8	PU19	8.07	1.82	-0.06	4.25	1.25	0.00	46.27	0.87*	-1.52	4.45	1.70	0.01
9	No. 40	6.98	-1.64	1.74**	3.21	1.67*	0.37**	32.29	0.05	4.36	3.54	2.52	0.01
10	IPU2-43	6.00	0.98	0.01	3.44	1.88	0.76**	30.71	0.75	1.08	3.38	2.32	0.12
11	T9	6.82	2.01	0.17	3.38	1.77	0.42**	35.22	1.83	15.02	3.78	-0.47	0.06
12	UH86-4	10.11	-0.86	1.24*	5.23	-0.40	0.83**	45.49	-1.64	44.52**	4.96	1.94	0.01
13	STTZ834	10.62	4.34**	-0.05	5.05	1.55	0.00	45.09	0.87*	10.03	4.96	0.86	-0.01
14	Mash 114	6.47	1.74	3.78**	3.22	-2.69	0.34**	41.44	2.88	28.54*	4.10	0.90	-0.01
15	SPS38	8.16	-1.02	-0.07	4.16	2.22	0.20*	36.96	0.63	-1.47	4.31	0.92	0.01
16	NKD4-2	11.64	1.41	-0.07	5.81	-0.37	0.00	53.55	1.18	2.80	5.64	0.92*	0.01
17	IPU96-16	6.38	2.22	0.04	4.08	-1.13	0.28*	28.33	0.81*	-1.34	3.42	-0.55	0.20*
18	IPB96-6	8.38	1.45**	-0.06	3.93	4.29	1.27**	40.16	4.21	64.48**	4.38	-1.78	0.01
19	PU 31 (C)	10.07	1.11*	0.71	5.08	2.86*	0.04	56.29	1.08	0.46	4.94	2.99	0.81**
20	Uttara (C)	6.33	0.98	0.01	3.04	2.76	0.69**	23.45	0.32	-1.69	3.37	-0.45	0.07
	General mean	8.38			4.21			42.31			4.37		
	SEm±	0.57	0.71		0.43	0.94		2.55	0.60		0.23	0.61	

X = Mean, b_i = Regression coefficient, S^2d_i = Deviation from regression *, ** significant at 5% and 1% level, respectively

Table 3 contd...

S.No.	Genotypes	Number of seeds/pod			1000 grain weight (cm)			Grain yield per plant (g)			Biological yield per plant (g)			Harvest index (%)		
		X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i	X	bi	S^2d_i
1	DUS 19	3.94	2.70	0.23*	34.11	-0.08	1.21	4.30	0.16**	-0.02	18.22	-0.40*	-0.32	19.79	-0.52	1.58
2	PGRU99022	4.77	4.12	0.10	37.31	-3.02	9.99	4.70	-1.73	0.09	20.95	-2.19	6.01**	22.29	-1.39	1.79
3	Mash 479	5.09	0.37	0.07	37.39	1.80	-0.77	4.67	1.14*	0.14	21.25	1.25	1.14	22.82	1.31	0.27
4	PLU499-52	5.66	0.49	-0.02	42.03	3.68*	-0.20	5.71	1.98**	-0.02	25.67	2.44	0.34	29.43	3.94	0.75
5	Mash338	5.20	1.27*	0.09	38.10	0.91	0.94	4.92	1.06	0.01	21.96	-1.37	0.49	24.06	2.89	-0.09
6	UH82-14	5.35	0.74	-0.01	38.70	1.29	0.58	5.04	1.39	0.05	22.46	1.70	0.02	24.58	1.58	-0.35
7	PL4158	3.96	0.97	0.00	33.82	1.11	-0.91	4.26	1.73	-0.01	17.92	2.35	-0.33	19.32	-2.52	0.27
8	PU19	4.95	1.56	0.11	36.84	0.67	0.24	4.54	0.63	-0.01	20.70	0.39	-0.22	22.32	0.61	-0.36
9	No. 40	3.58	2.38	-0.02	32.77	-0.88	-0.26	3.96	-0.37	0.20*	16.65	-0.37	2.30	18.85	-0.08	-0.39
10	IPU2-43	3.44	1.10	0.40**	33.39	-1.30*	-0.80	3.99	0.53	-0.01	17.28	0.82	-0.28	17.91	0.48	0.67
11	T9	4.25	0.74	1.07**	33.90	1.10	-0.59	4.17	1.49	0.01	22.86	0.44	10.25**	19.52	1.81	0.31
12	UH86-4	5.29	1.66	0.01	38.99	-0.89	1.22	5.10	0.49	0.47**	17.78	1.25	-0.26	23.53	-0.39	16.19**
13	STTZ834	5.45	1.77	-0.02	39.76	2.62*	-0.92	5.17	1.22	0.06	23.60	0.85*	-0.25	25.00	1.89	0.20
14	Mash 114	3.95	0.05	-0.02	34.23	0.69	-0.94	4.31	0.80	-0.01	18.14	0.78	-0.29	19.70	0.52	-0.37
15	SPS38	4.74	-0.17	0.21*	36.25	1.52	2.06	4.54	2.02	-0.01	20.34	1.62	-0.10	21.98	1.77	0.05
16	NKD4-2	5.67	0.70	0.02	42.71	0.86	2.91	3.53	2.35	0.06	26.00	2.06	2.06	28.78	2.90	13.04**
17	IPU96-16	3.56	-0.27	0.31**	31.80	2.22	-0.92	3.63	1.89	0.58**	15.80	2.29	10.88**	18.18	1.87	6.63*
18	IPB96-6	4.43	-1.50	0.02	36.47	4.04	0.39	4.67	2.95	0.41**	15.48	2.06	2.80	18.52	0.77	0.99
19	PU 31 (C)	5.49	0.99**	0.01	40.26	0.96	10.16	5.71	0.98*	0.11	24.01	0.96	-0.12	26.29	1.14	1.18
20	Uttara (C)	3.43	0.31	0.02	31.60	2.71	-0.83	5.25	-0.72*	-0.01	20.31	3.06	6.93**	17.72	1.41	0.72
	General mean	4.61			36.52			4.61			20.37			22.03		
	SE±m	0.28	0.71		1.05	0.91		0.25	0.65		1.12	0.79		1.16	0.85	

X = Mean, b_i = Regression coefficient, S^2d_i = Deviation from regression *, ** significant at 5% and 1% level, respectively

Regression coefficient ranged from 0.08 (No. 40) to 3.94 (PLU499-52). Regression coefficient was non-significant for all the genotypes. PU 31 was found the most stable and desirable genotypes as it had higher mean than general mean coupled with regression coefficient closer to unity. PLU499-52, STTZ834 and UH82-14 were suitable in high performing environments as they had higher mean than general mean with regression coefficient greater than unity. Similar results were obtained by Sharma and Rao (2015).

As per the environmental index assessments, the Environment 1 (E_1) was the most advantageous for the days taken to 50 per cent flowering, days taken to maturity, plant height, number of primary branches per plant, pod length, and number of seeds per pod since it had the maximum positive value. Likewise, the least effective environment for these attributes was determined to be Environment 3 (E_3) which had the minimal score, although it was the most beneficial for number of clusters per plant, number of pods per plant, 1000 grains weight, grain yield per plant, biological yield per plant and harvest index. Environment 2 (E_2) was particularly well suited to number of pods per cluster. Stability parameters of different traits revealed that PLU499-52 was stable for days to 50 percent flowering as it exhibited high mean performance, regression coefficient close to unity and non-significant deviation from regression. Genotype Mash 338 was stable for days to maturity, number of primary branches per plant, number of clusters per plant, number of pods per cluster, number of seeds per pod and 1000 grain weight as it exhibited high mean performance coupled with regression coefficient close to unity and minimum deviation from regression. Similarly, genotype PL4158 was stable for plant height. PU 31 was stable for number of clusters per plant, number of pods per plant, number of seeds per pod, 1000 grain weight, biological yield per plant and harvest index. PGRU 99022 was stable for number of pods per plant. For pod length, genotype NKD4-2 exhibited consistent performance. STTZ 834 was found stable for biological yield per plant. Stable genotypes with higher mean performance, unit value of regression coefficient and non-significant deviation from regression were identified earlier by Raman and Sinhamahapatra (2012), Singh *et al.* (2020) and Sidramappa *et al.* (2021) for various yield and yield attributing traits in pulses while estimating stability using Eberhart and Russell (1966) model.

CONCLUSION

From the present study, it was concluded that sufficient amount of variability was present among the genotypes, environments, GxE, environment linear and pooled deviation. Based on overall performance of the genotypes across three different localities of Jammu region, the genotypes PLU499-52 and STTZ834 were shortlisted as more suited to better performing environments because their stability was below average, although Uttara was regarded as a good performer in inferior environments for grain yield per plant since its stability was found above average. Although PU 31 and Mash 338 were both average in terms of stability, PU 31 had higher yield per plant than Mash 338. PU 31 was the most stable genotype for growing in all three localities tested in Jammu region. These stable genotypes may be useful in a breeding programme for evolving high yielding urdbean varieties well adopted to varying environmental conditions.

REFERENCES

Anonymous 2017. Regional Digest of Statistics, 2016-17. Directorate of Economics and statistics, Government of Jammu and Kashmir.

Bartlett, M. S. 1937. Some examples of statistical methods of research in agriculture and applied biology. *Supplement to Journal of Royal Statistical Society*, 4: 137-170.

Comstock, R. E. and Moll, R. H. 1963. Genotype-environment interactions. In "*Statistical Genetics and Plant Breeding*". NAS-NRC. Pp. 164-196.

Desai, V. K., Parmar, L. D., Chaudhary, A. R. and Chaudhary, N. B. 2020. Genetic variability, correlation, path coefficient and stability analysis for yield and its attributing traits in summer green gram [*Vigna radiata* (L.) Wilczek] accessions. *International Journal of Current Microbiology and Applied Sciences*, 9(6): 2942-2955.

Eberhart, S. A. and Russell, W. A. 1966. Stability parameters for comparing varieties. *Crop Science*, 6: 36-40.

Finlay, K. W. and Wilkinson, G. N. 1963. Analysis of adaptation in plant breeding programme. *Australian Journal of Agricultural Research*, 14: 742-754.

Gambhire, V. B., Raut, D. M., Dhakulkar, S. J. and Joseph, J. 2017. Genotype x environment analysis of blackgram (*Vigna mungo* L. Hepper) cultures over open condition by Eberhart and Russell Model. *International Journal of Current Microbiology and Applied Sciences*, 6(9): 1955-1963.

Kumar, N. S. and Peera, S. K. C. G. 2012. Stability for seed yield in black gram (*Vigna mungo* L. Hepper). *International Journal of Recent Scientific Research*, 3(5): 336-339.

Kumar, N. S., Eswaran, R. and Eniyavan, A. 2015. Genotype × environment interaction for seed yield and its component traits in black gram (*Vigna mungo* L. Hepper). *Plant archives*, 15(1): 211-215.

Kumar, S., Sharma, J. P., Kumar, A., Choudhary, H. K., Singh, A. P., Sandghu, R., Gupta, R., Singh, M. and Singh, A. K. 2020. Genotype x environments interactions for grain yield and its components in urdbean (*Vigna mungo* L. Wilczek) under rainfed conditions of Jammu region. *Indian Journal of Genetics and Plant Breeding,* 80(2): 194-203.

Lukoki, L., Marechal, R. and Otoul, E. 1980. The wild ancestors of the cultivated beans *V. radiate* and *V. mungo*. *Bulletin du Jardin Botanique National de Belgique*, 28: 23- 30.

Manivannan, N., Kumar, K. B., Mahalingam, A. and Ramakrishan, P. 2019. Stability analysis for seed yield in cowpea genotypes (*Vigna unguiculata* (L.) Walp.). *Electronic Journal of Plant Breeding,* 10(3): 1246-1249.

Lal, M., V. A., Saravanan and Sabesan, K. T. 2019. Linear regression model for stability analysis in blackgram (*Vigna mungo* L. Hepper) Germplasm. *Journal of Pharmacognosy and Phytochemistry,* 8(2): 1481-1483.

Raman, R. B. and Sinhamahapatra, S. P. 2012. Stability analysis of black gram [*Vigna mungo* (L.) Hepper] in summer season. *Journal of Crop and Weed,* 8(1): 111-113.

Rita, N., Kigwie, S., Noren, K., Brojan, N. and Pramesh, Kh. 2016. Stability analysis of high yielding varieties of black gram (*Vigna mungo* L. Hepper). *International Journal of Agriculture, Environment and Biotechnology,* 9(1): 17-24.

Sakila, M. and Pandiyan, M. 2018. Realization of facts and profiteering of black gram through different breeding methods. *International Journal of Chemical Studies,* 6(4): 3359-3369.

Sharma, R. and Rao, S. K. 2015. Stability analysis in black gram (*Vigna mungo* L.) genotypes. *Electronic Journal of Plant Breeding,* 6(4): 972-980.

Sidramappa, Kuchanur, P. H., Shobharani, M., Arunkumar, B., Kulkarni, S. A., Sowmya, H. C., Sheela, D., Laxuman and Bharati, S. 2020. Correlation and path coefficient in blackgram [*Vigna mungo* (L.) Hepper] across seasons. *International Journal of Current Microbiology and Applied Sciences,* 9(10): 873-878.

Singh, A. K., Wali, P., Singh, S. K., Vaid, A. and Singh, R. 2021. Estimates of genetic variability, heritability, genetic advance, character association and path analysis of Urdbean genotypes for grain yield. *Annals of Agriculture Research* 42 (3): 1-7.

Singh, O. V., Shekhawat, N. and Singh, K. 2020. Stability analysis for yield and some of yield component traits in cowpea [*Vigna unguiculata* (L.) Walp] germplasm in hot arid climate. *Legume Research,* 43(5): 623-626.

Vavilov, N. I. 1926. Origin variation, immunity of cultivated plants. *Chronica Botenica*, 13: 364.

Yan, W. and Hunt, L. A. 1998. Genotype by environment interaction and crop yield.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 485-488

Performance of Promorising Varieties of Wheat Under Late and Very Late Sowing Conditions in Grid Zone of M.P.

U.C. Sharma, Kayam Singh, Amit Kumar, L.S. Gurjar and C.B.S. Jatav
Krishi Vigyan Kendra, Baroda, Sheopur, Madhya Pradesh

ABSTRACT

A field experiment (crop cafeteria) was conducted during Rabi season 2016-17 and 2017-18 at Krishi Vigyan Kendra, Lahar Bhind (M.P.) intiltled to study the performance of six wheat varieties under late and very late sowing conditions. The experiment was laid out in split plot design with twelve treatment combinations in three replications. Treatments consisted of two sowing conditions i.e. late sown (15.12.2016) and very late sown (10.01.2017) in main plots and six wheat varieties viz. MP 4010, K-7903, WH-1129, GW-273, HD-3059 and WH-1021 in the sub plots. The results revealed that there was no statistical difference among sowing dates for yield and yield attributing characters, but significant differences were observed among different varieties in relation to yield and yield contributing parameters like effective tillers (m^{-2}), number of grains per spike and 1000 grain weight (g). Among varieties, HD3059 was the top yielder (45.28 qha^{-1}) which proved significantly superior rest of the treatment, variety MP-4010 and K-7903 can be considered as best variety for growing in late and very late sowing conditions.

Keywords: Performance, Promorising, Varieties, Wheat

INTRODUCTION

Wheat crop is an important among cereals. It is high source of protein, good source of fibre and good in manganese and magnesium in the grid zone of Madhya Pradesh. Its area and productivity is increasing rapidly across the globe, due to its wider adaptability and sustainability under diverse agro climatic conditions (Kumar *et al.,* 2014). There are various factors, which are responsible for low yield of wheat crop in the country but among these sowing time and and varietal selection are of primary importance. Wheat is the main crop of winter season and it has its own definite requirements for temperature and light for emergence, growth and flowering (Dabre *et al.,* 1993).

Selection of suitable crop varieties according to the agroclimatic conditions may play crucial role in realizing the optimum production of any crop commodity (Singh *et al.,* 2008). Delay in sowing results in poor tillering and crop growth is generally slow due to low temperature. In late planting the wheat variety should be of short duration that may escape from high temperature at the grain filling stage (Phadnawis and Saini, 1992). Late sowing results in reduction of yield contributing characters like number of tillers and number of grains per spike (Ansary *et al.,* 1989). The release of new varieties is a continuous process and different varieties perform differently under different sowing conditions. Therefore, the present study was conducted to judge the performance of various wheat varieties under late and very late sowing conditions.

MATERIALS AND METHODS

A field experiment (crop cafeteria) was conducted during Rabi season 2016-17 and 2017-18 at Krishi Vigyan Kendra, Lahar Bhind (M.P.). The experimental soil was loam in texture low in organic carbon, available phosphorus and potash and high in pH and electrical conductivity. The 12 treatments were executed in split plot design with three replications. The treatments comprised of two sowing dates in the main plots and seven varieties in the sub plots. The dates of sowing were 15.12.2016 (Late sown condition) and 10.01.2017 (Very late sown condition). The six varieties viz. MP

*Corresponding author email id: rakshitshantanu90@gmail.com

4010, K-7903, WH-1129, GW-273, HD-3059 and WH-1021 were grown in the sub plots. The sowing of the varieties were done by hand with the help of kudal method in rows of 22.50 cm spacing and at a depth of 4 -6 cm. The fertilizers were applied at the rate of 120 kg N, 60 kg P_2O_5 and 40 kg K_2O per hectare.1/3rd N, full phosphorus and potash were applied at sowing time and the remaining 2/3rd N were applied as 1/3rd N at first irrigation and 1/3rd N at second irrigation.

All other agronomic practices were kept normal and uniform for all the treatments. The data for germination count per square meter was recorded at 30 days after sowing. The data for other parameters like effective tillers per square meter, number of grains per spike, 1000 grain weight, biological yield and grain yield were recorded at maturity. For collecting data on effective tillers per square meter, three sites of one square meter each were randomly selected from each plot and mean was calculated. Grains per spike were calculated by randomly selecting ten spikes from each plot and then spikes threshed and total number of grain were calculated and then mean value was taken. A random sample of 1000 grains from each treatment was collected and weighed with digital balance for 1000 grain weight. The biological yield and seed yield were recorded on plot basis and were converted to quintal/ hactare. Spray of Sulphosulfuron 75% + Matsulfuron Methyl 5% WG @ 30+2g a.i /ha at 30 DAS

RESULTS AND DISCUSSION

The yield of any crop is determined by its stand count that is function of its initial germination. The germination count was significantly affected by date of sowing. The January sown crop recorded significantly lower germination count (170.0 m^{-2}) as compared to December sown crop (232.74 m^{-2}). This may be due to temperature fluctuation. During the month of January temperature falls and it could not fulfil the requirement for seed germination. Razzaq *et al.* (1986) also observed the similar findings. The different varieties also showed significant differences in germination count (m^{-2}). Maximum germination count was observed in variety WH1021 (215.30 m^{-2}) which was significantly superior to variety GW-273 and at por/3.15 will treatments than rest of the varieties. Differences in germination count might be attributed to their genetic diversity. These results are in line with those of Aslam *et al.* (2003). The interaction between date of sowing and varieties were found to be non-significant.

Tillering mainly depends upon the green photosynthetic area which is responsible for carbohydrate formation, grain filling and final grain yield. The wheat crop sown late recorded more tiller production as compared to very late sown crop condition, however the differences were found to be non-significant, but different varieties showed

Table 1: Effect of date of sowing on yield and yield attributes of wheat Varieties (pooled data of two years)

Treatments	Germination count (m^{-2})	Effective tillers (m^{-2})	No. of grains per spike	1000 grain weight (g)	Biological yield (q/ha)	Yield (q/ha)
Date of sowing						
Late	232.74	331.00	33.18	34.90	57.00	41.26
Very late	170.00	322.00	34.08	32.80	85.00	39.86
CD at 5%	16.42	NS	NS	NS	NS	NS
Varieties						
MP-4010	190.28	320.00	41.85	45.53	90.50	38.30
K-7903	195.10	322.00	40.20	43.10	85.65	37.50
WH-1129	198.50	328.00	36.10	37.50	98.50	36.85
GW-273	203.85	312.00	36.19	36.73	70.80	35.15
HD-3059	191.10	325.00	40.95	46.56	103.10	45.28
WH-1021	215.30	332.00	30.50	32.67	85.83	35.10
CD at 5%	12.15	25.03	3.10	1.53	8.20	3.75
Interaction	NS	NS	5.87	NS	NS	NS

significant differences in tiller production. Among the varieties, HD-3059 produced maximum number of tillers which were at par with rest of the varieties. The differential variation for tiller production among genotypes might be due to their genetic variability (Aslam *et al.,* 2003; Khaliq, 2018 and Shah *et al.,* 2016) The interactive effects between date of sowing and varieties were non-significant.

Number of grains per spike is an important yield attributing character. Data regarding number of grains per spike revealed that sowing dates did not affect significantly the number of grains per spike but significant differences were observed among varieties. The interaction between sowing dates and varieties was found to be significant. The variety HD3059 produced highest grains (41.35) per spike and it remained significantly superior over all other varieties. Variety WH1021 recorded the lowest number of grains (30.32) per spike in late sowing conditions. Differences in number of grains per spike among varieties might be due to their genetic variability. Similar results were reported by Haider (2004).

The data regarding 1000 grain weight revealed that sowing conditions and different varieties and even interaction of both did not significantly affect the 1000 grain weight. However, the crop sown under very late sowing conditions recorded lower 1000 grain weight as compared to crop sown under late sown conditions. Many workers reported decrease in grain weight due to late sowing (Khan, 2017; Akhtar *et al.,* 2006). This is because, delay in sowing shortens the duration of each development phase which ultimately reduces the grain filling period leading to lower grain weight (Spink *et al.,* 2018). Among varieties, maximum 1000 grain weight was observed in HD-3059 (46.56g) whereas least (32.67 g) was observed in variety WH1021.

Table 2: Interactive effect of date of sowing on grains per spike of wheat varieties (pooled data of two years)

Late sowing		Vey late sowing	Mean value of sowing
MP-4010	41.01	32.93	36.97
K-7903	36.93	35.67	36.30
WH-1129	34.75	36.07	35.41
GW-273	33.88	38.50	36.19
HD-3059	41.36	49.2	45.28
WH-1021	27.38	33.46	30.42
Mean	35.88	37.63	36.76
CD at 5% Date of sowing	NS		
Varieties	4.12		
Interaction	5.84		

Biological yield is reflected by growth parameters like leaf area, tiller production and plant height. It is evident from data that biological yield was not significantly affected by date of sowing, but different varieties showed significant effect on biological yield. The variety HD3059 recorded highest biological yield whereas least was observed in variety GW-273. The interaction between date of sowing and variety was found to be non-significant.

Grain yield of wheat crop is the combined effect of various yield attributing components. As shown in Table 1 that different sowing conditions did not affect grain yield, but significant differences were found among different varieties in relation to grain yield. Among varieties, HD-3059 recorded maximum yield (45.28 q/ha) and significantly superior over rest of varieties. The variety WH-1021 recorded significantly lower yield (35.10 q/ha) as compared to all other varieties and it was 29.0 percent lower yield than HD 3059. The highest yield of variety HD-3059 might be due to maximum number of grain per spike. No interaction effects were observed between sowing dates and different genotypes (Table 2). It can be summarised that variety HD3059 can be considered as best among six genotypes for growing under late and very late sowing conditions.

ACKNOWLEDGEMENT

The author want to express sincere gratitude to Rajmata Vijayaraje Sciendia Krishi Vishwa Vidyalaya, Gwalior for providing facilities organized crop cafeteria in "Krishi Vigyan Kendra, Lahar, Bhind (M.P.)" for the conduct of this research.

REFERENCES

Akhtar, M.; M.S. Cheema; M. Jamil and L. Ali. 2006. Effect of time of sowing on some important characters of wheat, *Triticum aestivum*, genotypes. *J. Agric. Res.,* 44(4): 255-259.

Ansary, A.H.; A.M. Khushak; M.A. Sethar; N.A. Ariam and M.Y.M. Emon. 1989. Effect of sowing dates on growth and yield of heat cultivars. *Pak. J. Sci. Ind. Res.,* 32: 39-42.

Aslam, M.; M. Hussain; M. Akhtar; M.S. Cheema and L. Ali. 2003. Response of wheat varieties to sowing dates. *Pak. J. Agron.,* 2(4):190-194.

Dabre, W.M.; S.B. Lall and G.L. Lngole. 1993. Effects of sowing dates on yield, ear number, stomatal frequency and stomatal index in wheat. *J. Maharashtra Agric. Univ.,* 18: 64-66.

Haider, R.S. 2004. Growth and yield response of three wheat varieties to N alone and in combination with P and P+K under late sown conditions. M.Sc. (Hons.) Agri. Thesis, University of Agriculture, Faisalabad-Pakistan.

Khaliq, D. 2018. Modeling the growth, radiation use efficiency and yield of wheat under different sowing dates and varying nitrogen levels under rainfed conditions. M.Sc. (Hons.) Thesis, University of Agriculture, Faisalabad-Pakistan.

Khan, N.A. 2017. Simulation of wheat growth and yield under variable sowing date and seeding rate. M.Sc. Thesis, Department of Agronomy, University Agriculture, Faisalabad.

Kumar, P.; A. Sarangi; D.K. Singh and S.S. Parihar. 2014. Wheat performance as influenced by saline irrigation regimes and cultivars. *Journal of Agri Search,* 1(2): 66-72.

Phadnawis, B.N. and A.D. Saini. 1992. Yield models in wheat based on sowing time and phenological developments. *Ann. Pl. Physiol.,* 6: 52-59.

Razzaq, A.; P. Shah; B. Sartaj Khan; K. Saeed and D. Mohammad. 1986. Effect of planting times on the growth and straw yield of wheat varieties. *Sarhad J. Agric.,* 2(2): 327-334.

Shah, W.A.; J. Bakht; T. Ullah; A.W. Khan; M. Zubair and A. Khakwani. 2016. Effect of sowing dates on yield and yield components of different wheat varieties. *J. Agron.,* 5(1): 106-110.

Singh, A.K.; N. Manibhushan; Chandra and R.C. Bharati. 2008. Suitable crop varieties for limited irrigated conditions in different agro climatic zones of India. *Int. J. Trop Agr.,* 26(3-4): 491-496.

Spink, J.H.; E.J.M. Kirby; D.L. Forest; R. Sylvester Bradley; R.K. Scott; M.J. Fouke's; R.W. Clare and E.J. Evans. 2018. Agronomic implications of variation in wheat development due to variety, sowing, site and season. *Plant, Variety and Seed,* 13: 91-105.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 489-494

Impact of Different Schemes for the Promotion of Sericulture in Hilly Region of Jammu Division of J&K

Lyaqat Ali[1]*, P.S. Slathia[2], S.K. Kher[2], Parveen Kumar[1] and M.I. Bhat[1]
[1]Associate Professor, Directorate of Extension, SKUAST-K, J&K
[2]Professor & Ex- Professor, Division of Agricultural Extension Education, SKUAST-J, Chatha, J&K

ABSTRACT

The present study was carried out to know the awareness and benefit availed from different Govt. schemes for the promotion of sericulture in hilly region of Jammu division with 240 respondents were selected by proportionate random sampling method from three districts, six blocks and 24 villages. The data was collected by using a pretested structured interview schedule. The data revealed that the awareness of silkworm rearers about different schemes it was found that respondents have high awareness about schemes namely supply of rearing appliances (97.22%), supporting for raising mulberry tree plantation in cluster form (97.22%), assistance for construction of rearing houses (94.44%) and low awareness in training programme on outside state (5.71%). There were six schemes which had no awareness among the silkworm rearers. As for as benefit availed were concerned 84.58 per cent respondents had availed the benefit of support for raising mulberry tree plantation in cluster form followed by 52.50 per cent respondents who availed the benefit from scheme of supply of rearing appliances and 42.91 per cent respondents availed the benefit from cluster development of mulberry plantation on state/departmental land. There were six schemes namely establishment of hot air dryers, establishment of reeling units, incentive on silk yarn, establishment of cocoon bank, establishment of silk exchange, corpus funds for market intervention in which the respondents had availed no benefit from these schemes.

Keywords: Different Schemes, Impact, Promotion, Sericulture

INTRODUCTION

Sericulture being a rural agro based industry; this sector has played a critical role in rural development, women empowerment and employment generation. Like any other agriculture allied sector, although production costs have increased in recent times an increased productivity and enhanced quality witnessed through technology intervention have proved that this sector is a commercially viable and an inclusive enterprise. Sericulture plays a vital role in the rural development in Jammu and Kashmir, as it integrates well with the farming systems and has potential to generate attractive income. It is remarkable for its low investment, quick and high returns that fits well into socio-economic conditions of India in general and Jammu and Kashmir in particular (Qadri-2010). Sericulture is a subsidiary occupation for about 25000 rural families in the state. Most of these families belong to economically backward section of the society. Annually about 850 MTs of cocoons are produced generating an income of about Rs 1100 lac for these silkworm rearers coupled with annual employment generation to the tune of 6 lac man days (Department of Sericulture report 2010-11). The nurseries of the department of sericulture serve as leaf reservoirs for the landless and marginal farmers. About 60 percent local annual silkworm seed demand is met out from the sericulture department. In Jammu region all districts have silk worm rearers. The total number of silkworm rearers in Jammu region is about 17167 and cocoon production is about 5.714 (lac. kgs) (Department of sericulture, Govt. of Jammu and Kashmir 2010-11).

In Jammu and Kashmir, sericulture industry, from rearing of worms to reeling of cocoons and weaving

*Corresponding author email id: lyaqetchoudhary@gmail.com

of silk is centuries old vocation. Agro based part of the industry is widely distributed where as industrial portion is restricted in Kashmir valley only. Raw silk produced is worldwide known as Kashmir silk being superior bivoltine type. Although this trade is centuries old in Kashmir but was introduced in Jammu division only about 100 years back (Koul, 2009). However in the subtropical belt of Jammu division this venture came into existence after 1950. Bulk of the silkworm rearing is carried out on leaf obtained from the Government plantation on road sides, river bunds, wild plantation and government land. In spite of good returns in shortest possible time no attempts have been made to raise private mulberry gardens by the farmers mainly due to shortage of irrigated cultivable land and only single crop system of silkworm rearing (Anonymous, 1988).

Keeping in view the enormous importance of sericulture in livelihood of the farmer a study was conducted to know rearers awareness and benefit availed of various schemes implemented by different agencies for the promotion of sericulture

MATERIALS AND METHODS

The present study was conducted in Jammu division of Jammu and Kashmir State. The Jammu division comprises of ten districts. The silk worm rearers are found in all these districts. On the basis of number of silkworm rearers in each districts, the districts were categorized into three categories with i) Less than 500 rearers ii) 500-1000 rearers iii) Above 1000 rearers. From each of these categories, one district having highest number of silkworm rearers was selected. In this way, three districts namely Poonch, Reasi and Rajouri were selected from these categories for the purpose of study. Based on the number of silkworm rearers in a block, two blocks having maximum silk worm rearers from each district was selected purposively. Thus a total of six blocks was selected for the purpose of study. From each selected block four villages having maximum number of silkworm rearers were selected purposively. Thus, twenty four villages were selected for the purpose of study. The descriptive cum diagnostic research design was employed for conducting the study. The respondents were selected by proportionate random sampling with a sample size of 240 respondents. Data were collected from the selected respondents with the help of semi-structured interview schedule by using the personal interview method. The respondents were interviewed either at their home, at community places or at their farms and their responses were recorded on the spot. The collected data were analyzed by using both parametric and non- parametric statistical tests are used. Computer based SPSS programme was used for analyzing the data.

RESULTS

The data presented in Table 1 regarding the awareness about different centrally cum state sponsored developmental schemes revealed that 99.16 per cent respondents had awareness about support for raising mulberry tree plantation in cluster form, followed by 96.64 per cent respondents who were aware about supply of rearing appliances, 95.41 per cent respondents had awareness about cluster development of mulberry plantation on state/departmental land. In case of health insurance schemes for women 50.83 respondents were aware, 7.09 per cent respondents were aware about the schemes namely training programme outside state. There were six schemes namely establishment of hot air dryers, establishment of reeling units, incentive on silk yarn, establishment of cocoon bank, establishment of silk exchange, corpus funds for market intervention which had no awareness among the respondents.

The data presented in the Table 2 reveals that Kruskal Wallis test was applied to all the schemes namely "support for raising mulberry tree plantation in cluster form", "Cluster development of mulberry plantation on state/Departmental land", "Supply of Rearing appliances", "Assistance for construction of Rearing Houses (CGI sheets)", "Assistance for construction of rearing Houses", "Health Insurance scheme for Women, Establishment of Hot air dryers", "Establishment of Reeling units, Incentive on silk yarn, Establishment of cocoon bank", "Establishment of silk exchange, Corpus funds for market intervention and Training programme outside state. No significant relationship was found among the different schemes and their awareness level.

The data presented in the Table 3 shows that 84.58 per cent respondents had availed the benefit of support

Table 1: Distribution of silkworm rearers according to their awareness about different sericulture development schemes

Name of the Schemes	District wise awareness of different schemes						Overall %tage
	Rajouri (n=170)		Poonch (n=36)		Reasi (n=34)		
	F	%	F	%	F	%	(n=240)
Support for raising mulberry tree plantation in cluster form	169	99.41	35	97.22	34	100	99.16
Cluster development of mulberry plantation on state/Departmental land	161	94.70	34	94.44	34	100	95.41
Supply of Rearing appliances	162	95.85	35	97.22	34	100	96.64
Assistance for construction of Rearing Houses (CGI sheets)	155	91.17	34	94.44	34	100	92.91
Assistance for construction of rearing Houses	142	83.52	31	86.11	32	94.11	85.41
Health Insurance scheme for Women	84	49.41	17	47.22	21	61.76	50.83
Establishment of Hot air dryers	00	00	00	00	00	00	00
Establishment of Reeling units	00	00	00	00	00	00	00
Incentive on silk yarn	00	00	00	00	00	00	00
Establishment of cocoon bank	00	00	00	00	00	00	00
Establishment of silk exchange	00	00	00	00	00	00	00
Corpus funds for market intervention	00	00	00	00	00	00	00
Training programme outside state	13	7.65	2	5.56	2	5.88	7.09

Table 2: District wise mean ranks score of different schemes (awareness)

Name of the schemes	Districts (Mean Ranks)			Chi-Square	Ranks
	Rajouri (n=170)	Reasi (n=34)	Poonch (n=36)	(p-value)	
Support for raising mulberry tree plantation in cluster form	120.79	121.50	118.17	2.04(.359)	3
Cluster development of mulberry plantation on state/ departmental land	119.65	126.00	119.33	1.90(.387)	5
Supply of Rearing appliances	119.05	124.00	120.68	1.54(.464)	6
Assistance for construction of rearing houses (CGI sheets)	118.41	129.00	122.33	3.49(3.487)	1
Assistance for construction of rearing Houses	118.24	130.94	121.33	2.57(2.556)	2
Health Insurance scheme for Women	118.79	133.62	116.17	1.943(.379)	4
Establishment of hot air dryers	120.50	120.50	120.50	0.00(1.00)	8
Establishment of reeling units	120.50	120.50	120.50	.000(1.00)	8
Incentive on silk yarn	120.50	120.50	120.50	.000(1.00)	8
Establishment of cocoon bank	120.50	120.50	120.50	.000(1.00)	8
Establishment of silk exchange	120.50	120.50	120.50	.000(1.00)	8
Corpus funds for market intervention	120.50	120.50	120.50	.000(1.00)	8
Training programme outside state	121.65	116.65	115.85	1.343	7

for raising mulberry tree plantation in cluster form followed by 52.50 per cent respondents who availed the benefit from schemes supply of rearing appliances and 42.91 per cent respondents availed the benefit from about cluster development of mulberry plantation on state/departmental land. The Table 3 further indicates that 28.70 per cent respondents availed the benefit from the scheme assistance for construction of Rearing Houses (CGI sheets) followed by15.00 per cent respondents availed the benefit from assistance for

Table 3: Distribution of respondents regarding the benefit availed under different schemes

Name of the Schemes	District wise percentage of Silkworm rearers						Overall %tage (n=240)
	Rajouri (n=170)		Poonch (n=36)		Reasi (n=34)		
	F	%	F	%	F	%	
Support for raising mulberry tree plantation in cluster form	137	80.58	33	91.66	33	97.05	84.58
Cluster development of mulberry plantation on state/departmental land	83	48.82	9	25.00	11	32.35	42.91
Supply of rearing appliances	83	48.82	22	61.11	21	61.76	52.50
Assistance for construction of rearing houses (CGI sheets)	44	25.82	11	30.55	14	41.17	28.70
Assistance for construction of rearing houses	25	14.70	5	13.88	6	17.69	15.00
Health insurance scheme for Women	8	4.70	1	2.77	3	8.82	5.00
Establishment of Hot air dryers	00	00	00	00	00	00	00
Establishment of reeling units	00	00	00	00	00	00	00
Incentive on silk yarn	00	00	00	00	00	00	00
Establishment of cocoon bank	00	00	00	00	00	00	00
Establishment of silk exchange	00	00	00	00	00	00	00
Corpus funds for market intervention	00	00	00	00	00	00	00
Training programme outside state	4	2.35	2	5.71	3	8.82	3.77

Table 4: District wise mean ranks score of different schemes (benefit availed)

Name of the schemes	Districts (Mean Ranks)			Chi-Square (p-value)	Ranks
	Rajouri (n=170)	Reasi (n=34)	Poonch (n=36)		
Support for raising mulberry tree plantation in cluster form	115.71	135.47	129.00	7.50(.020)	2
Cluster development of mulberry plantation on state/ departmental land	127.59	107.82	99.00	8.65(.013)	1
Supply of rearing appliances	116.09	131.62	130.00	3.15(.207)	4
Assistance for construction of rearing houses (CGI sheets)	117.06	135.41	122.67	3.29(.193)	3
Assistance for construction of rearing houses	120.15	123.68	119.17	.232(.890)	7
Health Insurance scheme for Women	120.15	125.09	117.83	1.446(.485)	5
Establishment of hot air dryers	120.50	120.50	150.50	.000(1.00)	8
Establishment of reeling units	120.50	120.50	120.50	.000(1.00)	8
Incentive on silk yarn	120.50	120.50	120.50	.000(1.00)	8
Establishment of cocoon bank	120.50	120.50	120.50	.000(1.00)	8
Establishment of silk exchange	120.50	120.50	120.50	.000(1.00)	8
Corpus funds for market intervention	120.50	120.50	120.50	.000(1.00)	8
Training programme outside state	119.31	120.01	123.33	1.15(.563)	6

construction of rearing houses and only 5.00 per cent of respondents had availed the benefit from health insurance schemes for women, only 3.77 per cent respondents had availed the benefit from training programme outside state.

There were six schemes namely establishment of hot air dryers, establishment of reeling units, incentive on silk yarn, establishment of cocoon bank, establishment of silk exchange, corpus funds for market intervention in which the respondents had availed no benefit. The data presented in the Table 4 reveals that Kruskal Wallis test was applied to all the schemes namely support for raising mulberry tree plantation in cluster form, cluster development of mulberry plantation on state/departmental land, supply of rearing appliances, assistance for construction of rearing houses (CGI sheets), assistance for construction of rearing houses, health insurance scheme for women, establishment of hot air dryers, establishment of reeling units, Incentive on silk yarn, establishment of cocoon bank, establishment of silk exchange, corpus funds for market intervention and training programme outside state. District wise mean ranks score of different schemes (benefit availed) The data further depicts that the benefit availed from different schemes by the respondents only two schemes namely cluster development of mulberry plantation on state/ departmental land 8.65(.013) and support for raising mulberry tree plantation in cluster form 7.50(.020) was found significant among the districts. Rest all the schemes were found non significant.

CONCLUSION

The awareness of silkworm rearers about different schemes it was found that respondents have high awareness about schemes namely supply of rearing appliances (97.22%), supporting for raising mulberry tree plantation in cluster form (97.22%), assistance for construction of rearing houses (94.44%) and low awareness in training programme on outside state (5.71%). There were six schemes which had no awareness among the silkworm rearers. Kruskal Wallis test was applied to all the schemes, no significant relationship was found among the different schemes and their awareness level.

As for as benefit availed were concerned 84.58 per cent respondents had availed the benefit of support for raising mulberry tree plantation in cluster form followed by 52.50 per cent respondents who availed the benefit from scheme of supply of rearing appliances and 42.91 per cent respondents availed the benefit from cluster development of mulberry plantation on state/ departmental land. There were six schemes namely establishment of hot air dryers, establishment of reeling units, incentive on silk yarn, establishment of cocoon bank, establishment of silk exchange, corpus funds for market intervention in which the respondents had availed no benefit from these schemes. Kruskal Wallis test was applied to all the schemes. Only two schemes namely cluster development of mulberry plantation on state/departmental land 8.65(.013) and support for raising mulberry tree plantation in cluster form 7.50(.020) was found significant among the districts. Rest all the schemes were found non- significant.

It has been suggested that more awareness programmes on various schemes of sericulture development should be organised by the state line department of sericulture so that the farmers can reap the benefit of sericulture development schemes. The minimum support price of cocoons should be enhanced, and the crop should be taken under crop insurance cover. Training intervention on various aspect of cocoon production technology should be organized by state line department of sericulture on regular basis on remote areas. Frequent mobility of the extension functionaries of state line department of sericulture particularly in far areas. It is recommended that adequate facility should be provided to the farmers for construction of silk worm rearing houses which will boost the cocoon production.

REFERENCES

Agatha, P. and Matei, A. 2007. Research concerning the economic impact of production integration in the family production sericultural farm. *Bulletin USMV-CN.*63-64:214-218.

Agatha, P. and Matei, A. 2013. Estimation of expenses, income and profit in mulberry growing. *Economic Engineering in Agriculture and Rural Development,* 13(3): 207-212.

Anonymous. 1988. *Dry land technology for increased crop production in Jammu division.* pp-1-5. Bulletin No. 88-7, Directorate of extension education. SKUAST, Shalimar, Campus, Srinagar, Kashmir.

Anonymous. 2011. *Brief note on Functioning of sericulture* Department of Sericulture Government of Jammu and Kashmir.

Babu, C.M., Dandin, S.B. and Swamy, T.T. 2011. Comparative economics of mulberry cultivation under different inputs of organic farming. *Indian Journal of Sericulture,* 50(1): 9-15.

Economic Survey, 2013-14. Directorate of economics and statistics, Government of Jammu and Kashmir, pp. 337-341.

Goswami, C and Bhattacharya, M. 2013. Contribution of sericulture to women income in Assam a study in

Goalpara district of Assam, India. *International Journal of Scientific and Research Publications*, 3(3): 1-6.

Kerutagi, M.G., Sastry, K.N. and Patil, R.R. 2002. Cost return structure of multi end basin silk reeling technology. In Karnataka *India Journal of Sericulture*, 41(1): 49 – 54.

Koul, A. 2009. Silkworm rearing and quality silk production in hilly tracts of Jammu. Paper presented at ICAR sponsored 21 days winter school, *Conservation farming through efficient use of resource to sustain livelihood of dry land farmers of North-West Himalayas,* 16th Jan.- 5th Feb., Division of Agronomy, Sher e Kashmir University of Agricultural Sciences and Technology of Jammu.

Lakshmanan, S. 2010. Impact of technological changes on income opportunities in mulberry sericulture an economic analysis. *Journal of agricultural economics*, 7(3): 75-84.

Qadri, S.F.I., Malik, M.A., Sabhat, A. and Malik, F.A .2010. Adoption of improved sericultural practices by sericulturists in border area of Kashmir. *International Journal of Agriculture Statistical Science,* 6(1): 197-201.

Ram, K. 2010. Silkworm rearing-A potential farming enterprise for income generation in the hands of hill farmers. Paper presented at ICAR sponsored 21 days winter school, *Integrated farming for high hills,* 5th Feb.-25th Feb., Division of Agronomy, Sher e Kashmir University of Agricultural Sciences and Technology of Jammu.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 495-505

Study of Adoption of Various Mulberry Plantation and Silkworm Rearing Technologies in Jammu Region

Ravi Kant*, Kamlesh Bali, Rakesh Kumar Gupta, Rakesh Sharma, Permendra Singh and Mohammad Iqbal Jeelani
Sher-e-Kashmir University of Agricultural Science and Technology of Jammu-180009, J&K

ABSTRACT

The introduction of new sericultural technology initiated the transformation of sericulture industry there by creating a large potential for increasing sericulture production in India. The productivity of sericulture depends on the extent to which farmers adopt new sericultural innovations. Adoption of improved technologies plays a major role in improving the productivity of any agriculture activity. Hence, the present study was conducted to know the extent of adoption of new technologies by the sericulture farmers in Jammu region which revealed that all three districts under study were cent per cent rainfed. Overall, around 71 per cent of respondents adopted recommended mulberry varieties and 41.33 per cent planted the tree type mulberry plantation. Farm yard manure was used by 19.11 per cent of total respondents. About 32 per cent of respondents adopted recommended two prunings of mulberry in year. Disease and pest management was adopted by only 11 and 6 per cent of the total respondents respectively. All the respondents reared recommended silkworm hybrid in both spring and autumn season. 56 per cent of respondents adopted recommended method of disinfection of rearing house and appliances. Only around 12 per cent of respondents reared chawki worms. About 68 per cent adopted either local grass/weed or pine tree leaves for spinning. Only 8 per cent of total respondents in district Doda followed recommended method of cocoon drying. Cocoon sorting and deflossing was very poorly adopted wherein overall, only 24 and 16.22 per cent of total respondents respectively adopted the practice.

Keywords: Chawki, Cocoon, Mounting, Mulberry, Silkworm

INTRODUCTION

Cocoon is an intermediate product for silk production and it has a direct bearing on the quantitative and qualitative variation in silk production. Varying soil and climatic conditions within the regions clubbed with different levels of economic conditions among the farming population and single crop system also affects the cocoon production resulting slow growth of sericulture development. Though cocoon production in Jammu division has increased to some extent in the recent past but still there is a wide gap between the actual yield obtained by the rearers and the production level actually possible with the available technology. Hence, the bottleneck of the problem is to increase the cocoon output per unit of input and thereby reduce the gaps between achievable cocoon yield at field level.

Nevertheless, to produce quality cocoons, farmers need to acquire knowledge about new technologies and also show interest to adopt such technologies in the field. It is observed that most of the farmers are reluctant to adopt recommended new technologies due to various socio-economic and biotic factors (Lakshmanan *et al.*, 1998). This not only results in reduced productivity but even 95 per cent of total cocoons produced by the farmers do not meet the quality standards. The farmers who do not adopt such technologies would generally lose higher income in sericulture and as such fetch low dividends (Lakshmanan, 1998).

It is surprising to note that on one hand there has been a big technological breakthrough in the Jammu division due to research contribution of Sericulture

*Corresponding author email id: ravi309527@gmail.com

Development Department, Division Sericulture SKUAST-Jammu and Central Silk Board, Miran Sahib and yet on the other hand cocoon production shows decline along with the mulberry wealth which also indicates downward trend inspite of the fact that good number of plants are planted year after year yet it can't be ignored that majority of the farmers have lost interest with mulberry raising, their planting and the silkworm rearing thereof. It is also equally true that, much importance has not been given to dissemination of technologies to the rearers and they still continue to raise cocoons through traditional methods of raising and as such do not adopt any package of practices which eventuates in decreased cocoon production/ productivity and finally less remuneration thereby loss of interest from the rearers.

It appears unbelievable that with many technologies available in the shape of package of practices, booklets, leaflets, be it from rearing or mulberry cultivation point of view and the assistance being extended to rearers through Sericulture Development Department (Jammu & Kashmir Govt.) in the shape of rearing sheds or rearing kits, the rearers still continue to harvest less cocoon crop/ounce of seed and yield gap between the lab and land is still widening which is indeed a matter of concern.

Sericulture plays a key role in the upliftment of rural population both socially and economically (Sreenivasa and Hiriyanna, 2014). So, many sericultural technologies have been developed and their recommendations have been made to improve the productivity and quality of cocoon at farmer's level (Kushwaha, 2013). Inspite of well developed extension network to transfer the technologies to the farmers, there is a wide gap in productivity of the cocoon between laboratory to land due to non or partial adoption of improved sericultural technologies. As a consequence farmer's are getting very low returns due to low productivity and poor quality of cocoons as compared to other agriculture crops and therefore looking for other crops or avenues for better income and proportionate return of their labour.

There are many improved technologies developed in sericulture at a fast pace in the last three decades. Proper adoption of these modified and innovative technologies by the farmers is vital for obtaining higher and better yield and thereby reducing the yield gap in cocoon production. The success of any technology largely depends on its effective adoption and utilization in the field. Providing sericulture knowledge to farmers is the need of hour for changing their attitudes, skills and adoption level which are essential components of rural development (Gowda *et al.,* 1992). The gap between the potential and actual yield in mulberry culture is very wide. One of important factor is attributed to be ignorance and non-adoption of improved recommended technologies.

With this background, a study was conducted to find out whether the technologies generated by various research institutes including Division of Sericulture SKUAST-Jammu and Central Silk Board, Miran Sahib have reached to the rearers and whether they have adopted these technologies.

MATERIALS AND METHODS

Survey was conducted at district Ramban, Doda and Kishtwar in Jammu region. An interview in the form of questionnaire was prepared for recording various mulberry plantation and silkworm rearing technologies in each district during the year 2019-20. The questionnaire and interview was carefully designed and utilized in the study area and respondents were personally interviewed and adoption index of 10 mulberry plantation and 17 silkworm rearing technologies of 225 silkworm rearers were calculated and recorded. The adoption index (%) of a recommended technology was calculated using formula used by Mahimasanthi *et al.* (2016).

RESULTS

The results of adoption index of different sericulture practices adopted by the respondents for mulberry plantation are presented in Table 1, 2, 3 and 4 and for silkworm rearing in Table 5, 6, 7 and 8 under following headings.

Adoption of mulberry plantation technologies

Mulberry varieties: 49 per cent of respondents adopted recommended varieties while remaining adopted both local as well as recommended varieties of mulberry. In district Doda (58.67%) of the respondents partially adopted both local as well as recommended variety whereas 41.33 per cent of respondents fully adopted recommended varieties. In district Kishtwar, the no. of full and partial adopters recorded were 33.33 per cent and 66.67 per cent respectively. The overall adoption index of mulberry varieties in three districts was recorded as 0.71.

Type and season of mulberry plantation: In district Ramban 49.33 per cent of total respondents adopted tree type of mulberry plantation and winter season as planting period. The no. of the respondents who fully adopted the practice in district Doda & Kishtwar were 41.33 per cent and 33.33 per cent respectively. The overall adoption index of tree type plantation in three districts was 0.41. Similar results were recorded in case of recommended season of plantation.

Pruning of mulberry trees: The data on the pruning of mulberry trees depicted that 40% of respondents adopted recommended methods of pruning in district Ramban followed by Doda (28%) and least in Kishtwar district (27%). The overall adoption index of pruning in mulberry was recorded as 0.32.

Application of manures, fertilizers and irrigation practices: None of the respondent adopted chemical fertilizers application and irrigation however farm yard manure application was applied by 21.33 per cent the respondents in district Ramban followed by Kishtwar (20%) and least in district Doda (16%) and overall, only 19.11 per cent applied FYM in mulberry plantation.

Table 1: Adoption index of various mulberry plantation methods in district Ramban

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	37(49.33)	38(50.67)	0	112	0.75(74.67)
Type of plantation	37(49.33)	0	38(50.67)	74	0.49(49.33)
Planting season	37(49.33)	0	38(50.67)	74	0.49(49.33)
Pruning	30(40)	0	45(60)	60	0.40(40)
Irrigation	0	0	75(100)	0	0(0)
Fertilizer application	0	0	75(100)	0	0(0)
Use of FYM	16(21.33)	0	59(78.67)	32	0.21(21.33)
Weed management	0	17(22.67)	58(77.33)	17	0.11(11.33)
Disease management	0	19(25.33)	56(74.67)	19	0.13(12.67)
Pest management	0	10(13.33)	65(86.67)	10	0.07(6.67)

Values given in parenthesis are in percentages

Table 2: Adoption index of various mulberry plantation methods in district Kishtwar

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	25(33.33)	50(66.67)	0	100	0.67(66.67)
Type of plantation	25(33.33)	0	50(66.67)	50	0.33(33.33)
Planting season	25(33.33)	0	50(66.67)	50	0.33(33.33)
Pruning	20(26.67)	0	55(73.33)	40	0.27(26.67)
Irrigation	0	0	75(100)	0	0(0)
Fertilizer application	0	0	75(100)	0	0(0)
Use of FYM	15(20)	0	60(80)	30	0.20(20)
Weed management	0	15(20)	60 (80)	15	0.10(10)
Disease management	0	13(17.33)	62(82.67)	13	0.09(8.67)
Pest management	0	5(6.67)	70(93.33)	5	0.03(3.33)

Values given in parenthesis are in percentages.

Table 3: Adoption index of various mulberry plantation methods in district Doda

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	31(41.33)	44(58.67)	0	106	0.71(70.67)
Type of plantation	31(41.33)	0	44(58.67)	62	0.41(41.33)
Planting season	31(41.33)	0	44(58.67)	62	0.41(41.33)
Pruning	21(28)	0	54(72)	42	0.28(28)
Irrigation	0	0	75(100)	0	0(0)
Fertilizer application	0	0	75(100)	0	0(0)
Use of FYM	12(16)	0	63(84)	24	0.16(16)
Weed management	0	19(25.33)	56(74.67)	19	0.13(12.67)
Disease management	0	18(24)	57(76)	18	0.12(12)
Pest management	0	11(14.67)	64(85.33)	11	0.07(7.33)

Values given in parenthesis are in percentages.

Table 4: Overall adoption index of various mulberry plantation methods

Mulberry plantation Technology	Adoption index	Adoption index	Adoption index	Adoption index
Mulberry variety	0.67(66.67)	0.75(74.67)	0.71(70.67)	0.71(70.67)
Type of plantation	0.33(33.33)	0.49(49.33)	0.41(41.33)	0.41(41.33)
Season of plantation	0.33(33.33)	0.49(49.33)	0.41(41.33)	0.41(41.33)
Pruning	0.27(26.67)	0.40(40)	0.28(28)	0.32(31.56)
Irrigation	0(0)	0(0)	0(0)	0(0)
Fertilizer application	0(0)	0(0)	0(0)	0(0)
Use of FYM	0.20(20)	0.21(21.33)	0.16(16)	0.19(19.11)
Weed management	0.10(10)	0.11(11.33)	0.13(12.67)	0.11(11.33)
Disease management	0.09(8.67)	0.13(12.67)	0.12(12)	0.11(11.11)
Pest management	0.03(3.33)	0.07(6.67)	0.07(7.33)	0.06(5.78)

Values given in parenthesis are in percentages

Disease and pest management measures: None of farmer adopted recommended plant protection measures against disease and pest. However 25.33 per cent and 13.33 per cent of the respondents in district Ramban adopted local methods of disease and pest control respectively. In district Kishtwar, 17.33 per cent and 6.67 per cent adopted partial or local methods of disease & pest management. In district Doda 24.67 per cent and 14.67 per cent adopted the local methods of disease and pest management. The overall adoption index of disease & pest management recorded in the three districts was 0.11 and 0.60 respectively.

Weed management: None of the farmer adopted recommended weed control measures. Around 25 per cent of the respondents in district Doda followed by Ramban (22.67%) and Kishtwar (20%) respectively adopted local methods of weed control. The overall adoption rate in all the three districts was 11.33 per cent.

Adoption of silkworm rearing technologies

Adoption of silkworm hybrid: Cent per cent respondents reared recommended double hybrid silkworm seed (FC1xFC2) procured either from CSB, Bangalore or SSPC, Vijaypura Karnataka and local silkworm seed production centres at Batote and Udhampur (Table 9, 10, 11 and 12).

Adoption of incubation black boxing and brushing: Only 16 per cent of the respondents in district Ramban followed by Kishtwar (10.67%) and district Doda (8%) adopted incubation, black boxing and brushing practice of the silkworm eggs. The overall adoption index of the practice was 0.12.

Adoption of disinfection of rearing house & appliances: In district Ramban, 25.33 per cent of the total respondents fully adopted followed by district Kishtwar (18.67%) and only 8 per cent in district Doda. The overall adoption index of disinfection of rearing house and appliances by the respondents in three districts was 0.56.

Adoption of chawki worms: In district Ramban, 17.33 per cent of the respondents reared chawki worms followed by Kishtwar (10.67%) and least in Doda (8%). Overall only 11.56 per cent respondents in all the three districts adopted chawki worm rearing

Adoption of bed spacing: The recommended practice of bed spacing was adopted by 16 per cent of the respondents in district Ramban followed by Doda (14.67%) and only 10.67 per cent in the district Kishtwar. The overall adoption index of bed spacing was 0.57.

Adoption of leaf harvesting: Around 31 per cent of respondents in district Ramban harvested leaf during recommended time followed by 20 per cent in district Kishtwar and only 8 per cent in Doda district. Overall, leaf harvesting during cooler hours was adopted by 60.67 per cent of the farmers.

Adoption of leaf storage: District Ramban had the maximum respondents (34.67%) who followed the recommended method and stored their harvested leaf in wet gunny cloth bags whereas it was 13.33 per cent in district Kishtwar and only 8 per cent in Doda. The overall adoption index of leaf storage in all the three districts was 0.59.

Adoption of feeding frequency: Recommended number of feeds in chawki stage is 4 while frequency is 2 to 3 times in late age rearing. In district Ramban 20 per cent of respondents adopted recommended method of three/four feeds per day followed by Doda (17.33%) and least in district Kishtwar (16%). The overall adoption index of feeding frequency in all the three districts was 0.59.

Table 5. Adoption index of various silkworm rearing technologies in district Kishtwar

Silkworm rearing Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Silkworm hybrid	75(100)	0	0	150	1(100)
Incubation and Black boxing	8(10.67)	0	67(89.33)	24	0.11(10.67)
Brushing	8(10.67)	0	67(89.33)	24	0.11(10.67)
Disinfection of rearing house and appliances	14(18.67)	61(81.33)	0	89	0.59(59.33)
Chawki rearing	8(10.67)	0	67(89.33)	16	0.11(10.67)
Leaf harvesting	15(20)	60(80)	0	90	0.60(60)
Leaf storage	10(13.33)	65(86.67)	0	85	0.57(56.67)
Feeding frequency	12(16)	63(84)	0	87	0.58(58)
Bed disinfection	13(17.33)	62(82.67)	0	88	0.59(58.67)
Bed spacing	8(10.67)	67(89.33)	0	83	0.55(55.33)
Use of mountages	25(33.33)	50(66.67)	0	100	0.67(66.67)
Harvesting of cocoons	11(14.67)	64(85.33)	0	93	0.57(57.33)
Cocoon sorting	16(21.33)	0	59(78.67)	32	0.21(21.33)
Packing of cocoons	16(21.33)	59(78.67)	0	91	0.61(60.67)
Deflossing	0	19(25.33)	56(74.67)	19	0.13(12.67)
Cocoon drying	0	75(100)	0	75	0.50(50)
Cocoon transportation	20(26.67)	55(73.33)	0	95	0.63(63.33)

Values given in parenthesis are in percentages.

Table 6. Adoption index of various silkworm rearing technologies in district Ramban

Mulberry plantation Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Mulberry variety	75(100)	0	0	150	1(100)
Type of plantation	12(16)	0	63(84)	24	0.16(16)
Planting season	12(16)	0	63(84)	24	0.16(16)
Pruning	19(25.33)	56(74.67)	0	94	0.63(62.67)
Irrigation	13(17.33)	0	62(82.67)	26	0.17(17.33)
Fertilizer application	23(30.67)	52(69.33)	0	98	0.65(65.33)
Use of FYM	26(34.67)	49(65.33)	0	101	0.67(67.33)
Weed management	15(20)	60(80)	0	90	0.60(60)
Disease management	17(22.67)	58(77.33)	0	75	0.61(61.33)
Pest management	12(16)	63(84)	0	87	0.58(58)
Use of mountages	37(49.33)	38(50.67)	0	112	0.75(74.67)
Harvesting of cocoons	18(24)	57(76)	0	93	0.62(62)
Cocoon sorting	26(34.67)	0	49(65.33)	52	0.35(34.67)
Packing of cocoons	24(32)	51(68)	0	99	0.66(66)
Deflossing	0	30(40)	45(60)	30	0.20(20)
Cocoon drying	0	75(100)	0	75	0.50(50)
Cocoon transportation	35(46.67)	40(53.33)	0	110	0.73(73.33)

Values given in parenthesis are in percentages

Table 7: Adoption index of various silkworm rearing technologies in district Doda

Silkworm rearing Technology	Full adopters	Partial adopters	Non adopters	Adoption score	Adoption index
Silkworm hybrid	75(100)	0	0	150	1(100)
Incubation and Black boxing	6(8)	0	69(92)	12	0.08(8)
Brushing	6(8)	0	69(92)	12	0.08(8)
Disinfection of rearing house and appliances	6(8)	57(76)	12(16)	69	0.46(46)
Chawki rearing	6(8)	0	69(92)	12	0.08(8)
Leaf harvesting	6(8)	69(92)	0	85	0.57(56.67)
Leaf storage	6(8)	69(92)	0	81	0.54(54)
Feeding frequency	13(17.33)	62(82.67)	0	88	0.59(58.67)
Bed disinfection	8(10.67)	41(54.67)	26(34.67)	57	0.38(38)
Bed spacing	11(14.67)	64(85.33)	0	86	0.57(57.33)
Use of mountages	30(40)	45(60)	0	94	0.63(62.67)
Harvesting of cocoons	19(25.33)	56(74.67)	0	94	0.63(62.67)
Cocoon sorting	12(16)	0	63(84)	24	0.16(16)
Packing of cocoons	12(16)	63(84)	0	87	0.58(58)
Deflossing	6(8)	12(16)	57(76)	24	0.16(16)
Cocoon drying	6(8)	69(92)	0	81	0.54(54)
Cocoon transportation	18(24)	57(76)	0	93	0.62(62)

Values given in parenthesis are in percentages

Adoption of bed disinfection: Use of lime or vijetha powder before and after moulting stage was recommended as bed disinfectant during rearing. In district Ramban, 22.67 per cent of the total respondents adopted the recommended use of bed disinfection followed by 17.33 per cent of the respondents in district Kishtwar and only 10.67 per cent in district Doda. The overall adoption index of bed disinfection in all the three districts was recorded as 0.53.

Adoption of type of mountage: Recommended type of mountage includes any supporting material that is fully disinfected, uniform in shape, size and highly durable. In district Ramban, data pertaining to that 49.33 per cent of the total respondents adopted plastic collapsible type of mountages followed by 40 and 33.33 per cent in Doda and Kishtwar districts respectively. The overall adoption index for this parameter stood at 0.68.

Adoption of harvesting schedule: The recommended practice of harvesting cocoons is on 7th or 8th day after spinning. In district Doda, 25.33 per cent of respondents adopted the recommended practice of harvesting schedule, followed by 24 per cent in district Ramban and least in district Kishtwar (14.67%). The overall adoption index of harvesting schedule of cocoons was 0.61.

Adoption of cocoon drying method: The recommended technique of drying the cocoons is use of cocoon drying machine or in the sun with black cloth covering. In district Doda, 8 per cent of the respondents adopted recommended technique while others followed local practice both in district Ramban and Kishtwar. The overall adoption index stood at 0.51.

Adoption of cocoon sorting: Sorting of cocoon involves separation of defective cocoons from the healthy ones. The data highlighted that sorting of cocoon was adopted by 34.67 per cent of the respondents in district Ramban followed by 21.33 per cent in Kishtwar and 16 per cent in Doda districts .The overall adoption index of the respondents adopting this practice was 0.24.

Adoption of deflossing of cocoons: The recommended way of deflossing cocoons is using the deflossing machine which was fully adopted only by 8

Table 8: Overall Adoption index of various silkworm rearing technologies

Silkworm rearing Technology	Adoption index (%)	Adoption index (%)	Adoption index (%)	Adoption index (%)
Silkworm hybrid	1(100)	1(100)	1(100)	1(100)
Incubation and Black boxing	0.11(10.67)	0.16(16)	0.08(8)	0.12(11.56)
Brushing	0.11(10.67)	0.16(16)	0.08(8)	0.12(11.56)
Disinfection of rearing house and appliances	0.59(59.33)	0.63(62.67)	0.46(46)	0.56(56)
Chawki rearing	0.11(10.67)	0.17(17.33)	0.08(8)	0.12(11.56)
Leaf harvesting	0.60(60)	0.65(65.33)	0.57(56.67)	0.61(60.67)
Leaf storage	0.57(56.67)	0.67(67.33)	0.54(54)	0.59(59.33)
Feeding frequency	0.58(58)	0.60(60)	0.59(58.67)	0.59(58.89)
Bed disinfection	0.59(58.67)	0.61(61.33)	0.38(38)	0.53(52.67)
Bed spacing	0.55(55.33)	0.58(58)	0.57(57.33)	0.57(56.88)
Use of mountages	0.67(66.67)	0.75(74.67)	0.63(62.67)	0.68(68.03)
Harvesting of cocoons	0.57(57.33)	0.62(62)	0.63(62.67)	0.61(60.67)
Cocoon sorting	0.21(21.33)	0.35(34.67)	0.16(16)	0.24(24)
Packing of cocoons	0.61(60.67)	0.66(66)	0.58(58)	0.62(61.56)
Deflossing	0.13(12.67)	0.20(20)	0.16(16)	0.49(48.67)
Cocoon drying	0.50(50)	0.50(50)	0.54(54)	0.51(51.33)
Cocoon transportation	0.63(63.33)	0.73(73.33)	0.62(62)	0.66(66.22)

per cent respondents in district Doda. None of the respondent followed recommended method in Ramban and Kishtwar districts. The overall adoption index of deflossing of cocoons was recorded 0.49.

Adoption of packing of cocoons: The recommended practice of packing cocoons is use of loose and well perforated cotton/gunny bag that provides proper space as well as aeration. 32 per cent of the respondent in district Ramban followed by 21.33 per cent in Kishtwar and only 16 per cent in Doda districts adopted the recommended practice. The overall adoption index of technology was 0.62.

Adoption of transportation of cocoons: The recommended practice involves transporting the cocoons with proper spacing and preferably in cooler hours. In district Ramban, 46.67 per cent of the respondents adopted the recommended time of transportation of cocoons followed by 26.67 per cent in Kishtwar and 24 per cent in Doda district. The overall adoption index of technology was recorded 0.66.

DISCUSSION AND CONCLUSION

The success of bivoltine silkworm rearing mainly depends on the quality of mulberry leaf. In present study 30.67 per cent of the respondents in three district Ramban followed by Kishtwar (20%) and only 8 per cent were adopting the recommended package of plucking leaves in cooler hours. The data on feeding frequency during non chawki indicated that 20 per cent of respondents in district Ramban followed by Doda (17.33%) and district Kishtwar (16%) were feeding silkworms three to four times per day. The adoption of lesser number of feedings per day resulted into susceptibility of worms to disease due to weakness and low cocoon yield. All the respondents followed feeding of chopped leaves during chawki stages and entire leaf/shoot in late age. In present investigation, 66.67 per cent of respondents in district Kishtwar followed by Doda (60%) and Ramban (50.67%) adopted either local grass/weed or pine tree leaves for spinning of cocoons while as others reared the silkworms in plastic collapsible mountages. Mounting material has a direct impact on the quality of cocoons and it influences the size, shape, grade of cocoons and price in cocoon market. Only 8 per cent of respondents in district Doda were following the recommended package of stifling of cocoons in cocoon drying machine while rest of the respondents used either black cloth covering or direct drying of cocoons in the sun. This variable also has a direct effect on price during auctioning of cocoons. The results of present study are in consonance with the findings of Singh and Himantharaj (2008), Krishnamoorthy and Radhakrishnan (2012) and Lyaqet (2015).

Disinfection of rearing house and appliances is the pre-requisite for success of silkworm rearing. In present study, 56 per cent of respondents in all the three districts adopted disinfection of rearing house while in district Ramban (25.33%) followed by Kishtwar (18.67%) and only 8 per cent of total respondents in district Doda followed recommended method of disinfection of rearing house and appliances while rest of the respondents of three districts either partially disinfected the rearing house or simply kept their rearing trays in sun without spraying any disinfectant. All of the respondents reared recommended hybrid in both spring and autumn season. Only 11.56 per cent of respondents reared chawki worms while as remaining percentage of respondents reared non-chawki worms. The disease incidence observed was more in rearing of respondents having non-chawki worms and was maximum in district Doda. Though the respondents were possessing knowledge of bed cleaning and bed spacing but practically only 22.67 per cent in district Ramban followed by Kishtwar (17.33%) and only 10.67 per cent were adopting recommended schedule of bed disinfection which directly influenced the disease incidence and low crop production. The observations are closely in consonance with the findings of Krishnamoorthy and Radhakrishnan (2012) and Lyaqet *et al.* (2016). The reasons for partial/non-adoption of recommended technologies could be lack of knowledge, high labour requirement, continuing on traditional practice and beliefs and financial constraints as majority of respondents were marginal rearers. The solutions for those problems are to be provided to these farmer groups through practical training, motivation towards acceptance of new ideas/ technologies and participated in various extension activities conducted by research personnel and extension agents. Most of the respondents adopted improper or partial disinfection of rearing room and appliances although cent per cent were provided with chemical disinfectant. This could be due to low level of knowledge or lack of training attained by the respondents as only 36 per cent were reported to be trained and financial constraints faced by the farmers to construct a separate rearing house were found to be a major constraint. This is in line with the results of Hiriyanna *et al.* (2002). As a result they rear their silkworms in dwelling houses which essentially is a rearing cum dwelling house. Presence of heavy inoculums load and hesitation of some rearers for conducting pre and post disinfection might have also resulted in mortality of worm and thus reduced productivity. Majority of the respondents were unaware of the use of basic inputs in silkworm rearing and allied operations. Only around 24 per cent of the total respondents (Table 4) had a well maintained and recommended separate rearing house, just 11.56 per cent maintained optimum temperature & humidity in rearing room, bed disinfection was adopted by 52.67 per cent respondents, cocoon sorting was very poorly adopted and recommended adoption rate was 24 per cent and only about 16.22 per cent of the respondent adopted deflossing of cocoons.

The reasons for low production might be the lack of separate rearing houses coupled with leaf shortage. Non/partial availability of basic infrastructure like cocoon storage seems to be the major reason responsible for low productivity as around percent respondents produced below 56 kg of cocoons per ounce of silkworm seed which is the national average (Baqual *et al.* 2015). The low level of technology adoption during rearing period results in great loss of final produce due to mortality of larvae and formation of flimsy and deformed cocoons. Low level of mass media exposure, extension contact and change proneness are also equally responsible for both low production and productivity of cocoons. Oveall only about 12 % of rearers had adopted incubation, black-boxing and brushing and were highly trained. They were provided separate rearing house and were residing in close vicinity of the department while as about 88 per cent of the respondents (Table 4) were non-chawki rearers. Chawki rearing was adopted by only 12 per cent of the respondents as one of the improved rearing technology. Overall recommended method of bed disinfection using lime & vijetha was found low among the respondents (52.67%).Overall cent per cent respondents had adopted bivoltine double hybrid FC1×FC2 procured from CSRTI-Mysore. About 60.67 per cent of the rearers had adopted mounting which included either plastic collapsible mountages or locally available pine leaves or weed grass or combination of either. Only 8 per cent of the respondent used recommended way of stifling the cocoon using cocoon dryer while others opted partial or local methods of direct sun drying or with black cloth covering. A very low no. of respondents in district Doda (8%) deflossed cocoons using recommended method because of high labour and time consumption involved. The farmers were aware that the cocoon price depends on its quality which in turn depends on the effective utilization of mounting method. Meenal & Rajan (2006) had also reported high adoption of mounting method by farmers of Tamil Nadu and Andhra Pradesh respectively. The studies of Lakshmanan *et al.* (1998), Saratchandra (2000) and Kanimozhi (2001) also found that lack of awareness to a certain technology results in non-adoption of the technology.

Around 41.33 per cent of respondents planted the tree type mulberry and plantation was done in winter season and the remaining per cent of the respondent were dependent either on department or the fellow farmers or some of them even had to purchase. The respondents who planted mulberry, about 73 per cent of those adopted the recommended variety of mulberry while the remaining planted local varieties. None of the respondent adopted fertilizer application but farm yard manure was used by 19.11 per cent of total respondents. All the districts under study were cent per cent rainfed. Since the areas under study were hilly areas, so tree type of mulberry plantation in scattered fashion was observed. About 21 per cent of respondents adopted recommended way of two prunings of mulberry in year, once in march–april before spring rearing and the other in July-August after spring harvest. Weed management was adopted partially or locally (21.34%) which included physical methods of hoeing with sickle.

Mulberry cultivation technology mainly involves adoption of various recommended practices involved in mulberry plantation and farm management such as mulberry variety, type of plantation, season of plantation, pruning, application of fertilisers, use of farm yield manure, irrigation, weed management, disease & pest management etc. The recommended varieties for the area under study were Goshoerami, Ichinose, Tr-10, China white, Sujanpur etc. Overall adoption index of the recommended variety was 72.67 per cent while the remaining per cent of respondents adopted local variety which may have increased the leaf requirement per ounce of the silkworm and decreased the quality of leaf. Tree type of plantation and winter season was adopted by cent per cent of the respondents. Pruning involves trimming of excess lateral branches in order to give the plant desired shape and structure for healthy growth of leaves. In temperate and subtropical areas top pruning once after spring harvest is recommended. The overall adoption index of recommended method of pruning in the study area was only 20.67 per cent (Table 5, 6 & 7). None of the respondent adopted fertiliser application whereas farm yard manure was adopted by only 19.11 per cent of the total respondents. This may be due to high cost. Weed management involved partial adoption practices mainly physical methods of cutting the weed. This may be due to high cost of weedicides and lack of knowledge of its application.

Silkworm rearing involves adoption of various recommended package of practice in order to get better cocoon yield. Technologies such as adoption of recommended silkworm seed, disinfection of rearing house and appliances with recommended quality & quantity of disinfectant, incubation, black boxing, brushing, proper bed spacing, bed disinfection, proper feeding, care during moult, maintenance of temperature & humidity, proper ventilation and disposal of diseased larvae, instar wise leaf selection, use of wet gunny cloth for storing leaf, use of rearing kit, leaf harvest during cooler hours, maintenance of leaf requirement per ounce, timely harvest of cocoons, cocoon sorting, proper packing of cocoons in gunny bags, use of plastic collapsible mountages, proper deflossing and drying of cocoons in cocoon drying machine. Among the various technologies related to silkworm rearing methods adoption of bivoltine double hybrid silkworm FC1× FC2 was cent per cent adopted in all the three districts. This may be due the fact that areas under study fall in bivoltine areas or temperate/ subtropical type of climate which is favourable for rearing of the double hybrid. Only around 12 per cent of total respondents reared chawki worms. This may be due the fact that these rearers were in close vicinity of the department offices and were highly trained and potential producers while the other rearers were from far flung areas. Recommended/full adoption was recorded highest in use of mountages (40.89%) followed by cocoon sorting (24%), packing of cocoons (23.11%), harvesting of cocoons(21.33),leaf harvesting (19.56%), leaf storage (18.67%), feeding frequency (17.78%),disinfection of rearing house and rearing appliances (17.33%), bed disinfection (16.89%), bed spacing (13.56%), cocoon drying (2.67%) and 2.67 per cent in deflossing (Table 5, 6, 7 & 8).

REFERENCES

Baqual, M.F., Kamili, A.S., Mir, M.A., Mir, S.A., Saleem, S. and Verma, G.R. 2015. Impact of mass media exposure and innovation proneness on cocoon production. *Journal of Experimental Biology and Agricultural Sciences,* 3(5): 454-457.

Gowda, S. L. R., Naika, K.V. and Jayaramaiah, K.M. 1992. Equipping sericulture farmers for rural development. *Journal of Rural Reconstruction,* 25 (2): 53-62.

Hiriyanna, Swamy, T.P., Kumaresan, P. and Vijaya Prakash, N.V. 2002. Comparative economics of bivoltine hybrids with multi × bivoltine hybrid cocoon production. *Indian Journal of Sericologia*, 41(1): 38-40.

Kanimozhi, V. C. 2001. Awareness, Knowledge and adoption behaviour of IVLP farmers: *An ex-post facto analysis, M.Sc, Thesis,* Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Krishnaswamy, T.S. and Radhakrishnan, S. 2012. Study on Knowledge and adoption of new sericulture technologies among small mulberry farm size holders of Udumalpet and Krishnagiri areas in Tamil Nadu. *Indian Journal of Sericulture,* 51(1): 50-58.

Kushwaha, R.V. and Singhvi, N.R. 2013. Extent of adoption of improved sericultural practices by the sericulturists of Budhana district of Maharashtra. *Agriculture Update,* 8(3): 469-471.

Lakshmanan, S. 1998. Adoption of technological innovations and productivity behavior of sericulture in Tamil Nadu. An econometric analysis. *Ph.D. thesis.* University of Mysore, Mysore, India.

Lakshmanan, S., Mallikarjuna, B., Raj, R.J., Jayaram, H. and Devi, R.G.G. 1998. Studies on adoption of sericulural innovation a at farmers' level in Tamil Nadu: An Empirical Analysis. *Indian Journal of Sericulture,* 37(1): 44-47.

Lyaqet, A. 2015. *Status and prospects of sericulture in Jammu division of Jammu and Kashmir state*, Ph.D. thesis, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, J&K, India.

Lyaqet, A., Kher, S.K., Slathia, P.S., Bali, R.K., Kumar, M and Bakshi, P. 2016. Knowledge level of silkworm rearers of Jammu division of Jammu and Kashmir State. *Indian Journal of Extension Education*, 52(1&2): 65-68.

Meenal, R. and Rajan, R.K. 2007. Impact of socio-economic characters of sericulturists on knowledge adoption and cocoon production in Tamil Nadu. *Indian Journal of Sericulture,* 46(1): 49-51

Saratchandra, B. 2000. Role of extension in popularizing improved sericulture technologies in different regions of India. Sourvenir, *National Conference on Strategies for Sericulture Research and Development,* November 16-18, Central Sericultural Research and Training Institute, Mysore, India, pp. 53-54.

Singh, A. and Himantharaj, M.T. 2008. A study on constraints faced in mounting practices and factors influencing the cocoon quality among farmers in three southern states. *Journal of Experimental Zoology,* 11(2): 267-271.

Sreenivasa, T. and Hiriyanna. 2014. A study on the factors influencing adoption of new technologies in non-traditional sericultural area of Chitradurga district, Karnataka. *Global Journal of Biology, Agriculture and Health Sciences,* 3(1): 239-243.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 506-511

Effect of Blanching and Drying on Nutritive and Sensory Quality of Amaranth and Fennel Leaves

Duwa*, Julie Dogra Bandral, Monika Sood and Nishu
Division of Food Science and Technology, Sher-e- Kashmir University of Agriculture Sciences and Technology of Jammu, J&K

ABSTRACT

Leafy vegetables provide a variety of nutrients, including ascorbic acid, carotene, and fibre. The drying technique has been emphasized as one of several food preservation methods to ensure its availability throughout the year. The dehydration process affects, to varying degrees, the quality attributes of color, texture and nutrient retention in vegetables in particular. Variations in nutrient retention and other quality attributes may be due to a number of factors, including the type of vegetables, type of pretreatment and drying method. It has been reported that washing, chopping, trimming, and blanching techniques affect vegetables yield and nutrients, as well as their processing methods such as drying or freezing. Though, it is generally accepted that blanching vegetables before drying or freezing (especially) improves their nutritional content and sensory properties. However, there is limited information comparing the quality of leafy vegetables dried in a cabinet dryer. This study has been undertaken to investigate the effect of blanching and drying on the nutritional and sensory quality of amaranths and fennel. Amaranths and fennel leaves were washed properly and the leaves were trimmed prior to blanching. Blanching was done in boiling water for 1 min after that leaves were dried in cabinet drier at 50°C. The effect of blanching and drying on physico-chemical and bio active components (vitamin C, total phenolic content and antioxidant activity) was evaluated.

Keywords: Blanching, Amaranths, Fennel, Nutritive value

INTRODUCTION

There are many species of fennel that are hard perennial, umbelliferous and grows all over the world. It is highly aromatic with a characteristic aniseed flavor and is used for cooking as well as in different medicines (Camejo-Rodrigues *et al*., 2003). Roots, young shoots, leaves, flowering stems, mature inflorescences and absolutely aged and dried seeds are usually used for home-baked remedies, which are very helpful in the treatment of many disorder, specifically those of the digestive system. Fennel is additionally extremely suggested for polygenic disorder, bronchitis and chronic coughs, for the treatment of excretory organ stones (Novais *et al.,* 2004).

Depending on the morphotype, source, climate, and harvesting stage of fennel, the chemical composition can vary. Every 100 g edible portion of fennel seeds contain on average: 8.8 g water; 15.8 g protein; 14.9 g fat; 36.6 g carbohydrate; 15.7 g fibre; and 8.2 g ash (containing 1.2 g Ca, 19 mg Fe, 1.7 g K, 385 mg Mg, 88 mg Na, 487 mg P and 28 mg Zn). Every 100 g contains: vitamin A (135 IU); niacin (6 mg); thiamine (0.41 mg); and ribofl avin (0.35 mg); with an energy value of about 1440 kJ. The seeds contain, sugars, mucilage, starch, tannin, essential oil and fixed oil (Bernath *et al.,* 1994). The quantity and variety of vitamins often changes : folates, 270 mg/ kg; vitamin B3, 6.4 mg/kg; vitamin C, 8.7–340 mg/kg. It contains potassium (4.24–5.85 g/kg), with less quantity of phosphorus (500 mg/kg), calcium (5.6–363 mg/ kg), magnesium (8.2–389 mg/k) and sodium (7.7– 512 mg/kg) (Koudela and Petrikova, 2008).

An amaranth is a genus of plants that is believed to produce high-quality protein, unsaturated oil, and various other valuable compounds. It is appreciated for being leafy vegetables and cereals. It is noted for its hardiness in adverse environmental conditions, as

*Corresponding author email id: duwashah3@gmail.com

well as the high nutritional value of its seeds (Bejosano and Corke, 1998). Human beings utilize both leaves and grains because of its high nutritional value (Tucker, 1986). As a cereal grain, amaranth contains more protein than other grains, and its lysine content is significantly higher than other grains (Bressani, 1986). After the drying process, a variety of pretreatment methods are available to maintain or enhance the quality of the dried product (Hossain *et al.,* 2021). Blanching is the most important treatment that is done before drying that helps to destroy many detrimental enzymes and is also likely to retain color and certain shape after treatment (Mate *et al.*, 1999).

MATERIALS AND METHODS

Collection of raw materials: Fresh amaranths and fennel leaves were collected from the local market of Jammu. Diseased and damaged leaves were discarded.

Sample preparation: Fresh leaves of amaranths and fennel were rinsed in water, and the edible portions were separated from the inedible portion. The edible portions were chopped into small pieces (500 g). A portion of the chopped vegetables was blanched in 500 ml boiled water for 1, 2 and 3 min, while the other portion was not blanched. The blanched portion was subsequently drained off of water then dried in cabinet dryer at 50°C till constant weight was obtained. The dried vegetables were ground into a powder for further analysis.

In Microwave Blanching first, 10 g of the sample were placed in a pottery bowl and 100 ml of water was added. The bowl was then placed in the microwave oven cavity for blanching. The blanching was performed at four microwave power levels of 300 W and three duration levels of 20, 40 and 60 seconds. After blanching, samples were cooled promptly with cold water, dried and then analyzed.

Sample analysis

Antioxidant activity determination by DPPH Assay: Free radical scavenging ability: The free radical scavenging ability of the vegetables against DPPH (1, 1 –diphenyl -2 picrylhydrazyl) free radical was evaluated (Braca *et al.,* 2001) briefly, 1 ml of the vegetable aliquot (0.5 g of the vegetables homogenized in 20 ml methanol)was mixed with 0.004% MeOH solution containing 1, 1 –diphenyl -2 picrylhydrazyl (DPPH) radicals, the mixture was left in the dark for 30 min before measuring the absorbance at 516 nm.

Total phenolics determination: Total phenolics content was determined by the Folin-Ciocalteu colorimetric method (Tugli *et al.,* 2019) using gallic acid as a standard phenolic compound. 450 μl of distilled water was added with 50 μl of the extract and then treated with 2.5 ml of 0.3 N Folin-Ciocalteu reagent. After 5 min, 2 ml of 7.5% Na_2CO_3 solution was added and the mixture was incubated at 30°C for 1.5 h with intermittent shaking. The absorbance of the resulting blue colored solution was measured at 765 nm against blank. The evaluation was carried out, based on the six-point standard calibration curve of gallic acid (20, 100, 200, 300, 400, 500 mg/L) in 80% aqueous methanol. The total phenolic content was expressed as gallic acid equivalents (GAE) in milligrams per gram of dry material.

Moisture (AOAC, 2005): Moisture content in the samples was determined by following the oven drying method as the loss in weight due to evaporation from sample at a temperature of 105±1°C. The weight loss in each case represented the amount of moisture present in the sample.

Per cent moisture = [Loss in weight (g) / Weight of sample (g)] × 100

Vitamin C: Vitamin C was estimated as per the method described by Nielsen (2017) using 2,6 dichlorophenol indophenols dye. Initially the dye factor was determined by titrating a mixture of 5 ml of standard ascorbic acid plus 5ml of 3 percent metaphosphoric acid solution against 2, 6, dichlorophenol indophenol dye till faint pink colour appeared which persists for 15 seconds. The volume used was noted and dye factor was determined as:

Dye factor = 0.5 / Titre value

The vitamin C content was estimated by taking 10 ml of sample in a volumetric flask and volume made to 100 ml with 3 per cent metaphosphoric acid. Sample was then filtered using fluted filter paper. The aliquot of 10ml was taken in a titration flask and titrated against 2, 6 dichlorophenol indophenol dye till light pink colour appeared (which persisted for 15 seconds), Vitamin C content was calculated as:

Vitamin C (mg /100g) = [Titer value × dye factor × volume made up / ml of filtrate taken for estimation × weight of sample] × 100

Crude protein: The crude protein content was determined by micro Kjeldahl method, using the factor 6.25 for converting nitrogen content into crude protein (Sadasivam and Manickam, 2008). Weighed sample of 2 g was digested with concentrated sulphuric acid (2 ml) and 2 g of catalyst mixture ($K_2SO_{4,}$ $CuSO_4$ and SeO_2) in a long neck Kjeldahl flask for 2 hours till free from carbon. The contents were cooled and transferred to 100 ml volumetric flask and volume was made to 100 ml with distilled water. Measured aliquot was distilled with 40 per cent sodium hydroxide and liberated ammonia was collected through a condenser in a flask containing 10 ml (4%) boric acid solution and few drops of mixed methyl red and bromocresol green indicator and was titrated against standardized 0.1 N sulphuric acid and crude protein content was calculated using the equation below. A blank sample was also run along with the sample.

Per cent nitrogen = [Titre value × 0.00014 × Volume made / Aliquot taken (g) × Weight of sample (g)] × 100

Crude fiber: Two g fat free sample was taken in a beaker to which 200 ml of 1.25 per cent sulfuric acid was added (Wijewardana *et al.*, 2016). Beaker along with contents was placed on hot plate and boiled for 30 minutes. After boiling, the contents of the beaker were filtered through Whatman filter paper no. 4. The filter paper was then transferred in a beaker containing 200 ml of 1.25 per cent sodium hydroxide. The contents weighed again were allowed to digest for 30 minutes then filtered and washed again with hot water and alcohol thrice till fee for alkali. The residue was then transferred in pre-weighed silica crucibles followed by drying in hot air oven at 100°C. The crucibles were then kept in muffle furnace and ignited for 30 minutes at 600±10°C followed by cooling and weighing. The loss in weight after ignition represents the crude fiber and was calculated as follows:

Per cent crude fibre = [Loss in weight on ignition (g) / Weight of sample (g)] × 100

Crude fat: Crude fat was determined by the Soxhlet extraction technique (AOAC, 2007). 5 gm of sample was extracted with petroleum ether at 60°C in Soxhlet extraction apparatus for 6 hr. The ether extract in pre-weighed beakers was evaporated completely and the increase in weight of beaker represented the fat content.

Per cent crude fat = [Amount of evaporated residue (g) / Weight of sample (g)] × 100

Total ash: Ash A known quantity of ground sample was taken in a pre-weighed a silica crucible and charred over the heater to make it smoke free (Wijewardana *et al.*, 2016). The crucible with the sample was ignited at 600ºC for 3 hours in a muffle furnace. When muffle furnace was slightly cooled, the crucible with ash was taken out, kept in desiccators to cool down, constant weight was taken. The difference between the weight of the silica crucible as empty and the ash was the amount of total ash. The percent ash was calculated (AOAC, 2005).

Ash (%) = [Weight of ash (g) / Weight of sample (g)] × 100

The total flavonoid content in vegetable amaranth extract was determined using the aluminum chloride colorimetric method described by (Chang *et al.,* 2002). For this assay, 500 µl of leaf extract was transferred to a test tube along with 1.5 ml of methanol, 0.1 ml of 10% aluminum chloride, 0.1 ml of 1 M potassium acetate and 2.8 ml of distilled water. After 30 min at room temperature, the absorbance of the reaction mixture was measured spectrophotometrically using a Hitachi U1800 instrument (Hitachi, Tokyo, Japan). Rutin was used as the standard compound, and TFC is expressed as ìg rutin equivalent (RE) g^{-1} dw.

RESULTS AND DISCUSSION

The data presented in Table 1 shows that the moisture content was highest in T_4(87.63%) and lowest in T_7(84.08) in case of amaranth while in case of fennel (Table 2) the moisture content was highest in T_4 (76.70%) and lowest in T_7 (75.07%). Moisture content of conventionally blanched leafy vegetables was more than that of unbalanced whereas, moisture content of amaranth and fennel blanched by microwave was lesser as compared to conventional method. The increase in moisture content of amaranths and fennel on blanching can be attributed to the disruption of cell wall, therefore allowing membranes to fill spaces by water as reported

Table 1: Effect of blanching on nutritional composition of amaranth

Treatments	Moisture Content (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)	Crude Fibre (%)
T_1 (Control)	83.49	13.75	2.09	14.55	5.93
T_2 (Conventional Blanching for 1min)	84.97	13.57	2.01	14.48	5.98
T_3 (Conventional Blanching for 2 min)	86.21	13.06	1.89	14.44	6.06
T_4 (Conventional Blanching for 3 min)	87.63	12.72	1.81	14.37	6.09
T_5 (Microwave Blanching for 20 sec)	83.57	13.67	2.06	14.51	6.02
T_6 (Microwave Blanching for 40 sec)	83.65	13.59	1.97	14.47	6.09
T_7 (Microwave Blanching for 60 sec)	84.08	13.41	1.91	14.42	6.14
Mean	84.80	13.39	1.96	14.46	6.04
C.D	0.09	0.05	0.04	0.03	0.04

Table 2: Effect of blanching on nutritional composition of fennel

Treatments	Moisture Content (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)	Crude Fibre (%)
T_1 (Control)	74.73	5.03	0.83	4.63	10.89
T_2 (Conventional Blanching for 1min)	75.42	4.87	0.75	4.59	10.94
T_3 (Conventional Blanching for 2 min)	75.67	4.61	0.71	4.52	10.99
T_4 (Conventional Blanching for 3 min)	76.70	4.15	0.65	4.47	11.01
T_5 (Microwave Blanching for 20 sec)	74.86	4.98	0.79	4.60	10.97
T_6 (Microwave Blanching for 40 sec)	74.93	4.91	0.74	4.55	11.05
T_7 (Microwave Blanching for 60 sec)	75.07	4.86	0.69	4.49	11.08
Mean	75.34	4.77	0.73	4.55	10.99
C.D	0.06	0.05	0.05	0.07	0.06

by (Traore *et al.,* 2017). Table 1 further shows that the highest crude protein of Amaranth was found in T_1(control) (13.75%) and lowest was found T_4 (12.72%) and similarly from Table 2 fennel crude protein was highest in T_1 (5.03%) and lowest in T_4 (4.15%). The decrease in crude protein of amaranth and fennel on blanching may be because of degradation of proteins due to the severity of thermal process (Acho *et al.,* 2014). The ash content of amaranth was highest in T_1 (14.55%) and lowest in T_4 (14.37%). Similarly, the highest ash content was present in T_1 (4.63%) and lowest in T_4 (4.47%) in case of fennel. As compared to control samples, the blanched samples showed decrease in total ash content. This decrease in ash content might be due to the leaching of minerals in water. Saranya *et al.* (2017) reported a decrease in iron content of green leafy vegetables on blanching thus confirming our results. It is observed in Table 1 that the crude fibre of amaranth was highest in T_7 (6.14%) and lowest in T_1 (5.93%). Similarly from Table 2 crude fibre of fennel was highest in T_7 (11.08%) and lowest in T_1 (10.89%). Blanching resulted in a slight increase in crude fiber content of amaranth and fennel. The increase of temperature during blanching leads to the hydrolysis of glycosidic linkage of polysaccharides which slightly increases the fiber content as reported by Funke (2011).

Table 1 and Table 2 depicted that the fat of both amaranth and fennel is highest in control i.e. 2.09% and 0.83 % and lowest in T_4 i.e. 1.81% and 0.65%. Fat content of the green leafy vegetables decreased on blanching, the reduction in fat content may be due to the breakdown of fat into fatty acids and glycerol (Akhtar *et al.*, 2005).

The total phenol content, total flavonoid content, antioxidant activity and vitamin C content of amaranths and fennel is presented in Table 3 and Table 4. The

Table 3: Effect of blanching on bioactive components of amaranth

Treatments	Antioxidant activity (%)	TPC (mg GAE/g)	TFC (mg QE/g)	Vitamin C (mg/100 g)
T_1 (Control)	79.85	5.63	3.11	57.19
T_2 (Conventional Blanching for 1min)	80.07	5.97	3.16	52.01
T_3 (Conventional Blanching for 2 min)	80.18	6.21	3.20	48.37
T_4 (Conventional Blanching for 3 min)	80.26	6.38	3.25	45.55
T_5 (Microwave Blanching for 20 sec)	80.76	6.06	3.21	56.61
T_6 (Microwave Blanching for 40 sec)	80.86	6.32	3.27	55.08
T_7 (Microwave Blanching for 60 sec)	80.93	6.47	3.32	53.19
Mean	80.41	6.15	3.21	52.57
C.D	0.06	0.08	0.03	0.10

Table 4: Effect of blanching on bioactive components of fennel

Treatments	Antioxidant activity (%)	TPC (mg GAE/g)	TFC (mg QE/g)	Vitamin C (mg/100 g)
T_1 (Control)	71.63	2.68	1.51	68.12
T_2 (Conventional Blanching for 1min)	71.69	2.75	1.57	63.08
T_3 (Conventional Blanching for 2 min)	71.72	2.83	1.61	59.12
T_4 (Conventional Blanching for 3 min)	71.76	2.86	1.65	56.03
T_5 (Microwave Blanching for 20 sec)	71.79	2.79	1.62	67.22
T_6 (Microwave Blanching for 40 sec)	71.85	2.89	1.69	65.48
T_7 (Microwave Blanching for 60 sec)	71.88	2.91	1.71	64.09
Mean	71.76	2.81	1.62	63.30
C.D	0.07	0.04	0.03	0.04

total phenolic content of amaranths varied from 5.63 to 6.47 mg GAE/g while the total flavonoid content varied from 3.11 to 3.32 mg QE/g. The highest vitamin C content of 57.19 mg/100g was observed in control sample and the lowest vitamin C content of 45.55 mg/100g was recorded in T_4. In case of fennel the total phenolic content varied from 2.68 to 2.91 GAE/g while the total flavonoid content varied from 1.51 to 1.71 QE/g. The vitamin C content of 68.12 mg/100g was observed in control sample and the lowest vitamin C content of 56.03 mg/100g was found in T_4. Blanching resulted in an increase in antioxidant activity, total phenolic content and total flavonoid content of amaranthus and fennel. The basis of the increase of total phenolic content and total flavonoid content could be attributed to the possible breakdown of the tannins (Akindahunsi and Oboh, 1999) present in the vegetables during blanching to simple phenol which in turn increases the anti-oxidant activity. As shown in Table 3 and Table 4 the vitamin C of amaranth and fennel is highest in control i.e. 57.19% and 68.12% and lowest in T_4 i.e 45.55% and 56.03 %. The loss in vitamin C content during blanching could be attributed to the fact that vitamin C is very soluble in water and not stable at high temperature (Nagy *et al.*, 1977).

CONCLUSION

The present results clearly indicate that microwave blanching is the best method for blanching Amaranth and fennel leaves, as this method minimizes vitamin C loss and maintains nutritive value and phenolic content similar to the fresh product. A proper combination of time and temperature, along with the incorporation of modern techniques, might be useful. This information may help to establish an applicable blanching procedure that can be suitable for green leafy vegetables like fennel and amaranth.

REFERENCES

Acho, F.C., Zoué, L.T. and Niamke, S. L. (2015). Nutritional and Antioxidant Characterization of Blanched Leafy Vegetables Consumed in Southern Côte d'Ivoire (Ivory Coast). *Br Biotechnol J*, 154-164.

Akhtar, S., Anjum, F.M and Rehman, S. (2005). Effect of iron and zinc fortification on chemical composition of whole wheat flour. *Journal of Research Science*, 16(2): 95-103.

Akindahunsi, A.A., and Oboh, G. (1999). Effect of some post-harvest treatments on the bioavailability of zinc from some selected tropical vegetables. *La Rivista Italiana Delle Sostanze Grasse*, 76, 285-287.

AOAC (2007). Official Methods of Analysis. 18th Edition, Association of Official Analytical chemists, Gaithersburg.

Bejosano, F.P. and Corke, H. (1998). Protein quality evaluation of Amaranthus wholemeal flours and protein concentrates. *Journal of the Science of Food and Agriculture*, 76(1): 100-106.

Bernath, J., Kattaa, A., Nemeth, E., & Franke, R. (1994). Production-biological investigation of fennel (Foeniculum vulgare) populations of different genotype. *Atti del Convegno Internazionale*, pp 287-292.

Braca, A., Nunziatina, De Tommasi, Lorenzo, Di Bari, Cosimo, Pizza, Mateo, Politi, and Ivano, Morelli (2001). Antioxidant principles from Bauhinia terapotensis. *Journal of Natural Products,* 64: 892–895.

Bressani, R. (1989). The proteins of grain amaranth. *Food Reviews International*, 5(1): 13-38.

Camejo-Rodrigues, J., Ascensao, L., Bonet, M. À. and Valles, J. (2003). An ethnobotanical study of medicinal and aromatic plants in the Natural Park of "Serra de Sao Mamede" (Portugal). *Journal of ethnopharmacology*, 89(2-3): 199-209.

Chang, C. C., Yang, M. H., Wen, H. M. and Chern, J. C. (2002). Estimation of total flavonoid content in propolis by two complementary colorimetric methods. *Journal of Food and Drug Analysis*, 10(3).

Francisco M, Velasco P, Moreno DA, Garcia-Viguera C, Cartea ME. (2010. Cooking methods of *Brassica rapa* affect the preservation of glucosinolate, phenolics and vitamin C. *Food Research International*, 43: 1455-1463.

Funke, O.M. (2011). Evaluation of nutrient contents of amaranth leaves prepared using different cooking methods. *Food and Nutrition*, 2: 249-252.

Hossain, M. A., Mitra, S., Belal, M. and Zzaman, W. (2021). Effect of foaming agent concentration and drying temperature on biochemical properties of foam mat dried tomato powder. *Food Research*, 5(2), 291-297.

Koudela, M., and Petrikova, K. (2008). Nutritional compositions and yield of sweet fennel cultivars-Foeniculum vulgare Mill. ssp. vulgare var. azoricum (Mill.) Thell. *Hort. Sci*, 35(1), 1-6.

Mate, J. I., Zwietering, M., and Van't Riet, K. (1999). The effect of blanching on the mechanical and rehydration properties of dried potato slices. *European Food Research and Technology*, 209(5): 343-347.

Nagy, S. and Smooth, J.M. (1977). Temperature and storage effects on percent retention and percent U.S. recommended dietary allowances of vitamin C in canned single-strength orange juice. *Journal of Agricultural and Food Chemistry*, 25(1): 135–138.

Novais, M. H., Santos, I., Mendes, S. and Pinto-Gomes, C. (2004). Studies on pharmaceutical ethnobotany in arrabida natural park (Portugal). *Journal of ethnopharmacology*, *93*(2-3), 183-195.

Sadasivam,S. and Manickam, A.(eds). 2008. *Biochemical Methods*. pp 215-216. New Age international Publisher, New Delhi.

Saranya, R., Devanesan, G., Ramesh, S. and Gopi, R. (2017). Effect of processing on nutritional quality and antioxidant potentials of leafy vegetables. *Journal of Food Processing & Technology*, 8: 694.

Traore, Korotimi, Charles Parkouda, Aly Savadogo, Fatoumata Ba Hama, Regine Kamga, and Yves Traore. (2017). Effect of processing methods on the nutritional content of three traditional vegetables leaves: Amaranth, black nightshade and jute mallow. *Food Science & Nutrition,* 5(6): 1139-1144.

Tucker, J. B. (1986). Amaranth: the once and future crop. *Bioscience*, 36(1), 9-13.

Tugli, L. S., Essuman, E. K., Kortei, N. K., Nsor-Atindana, J., Nartey, E. B., & Ofori-Amoah, J. (2019). Bioactive constituents of waakye; a local Ghanaian dish prepared with Sorghum bicolor (L.) Moench leaf sheaths. *Scientific African*, *3;* e00049.

Wijewardana, R. M. N. A., Nawarathne, S. B., and Wickramasinghe, I. (2016). Effect of various dehydration methods on proximate composition and retention of antioxidants in different fruit powders.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 512-514

Yield Gap Analysis of Black gram Production Through Cluster Frontline Demonstration in Rajouri District of J&K

Suraj Parkash[1]*, Arvind Kumar Ishar[2], Parul Gupta[3], Vishal Sharma[4] and A.K. Sinha[5]
[1,2,3]Subject Matter Specialist, KVK Rajouri, [4]Subject Matter Specialist, KVK Kathua, SKUAS&T-Jammu, J&K
[5]Subject Matter Specialist, Samba, SKUAS&T-Jammu, J&K

ABSTRACT

Black gram *(Vigna mungo* L.) is an important food legume widely consume in India. It also plays an important role in sustainable agriculture enriching the soil through biological nitrogen fixation. Krishi Vigyan Kendra, Rajouri during the period from 2019-20 to 2021-22 conducted total 245 Custer Frontline Demonstrations (CFLDs) of black gram crop. The highest seed yield (6.62 ha^{-1}) was recorded in the year 2021-22. There was a wide yield gap between the potential, demonstration and farmers yields in black gram mainly due to technological and extension gaps. The results of the study revealed that the average yield of demonstration plots and farmers plot (check) were 6.28 q ha^{-1} and 5.18 q ha^{-1} respectively. On overall average bases 21.40% higher grain yield was recorded under demonstration plots than farmers plot. The technological yield gap and extension yield gap during the study period varied to the extent of 6.38 to 6.90 q ha^{-1} and 0.09 to 1.32 q ha-^{1} respectively. The overall technology gap, extension gap, and technology index in black gram were 6.71 q ha^{-1}, 1.10 q ha^{-1} and 52 % respectively. The yield gap analysis emphasizes the need to educate the farmers through various extension means for adoption of improved agricultural technologies to regress the trend of wide extension gap.

Keywords: Black gram, Yield gap, Technology gap

INTRODUCTION

Black gram (*Vigna mungo* L.) commonly called as Urad, is the most important pulse crop in India. India is its primary origin and is mainly cultivated in Asian countries including Pakistan, Myanmar and parts of Southern Asia. About 70 per cent of the world's blackgram production comes from India. India is the world's largest producer as well as consumer of black gram. Black gram area accounts for about 19 per cent of India's total pulse acreage which contributes 23 per cent of total pulse production (Black gram Outlook Report, 2021). It produces about 24.5 lakh tones of black gram annually from about 4.6 million hectares of area, with an average productivity of 533 kg per hectare in 2020-21 (agricoop.nic.in). The productivity of black gram per unit area could be increased by adopting improved practices in a systematic manner along with high yielding varieties (Rai *et al.,* 2015). The pulse "black gram" play significant role in Indian diet. It contains about 20% protein, which is almost three times that of cereal and other minerals and vitamins. In pulse crops there are a number of diseases, insect and pest, which cause heavy losses resulting in poor production.

MATERIALS AND METHODS

Krishi Vigyan Kendra, Rajouri conducted 245 cluster front line demonstrations on Black gram during the period 2019-20 to 2021-22 under close supervision of scientists. The demonstration trials of black gram were carried out in 24.65 ha area at farmer's field adjacent the farmer's practices. The soil condition of demonstration area was sandy loam having medium to high fertility status. The demonstration module technology includes improved variety of black gram (PU-31 and Mash-114), seed treatment with Thirum + Bavistin @ 2.0 g/kg seed and Trichoderma virdae @ 10g/kg of seed, inoculation of microbial organism Rhizobium + phosphorus solubilizing bacteria (PSB) @ 20 gm/kg seed, weed management (one hand

*Corresponding author email id: surajkvkpoonch@gmail.com

weeding at 25- 30 DAS), seed rate (20 kg/ha) and line sowing method. The spacing between rows and plants was maintained with 30 x 10 cm in FLDs. Need based plant protection measures, were applied against the incidence of insect pests and proper agronomical practices were maintain under demonstrated plots. The treatments comprised of recommended package of practices viz; integrated nutrient management 20:40:20 NPK kg/ha was given based on soil testing reports. Other hand, the farmer's practices were included with local seed having higher seed rate (25-30 kg/ha), broad casting and one hand weeding at 35-40 DAS (Table 1). The farmers neither adopted any seed treatment method with fungicides and biofertilizers nor applied any fertilizer and plant protection measures. The black gram seed was sown between the periods of 15th July to 20th July. Regular visits by KVK scientist were conducted to guide the farmers and collection of data. The harvesting of crops was done manually at maturity stage and yield data was obtained from demonstrations and farmer's practices for statistical analysis. The production parameters viz; extension gap, technology gap, technology index, yield index, increase yield (%), benefit cost ratio between demonstrated and existing farmer's practices was computed as described by Samui *et al.,* (2000).

RESULTS AND DISCUSSION

The transfer of improved farm technology under Cluster frontline demonstrations (CFLDs) resulted in significantly higher grain yield of Black gram under demonstration plots (6.10 to 6.62 q ha^{-1}) than farmers' plot yield (5.10 to 5.30 q ha^{-1}), which may be attributed to the adoption of recommended technologies in FLDs' during study period (Table 2). The percent yield increase in black gram in demonstration plots over farmers' plots was lowest in Mash-114 during Kharif 2020-21 (17%) and highest in PU-31 during kharif 2021-22 (25%). The overall percent increase in yield of demonstration plot over farmer's plot was 21.40%. The present finding are in conformity with the findings of Shashikumar (2015) on maize and Poonia and Pithia (2011) on chickpea.

The technological gap during the study period varied to the extent of 6.38 to 6.90 ha^{-1}. The overall average technological gap was 6.71. The technology gap was highest (6.90 q ha^{-1}) in Mash-114 during 2019-20 and 2020-21. Generally, the technological gaps appear even if the FLDs' are conducted under the close supervision of farm scientists on the farmers' fields. This may be attributed mainly to lack of irrigation infrastructure, ill distribution of rainfall, variation in soil fertility and cultivation of pulses on unproductive lands, non congenial weather conditions and local specific crop management problems faced in order to harness the yield potential of specific crop cultivars under demonstration plots (Table 2).

The extension gap during the study period varied to the extent of 0.90 to 1.32 q ha^{-1}. The overall average extension gap was 1.10 q ha^{-1}. This emphasized the need to educate the farmers through various extension strategies like FLDs, exposure visits and farmer's field school for adoption of improved agricultural technologies so as to regress the trend of wide extension gap.

The technology index showed the feasibility of the evolved technology at the farmers' fields. The lower

Table 1: Gap analysis between demonstration practices and farmer's practices

Practices	Demonstration Practice	Farmer's Practice	Gap
Land Preparation	Two Ploughings	Two Ploughings	No Gap
Variety	PU-31 and Mash-114	Local Variety	Full Gap
Seed Rate	20 kg	30-40 kg	Higher Seed Rate
Seed Treatment	Thirum+Bavistin 2:1 @ 2.0 g/kg seed & Trichoderma virdae @10g/kg of seed	No seed Treatment	Full Gap
Sowing Method and Spacing	Line Sowing 30×10 Cm	Broad Casting	Full Gap
Manure and Fertilizer	20 :40:20 NPK kg/ha	No Use of Fertilizer	Full Gap
Weed Management	One hand weeding at 25- 30 DAS	One hand weeding at 35-40 DAS	Partial Gap
Plant Protection Measures	Need Based Plant Protection Measures	No Plant protection Measures	Full Gap

Table 2: Technology gap, Extension gap and Technology index in Black gram crop

Year	Variety	No. of FLDs	Area (ha)	Average Yield (qt/ha)			% increase	Tech-nology gap (q/ha)	Exten-sion gap (q/ha)	Tech-nology index (%) CFLD
				Potential	Demo. Plot	Farmer's Plot				
2019-20	PU-31	22	2.50	12-14	6.25	5.10	23	6.75	1.15	52
	Mash-114	60	7.50	12-14	6.10	510	20	6.90	1.00	53
2020-21	PU-31	50	3.65	12-14	6.37	5.20	22	6.63	1.17	51
	Mash-114	13	1.00	12-14	6.10	5.20	17	6.90	0.90	53
2021-22	PU-31	100	10.00	12-14	6.62	5.30	25	6.38	1.32	49
Average		245	24.65	13	6.28	5.18	21.40	6.71	1.10	52

the value of technology index, the more is feasibility of technology. Fluctuation in technology index (ranging between 49-53%) and overall average technology index was observed 51 percent during the 3 years of CFLD, may be attributed to the dissimilarity in soil fertility status, weather conditions (low or untimely rainfall), insect-pests, and diseases. Our results are also in conformity with the findings of Shashikumar (2015) on maize crop and Gaddi *et al.* (2002b) on cotton.

CONCLUSION

It is concluded that the front line demonstration conducted on improved technologies of black gram at farmer's fields of Rajouri district of J & K showed that the farmers could increase black gram production significantly. In demonstration the integration of improved production technology of black gram performed better than control plots. It improves the productivity by 21.40 percent. The productivity gain under CFLDs over farmer's practice created awareness and motivated the other farmers to adopt appropriate production technology of black gram in the district.

REFERENCES

Dubey, S.S.; P.S. Tripathi and R.K. Sharma. 2010. Yield gap analysis of black gram production through frontline demonstration. *Journal of Progressive Agriculture,* 1(1): 42- 44.

Kirar, B.S.; S.K. Mahajan; R. Nshine; H.K. Awasthi and R.K. Shukla. 2005. Impact of technological practices on the productivity of Soybean in Frontline demonstration. *Ind. Res. J. of Ext. Edu.,* 5(1): 15-17.

Poonia, T.C. and M.S. Pithia. 2011. Impact of front line demonstrations of chickpea in Gujarat. *Legume Research,* 34(4): 304- 307.

Rai, A.K.; S. Khajuria; K. Lata; J.K. Jadhav Rajkumar and B.S. Khadda. 2016. Popularization of vegetable pigeon pea (*Cajanus cajan*) in central Gujarat through demonstration in farmers field. *Indian Journal of Agricultural Sciences,* 85(3): 349-353.

Sagar, R.L. and Ganesh Chandra, 2004. Front line demonstration on seasame in West Bengal. *Agricultural Extension Review,* 16 (2): 7-10.

Samui, S.K., Maitra, S., Roy, D. K., Mandal, A.K. and Saha, D. 2000. Evaluation front line demonstration on groundnut. *Journal of the Indian Society Costal Agricultural Research,* 18(2): 180-183.

Singh, P.K. 2002. Impact of participation in planning on adoption of new technology through FLD. MANAGE Extension Research Review July-Dec-45-48.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 515-518

Russia Ukraine War – Impact on Global Agriculture and Fisheries Food Security

Ankita Kumari Bhagat[1]*, Akhil Gupta[2] and J.P. Sharma[3]
[1]BSc (Hons) Agriculture, Faculty of Agriculture, SKUAST Jammu, UT of J&K
[2]Associate Professor (Fisheries), Fisheries Unit, SKUAST Jammu, Chatha, UT of J&K
[3]Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha

"*The essence of war is fire, famine and pestilence. They contribute to its outbreak; they are among its weapons; they become its consequences.*" – *Dwight D. Eisenhower*

Russian invasion of Ukraine began on 22nd February 2022. This has led to an immense loss to humanity, infrastructure, economy and many other irrevocable entities. It is clear that the war has resulted in a massive, and deteriorating, food security challenge and disrupted livelihoods of the Nation and has put a question mark on the Global Food security chain and affecting the agricultural scenario especially during the spring season of the year. The International Monetary Fund (IMF) states that the entire global economy will be impacted by the ripple effects of the war through three main channels: higher inflation levels, disruption of supply chains, and reduced business confidence.

The Russian war against Ukraine has a significant impact on the EU seafood sector. Increased prices for energy and raw materials have led to high operating costs for fishermen, aquaculture farmers and fish-processing companies. Russia and Ukraine are Global Agricultural Powerhouses of Maize, wheat, oilseeds and fertilizers. Both the nations are the good players in the global trade of food and agricultural products. In all aspects, this war has resulted in the slowdown of the agriculture exports.

On the report of United Economic Forum, Russia and Ukraine account for more than 30% of global grain exports, Russia alone provides 13% of global fertiliser and 11% of oil exports, and Ukraine supplies half of the world's sunflower oil. In combination, this is huge a supply shock to the global food system, and a protracted war in Ukraine and the growing isolation of Russia's economy could keep food, fuel andfertiliser prices highfor years.

Maize: The contribution of Russia as Maize exporter to Global share is very limited as compared to that of Ukraine. The share of Russia as maize exporter to Global share is 3% between 2016-17 and 2020-2021. During the same period, Ukraine's Global share as maize exporter is 15%; adding to this Ukraine is also the 4th largest maize exporter.

Wheat: In the year 2021, Russia and Ukraine together accounted for 30% of the wheat in the global market. Russia is the top global wheat exporter with 18% global market share and Ukraine accounts for the 10% of the global market share as wheat exporter. Also, Ukraine is 6th largest wheat exporter in 2021. Nearly 50 countries are dependent on both Russia and Ukraine to meet their wheat needs. Out of which about 20 countries fetch 50% of their wheat demands from these two nations. This war may lead to increase in the prices of wheat by 9% and in severe scenario by 21% for short term.

Oilseeds: Russia and Ukraine together contribute 55% of the global share in Sunflower oil. Ukraine alone supplies half of the world's sunflower oil.

Fertilizers: The Russian Federation plays a vital role in the export of the fertilizers to the world. In the year 2020, Russia is ranked as the largest exporter of the Nitrogenous fertilizers, second leading supplier of the potassic fertilizers and third largest exporter of the phosphoric fertilizers. Thus, the major chunk of Global agriculture depends highly on Russian Federation to meet their demand of macronutrient fertilizers.

*Corresponding author email id: ankita1bhagat@gmail.com

Risk due to War on Global Agriculture and Food Security

Trade associated risks: Due to war the export of agricultural commodities is disrupted very badly and is resulting in unfulfilled import demand and higher international food prices. Many facilities have been disrupted such as production supply chain, shortage of food grains and agricultural inputs. There are many dependent buyers especially the African countries have to look for the alternative importers in case of wheat being staple food grain of the world. This would additionally burden the global market. Ukraine being third largest maize exporter might lose its position to China, European Union, Egypt and Turkey as well during 2021-2022.

Price associated risks: As per FFPO (FAO Food Price Index), international export quotations of basic foodstuffs have seen near-uninterrupted increases since the second half of 2020 and, in nominal terms, in February 2022 they stood at an all-time high. Although prices of all the commodity groups encompassed by the FFPI1 have registered gains since the latter part of 2020, the global cereal and vegetable oil markets, in which both Ukraine and the Russian Federation play significant roles, have been amongst those most affected. The prices of food grains and oilseeds during this period are increasing in 2021.

The most remarkable risk is the increase in the price of the Nitrogenous fertilizers and phosphoric fertilizers which will ultimately led to increase in the cost of cultivation and produce as well.

Logistical risks: In Ukraine, the damage has been done to roads, seaports, storage units, processing units and other infrastructure. This can result in the disruption of the supply chain and the poor production and wastage of many agricultural commodities. Moreover, the import and export facilities both are obstructed due war conditions.

Production risks: Earlier the production prospects for the winter cereal crops in both the countries were favourable. Due to the upsurge in war casts uncertainty over the winter-cereal harvest in Ukraine. The war has resulted into the reduced displacement of the goods, damaged infrastructure, restriction on the movement of the people and especially that of the farmers from attending their fields and doing the required farm operations such as harvesting, threshing and processing of the crops. Also, labour shortage is one the parameter that is affecting the agriculture sector in the meantime of spring harvest season.

Despite this, high fertilizers prices also may lead to the unavailability to the farmers except large and industrial farmers. Moreover, due to explosive properties of the nitrogenous fertilizers, they may direct to their use in the war as defence. Thus, the farmers of Ukraine are advised to stock up the pesticides, crop protection entities and other inputs that can compensate the losses due to the unavailability of fertilizers in this difficult situation.

As per FAO, the 20% of the wheat area will not be harvested due to the destruction and the inability to perform the farm operations and the local sources issues that the 28% of area under wheat could not be available for harvesting. Also, the upcoming season of cultivation of the crops like sunflower, spring maize and mustard – rapeseed might pose the problem of their cultivation is yet in dilemma. Meanwhile, forecasts by the Ministry of Agrarian Policy and Food of Ukraine indicate that Ukrainian farmers will plant 50% of planned spring area with certainty, whereas planting of about 20% of the planned area remains questionable, and the balance would be highly unlikely to be planted.

Energy associated risks: Agriculture itself is an energy conversion processthe conversion of solar energy through photosynthesis into food energy for humans. It is highly dependent on the energy directly and indirectly. Also, energy plays a key role in achieving the increasing productivity and production as well. The Russian Federation is a key player in global energy market. Due to dependence of many developed and developing countries on Russia to, meet its energy demand may face sharp increase in the energy prices. As mentioned earlier, the prices of fertilizers have been increased and also many other agricultural energy-intensive products face inflation. The hike in the prices of inputs will eventually lead to increase in the cost of inputs and higher food prices. Other than this, this may also lead to use of low inputs and depressing yields in 2022-2023 season which further increase the risk to global food security in the upcoming years.

Ways to tackle Global food security crisis due to Russia - Ukraine war

- Three major things as suggested by United Economic Forum are as follow:

1. First, The countries which are major food grain producers such as South East Asian countries must try to increase the productivity and the fix the supply chains, logistic operations and work on the relaxation on the import policies for the of the trouble free import of the food commodities.
2. Second, the world needs short term oil producing nations in order to increase the fuel supplies can help to bring down the fuel, fertilizers and the shipment costs. This will benefit the entire global food system during this period of crisis. These oil exporting nations will provide the humanitarian aid during this difficult period as an assistance to tackle global food security. Moreover, we need to reduce our global dependence on the fossil fuels including agriculture as well.
3. Third, the Government, International institutes and the Agencies including private sector even would offer social protection through food and financial aids.

- Countries that are highly dependent on Ukraine and Russia should look for the alternative sources to import the agriculture inputs and produce. Moreover, they can also find new and diverse food supplies to ensure the supply of food necessary for healthy diets.
- Keep the trade of food and fertilizers open by preventing the war from negatively affecting productive and marketing activities in both countries in order to enable them to meet domestic production and consumption needs, while also satisfying global demands. In order to ensure that supply chains continue to function properly or are in a position to resume operations swiftly, such efforts should include steps to protect productive assets, including standing crops, livestock, inputs and machinery, from damage or any war-induced disruption.
- The countries should support vulnerable groups, including internally displaced people.
- Global market transparency plays a key role when agricultural commodity markets are under uncertainty and need to adjust to shocks affecting supply and demand and safe guarding the global food security as well.
- Initiatives like G-20's Agricultural Market Information systems (AIMS) attempts to increase the transparency with the provision of objective, timely and up-to-date market assessments that enable informed policy decisions.

Impact of Russia Ukraine war on India's Agriculture sector

India depends heavily on the Russia and Ukraine for the agricultural commodities and this war has proven to be a headache for the Indian farming sector. As stated by India's Finance Minister Nirmala Sitaraman, "*the government is worried that the disruptions caused by the war will have far-reaching consequences on India's farming sector.*"

Negative Impact of War on India

Fertilizer Sector: Around 11% of the Fertilizer imports of India are met by Russia and Ukraine together. Russia alone supplies 17% of the India's potash imports and nearly 60% of the imports of NPK (Nitrogen, Phosphorus, Potassium) – vital components in fertilizers. Therefore, shortage of fertilizers may be the foreseen impact on the increasing input cost of cultivation which will eventually lead to the increase in the food prices for the consumers. Also, the farmers may use fewer inputs which may result in the depressing production and consequently the increasing food prices. On the Positive note fertilizer industry in India is heavily subsidized which would lead to the enforcement of increasing the subsidies and to take more protectionist measures.

In order to avoid this situation and securing the fertilizer supply in the country, India's top potash manufacturer, India Potash Ltd, signed a deal with an Israeli fertiliser company for over 600,000 tonnes of potash for the next five years.

Edible Oils: Another major Impact of Ukraine Russia conflict is on the Edible Oils Industry. In India, the demand of Edible oilseeds is very high and domestic production has not been able to maintain the pace with the demand of the consumers. As a result India is highly dependent on the other countries for the import of edible oilseeds. India imports more than half of its edible oils and In fact, India receives 90% of its sunflower oil supplies from Russia and Ukraine. Thus, the war may lead to the drastic fall in the production and import of edible oils especially sunflower oil. Also since the invasion of Russia into the Ukraine, the price of cooking oils, including thee sunflower oil, has continued to increase in India.

Positive Impact of War on India

As mentioned earlier, Russia and Ukraine are severely affected by war which is eventually impacting their export ability of the wheat and this void has provided a great opportunity to India. Major wheat importing countries like Egypt, Israel, Oman, Nigeria, and South Africa, which were heavily dependent on the Ukraine and Russia has as of now approaching India for the supply of wheat. India Produces 14% of the Global wheat with the global market share of only 3% but Indian wheat stocks are 3 times the mandatory limit of 7.6 million tonnes and this is enough to fill the gap left by Kyiv and Moscow. Also, India takes adequate steps to reduce the impact of the conflict in Ukraine on its agricultural sector, including by seeking additional import options and tapping into export markets.

Impact on Fisheries

The EU fisheries and aquaculture sector was affected by rising energy prices in the course of 2021, and Russia's invasion of Ukraine has led to a further escalation in energy costs. Marine gasoil prices are reaching peaks that are more than double compared to early 2021. Black Sea fisheries face direct impacts from the war, in particular for Romanian vessels that used to fish close to Ukrainian waters and are now advised to stay away from the conflict zone. Aquaculture and fish processing companies are also affected by increased energy costs, as well as by high logistic costs and trade disruption. Although import bans do not cover seafood from Russia (apart from caviar and shellfish products added in the fifth round of sanctions), trade flows are severely hampered, particularly affecting EU fish-processing companies that rely heavily on supplies of whitefish from Russia. "We've seen huge increases in fish prices over the last six months anyway," Andy Crombleholme, owner of a fish shop named Kirby's, told the news outlet. "We're already a lot higher than where we were pre-pandemic. The National Federation of Fish Friers worried that more than a third of the fish shops in Britain could be forced out of business. However at present Indian fisheries and aquaculture sector is not affected by Russia's – Ukraine war.

CONCLUSION

The war between Russia and Ukraine has resulted in the conflicts which are not limited to these nations only. Apart from this, the shockwaves of the war are experienced across the world. The biggest impact of war is on the Global food security as Russia and Ukraine are the key players in global agricultural sector. This means the current year and upcoming 2023 is shaping to be very difficult year for the global food systems. On the contrary FAO, WEF etc. are suggesting the best of the ways to tackle the ill effects of the war on the global food security chain and this is a golden chance for many countries to exploit their potential in agriculture in order to maintain the global food security.

REFERENCES

8 April 2022, https://reliefweb.int/report/world/impact-ukraine-russia-conflict-global-food-security-and-related-matters-under-mandate#:~:text=It%20is%20clear%20that%20the,reached%20an%20all%2Dtime%20high.

31 March 2022, https://www.weforum.org/agenda/2022/03/a-food-crisis-was-brewing-even-before-the-ukraine-war-but-taking-these-three-steps-could-help-the-most-vulnerable

24 March 2022, https://www.statecraft.co.in/article/how-will-the-ukraine-war-impact-india-s-agricultural-sector

21 February 2022, https://gro-intelligence.com/insights/impact-of-the-russia-ukraine-conflict-on-global-agriculture-by-the-numbers

17 March 2022, https://youtu.be/ovH2Lhd1nfE

https://epthinktank.eu/2022/04/20/russias-war-on-ukraine-support-for-the-fishing-aquaculture-and-fish-processing-sectors/

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 519-529

Determination of Horizon, its Boundary and Depth in the Soil Profiles of North Western Himalayas

Owais Bashir[1]*, S.A. Bangroo[1], Sameera Qayoom[4], Tahir Ali[1], Z.A. Baba[1], Nasir Bashir[1], G.H. Rather[2], Irfan Gani[3], Rehana Rasool[1] and Tajamul islam Shah[1]
[1]Division of Soil Science and Agricultural Chemistry, SKUAS&T, Kashmir-193201, J&K
[2]Division of Fruit Sciences, [3]Division of Floriculture, [4]Division of Agro-materology, SKUAS&T-Kashmir-190025, J&K

ABSTRACT

The scientific study of the soil started almost 70-80 years ago with two schools of thought; one worked in the lab and others in the field. The main aim of the researchers studying in the field was to determine the profiles of soil along with its horizons to the extent of the knowledge of physical, chemical and biological properties. The distinctness of soil with depth means that soil has a unique profile. All the soils in the world have some specific depth functions. The change of soil colour or soil texture in a soil profile can be considered a good indicator of the soil formation and process and has been used as a proxy for the degree of development or soil age. Uniform, gradational and rapidly changing soil textures are soil profile forms used for soil classification. In the current study, we studied twelve profiles having four different land uses and observed several horizons having various boundaries. The upper horizons had diffused and wavy boundaries than the lower horizons. There was seen a clear relationship between the horizons and the various land uses.

Keywords Horizon, Texture, Structure, Consistency

INTRODUCTION

Pedology is one of the most fascinating and ancient branches of soil science and includes petrology and pedogenesis (Ma *et al.,* 2019, Bonfatti *et al.,* 2018, Padarian *et al.,* 2018, Zeraatpisheh *et al.,* 2017, Zhang *et al.,* 2017, Rahmati *et al.,* 2017, Angelini *et al.,* 2017) The other branches of soil science are said to be evolved from this particular branch. Dokuchiev, the father of soil science, is known to be the first pedologist as he wrote his book entitled "Fundamental principles of pedology". The scientific study of the soil started almost 70-80 years ago with two schools of thought; one worked in the lab and was known as agro-chemists (Neina, 2019). The main aim of their study was to enhance soil conditions in existing agriculture fields. The second group of researchers were few, and they worked in the field and were known as agro-geologists or pedologists. (Hartemink 2009, Brevik 2009, Hartemink *et al.,* 2008, Feller *et al.,* 2008, Hartemink *et al.,* 2001).

They aimed to expand the knowledge of soil while characterizing, classifying and mapping it. Soil science became an established science when agro-geologists and agro-chemists held a joint meeting which later got established into a professional society, the International Society of Soil Science, in 1924. This pedologist worked in the field and reported that the pedogenesis or pedological process is said to be responsible for the horizon development (Owliaie *et al.,* 2018, Abbaslou *et al.,* 2013, Moazallahi and Farpoor, 2011, Dominati *et al.,* 2010, Khresat, Qudah 2006, Moazallahi, and Farpoor 2009). The major factors responsible for forming soil horizons include parent material, climate, organism, relief and time (Mishra and Roy, 2019; Mahala, 2018, Zhang *et al.,* 2016). These horizons play an important impact in soil classification. The classification of any soil depends upon the number and type of horizons present. Hans Jenny (1941) reported that all the soils in this world have vertical distribution called horizons. These horizons reveal the potential problems and the history and environment

*Corresponding author email id:

of the region. Generally, three genetic horizons occur, which include master horizons, transitional horizons and subordinate distinctions within the master horizon (Zhang *et al.,* 2019a, Zhang *et al.,* 2019b, Lowe 2019, Wu *et al.,* 2018). Each horizon is described with the characters, including horizon depth, horizon symbol, soil colour under dry wet and moist conditions, mottling, texture, consistency, cutans, concretions, nodules and cementation. Many researchers have worked on the soil horizons. Jenny stated that horizon designation is a difficult process and needs a lot of expertise and suggested using soil indicatrix for refinement and clarification of soil profiles and horizons. (Minasny *et al.,* 2016). However, there are so many difficulties with horizon recognition. It has been considered more art based on previous experience rather than science with a defined set of principles.

The classification of soils depends on the soil horizons within that profile. The approach appeared to be very simple as thought that soil profiles are formed by the straightforward interaction of active and passive soil-forming factors, including climate, biota, parent material, and relief over a certain period, leading to the development of soil with a specific horizon sequence (Silva *et al.,* 2018, Bockheim 2018, Ribeiro *et al.,* 2017, Macedo *et al.,* 2017, Stockmann *et al.,* 2016, Sidorova 2016, Roudier *et al.,* 2016, Mohammed *et al.,* 2016, Minasny *et al.,* 2016, Khitrov *et al.,* 2016) This led to the concept of homology in soil science as it could form the basis of classification. As in the animal and plant kingdom, the classification is based on homologous relationships because of certain prominent characters, but it is intricate and outrageous to develop such relations in soil science. If the two soils have similar profiles still, they can differ due to the horizon depth and boundary (Hartemink *et al.,* 2020, Goebes *et al.,* 2019). The soil measurements are usually done based on horizons or defined depth intervals in a profile. Soil samples are usually bulked based on horizons, ensuing in "stepped" data that may disassemble soil properties' persistence. Soil scientists also measure soil properties at fixed depth intervals. The current study was to identify and delineate soil horizons and their depth and boundary along with the profile of various land use.

MATERIALS AND METHODS

Study area: The study area is located in the temperate Himalayas of the North-Western part of India between the latitude 34º12′ to 34º20′ North latitude and 74º20′ to 74º34′ East longitude with an elevation of 1584 meters and an area of 3353 km^2. The region has high, mid and low altitudes consisting of mountains, hills and valleys. The region has an annual rainfall of 1270 mm and an average temperature of 24° C. The highland is separated by a wide valley stretched by the river Jhelum in the eastern and western directions. In the northwestern part is the Jhelum and in the southern part is Pakistan. The area's topography is steep slopy to moderately sloppy, with some plain areas as well (Figure 1).

Soil profile description and sampling

The 12 profiles were excavated from the study site with four different land uses, including agriculture, horticulture, forest and fallow lands. These profiles were exposed for two to three days to easily differentiate the horizons. Samples were collected from each horizon

Table 1: Previous study on soil horizons

Topic Name	Country	Author
Variation of the soil horizons in the soil profile	USA	Hartemink *et al.,* 2020
Digital mapping of a soil profile	USA	Zhang *et al.,* 2016
Application of mid-infrared spectroscopy for rapid characterization of key soil properties for engineering land use	Kenya	Warura *et al.,* 2019
Improving In-Situ Estimation of Soil Profile Properties Using a Multi-Sensor Probe	USA	Pie *et al.,* 2019
Characterization of soil profiles in a landscape affected by long-term tillage	USA	Papiernik *et al.,* 2007
Soil spatial patterns analysis via X-ray fluorescence spectrometry and multivariate statistical methods	Romania	Pîrnău *et al.,* 2020
A vertical profile imaging method for quantifying rock fragments in gravelly soil	China	Jiang *et al.,* 2020

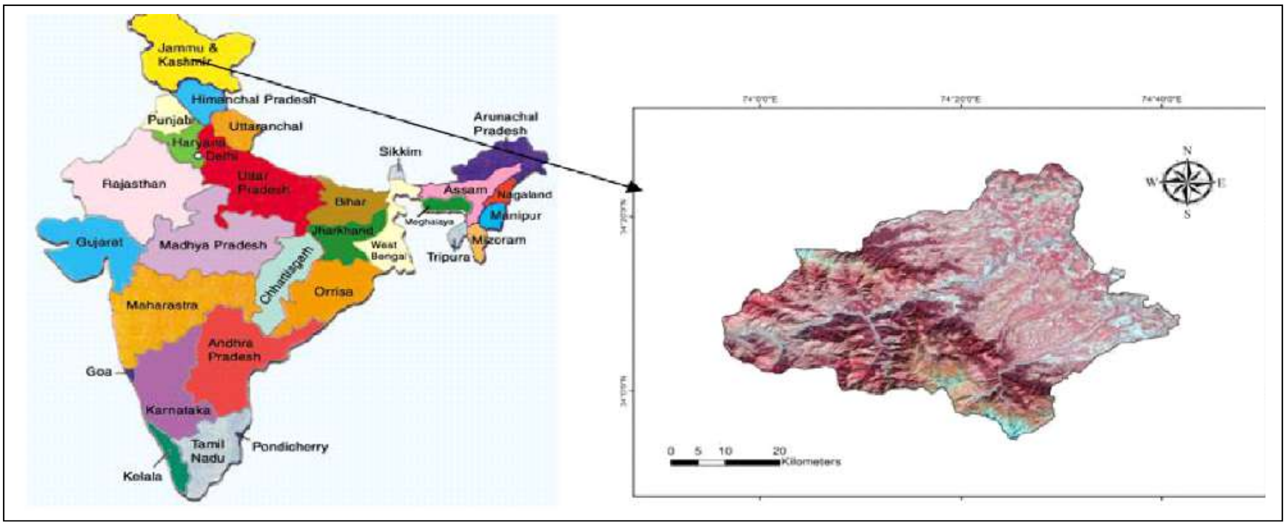


Figure 1: GIS map of the study area

to a depth depending on the development of the soil and the lithic contact below the soil. The horizons were depicted following the standard descriptive nomenclature (Schoeneberger *et al.,* 2012).

RESULTS AND DISCUSSION

Certain soil horizons were reported in the twelve soil profiles with four land uses. Four land uses were excavated from each altitude, including the high, mid and low altitudes. The horizons were distributed according to the clay content, soil consistency, texture, structure and the colour of the soils.

In Profile P1, five horizons were present, and the depth ranged from 0-179 cm. The surface horizon (Ap) had a 0-21 cm depth with diffused wavy boundary and brown colour (10YR 5/3). The sub-surface horizons (AB, Bt1, Bt2, Bt3) ranged from 22-179 cm and had clear, smooth to the diffused wavy boundaries and the soil colour varied from pale brown (10YR 4/2) to dark brown (10YR 2/2). In dry conditions, the consistency of these soils ranges from hard to very hard, firm and friable in moist conditions and moderately sticky to sticky when wet. The plasticity was slightly plastic to plastic in all horizons, and no effervescence was recorded in these horizons. In Profile P2, there were three horizons, and the total soil depth was 83 cm, with surface horizons (Ap) having a depth of 18 cm. The subsurface horizons. The colour of the surface and sub-surface horizons ranged from brown (10YR 5/3) to slightly greyish brown (10 YR 5/2). The boundary of these soils ranged from gradual wavy to diffused wavy, and texture varied from sandy loam to loam. The dry consistency of these horizons varied from slightly hard to hard, moist consistency from friable to firm and wet consistency from slightly sticky to non-sticky and non-plastic.

An effervescence was recorded in sub-surface horizons. There was no evidence of clay cutans, mottles or cracks in different horizons of the profile. In contrast, as many fine to few fine roots were observed throughout the profile. The Profile P3 had a total depth of 188 cm in five horizons, the depth of the surface horizon ranged from 0-17 cm, and the soil colour recorded was brown (10 YR 5/4). The sub-surface horizons had a colour value of pale brown (10YR 4/3) to dark brown (10 YR 3/2). The soil texture of surface horizons was sandy loam, and that of sub-surface horizons was loam to clay loam. The upper horizons had clear, smooth boundaries, while the lower horizons recorded diffused wavy boundaries.

The soil structure of surface horizons had a coarse weak, and crumb structure, and the lower horizons had medium moderate angular blocky to the fine moderate sub-angular blocky structure. In dry conditions, the consistency of these soils ranged from loose to slightly hard, friable when moist and slightly sticky when wet. The plasticity was slightly plastic to plastic with no enthusiasm in all the horizons. Roots were present in all horizons, while fine roots were only confined to a depth of 85 cm. In profile, P4 surface horizons extended up to 30 cm with a total soil depth of 114 cm. The soil colour of the surface horizons was brown (10YR 5/4), and the sub-surface horizons had dark brown colour (10YR 3/4). The horizon boundary was clear and smooth in surface horizons and diffused wavy in sub-surface horizons. The texture of surface horizons was sandy loam with coarse, moderately granular structure. The sub-surface horizons had loamy to clay loam texture with medium moderate subangular blocky to the fine, strong angular blocky structure. The consistency varied from hard to very hard when dry, friable to the very firm when moist and slightly sticky to sticky under wet conditions. The horizons were slightly plastic plastic in nature with no effervescence. Few fine roots to very few fine roots were observed in the surface horizons only.

The profile P5 had a total depth of 191 cm in five horizons, the depth of the surface horizon ranged from 0-24 cm, and the soil colour recorded was brown (10 YR 4/4). The sub-surface horizons had a colour value of dark brown (10YR 3/2). Soil texture of surface horizons was loam, and that of sub-surface horizons was silt clay loam to clay. The upper horizons had diffused wavy boundaries while the lower horizons recorded clear, smooth boundaries. The soil structure of the surface horizon had a medium moderate sub-angular blocky structure, and the lower horizons had fine, strong angular blocky to the fine, strong sub-angular blocky structure. The consistency varied from hard to extremely hard when dry, friable to the very firm when moist and slightly sticky to sticky when wet. The plasticity was slightly plastic to moderately plastic with no effervescence in all the horizons. Roots were present in all horizons, while fine roots were only confined to a depth of 85 cm. Profile P6, five horizons were observed with a total depth of 162 cm, with surface horizons having a depth of 19 cm. The colour of the surface and sub-surface horizons ranged from brown (10YR 4/3) to very dark brown (10 YR 2/3). The boundary of these soils ranged from clear smooth to diffused wavy, and texture ranged from loam to clay loam. The soil structure of the surface horizon was coarse moderate granular to fine strong subangular blocky in the B horizon.

In contrast, the BC horizon had a fine, strong sub-angular blocky structure. The dry consistency of these horizons ranged from hard to extremely hard, moist consistency from friable to very firm and wet consistency from slightly sticky and slightly plastic to sticky and plastic in surface to sub-surface horizons, respectively. No effervescence was recorded in all horizons. There was no evidence of clay cutans, mottles or cracks in different profile layers. While as many coarse roots were present in surface horizons, fine to few fine roots were observed throughout the profile. Profile P7 four horizons were present, and the depth

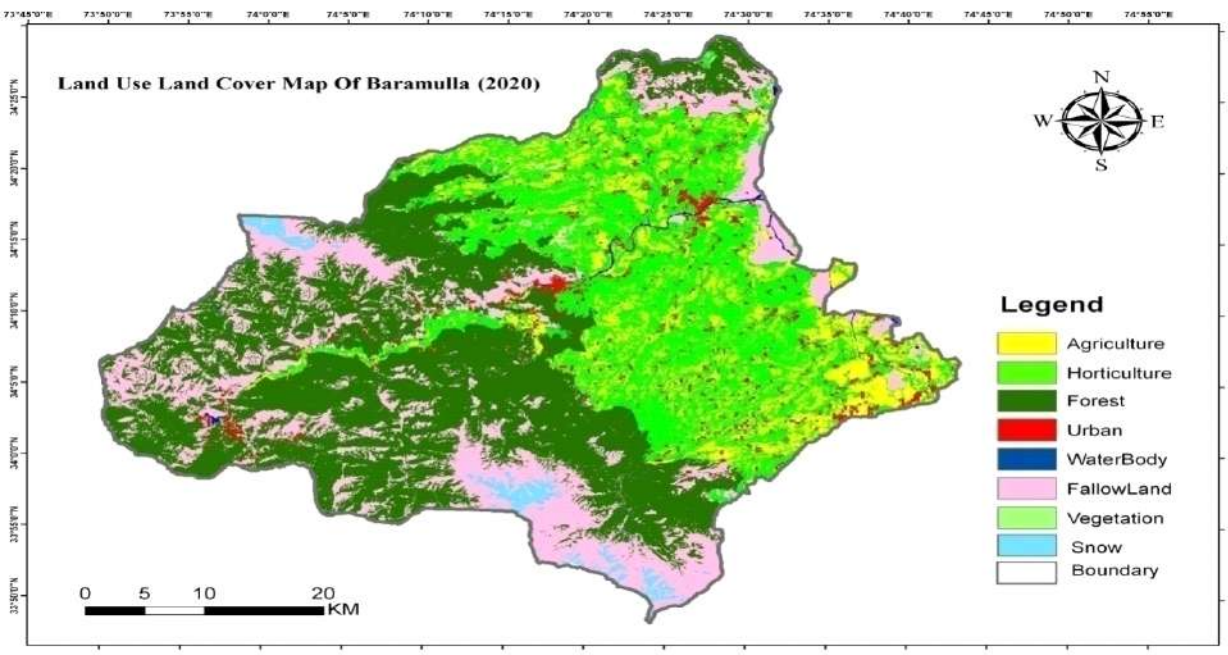


Figure 2: Land use and land cover map of the study area

ranged from 0-152 cm. The surface horizon was 27 cm with diffused wavy boundary and a light yellowish-brown colour (10YR 5/4).

The sub-surface horizons ranged from 28 to 152, having diffused smoothly to diffused wavy boundaries and the soil colour of pale brown (10YR 4/3) to brown (10YR 4/4). The textural class of these soils ranged from sandy loam to loam, and structure varied from coarse weak sub-angular blocky in surface horizons to fine, strong angular blocky in sub-surface horizons. The consistency was slightly hard to very hard when dry, friable to a firm when moist and slightly sticky to sticky when wet. The soils were slightly plastic, and no effervescence was recorded in all these horizons. The profile P8 surface horizons extended up to 25 cm with a total soil depth in a range of 149 cm. The soil colour of the surface horizons was greyish brown (10YR 3/3), and the sub-surface horizons were having very dark brown colour (10YR 2/2). The horizon boundary was clear and smooth in surface horizons and gradual smooth in sub-surface horizons. The texture of surface horizons was silt loam with coarse moderately granular structure, and the sub-surface horizons had loam to clay loam texture with medium moderate sub-angular blocky to a fine strong sub-angular blocky structure. The consistency varied from slightly hard to hard when dry, loose to friable when moist and slightly sticky to moderately sticky under wet conditions. The horizons were slightly plastic plastic in nature with no effervescence. Few fine roots to very few fine ones were observed only in the surface horizons.

In profile P9, there was a total depth of 188 cm in six horizons, the depth of the surface horizon ranged upto 13 cm, and the soil colour recorded was light brown (10 YR 5/4). The sub-surface horizons had a colour value of yellowish-brown (10YR 3/4) to very dark brown (10 YR 2/3). Soil texture of surface horizons was silt loam, and that of sub-surface horizons was silt loam to silt clay loam with BC1 horizon having sandy texture. The upper horizons had diffused wavy boundaries while the lower horizons recorded clear, smooth boundaries. The soil structure of surface horizons had medium moderate sub-angular blocky, and the lower horizons had medium moderate subangular blocky to fine, strong angular blocky structure with BC1 horizon having a coarse weak and granular structure. The consistency varied from hard to very hard when dry, friable to the firm when moist and slightly sticky when wet. The soils were slightly plastic with no effervescence in all the horizons. Roots were present in upper horizons, while fine roots were confined to a depth of 96 cm only. In profile P10, there were five horizons, and the total soil depth was 173 cm, with surface horizons having a depth of 19 cm. The colour of the surface and sub-surface horizons ranged from light yellowish brown (10YR 5/2) to very dark brown (10 YR 2/2). The boundary of these soils ranged from clear smooth to diffused wavy, and texture ranged from silt loam to silt clay loam. The soil structure of the surface horizon was coarse moderate crumb to medium moderate angular blocky in sub-surface horizons. The dry consistency of these horizons was slightly hard to hard, moist consistency from loose, friable to very firm and wet consistency from slightly sticky and slightly plastic to moderately sticky and moderately plastic in surface to sub-surface horizons, respectively. None of the horizons recorded effervescence. There was no evidence of clay cutans, mottles or cracks in different profile layers. While as many coarse roots were present in surface horizons, fine to few fine roots were observed throughout the profile. In profile P11, there were six horizons, and the total soil depth was 207 cm, with surface horizons having a depth of 28 cm and the lowest horizons showing the presence of water. The colour of the surface and sub-surface horizons ranged from yellowish-brown (10YR 4/2) to very dark brown (10 YR 2/2).

The boundary of these soils ranged from clear smooth to graduated smooth and texture varied from clay loam to clay in the surface and sub-surface horizons. The soil structure of the surface horizon was medium moderate sub-angular blocky to fine strong angular blocky and fine, strong sub-angular blocky structure. Dry consistency was slightly hard to very hard, moist consistency from friable to very firm, and wet consistency from slightly sticky-slightly plastic to moderately sticky and plastic from surface to sub-surface horizons. No effervescence was recorded in all horizons. There was no evidence of clay cutans, mottles or cracks in different profile layers. In contrast, many fine to few fine roots were observed throughout

Table 2: Description of the various profiles

Profile (Land-uses)	Horizon	Depth (cm)	Boundary	Structure	Consistency	Plasticity
P_1 (Agriculture)	Ap	0-21	dw	m2cr	sh fr ss	Sp
	AB	21-44	cs	m2 sbk	sh fr s	mp
	Bt1	44-87	cs	m2 sbk	h vfi s	P
	Bt2	87-134	dw	m2 abk	vh fi s	P
	Bt3	134-179		m2abk	h fi ms	Mp
P_2 (Horticulture)	Ap	0-18	dw	m2gr	sh fr ss	Sp
	AC	18-56	gw	m2abk	h fi ms	P
	C	56-83		c1gr	h fr ss	Sp
P_3 (Forest)	Ap	0-17	cs	c1cr	sh fr ss	Sp
	AB	17-51	cs	c2gr	sh fi s	Mp
	Bt1	51-98	ds	m2sbk	vh fi ms	P
	Bt2	98-152	dw	f3abk	eh fi ms	P
	BC	152-188		m2sbk	h vfi s	P
P_4 (Fallow)	A	0-30	cs	c2gr	s hl ss	Mp
	Bt1	30-52	ds	m2gr	sh fr ms	Sp
	Bt2	52-88	gs	m2sbk	h fr ms	Mp
	Bt3	88-102	dw	f3abk	eh fi s	P
	C	102-114		f2abk	sh fr ss	P
P_5 (Agriculture)	Ap	0-24	dw	m2sbk	h fi ss	Sp
	AB	24-71	cs	m2sbk	sh fr ss	Mp
	Bt1	71-118	cs	f3sbk	eh vfi s	P
	Bt2	118-151	ds	f2abk	vh vfi vs	P
	Bt3	151-191		m3sbk	eh vfi s	P
P_6 (Horticulture)	Ap	0-19	cs	c2gr	sh fi ss	Sp
	Bt1	19-56	cs	m2sbk	h fr s	Mp
	Bt2	56-103	ds	m3abk	h fi ms	P
	Bt3	103-145	dw	f2abk	eh vfi s	P
	BC	145-162		f3sbk	eh vfi s	P
P_7 (Forest)	A1	0-27	dw	c1sbk	sh l ss	Sp
	A2	27-41	ds	f2sbk	h fi ss	Sp
	B	41-89	dw	f3abk	h fi s	P
	C	89-152		m1gr	h fi s	P
P_8 (Fallow)	A	0-25	cs	c2gr	sh l ss	So
	Bt1	25- 67	cs	m2gr	h l ss	Sp
	Bt2	67-83	gs	f3sbk	h fi ms	Mp
	BC	83-149		m2sbk	sh l ms	Sp
P_9 (Agriculture)	Ap	0-13	dw	m2sbk	h fi ss	Sp
	AB	13-31	cs	m3sbk	sh fi ss	Mp
	Bt1	31-75	cs	f3abk	h fi s	Mp
	Bt2	75-117	cs	m2abk	vh vfr s	P
	BC1	117-126	gw	c1gr	l fr ss	So
	BC2	126-188		f2sbk	h vfi s	P

Table 2 contd....

Profile (Land-uses)	Horizon	Depth (cm)	Boundary	Structure	Consistency	Plasticity
P_{10} (Horticulture)	Ap	0-19	cs	c2cr	sh l ss	So
	Bw1	19- 54	dw	c2sbk	sh fi ss	Sp
	Bw2	54-96	gw	m2abk	h fr ss	Mp
	Bw3	96-134	ds	m2abk	h fi ss	P
	BC	134-173		m2gr	sh fi ms	Sp
P_{11} (Forest)	A	0-28	cs	m2sbk	sh fr ss	Mp
	Bt1	28-59	cs	f2sbk	sh fi s	P
	Bt2	59-87	cs	f3sbk	h fi vs	P
	Bt3	87-132	gs	f3sbk	h fi vs	P
	Bg	132-181	gs	m2abk	sh vfi s	P
	BCg	181-207		m2sbk	sh vfi s	P
P_{12} (Fallow)	A	0-28	Cs	m2gr	sh l ss	So
	AC	28-56	Gw	c2gr	h fi ss	Mp
	C	56-88		c1gr	sh fr ss	Sp

Symbols used in Table-2

Boundary			Structure			Consistency		
b	:	broken	1	:	Weak	h	:	hard
c	:	Clear	2	:	moderate	sh	:	slightly hard
d	:	diffused	3	:	Strong	vh	:	very hard
g	:	gradual	f	:	Fine	l	:	loose
s	:	smooth	m	:	Medium	vfr	:	very friable
w	:	wavy	c	:	Coarse	fr	:	friable
			cr	:	Crumb	fi	:	firm
			gr	:	Granular	vfi	:	very firm
			sbk	:	sub-angular blocky	ss	:	slightly sticky
			abk	:	angular blocky	s	:	sticky
						ms	:	moderately sticky
						vs	:	very sticky
						so	:	non-plastic
						sp	:	slightly plastic
						mp	:	moderately plastic
						p	:	plastic

the profile. The profile P12 surface horizons extended up to 28 cm with a total soil depth of 88 cm. The soil colour of the surface horizons was light yellowish brown (10YR 5/4), and the sub-surface horizons had brown colour (10 YR 5/3). The horizon boundary was smooth and clear in surface horizons and wavy gradual in sub-surface horizons. The texture of surface horizons and the sub-surface horizons was loam with medium moderate granular structure. The consistency in dry conditions was slightly hard to hard. It was friable to firm and slightly sticky to sticky under wet conditions moist conditions. The horizons were slightly plastic to moderately plastic in nature with no effervescence. There was no evidence of clay cutans, mottles or cracks in different layers of the profile.

DISCUSSION

Twelve soil profiles were exposed in the study area, four from each altitude with various land uses. The study area soils were moderately deep except for profiles P2, P4 and P12, which showed a shallow depth. The soils of P8 and P7 mid-altitude were comparatively shallower than the other profiles. The profile depths may be attributed to the variation in topography and slope gradient (Wubie and Assen, 2020, Husien *et al.,* 2015, Sitangang *et al.,* 2006; Prathibha *et al.,* 2018). The other reasons are removal of finer soil particles, erosion of upper horizons, paucity of soil plasma, the degree and intensity of factors of soil formation etc. (Sitangang et al. 2006, Dengiz et al. 2012, Naidu and Sireesha 2013 Karuma e*t al.* 2014 and Harshitha *et al.* 2018). The colour of soils at high altitudes varies from dark brown to brown, and in mid-altitude, it varies from dark brown to pale yellow.

Similarly, the soil colour of low altitudes ranges from dark brown to yellowish-brown. In the various land uses, the forest area soils were darker than the other land uses. The soil colour is an apparent character of chemical and mineralogical properties. The textural property of the soils as determined by moisture regime and topographic position also play a dynamic part in soil colour. (Choudhury et al. 2013, Naidu and Sireesha 2013, Moritsuka et al. 2014, Purswani 2018. The data also revealed that surface soils were darker in colour due to the large quantity of organic matter and clay humus complexes. The presence of grey colour in these profiles may be due to the clotting of calcium and iron with humus components. The yellowish-brown, dark yellow-brown, dark brown, and very dark brown colour in the upper and lower horizons of profiles reveals a good drainage condition of these soils (Panagos *et al.,* 2018, Debele *et al.,* 2018; Chen *et al.,* 2018.

The high altitude soils' structure was coarse granular to angular blocky, while in the mid-altitude, it varied from medium granular to moderate subangular blocky. The low altitude, was having soil structure of medium moderate angular blocky to fine strong subangular blocky. The soils of agricultural land use had fine, strong sub angular structures, while the forest soils had weak granular to the medium moderate sub-angular blocky structure. The hardness and development of sub-angular blocky and angular blocky structures may be associated with an increase in clay fraction, compaction, tillage and climate (Tellen and Yerima 2018). The consistency in the profiles ranged from slightly hard to hard, friable to very firm and slightly sticky to sticky under dry, moist and wet conditions, respectively. The surface horizons showed slight hardness and a friable and sticky nature, which may be attributed to the high organic carbon, continuous manipulation, and less clay. (Ukut *et al.,* 2014; Yitbarek *et al.,* 2016 and Fekadu *et al.,* 2018). The increase in hardness, firmness and stickiness increased with the depth, which may be associated with compaction and clay content in sub-surface horizons (Pulakeshi *et al.,* 2014).

CONCLUSION

In the study of profiles we have observed both shallow and deep profile depths. In the higher altitudes the profile depth was less than the low and mid altitudes representing the effect of topography and slope on the soil formation. The horizon boundary were broken, clear, diffused, gradual, smooth and wavy. Mostly in all the profiles the boundary were clear and smooth representing a mature profile. The soils had fine weak granular to medium moderate crumb structure in surface horizons with increase in grade, class and type (sub-angular blocky to angular blocky) in the sub-surface horizons. The consistency changed from slight hard, friable, slightly sticky and slightly plastic in surface horizons to hard, firm, sticky and plastic in sub-surface horizons. The soils were slightly plastic to plastic representing a good clay content. A specific objective of soil depth and its boundaries can lead to a classical understanding of soil processes and soil horizon variation.

REFERENCES

Abbaslou, A. Abtahi, F. J. Martin Peinado, H. Owliaie, and F. Khormali, (2013). Mineralogy and characteristics of soils developed on Persian Gulf and Oman sea basin, southern Iran. *Soil Sci.,* 178 (10): 568–584

Angelini, M. E., Heuvelink, G. B. M. & Kempen, B. 2017. Multivariate mapping of soil with structural equation modelling. *European Journal of Soil Science,* 68, 575–591.

Bipin B Mishra, Richa Roy (2019). Photopedogenesis: A Fundamental Soil Forming Process in Rock Weathering and Rhizospheric Stability on Earth and Lunar Surface. *Agri Res & Tech: Open Access J.,* 23(3)

Bockheim, J.G., 2018. Diversity of diagnostic horizons in soils of the contiguous USA: a case study. *Catena*, 168, 5–13.

Bonfatti, B. R., Hartemink, A. E., Vanwalleghem, T., Minasny, B. & Giasson, E. 2018. A mechanistic model to predict soil thickness in a valley area of Rio Grande do Sul, Brazil. *Geoderma,* 309: 17–31.

Brevik, E.C., 2009. The teaching of soil science in geology, geography, environmental science, and agricultural programs. *Soil Survey Horizons,* 50, 120–123.

Chen, Y., Zhang, M., Fan, D., Fan, K. and Wang, X. 2018. Linear Regression between CIE-Lab Color Parameters and Organic Matter in Soils of Tea Plantations. *Eurasian Soil Science* 51(2): 199-203.

Choudhury, B. U., Mohapatra, K. P., Das, A., Das, P. T., Nongkhlaw, L., Fiyaz, R. A. and Munda, G. C. 2013. Spatial variability in distribution of organic carbon stocks in the soils of North East India. *Current Science* pp. 604-614.

Debele, M., Bedadi, B., Beyene, S. and Mohammed, M. 2018. Characterization and Classification of Soils of Muger Sub-Watershed, Northern Oromia, Ethiopia. *East African Journal of Sciences* 12(1): 11-28.

Dengiz, O., Zaglam, M. and Sarioglu, F. E. 2012. Morphological and physiochemical characteristics and classification of verti soils developed on deltaic plain. *Open Journal of Soil Science* 2: 20-27.

Dominati, E.; M. Patterson, and A. Mackay. (2010). "A framework for classifying and quantifying the natural capital and ecosystem services of soils," Ecol. Econ. 69, 1858–1868

Dora Neina 2019 . The Role of Soil pH in Plant Nutrition and Soil Remediation. *Hindawi Applied and Environmental Soil Science,* 1: 1-9.

Fekadu, E., Kibret, K., Bedadi, B. and Melese, A. 2018. Characterization and classification of soils of Yikalo Subwatershed in Lay Gayint District, Northwestern Highlands of Ethiopia. *Eurasian Journal of Soil Science,* 7(2): 151-166.

Feller, C., Blanchart, E., Herbillon, A., 2008. The importance of French tropical research in the development of pedology. *Soil Science Society of America Journal,* 72: 1375–1381.

Goebes, P., Schmidt, K., Seitz, S., Both, S., Bruelheide, H., Erfmeier, A., Scholten, T., & Kühn, P. (2019). The strength of soil-plant interactions under forest is related to a Critical Soil Depth. *Scientific reports*, 9(1): 8635.

Hartemink, A.E., 2009. The depiction of soil profiles since the late 1700s. *Catena,* 79: 113–127.

Hartemink, A.E., McBratney, A., Minasny, B., 2008. Trends in soil science education: looking beyond the number of students. *Journal of Soil and Water Conservation,* 63: 76a–83a.

Hartemink, A.E., McBratney, A.B., Cattle, J.A., 2001. Developments and trends in soil science: 100 volumes of Geoderma (1967–2001). *Geoderma,* 100: 217–268

Hartemink, Alfred & Zhang, Yakun & Bockheim, James & Curi, Nilton & Silva, Sérgio & Grauer-Gray, Jenna & Lowe, David & Krasilnikov, Pavel. (2020). Soil horizon variation: A review. *Advances in Agronomy,* 160: 125-185.

Husien H, Mohamed A, Melanie D (2015). Impacts of land use and land cover changes and topographic aspects on soil quality in the Kasso catchment, Bale Mountains of the south eastern Ethiopia. *Singap J Trop Geogr,* 36: 357–375.

Karuma, A. N., Gachene, C. K., Msanya, B. M., Mtakwa, P. W., Amuri, N., & Gicheru, P. T. Soil Morphology, Physico-Chemical Properties and Classification of Typical Soils of Mwala District, Kenya. *International Journal of Plant & Soil Science,* 4(2): 157-170.

Khitrov, N.B., 2016. Vertisols with Gilgai microtopography: classification and parameters of microtopography and morphological types of soils (a review). *Eurasian Soil Sci.,* 49: 125–144.

Khresat, S. A. and E. A. Qudah, (2006). Formation and properties of aridic soils of Azraq Basin in northeastern Jordan. *J. Arid Environ.,* 64: 116–136

Lowe, D.J. (2019). Using soil stratigraphy and tephrochronology to understand the origin, age, and classification of a unique Late Quaternary tephra-derived Ultisol in Aotearoa New Zealand. Quaternary, 2: 1–34.

Ma, Y. X., Minasny, B., Welivitiya, W. D. D. P., Malone, B. P., Willgoose, G. R. & McBratney, A. B. 2019. The feasibility of predicting the spatial pattern of soil particle-size distribution using a pedogenesis model. *Geoderma,* 341: 195–205

Macedo, R.S., Teixeira, W.G., Corr^ea, M.M., Martins, G.C., Vidal-Torrado, P., 2017. Pedogenetic processes in anthrosols with pretic horizon (Amazonian Dark Earth) in Central Amazon, Brazil. *PLoS One,* 12: e0178038.

Mahala, A. (2018). Soil erosion estimation using RUSLE and GIS techniques—a study of a plateau fringe region of tropical environment. *Arab J. Geosci.,* 11: 335

Minasny, B., Stockmann, U., Hartemink, A.E., McBratney, A.B., 2016. Measuring and modelling soil depth functions. In: Hartemink, A.E., Minasny, B. (Eds.), Digital Soil Morphometrics. Springer International Publishing, Dordrecht, pp. 225–240.

Moazallahi, M. and M. H. Farpoor (2009). Soil micromorphology and genesis along a lithotoposequence in Kerman Province, central Iran. *Aust. J. Basic Appl. Sci.,* 3: 4084–4087.

Moazallahi, M. and M. H. Farpoor. (2011). Soil genesis and clay mineralogy along the xeric–aridic climatoposequence, south central Iran. *J. Agric. Sci. Technol.* 14: 683–696.

Mohammed, A.K., Hirmas, D.R., Gimenez, D., Mandel, R.D., Miller, J.R., 2016. A digital morphometric approach for quantifying ped shape. *Soil Sci. Soc. Am. J.,* 80: 1604–1618.

Moritsuka, N., Matsuoka, K., Katsura, K., Sano, S. and Yanai, J. 2014. Soil color analysis for statistically estimating total carbon, total nitrogen and active iron contents in Japanese agricultural soils. *Soil Science and Plant Nutrition* 60(4): 475-485.

Naidu, M. V. S. and Sireesha P. V. G. 2013. Studies on Genesis, Characterization and Classification of soils in semi-arid Agri-ecological Region: A case study in Banaganapalle Mandal of Kurnool district in Andhra Pradesh. *Journal of the Indian Society of Soil Science* 61(3): 167-178.

Owliaie, H.R., Adhami, E., Ghiri, M.N. *et al.* (2018)Pedological Investigation of a Litho-Toposequence in a Semi-Arid Region of Southwestern Iran. *Eurasian Soil Sc.,* 51, 1447–1461.

Padarian, J., Minasny, B. & McBratney, A. B. 2018. Using deep learning for Digital Soil Mapping. *SOIL Discuss,* 5: 79–89

Panagos, P., Standardi, G., Borrelli, P., Lugato, E., Montanarella, L. and Bosello, F. 2018. Cost of agricultural productivity loss due to soil erosion in the European Union: From direct cost evaluation approaches to the use of macroeconomic models. *Land Degradation and Development,* 29(3): 471-484.

Papiernik, S.K.; Lindstrom, M.; Schumacher, T.; Schumacher, J.; Malo, D.; Lobb, D. 2007. Characterization of soil profiles in a landscape affected by long-term tillage. *Soil Tillage Res.*, 93: 335–345.

Pei, X.; Sudduth, K.A.; Veum, K.S.; Li, M. (2019) Improving In-Situ Estimation of Soil Profile Properties Using a Multi-Sensor Probe. *Sensors* , 19: 1011.

Prathibha, K. S., Hebbara, M., Patil, P. L. and Anjali, M. C. 2018. Soil morphological properties and classification of kavalur-1 micro-watershed of Koppal district, Karnataka. *Journal of Pharmacognosy and Phytochemistry 7*(4): 167-173.

Pulakeshi, H. B. P., Patil, P. L. and Dasog, G. S. 2014. Characterization and classification of soil resources derived from chlorite schist in northern transition zone of Karnataka. *Karnataka Journal of Agricultural Sciences,* 27: 1.

Purswani, E. 2018. Assessment of soil characteristics in different land-use systems in Gandhinagar, Gujarat. *Proceedings of the International Academy of Ecology and Environmental Sciences,* 8(3): 162.

Radu Gabriel Pîrnău, Cristian Valeriu Patriche, Bogdan Roca, Ionuþ Vasiliniuc, Nicoleta Vornicu, Simina Stanc, Soil spatial patterns analysis at the ancient city of Ibida (Dobrogea, SE Romania), via portable X-ray fluorescence spectrometry and multivariate statistical methods, CATENA, 10.1016

Rahmati, O., Tahmasebipour, N., Haghizadeh, A., Pourghasemi, H. R. & Feizizadeh, B. 2017. Evaluation of different machine learning models for predicting and mapping the susceptibility of gully erosion. *Geoderma,* 298: 118–137

Ribeiro, B.T., Silva, S.H.G., Silva, E.A., Guilherme, L.R.G., 2017. Portable X-ray fluorescence (pXRF) applications in tropical soil science. *Cienc. Agrotecnol.,* 41: 245–254.

Roudier, P., Manderson, A., Hedley, C., 2016. Advances towards quantitative assessments of soil profile properties. In: Hartemink, A.E., Minasny, B. (Eds.), Digital Soil Morphometrics. Springer International Publishing, Dordrecht, pp. 113–132.

Sidorova, V.A., 2016. Dynamics of the spatial variability of soil properties of grassland agrocoenosis of Karelia during post-anthropogenic development. *Russ. J. Appl. Ecol.,* 3: 23–27.

Silva, S.H.G., Silva, E.A., Poggere, G.C., Guilherme, L.R.G., Curi, N., 2018. Tropical soils characterization at low cost and time using portable X-ray fluorescence spectrometer (pXRF): effects of different sample preparation methods. *Cienc. Agrotecnol.* 42: 80–92.

Sitangang, M., Rao, Y. S., Ahmed, N. and Mahapatra, S. K. 2006. Characterization and classification of soil of water shed area of Shikahpur, Gurgaon district, Haryana. *Journal of the Indian Society of Soil Science,* 54(1): 106-110.

Stockmann, U., Cattle, S.R., Minasny, B., McBratney, A.B., 2016. Utilizing portable X-ray fluorescence spectrometry for in-field investigation of pedogenesis. *Catena,* 139: 220–231.

Tellen, A. V. and Yerima, B. 2018. Effects of land use change on soil physicochemical properties in selected areas in the North West region of Cameroon. *Environmental Systems Research* 7(3): 1-29.

Ukut, A. N., Akpan, U. S. and Udoh, B. T. 2014. Characterization and classification of soils in steep sided hills and sharp-crested ridges of Akwa Ibom State, Nigeria. *Net Journal of Agricultural Science,* 2(2): 50-57.

Waruru, B.K., Shepherd, K.D., Ndegwa, G.M., Sila, A., Kamoni, P.T.. 2015. Application of mid infrared spectroscopy for rapid characterization of key soil properties for engineering landuse. *Soils Found.,* 55(5): 1181– 1195

Wu, S., Wang, C., Liu, Y., Li, Y., Liu, J., Xu, A., Pan, K., Li, Y., Pan, X., 2018. Mapping the salt content in soil profiles using Vis-NIR hyperspectral imaging. *Soil Sci. Soc. Am. J.,* 82: 1259–1269.

Wubie, M.A., Assen, M. (2020). Effects of land cover changes and slope gradient on soil quality in the Gumara watershed, Lake Tana basin of North–West Ethiopia. *Model. Earth Syst. Environ.* 6: 85–97.

Yitbarek, T., Beyene, S. and Kibret, K. 2016. Characterization and classification of soils of Abobo Area, Western Ethiopia. *Applied and Environmental Soil Science. Eurasian Journal of Soil Science,* 7(4): 292-299.

Zeraatpisheh, M., Ayoubi, S., Jafari, A. & Finke, P. 2017. Comparing the efficiency of digital and conventional soil mapping to predict soil types in a semi-arid region in Iran. *Geomorphology,* 285: 186–204.

Zhang L, Bai KZ, Wang MJ, Karthikeyan R (2016) Basin-scale spatial soil erosion variability: Pingshuo opencast mine site in Shanxi Province. *Loess Plateau of China Nat Hazards,* 80(2): 1213–1230.

Zhang, G.-L., Liu, F. & Song, X.-D. 2017. Recent progress and future prospect of digital soil mapping: A review. *Journal of Integrative Agriculture,* 16: 2871–2885.

Zhang, Y., Hartemink, A.E., 2019b. A method for automated soil horizon delineation using digital images. *Geoderma,* 343: 97–115.

Zhang, Y., Hartemink, A.E., Huang, J., 2019a. Quantifying coarse fragments in soil samples using a digital camera. *Eurasian Soil Sci.,* 52: 954–962.

Zhuo-Dong Jiang, Qiu-Bing Wang, Kabindra Adhikari, Kristofor R. Brye, Zhong-Xiu Sun, Fu-Jun Sun, Phillip R. Owens, A vertical profile imaging method for quantifying rock fragments in gravelly soil, CATENA.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 530-534

Varietal Assessment of Different Crops under Sub-tropical conditions of Kathua District

Vishal Mahajan, Ashu Sharma, Berjesh Ajrawat*, Anamika Jamwal, Ajay Kumar, Vishal Sharma and Pawan Kumar Sharma
Krishi Vigyan Kenrda, Kathua, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, J&K

ABSTRACT

A demonstration cum field experiment was conducted at Krishi Vigyan Kendra, Kathua during rabi season to study the performance of different varieties of crops in crop cafeteria under subtropical conditions. Fifteen varieties of wheat *i.e.* HD-2967, HD-3086, HD-3059, WH-1142, WH-1021, RSP-561, PBW-621, JAUW-584, JAUW-598, HS-542, WH-1080, WH-1105, PBW-175, Raj-3077 and Raj-3765; five varieties of chickpea *i.e.* PBG-5, PBG-7, GNG-1581, C-235 and GNG-469; four varieties of Gobhi sarson *i.e.* DGS-1, RSPN-25, GSL-2 and GSC-7 were sown during the period from 2015-16 to 2019-20. Data recorded on yield characters revealed that the average maximum yield of wheat was obtained from HD-2967 (38.48 q/ha) while the minimum yield was recorded with PBW-175 (31.77 q/ha). Wheat crop gave average productivity by 83.16, 102.78 and 18.82 per cent more over district, state and national yield, respectively. Chickpea variety GNG-469 recorded the highest average yield (16.32 q/ha) whereas, PBG-7 recorded the minimum average yield (10.92 q/ha). The demonstrated technology of chickpea in crop cafeteria gave 95.45, 138.10 and 37.29 per cent more over district, state and national yield, respectively. The average maximum yields were recorded with gobhi sarson variety RSPN-25 (16.06 q/ha) followed by DGS-1 (14.78 q/ha), GSL-1 (14.30 q/ha) and GSC-7 (13.32 q/ha). Gobhi sarson crop gave 62.14, 86.66 and 8.63 per cent more yield over district, state and national yield, respectively.

Keywords: Assessment, Different Crops, Sub-tropical, Varietal

INTRODUCTION

Agriculture is the country's largest enterprise working as the backbone of the Indian economy. It employs more than 50 percent of the country's population, mainly in rural areas, and contributes about 19.9 percent of gross domestic product (Agricultural Statistics at a Glance, 2020). One of the reasons for declining factor productivity in the country is the continued depletion of natural resources under intensive agriculture to attain food sufficiency goals. Our soil health has indeed been affected as a consequence of multi-nutrient deficits and a drop in organic carbon levels. Climate change has already caused havoc on our current crop profile and is threatening to play considerably more trouble in the future. Lack of water resources, evaporation, soil suitability and selection of suitable varieties, along with changes in sowing and harvesting dates, significantly affect crop productivity (Ito *et al.*, 2018). Other harmful effects also ultimately results from either the heavy use of chemical herbicides, pesticides, fertilizers and intensification of agricultural production in the last few decades, including nitrate in ground water, contamination of food materials, stratospheric changes, loss of beneficial microorganisms/insects and reduction in genetic diversity, leading to higher susceptibility to pests and diseases (Pathak *et al.*, 2012; Prashar and Shah, 2016). Sub-tropical areas of Kathua district is likewise dealing with the same issues which are contributing to low productivity. Low crop yield can be caused by a variety of issues, including the use of inferior varieties, insufficient seed rates, sowing techniques, untreated seed, imbalanced use of fertilizers, plant protection measures and weed management practices. For technology transfer, there are numerous approaches available, including training, front-line

*Corresponding author email id: bajrawat@gmail.com

demonstrations, on-farm trials, crop cafeterias, Kisan Mela & Kisan Gosthi, radio and television talks, and the use of print media in agriculture. Crop cafeteria, for example, plays a vital function as a facilitator in the technology transfer process among farming communities. It provides practical experiences and face-to-face interactions with KVK technocrats for imparting technical knowhow to farmers, rural youths, and extension bureaucrats, based on the premise of "seeing is believing." In light of the foregoing, Krishi Vigyan Kendra Kathua has decided to use crop cafeteria to test and promote high yielding varieties of wheat, chickpea and gobhi sarson with suggested production technology among rural communities under sub-tropical conditions.

MATERIALS AND METHODS

A field experiment was conducted during the *rabi* seasons of 2015 to 2020 at Krishi Vigyan Kendra, Kathua. The soil of the experimental site was sandy loam in texture, neutral in pH, low in organic carbon and available nitrogen and medium in available phosphorus and potassium. Krishi Vigyan Kendra, Kathua has planned to evaluate and popularize the HYVs of Wheat, Chickpea and Mustard with good agronomical practices and plant protection measures among farming communities through crop cafeteria. Fifteen varieties of wheat *i.e.* HD-2967, HD-3086, HD-3059, WH-1142, WH-1021, RSP-561, PBW-621, JAUW-584, JAUW-598, HS-542, WH-1080, WH-1105, PBW-175, Raj-3077 and Raj-3765; five varieties of chickpea *i.e.* PBG-5, PBG-7, GNG-1581, C-235 and GNG-469; four varieties of Gobhi sarson *i.e.* DGS-1, RSPN-25, GSL-2 and GSC-7 were sown during the period from 2015-16 to 2019-20. All the varieties were sown in 12 m^2 area with appropriate row to row and plant to plant distances. All the recommended agronomical and cultural practices were followed for cultivation of different crop. The yield data were collected from the crop cafeteria and analyzed by using simple statistical tools.

RESULTS AND DISCUSSION

The latest technological interventions comprising improved varieties, seed treatment, time and method of sowing, recommended dose of fertilizers, weed management and proper plant protection measures were used as per package and practices of each crop. Results of crop cafeteria on wheat crops during five years are presented in Table 1. Data were recorded on yield characters revealed that the average maximum yield of wheat was obtained from HD-2967 (38.48 q/ha) followed by HD-3086 (38.27 q/ha), PBW-502 (37.50 q/ha), JAUW-584 (37.38 q/ha), JAUW-598 (36.88 q/ha), HD-3059 (35.37 q/ha), WH-1021 (34.84 q/ha), Raj-3077 (34.27 q/ha), WH-1142 (33.94 q/ha), RSP-561 (33.92 q/ha), WH-1105 (32.91 q/ha), WH-1080 (32.83 q/ha), PBW-621 (32.77 q/ha) and PBW-175 (31.77 q/ha) during the experimentation. The yield of all crops was also compared at district, state and national level and it was found that the productivity of crop cafeteria reflected significantly more over district, state and national level. The average wheat productivity was 39.23 q/ha from demonstrated plot during 2015-16 to 2019-20 (Table 2). The highest average wheat productivity i.e. 40.81 q/ha was received during 2018-19 followed by 39.98 q/ha, 39.76 q/ha, 39.31 q/ha and 36.28 q/ha during 2017-18, 2016-17, 2015-16 and 2019-20 respectively. The demonstrated technology of wheat in crop cafeteria yielded 83.16, 102.78 and 18.82 per cent more over district, state and national yield, respectively. Singh *et al.* (2019) also reported similar findings in wheat crop under crop cafeteria.

With the adoption of better technological interventions the average productivity of chickpea was 13.77 q/ha during 2015-16 to 2019-20 (Table 1). The cultivar GNG-469 (16.32 q/ha) recorded higher average yield followed by GNG-1581 (15.52 q/ha), C-235 (13.96), PBG-5 (12.10 q/ha) and PBG-7 (10.92 q/ha). The maximum average productivity was 14.84 q/ha during 2019-20 followed by 14.07, 14.05, 12.97 and 12.90 q/ha during 2018-19, 2016-17, 2015-16 and 2017-18 respectively. The demonstrated technology of chickpea in crop cafeteria gave 95.45, 138.10 and 37.29 per cent more yield over district, state and national yield, respectively. These results are in conformity with those of Singh *et al.* (2015).

The perusal of data presented in Table 1 revealed that the gobhi sarson variety RSPN-25 recorded maximum average yield to the corresponding value of 16.06 q/ha followed by DGS-1 (14.78 q/ha), GSL-1 (14.30 q/ha) and GSC-7 (13.32 q/ha). The average yield (14.62 q/ha) was recorded from crop cafeteria during 2015-16 to 2019-20 (Table 4). Highest average yield *i.e.* 15.77 q/ha was recorded during 2018-19

Table 1: Performance of crop cafeteria on yield of different crops

Name of the crop/ variety	Yield (q/ha)					Average yield (q/ha)
	2015-16	2016-17	2017-18	2018-19	2019-20	
Wheat						
HD-2967	36.55	37.65	36.90	39.43	41.85	38.48
HD-3086	37.15	38.81	35.71	38.90	40.76	38.27
HD-3059	35.22	35.63	36.15	33.72	36.12	35.37
WH-1142	32.14	33.53	34.10	34.84	35.10	33.94
WH-1021	32.45	33.86	35.36	36.74	35.80	34.84
RSP-561	30.64	32.91	35.32	35.81	34.93	33.92
PBW-621	31.40	30.15	32.37	35.13	34.79	32.77
JAUW-584	37.03	36.65	37.55	37.44	38.25	37.38
JAUW-598	36.74	36.34	35.80	38.21	37.30	36.88
PBW-502	38.30	38.70	36.40	35.46	38.62	37.50
WH-1080	32.17	32.65	31.87	33.66	33.80	32.83
WH-1105	31.80	32.40	32.75	33.50	34.10	32.91
PBW-175	31.63	30.55	32.16	32.69	31.84	31.77
Raj-3077	34.72	33.11	33.68	34.17	35.70	34.28
Raj-3765	32.90	34.63	34.85	33.72	35.25	34.27
Average	34.06	34.50	34.73	35.56	36.28	35.03
Chickpea						
PBG-5	11.25	12.67	10.85	12.45	13.30	12.10
PBG-7	10.10	11.35	9.77	11.40	12.00	10.92
GNG-1581	14.25	16.55	15.11	15.50	16.20	15.52
C-235	12.70	13.81	13.45	14.35	15.47	13.96
GNG-469	16.57	15.85	15.30	16.67	17.22	16.32
Average	12.97	14.05	12.90	14.07	14.84	13.77
Gobhi Sarson						
DGS-1	14.25	13.55	15.31	15.13	15.68	14.78
RSPN-25	16.05	15.33	16.50	15.94	16.50	16.06
GSL-2	13.73	14.28	13.85	15.51	14.15	14.30
GSC-7	12.95	11.63	13.50	16.50	12.00	13.32
Average	14.25	13.70	14.79	15.77	14.58	14.62

Table 2: Impact of wheat crop cafeteria in terms of productivity enhancement

Year	Average yield in crop cafeteria (q/ha)	District yield (DY) (q/ha)	State yield (SY) (q/ha)	National yield (NY) (q/ha)	% change over DY	% change over SY	% change over NY
2015-16	39.31	19.52	19.47	30.34	101.37	101.89	29.56
2016-17	39.76	19.19	16.38	32.00	107.17	142.71	24.24
2017-18	39.98	21.60	16.28	33.68	85.10	145.59	18.71
2018-19	40.81	23.57	23.3	35.33	73.16	75.16	15.52
2019-20	36.28	24.35	24.42	34.21	49.00	48.57	6.05
Average	39.23	21.65	19.97	33.11	83.16	102.78	18.82

Source of District, State and National yield data: Agricultural Statistics at a Glance, 2020

Table 3: Impact of chickpea crop cafeteria in terms of productivity enhancement

Year	Average yield in crop cafeteria (q/ha)	District yield (DY) (q/ha)	State yield (SY) (q/ha)	National yield (NY) (q/ha)	% change over DY	% change over SY	% change over NY
2015-16	12.97	5.40	6.31	8.40	140.26	105.61	54.45
2016-17	14.05	6.67	5.47	9.74	110.58	156.78	44.21
2017-18	12.90	7.55	5.53	10.78	70.81	133.20	19.63
2018-19	14.07	7.73	5.35	10.41	82.07	163.07	35.20
2019-20	14.84	8.55	6.40	11.16	73.54	131.84	32.96
Average	13.77	7.18	5.81	10.10	95.45	138.10	37.29

Source of District, State and National yield data: Agricultural Statistics at a Glance, 2020

Table 4: Impact of gobhi sarson crop cafeteria in terms of productivity enhancement

Year	Average yield in crop cafeteria (q/ha)	District yield (DY) (q/ha)	State yield (SY) (q/ha)	National yield (NY) (q/ha)	% change over DY	% change over SY	% change over NY
2015-16	14.25	7.30	6.12	11.83	95.14	132.76	20.41
2016-17	13.70	8.67	5.26	13.04	57.99	160.41	5.04
2017-18	14.79	8.20	7.93	14.10	80.37	86.51	4.89
2018-19	15.77	10.50	11.49	15.11	50.19	37.25	4.37
2019-20	14.58	11.48	12.53	13.45	27.03	16.38	8.42
Average	14.62	9.23	8.67	13.51	62.14	86.66	8.63

Source of District, State and National yield data: Agricultural Statistics at a Glance, 2020

followed by 14.79, 14.58, 14.25 and 13.70 q/ha during 2017-18, 2019-20, 2015-16 and 2016-17, respectively. The gobhi sarson crop gave 62.14, 86.66 and 8.63 per cent more yield as compared to district, state and national yield, respectively. These findings approbate with the results of Pandey *et al.* (2013).

Yield gap of different crops was also analyzed with average yield of district, state and national and wide yield gap was observed in different crops during study period. It is emphasized the need to educate the farmers through various means for the adoption of improved production and protection technologies to reverse this trend of wide yield gap. More and more use of latest production technologies with high yielding varieties and integrated plant protection components will subsequently change this alarming trend of galloping yield gap. This finding is in corroboration with the findings of Raj *et al.* (2013). The possibility of increasing yield of wheat,

Chickpea and gobhi sarson per unit area was found in the area at significant level. It may be due to genetic variability of varieties with optimum seed rate, seed treatment, spacing with optimum plant stand, optimum fertilizer application, need based plant protection, proper weed management and local climatic situation.

CONCLUSION

Based on the findings, the current study can concluded that crop cafeteria demonstrations of high yielding varieties of different crops using the most up-to-date production technologies were found to be more effective, and there are also bright chances to increase the yield of these crops by using improved technologies and proper plant protection management. Farmers and extension personnel must be educated using a variety of methods, including off and on-campus trainings, method demonstrations, front-line demonstrations, and so on, in order to improve crop output and reduce the alarming trend of widening yield gaps.

REFERENCES

Agricultural Statistics at a Glance. (2020). Government of India, Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare, Directorate of Economics and Statistics, New Delhi.

Ito, R. Vasconcelos, H.L., Feeley, K.J. (2018). Global climate change increases risk of crop yield losses and food insecurity in the tropical Andes. *Glob. Chang. Biol.,* 24: 592-602.

Pandey, SK, Baksh, H and Kumar, M. (2013). Performance of hybrid tomatoes in crop cafeteria: An effective tool for technology evaluation and dissemination. *Annals of Horticulture,* 6(1): 139-141.

Pathak, H., Aggarwal, P. K. and Singh H. D. (2012). Climate change impact, adaptation and mitigation in agriculture: Methodology for assessment and application. Division of Environmental Science, IARI, New Delhi, India.

Prashar, P. and Shah, S. (2016). Impact of fertilizers and pesticides on soil microflora in agriculture. https:// www. researchgate.net/publication/301542254.

Raj, A.D., Yadav, V. and Rathod, J.H. (2013). Impact of front-line demonstrations (FLD) on the yield of pulses. *International Journal of Scientific and Research Publications*, 3(9): 1-4.

Singh, Mamta, Yadav, K.S., Singh, Vinita, Pachauri, Vivekin and Dwivedi, A.P. (2015). Cropcafeteria: an effective approach for technology evaluation and dissemination. National Conference on GRISAAS-2015 at RSKVV, Gwalior, M.P.

Singh, R. P., Singh, R.P., Singh, A. K., Singh, D. and Singh, M. (2019). Technology evaluation and dissemination among farming communities through crop cafeteria. *Indian Journal of Extension Education*, 55(4): 151-157.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 535-540

Managing Plant Health using Biopesticides for Environmental Sustainability

H.B. Singh
Department of Biotechnology, GLA University, Mathura-281406, Uttar Pradesh

Biopesticide formulation based on bacteria, fungi, viruses, nematodes, protozoa etc. are know as microbial pesticides. These microbial pesticides also include antagonistic organisms for biological control of plant diseases. Nine microbes namely *Bacillus subtilis, Gliocladium* spp., *Trichoderma* spp., *Pseudomonas Fluorescens, Beauvaria bassiana, Metarrhizium anisopliae, Verticillium lecanii,* Grannulosis viruses and nuclear polyhedral viruses (NPV) have been included in a schedule vide an amendment in insecticides Act, 1968 for the commercial production of biopesticide and published in the Gazette of India dated 26th March 1999. To date 26 more microbes have been included in the schedule to the Insecticide Act 1968 for production of microbial biopesticides. *Trichoderma viride, T. harzianum, Pseudomonas, Beauvaria bassiana, Metarrhizium anisopliae* and *Bacillus subtilis* have curved a niche for themselves in India as important biocontrol agents for management of various pests and diseases (Singh et al. 2016a). However, their reach is still limited to some selected states in our country. The major reason for this phenomenon is the mushrooming of some spurious producers. This not only sows the seeds of doubt in farmers mind about the profitability of microbial biopesticides but also the ill effect of these biopesticides. The research on biocontrol agents (BCAs) can be fruitful only when we commercialize and register the product based on superior strains. To achieve this, certain norms specified by Central Insecticides Board are to be followed. The mass production of microbes based formulation is also very important part in the development of technology. Although the biological control ability of *Trichoderma* has been shown for many years, the ability of these fungi to increase the rate of plant growth and development, especially to enhance the production of more robust roots is now being documented. The present paper will discuss about these parameters setup by CIB and other aspects related to commercialization and registration of biopesticides (Singh *et al.* 2016 b).

A major problem in agriculture is the difficulty in managing different diseases caused by pathogens specially root pathogens and even when chemical pesticides are available, questions arise concerning their efficiency when applied to soil in nurseries or in the field. It is likely that in the future most systems of agricultural crop production will be less intensive with significantly reduced chemical inputs, not only of fertilizers but also of pesticides. Pest resistance selection and biocontrol procedures therefore become the two essential approaches to guarantee an acceptable level of crop protection. Resistance can be selected through breeding or using tissue culture techniques to produce clones with desired traits. The management of plant diseases is an imperative need in the 21st century to meet the increasing demand for a continuous and healthy (devoid of residues of chemical pesticides) food supply for an ever-increasing human population. The practices in vogue for disease management nowadays are based largely on genetic resistance in the host plant (a long and time taking process), management of the plant and its environment (no always successful) and synthetic pesticides. The use of chemical pesticides in agriculture though have helped to maintain a low-cost, high quality food supply, their positive contribution has been challenged by individuals and groups suggesting that the negative environmental effects of these pesticides far outweigh their societal benefits. The US Environmental Protection Agency's (EPA) Science Advisory Board recommended, "The value of natural ecosystems is not limited to their immediate utility to humans. They have an intrinsic, moral value that must

Email id: hbs1@rediffmail.com

be measured in its own terms and protected for its own sake". In this context the use of biological control is increasingly capturing the attention of plant pathologist and gaining the stature as a possible and practical agricultural method of controlling the soilborne plant pathogens (Singh *et al.* 2017, Manoharachary *et al.* 2020, Rakshit *et al.* 2022).

NEED FOR COMMERCIALIZATION OF BIOPESTICIDES IN INDIA?

Our research in the field of agriculture immediately after independence has been mainly basic. It was only after the green revolution that the research in agricultural disciplines started to move towards applied areas and the scientists started to categorize the effective researchers on the basis of their reach to the farmers, how easily it could be applied in the field and the cost-benefit ratio etc. In our country and elsewhere N, P, K has been used since ancient times through the use of cow dung, leftovers of the previous crops etc. and the disease management practices were in vogue with the use of simple techniques of rouging and burning the diseased plant, use of CuSO4, etc. But it was only-after the chemical fungicides began to be produced on commercial scale did the production of crops burgeoned. Same is the case with biological control agents. The scientists have screened a large number of antagonists, selected the effective ones and tried them in field for controlling the diseases in micro-plots. In this process crude formulations of the effective antagonists were developed.

The next logical step of the above sequence should have been commercialization of the biocontrol products. The commercialization of biocontrol products is also necessary to overcome the negative and harmful effects of the chemicals, which are caused by their prevalence in our current schemes of disease management. This is more so in case of developing countries where the chemicals banned in most of the developed countries are still in use e.g. Pentachloronitrobenzene (PCNB), a highly toxic fungicide is still used for disease management in our country whereas it is banned in USA. It is anticipated that the successful development and commercialization of the biocontrol fungi will effectively reduce the use of hazardous chemicals and ultimately it may eliminate them. This will help us to provide out future generations with safer and cleaner soil, water and air than it is now. In India it is very difficult to convince largely illiterate farmers to use biocontrol products instead of hazardous chemical pesticides. Rough estimates by a company indicate that the biocontrol products constitute less than 1.5-2.0 per cent of crop protection market which is in tune with the global scenario. List of biopesticides included in the schedule to the insecticide act, 1968 is given in the (Table 1).

Table 1: List of bio-pesticides (botanicals) included in the schedule to the insecticide act, 1968

Plant origin Biopesticides:	
1.	Pyrethrins (Pyrethrum)
2.	Neem Products
3.	Karanjin
4.	Extracts of Cymbopogan species
5.	Oxymatrine
6.	Reduced Azadirachtin (s)
7.	Triptericium of wilfordii Hook GTW – Plant extract
8.	Bitterbarkomycin
9.	Squamocin
10.	Eucalyptus leaf Extra

It has been said of biocontrol researchers that they are very good at moving the ball up and down the field but are not able at good finish i.e. crossing the goal line. Worldwide, approximately 80 biocontrol products have made it over the goal line to become commercial products. The products are restricted in their use in the sense that they can control only one or two pathogens and have been tried on relatively few crops before being released in to the market. There has also been relatively little investment in the development and production of commercial formulation of biocontrol-active microorganisms probably due to the cost of developing, testing, registering and marketing of these products. The efforts made in the direction of commercialization of biocontrol agents may be categorized in three groups based on both the increasing level of difficulty and decreasing potential of repeat sales. The first group proposed to apply the antagonist directly and precisely to the infection court when and where needed much like the use of soothing balm in medicine. This is done to preempt or swamp the pathogen by the application of high population of antagonist organism e.g. seed-applied antagonists for protection of germinating seeds against damping-off and antagonists applied to fruits for protection against fruit decay in storage and bacterial growing at below 0°C for protection of plants against frost injury .Nearly all microbes commercialized to date fall in to this group with the exception of *Gliocladium virens* GL-21 which is applied in soil in close proximity to seed or plant with sufficiently high inoculum density to assure instantly high population in the infection court. This group of bioagents forms the first logical step in their commercialization for use against plant diseases and is important for the group's significant contribution in increasing the experience and familiarity with microbes within the industry, growers and society.

Plant Growth Promoting Rhizobacteria (PGPR) form the backbone of second group which includes antagonists being applied at one place e.g. on seeds with the intent that they will spread with the growth of the plants and protect their roots and shoots. Recently use of biostimulants has gained importance for managing plant health as they are eco-friendly in nature for long term sustainability (Singh and Vaishnav. 2022 a, b, c, d). Delivery of biopesticides is another area where research work is going on globally however seed biopriming with microbials are gaining popularity now-a-days (Rakshit and Singh 2020). This group of antagonists may include cases exemplifying the strategy of inundative and augmentative application where the antagonists is expected to multiply, persist for part or all of the life of the plant and increase an inadequate population of a related or similar antagonist already present in the rhizosphere. For example anoxygenic *Aspergillus flavus* was used to spread from colonized wheat grains scattered on the soil surface on to the floral parts of cotton plants where they forestall the establishment of toxigenic strains of *A. flavus*. This category of examples presents a more challenging approach to biocontrol as the antagonists involved are subjected to greater vulnerability to the effects of competition and environmental conditions. No antagonists of this group have been commercialized to date.

The failure or inconsistent performance of the biological control in the rhizosphere with introduced microbes are as follow:

i) Low disease pressure for an effective test.

ii) The treatment favours the increased damage from non-target diseases.

iii) Colonization of the roots affected by the introduced strain or the loss of ecological competence by strain is variable and

iv) The expression of production of antibiotics, wherever it is necessary for the effective action of antagonist, is either too late or too low in quantity to be effective for controlling the disease.

However, these limitations can be sorted out by selection of effective strains of antagonist and improvement in their activity through modern biotechnological methods. Some other challenges related to commercialization of biocontrol products are a mixture of institutional problems, technical limitations and unrealistic expectations from these products. However, we will have to overcome these obstacles if we are serious about the development of commercial products for biological control. The rhizosphere competence of the formulation developed as result of years of research varies with changing soil conditions. After isolating a rhizosphere competent strain of an effective biocontrol agent/antagonist all the researches a must be directed towards the development and production of the strain. The field trials are necessary supplements for the development of a product, which need to be carried out under different soil conditions in different field, on different crops and various pathogenic fungi in order to develop a broad-spectrum product, which can effectively control a large number of pathogenic fungi under different conditions. Biocontrol fungi control diseases and in addition have other benefits, including amelioration of intrinsic physiological stresses in seeds and increasing resistance to abiotic stresses (Singh *et al.* 2017).

Another constraint is the selection of suitable substrate for the development of effective formulation. A number of substrates have been tried for the development of biocontrol formulation. It would be economically viable to use the agricultural wastes viz., tea, coffee waste, rice hay, distilled wastes from soil yielding plants, wheat bran etc. We have developed an economical method for mass multiplication of biocontrol fungi for field application. Different substrates used for mass production of biocontrol fungi in laboratory conditions are namely Powdered rye grass seed, Diatomaceous earth granules + molasses, Wheat bran formulation ,Wheat bran saw dust formulation, Molasses- yeast medium, Wheat bran peat formulation, Sorghum seeds, Sugarcane and Maize straw, Tapioca rind or thippi substrate, Talc formulation, Coffee fruit skin and cherry husk ,Alginate-Wheat bran, Coconut coir pith, Alginate pellets, Vermiculite wheat bran and cellulose granule formulation, Distilled waste of aromatic plants, Soy flour and molasses ,Sugarcane press mud, Used tea leaves, Pine needles, Banana pseudo stem Pine apple peelings Compost, Rye grains etc. A large number of commercialized products have been developed and are available in the world market for disease management but they are either location specific or disease specific or both. Not many products are available which are broad-spectrum one and used on large scale. As of today, a large number of diseases are not covered by the commercialized biocontrol formulations. Currently in the market, a number of biologically based products are being sold for the control of fungal plant diseases. Thus, there is need for moving ahead with selecting the effective strains of biocontrol fungi and developing them as broad-spectrum formulations for use against a large number of soil-borne diseases in varying soil conditions. A large chunk diseases of biocontrol products commercialized all over the world for managing soil borne fungal diseases of plants are *Trichoderma*-based e.g. in our country, about 400 manufacturers are producing *Trichoderma*-based formulations. Economics is the key as well as an important barrier to commercialization of microbial agents for use in agriculture. This is manifested by the fact that the cost of development and registration (the policy varying in different countries) has to be paid by a very limited market e.g. the market represented by a single crop. In USA, providing the toxicological data to EPA greatly reduces the prospects for commercialization. Another major obstacle is an absence of infrastructure for scale up and commercialization of biocontrol products in most of the countries. A system similar to that developed for release of new cultivars by breeders must be developed for commercialization and dissemination of biocontrol agents to the farmers.

The ideal conditions required for development of a biocontrol agents and its subsequent commercialization are:

- Selection of Suitable Strain
- Shelf Life and Storage
- Application Technology
- Scale up and Quality Control
- Registration

One of the major hurdles to be overcome in the commercialization process is registration of the organisms involved in the production of biocontrol products. In the European Countries an efforts has been made to provide a consistent legal framework throughout the European Union by Directive 91/414/EEC "Concerning the placement of plant protection products on the market". But there has been considerable debate surrounding this issue and it has still not been fully resolved creating uncertainly in the industry. In USA, EPA has four tiers of testing for adverse effects that might occur form the microbial pesticides. These include non-target toxic or pathogenic effects on both plants and animals. In March, 2009 Government of India has enforced law that antagonistic organism viz. *Trichoderma* spp., *Gliocladium* spp., *Bacillus* spp., *Pseudomonas* spp. etc. be included in the schedule of Insecticide Act 1968. In India, the condition is entirely different. Here the chemical pesticide industry has monopolized the crop protection market and they are harming the environment for microbial biocontrol products by flooding the market with spurious products. But industrialists deny the allegations by stressing that they are merely exploring ways to become eco-friendly. The government's attitude is also not encouraging. There is need for a paradigm shift in which business is done to create a market for biocontrol products in India. All biopesticide formulations contain microbes in one form or other. There are certain legal bindings for registration of any microbial product which need to be completed before the product can be marketed. The import, manufacture, sale transport and distribution of biopesticides is regulated in India by Insecticides Act 1968 and rules framed there under (Keswani *et al.* 2016). The major points of this requirement are as follows:

The Central Insecticides Board has approved inclusion of more microorganisms to the schedule of Insecticides Act to regulate the manufacture and use in India (Table 2).

Table 2: Microbial pesticides included in the schedule to the Insecticide Act, 1968

1.	*Nomurea rileyi*
2.	*Hirsutella* species
3.	*Verticillium chlamydosporium*
4.	*Streptomyces griseoviridis*
5.	*Streptomyces lydicus*
6.	*Ampelomyces quisqualis*
7.	*Candida oleophila*
8.	*Fusarium oxysporum* (non pathogenic)
9.	*Burkholderia cepacia*
10.	*Coniotyrium minitans*
11.	*Agrobactarium radiobacter* strain 84
12.	*Agrobactarium tumefaciens*
13.	*Pythium oligandrum*
14.	*Erwinia amylovora* (hairpin protein)
15.	*Phlebia gigantean*
16.	*Paecilomyces lilacinus*
17.	*Penicilliuim islanidicum* (for groundnut)
18.	*Alcaligenes* spp.
19.	*Chaetomium globosum*
20.	*Aspergillus niger* – strain AN27
21.	VAM (fungus)
22.	*Myrothecium verrucaria*
23.	*Photorhabdus luminescences* akhurustii strain K-1
24.	*Serratia marcescens* GPS 5
25.	*Piriformospora indica*

After inclusion of an organism in the schedule an applicant can submit Form I along with prescribed fees to the Registration Committee (RC) under the Section 9(3B) as per the guidelines of data generation. Permanent certification is issued under section 9(3) as per guidelines.

DATA REQUIREMENTS

Usually the CIB-RC allows commercialization in terms of import, manufacture, sale transport and distribution of biopesticides only after the grant of regular registration. The data requirements for all microbes to be registered is provided at http://www.cibrc.nic.in.

FUTURE PROSPECTS

What is the future of biological control against the plant pathogens causing various diseases all over the entire world? To convert the prognosis for the future of biological control the major question is how the technology can be moved from laboratory to the commercial growers. More scientific efficacy trials with proper replication and statistical analysis are need under commercial or near-commercial conditions. Biocontrol products are either marketed as standalone products or formulated as mixtures with other microbials. But intensive research is required in formulating mixtures which could fetch us some more success stories. To help improve the global market perception of biopesticides as effective products, the biopesticide Industry Alliance is establishing a certification process to ensure industry standards for efficacy, quality and consistency. This data should be in the public domain; its ready accessibility to growers and extension personnel will be more persuasive than reliance on company advertisements. The reasons for the lack of data on biological control are not far to seek. Some are:

a) Many of the date are proprietary and found only in company reports or in registration submissions.
b) Universities and research institutions have moved away from routine testing of products and results are published in research station bulletins which are not accessible through citation services.
c) Many trials may show lack of effectiveness and are not published.
d) Trials showing the effectiveness of biocontrol products are not published in scientific journals because of perceived lack of the innovation.

More studies are required on the epidemiology and ecology of the pathogen, which is specially lacking for soil borne pathogens. In addition several other questions must be answered before harping on the successes of biological control in comparison to chemical control methods. For example:

a) What is the method of introduction of pathogen and its spread?
b) What is the relationship between the population density and damage?
c) What are the effects of various environmental conditions on the efficacy of introduced microorganism?

Every option, which we have, doing nothing being one of them, has environmental consequences. But we have to find a way out of this quagmire to assume that our commercial products for biocontrol of plant diseases have the effectiveness and safety as their chief traits. Only then, the commercialization of biocontrol agents can be assumed to be successful. For biocontrol to be more acceptable, the concept that the disease should be managed rather than completely controlled is useful and has to be instilled in the mind of end users. Besides, the market size, inconsistency and methods of production, formulation and distribution have made commercial companies reluctant to support the sustained efforts in biocontrol research. Recent research approaches on *Trichoderma* particularly genomics, transcriptomics, proteomics and metabolomics can be used for developing next generation products with increased shelf life. Additional research efforts in all phases of biocontrol are needed to overcome these obstacles.

REFERENCES

Keswani, C., Sarma, B.K., Singh, H.B. (2016) Synthesis of Policy Support, Quality Control, and Regulatory Management of Biopesticides in Sustainable Agriculture. In: Agriculturally Important Microorganisms: Commercial and regulatory requirement in Asia. Eds. H. B. Singh, B.K. Sarma, C. Keswani. Springer Singapore, pp.167-181.

Manoharachary, C, Singh, H B and Ajit Varma. (2020) Eds..*Trichoderma*: Agricultural Applications and Beyond. Springer, Nature Switzerland p. 367.

Rakshit, A. and H B Singh. (2018). Eds. Advances in Seed Priming. Springer Natutre Singapore p. 307.

Rakshit, A., Meena, VS, Abhilash,PC, Sarma, VK, Singh, H.B. Leonardo, F., Parihar, M and A K Singh. (2022). Eds. Biopesticides: Advances in Bioinoculants Vol.2 Elsevier, p.430.

Singh, H.B, Sarma, B.K., Keswani, C. (2016b) (Eds.) Agriculturally Important Microorganisms: Commercialization and Regulatory Requirements in Asia. Springer, Singapore. 336 pages, Singh, H.B, Sarma, B.K., Keswani, C. (2017) (Eds.) Advances in PGPR Research. CABI- UK. 408 pages.

Singh, H.B. and Anukool Vaishnav. Eds. 2022a. New and future Developments in Microbial Biotechnology and Bioengineering. Sustainable Agriculture: Microorganisms as Biostimulants. Elsevier p.374.

Singh, H.B. and Anukool Vaishnav. Eds. 2022b. New and future Developments in Microbial Biotechnology and Bioengineering. Sustainable Agriculture: Advances in Microbe Based Biostimulants. Elsevier p.462.

Singh, H.B. and Anukool Vaishnav. Eds. 2022c. New and future Developments in Microbial Biotechnology and Bioengineering. Revitalization through Organic. Elsevier p.366.

Singh, H.B. and Anukool Vaishnav. Eds. 2022d. New and future Developments in Microbial Biotechnology and Bioengineering. Reving Green Chemicals. Elsevier (in press).

Singh, H.B., Keswani, C., Kartikay Bisen, Sarma, B.K., Chakrabarty, P.K. (2016a) Development and Application of Agriculturally Important Microorganisms in India. In: Agriculturally Important Microorganisms: Commercial and regulatory requirement in Asia. Eds. H. B. Singh, B. K. Sarma, C. Keswani. Springer Singapore, pp.167-181.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 541-544

Antimicrobial Potential of Jamun Seeds

Vikas Sharma[1]*, Arti Heer[1], Navneet Kour[1] and Shivangi Sharma[2]
[1]Division of Biochemistry, Faculty of Basic Sciences, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Main Campus Chatha, Jammu-180 009, J&K
[2]Department of Chemistry, University of Jammu, Baba Saheb Ambedkar Road, Jammu-180006, J&K

ABSTRACT

The antibiotic treatment is so common these days that people start taking drugs even for the little of ailment resulting in misuse of antibiotics. This leads to decrease in susceptibility of microorganisms to the present antibiotics or antimicrobial agents. Currently, in addition to antibiotics and chemically synthesized drugs, the trend to look out for alternative medicines such as natural or herbal medicines is increasing because of fewer side effects or toxicity owing to their natural sources. Therefore, the need for novel / more effective antimicrobial drugs, is an absolute necessity and remains a very important area of research against pathogens. In the present study, antifungal and antibacterial effect of seed part of *Syzygium cumini* has been evaluated against three fungal and five bacterial strains *via* methanolic extract. Results revealed that Jamun seeds showed remarkable activity against the fungal and bacterial strains.

Keywords: Syzygium cumini, Antifungal, Antibacterial, Methanolic extract

INTRODUCTION

Syzygium cumini (Linn.), known as jambul, jambolan, jamblang or jamun, is a widely distributed forest tree in tropical / subtropical regions of the world and is native to Bangladesh, India, Pakistan, Sri Lanka, Malaysia, Philippines, Indonesia. The tree has a great economic importance since most of the parts like bark, leaf, seed, fruit are used as an alternative medicine to treat various diseases. The plant is effective in the treatment of inflammation, ulcers, diarrhea and preclinical studies have shown that it to possess chemopreventive and radioprotective properties. The fruit, seed and even juice of the fruit play an important role in the treatment of diabetes mellitus (Swami *et al*., 2012). Jamun possesses anti-cancer/ antineoplastic, anti-viral (Jain and Seshadri, 1975; Venkateswarlu, 1962; Barh and Viswanathan, 2008), radioprotective (Jagetia and Baliga, 2002 & 2003; Jagetia *et al.,* 2005 & 2008) and chemopreventive (Parmar *et al.,* 2010) effects, all of which are useful in the prevention and treatment of cancer. The reasons for the myriad pharmacological effects are due to the presence of diverse phytochemicals like flavonoids, glucosides, anthocyanins and terpenes (Sagrawat *et al.,* 2006). Dental caries is a common disease that results in tooth loss or cavitations. *In vitro* antibacterial activity of leaves of *S. cumini* was studied against *S. viridans, S. mutans, E. coli, P. aeruginosa, S. aureus* and *B. subtilis.* The aqueous, methanolic, hexane and ethyl acetate extracts exhibited the antimicrobial activity against dental caries causing strains. The largest zone of inhibition was obtained with the methanolic extract against *E. coli* (20 mm). MIC of extract was also determined against the selected microorganisms showing zone of inhibition e" 8 mm. The study concluded that leaves possess very good antibacterial activity against dental caries causing microorganisms and can be used as a potential source for making a phytomedicine that can be used to cure dental caries (Tahir *et al*., 2012). Leaf / fruit extracts of the plant also showed maximum zone of inhibition (18 mm) against fungal strain - *Penicillium chrysogenum* and minimum (7 mm) against *C. albicans* (Pareek and Meena, 2015). In view of the above, *in vitro* antifungal and antibacterial potential of plant seeds has been investigated in the present research work.

*Corresponding author email id: vikas.skuast@gmail.com

MATERIALS AND METHODS

Plant material and preparation of extract: *Syzygium cumini* seeds were authenticated at site and enough quantity of seeds were collected. The seeds were chopped, shade-dried and ground into powdered form. The methanolic extract was prepared by percolating the dried ground plant material (100 g) with 99% methanol and then concentrating it to dryness under reduced pressure (Kandil *et al*,.1994).

Determination of antibacterial activity: Qualitative analysis for evaluating antimicrobial activity of test material was carried out by agar–well diffusion method with modification. Two gram positive (*Bacillus subtilis,* MTCCC 2389 and *Staphylococcus aureus* MTCC7443) and three gram negative (*Micrococcus luteus,* MTCC4821., *Escherichia coli,* MTCC2127*., Klebsiella pneumoniae,* MTCC7162) bacterial strains were used in the present study. 20 mL of sterilized nutrient agar was inoculated with 100 μL of bacterial suspension (10^8 CFU/mL) and then poured on to sterilized petri plates. The agar plates were left to solidify at room temperature. A well of 6 mm diameter was aseptically bored into the agar plates and 20 μL of the essential oil (diluted with DMSO, 1:1) was added in each well. Chloromphenicol (10 μg) was used as a positive reference to determine the sensitivity of bacteria and DMSO as negative reference. The plates were kept at 4°C for 2 h to allow the dispersion and then incubated at 37°C for 24 h.

Determination of MIC by broth dilution method: Broth dilution technique was used to determine the minimum inhibitory concentration of the test material against bacterial strains. One millilitre of nutrient broth was kept in each tube and autoclaved. The essential oil diluted with DMSO (1:1) was filtered with 0.22 μm filter disk before use and then added to each tube to keep the final concentration ranging from 62.5 μg/mL–2000 μg/mL. The test bacterial suspension was added into each tube to yield bacterial density of 10^6 CFU/mL and the inoculated tubes were incubated at 37 °C for 24 h. Tubes containing nutrient broth without essential oil served as positive control, whereas those without bacteria as negative control. After incubation, 50 μL of 0.2 mg/mL *p*-iodonitrotetrazolium violet (INT) was added in each tube to indicate the bacterial growth. The tubes were again incubated for 30 min at 37°C. Development of pink colour in the tube (due to reduction of dye) indicated the bacterial growth whereas tubes without colour indicated no active bacterial growth. The lowest concentration at which no bacterial growth was observed (as indicated by colour) corresponded to the minimum inhibitory concentration (MIC). All the assays were performed in triplicate.

Determination of antifungal activity: The antifungal activity of the test samples was determined by Poisoned Food Technique (a type of agar dilution method) against three pathogenic fungal strains *viz., Alternaria alternata, Curvularia lunata* and *Bipolaris specifera* (procured from Division of Plant Pathology, SKUAST-Jammu). Different concentrations of test component were prepared in sterilized potato dextrose agar and

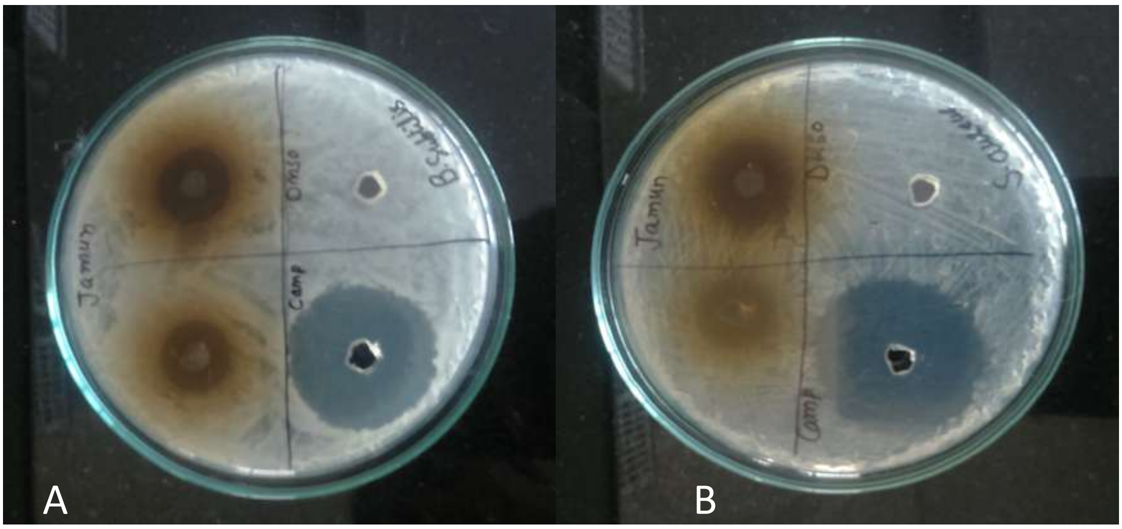


Plate 1: Antibacterial effect of *Syzygium cumini* against (A) *Bacillus subtilis* (B) *Staphylococcus aureus*

poured in 9 cm petri plates. After this, 5 mm bit of test fungus was inoculated in the centre of the agar plate (mycelia surface of the bit was placed upside down) followed by incubation of petri plates at 26ºC. The extension diameter (mm) of hyphae from the center to the dish was measured at 24 h interval, till the growth of fungus in the plate without test component (control) reached the edge of the plates. The experiment was repeated thrice and results were expressed as average of three replicates. Fungal growth diameter in each plate containing concentrations of test component was determined to calculate per cent growth inhibition.

RESULTS AND DISCUSSION

The methanolic extract from the seed part of *S. cumini* showed remarkable activity against the fungal strains as indicated by IC_{50} values - *B. specifera* (IC_{50} = 1.7 ± 0.016 mg/mL), *A. alternata* (IC_{50} = 1.5 ± 0.11 mg/mL) and *C. lunata* (IC_{50} = 1.27 ± 0.11 mg/mL) (Table 1). The striking observations were shown by the plant in case of antibacterial analysis as the plant was found highly active against four bacterial strains *viz., B. subtilis* (25±0.54 mm), *M. luteus* (20±0.36 mm), *E. coli* (20±0.75 mm) and *K. pneumoniae* (20±0.65 mm). The extract also showed activity against *S. aureus* with zone of inhibition of 1.5±0.52 mm (Table 2). The resistance occurring across many different infectious agents and has special focus on antibiotic resistance in seven different bacteria responsible for common serious diseases such as sepsis, diarrhoea, pneumonia, urinary tract infections and some sexually transmitted diseases like gonorrhea. Pneumonia is responsible for 2nd highest number of deaths among children under five year age. So, screening of new complex antimicrobial agents poses a huge challenge and is required especially in the era of drug resistant microbial strains. Like animals, plants are also serious victims of pathogenic microorganism causing diseases. Fungal diseases presently destroy at least 125 million tonnes of the top five food crops - rice, wheat, maize, potato, soybean, each year, which could otherwise be

Table 1: Growth inhibitory effect of *Syzygium cumini* seeds on fungal strains

Extract	Concentration	Phytopathogenic fungi		
		Alternariaalternata	***Curvuleria lunata***	***Bipolaris specifera***
Methanolic	0.5 (mg/mL)	18	35	31.25
	1 (mg/mL)	38.75	41	43.75
	2 (mg/mL)	59.5	53.75	67.5
	IC_{50}	1.5±0.11	1.7 ±0.016	1.27±0.011
Amphotericin B	10 (μg/mL)	48.5	46.20	50.75
(positive control)	20 (μg/mL)	65.00	61.00	71.50
	40 (μg/mL)	83.60	81.60	85.69
	IC_{50}	9.5±0.1	12.1±0.4	5.7±0.2

Maximum growth inhibition by test material as indicated by IC_{50} value is given in bold numbers

Table 2: Antibacterial analysis of *Syzygium cumini* seeds

Extract	Conc. (mg/mL)	Bacterial strains				
		***B. subtilis* MTCC2389**	***M. luteus* MTCC4821**	***S. aureus* MTCC7443**	***E. coli* MTCC2127**	***K. pneumoniae* MTCC7162**
Zone of inhibition (mm)						
Methanolic	100 mg/mL (10μl)	25± 0.54	20± 0.36	15±0.52	20±0.75	20±0.65
MIC	62.5 μg/ml-2000 μg/ml	250	500	500	500	250
Positive control CMP^{+}	1 mg/mL(10 μl)	36±1.3	35.6±1.2	26.2± 0.9	35±1.1	35±1.3
Negative control DMSO	10 μl	-	-	-	-	-

Values indicating maximum zone of inhibition of test component are given in bold numbers
CMP^{+}: Chloramphenicol; DMSO: Dimethylsulfoxide
Mark (-) indicates no activity

used to feed those who do not get enough to eat. These crops are the major source of calories consumed by people. Rice blast, corn smut in maize, stem rust in wheat, soybean rust and late blight in potatoes are some diseases affecting productivity of the crops plants. Most frequently, chemicals / fungicides are used to control the diseases caused by plant pathogens. However, there is a serious problem in the effective use of these chemicals due to the development of resistance by the fungi (Zhang *et al.*, 2009). To overcome this problem, higher concentrations of these chemicals are used, but this increases the risk of high level of toxic residues in the products. This problem is a natural consequence of the adaption of infectious pathogens to antimicrobials used in several areas including medicine, food, animals, crop production and disinfectants in farms, hospital / households. This has forced the researchers to search new antimicrobial compounds from natural origin like medicinal plants which are more effective and less toxic to human health and environment.

To conclude, seeds of *S. cumini* were collected from RRSSF, Raya SKUAST-J and tested against different fungal and bacterial strains and methanolic extract from the seed part of plant possesses antimicrobial efficiency and forms a good basis for selection of this plant part for phytochemical and pharmacological analysis.

REFERENCES

Barh, D. and Vishwanathan, G. 2008. *Syzygium cumini* inhibits growth and induces apoptosis in cervical cancer cell lines: A primary study. *Ecancer Medical Science-The Open Access Journal,* 2: 83-113.

Jagetia, G.C. and Baliga, M.S. 2002. *Syzygium cumini* (jamun) reduces the radiation-induced DNA damage in the cultured human peripheral blood lymphocytes: a preliminary study. *Toxicology Letters*, 132: 19-25.

Jagetia, G.C. and Baliga, M.S. 2003. Evaluation of the radioprotective effect of the leaf extract of *Syzygium cumini* (jamun) in mice exposed to a lethal dose of gamma-irradiation. *Nahrung,* 47: 181-185.

Jagetia, G.C., Baliga, M.S. and Venkatesh, P. 2005. Influence of seed extract of *Syzygium cumini* (jamun) on mice exposed to different doses of gamma-radiation. *Journal of Radiation Research (Tokyo)*, 46: 59-65.

Jagetia, G.C., Shetty, P.C. and Vidyasagar, M.S. 2008. Treatment of mice with leaf extract of jamun (*Syzygium cumini*) protects against the radiation-induced damage in the intestinal mucosa of mice exposed to different doses of ã-radiation. *Pharmacology Online*, 1: 169-195.

Jain, M.C. and Seshadri, T.R. 1975. Anthocyanins of *Eugenia jambolana* fruits. *Indian Journal of Chemistry,* 3: 20-23.

Kandil O, Radwan NM, Hassan AB, Amer AAM, Banna EHA & Amer WMM. 1994. Extracts and fractions of *Thymus capitatus* exhibit antimicrobial activities. *Journal of Ethnopharmacology* 45: 97-111.

Pareek A. and Meena, R.K. 2015. Antimicrobial activity of *Syzygium cumini. Indian Journal of Applied Research*, 5: 64-66.

Parmar, J., Sharma, P. and Verma, P. 2010. Chemopreventive action of *Syzygium cumini* on DMBA-induced skin papillomagenesis in mice. *Asian Pacific Journal of Cancer Prevention*, 11: 261-265.

Sagrawat, H., Mann, A.S. and Kharya, M.D. 2006. Pharmacological potential of *Eugenia jambolana*: a review. *Pharmacognosy Magazine*, 2: 96-105.

Swami, S.B., Thakor, N.S.J., Patil, M.M. and Haldankar P.M. 2012. Jamun *(Syzygium cumini)*: A Review of Its food and medicinal uses. *Food and Nutrition Sciences*, 3:1100-1117.

Tahir, T., Ahmed, S., Hussain, N., Perveen I. and Rahman, S. 2012. Effect of leaves extract of indigenous species of Sy*zygium cumini* on dental caries causing pathogens. *International Journal of Pharma and Bio Science*, 3: 1032 – 1038.

Venkateswarlu, G. 1962. On the nature of colouring matter of the jambul fruit (*Eugenia jambolana*). *Journal of Indian Chemical Society,* 29: 434-437.

Zhang JW, Li SK & Wu WJ. 2009. The main chemical composition and *in vitro* antifungal activity of the essential oils of *Ocimum basilicum* Linn. *Molecules* 14: 273-278.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 545-552

Occurrence and Management of White Rust through Cultural Practices and Host Resistance in Mustard

Amrish Vaid*, Mukesh Choudhary, Sachin Gupta, S.K. Singh, S.K. Rai, Bushra Rasool and Shiney Chatak
Division of Plant Pathology, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Chatha

ABSTRACT

The rapeseed-mustard is the world's third most important source of edible oil after soybean and palm oil. Mustard (*Brassica juncea* L.) belongs to the family Brassicaceae, a cross-pollinated crop, amphidiploid with chromosome number 2n=36. Many biotic and abiotic stresses affect the crop's production and productivity. Among biotic stresses, four diseases *viz*., white rust (*Albugo candida*), white rot (*Sclerotinia sclerotiorum*), Alternaria blight (*Alternaria brassicae*), and powdery mildew (*Erysiphe cruciferarum*) are of great economic concern. White rust caused by *Albugo candida* is the most destructive and widespread disease of mustard around the world. This disease causes yield losses of 20-90 percent throughout the world and 17-34 percent in the Indian subcontinent. Symptoms were observed on all aerial plant parts, including leaves, stems, and pods. Local infection was characterized by the formation of small, round spots, creamy whitish pustules or "blisters" raised on the undersurface of leaves, and the spots conjoined and pustules developed on the upper side of the leaves as well as on the stem and tender shoots. Systemic infection symptoms included distortion, hypertrophy, hyperplasia, and inflorescence sterility. An extensive survey of major mustard growing areas of the Jammu Division conducted during the 2020-21 *Rabi* season, revealed that disease was prevalent in all the surveyed districts *viz*., Jammu, Reasi, Samba, and Kathua. The maximum mean disease incidence (49.92%) and disease severity (35.07%) was recorded in March and the lowest mean disease incidence (28.48%) and severity (21.78%) were recorded in January. The highest mean disease incidence and severity were recorded in district Samba, followed by Jammu and Kathua. While the minimum mean disease incidence and disease severity were recorded in the Reasi district. Delay in sowing time and row to row spacing (20 cm) showed an increase in the incidence and severity of white rust. While the least disease incidence (13.60%) and severity (7.47%) were recorded in early sown crops. Among seventeen genotypes of mustard screened against white rust under field conditions, five genotypes *viz.,* RSPR-01, RSPR 69, NRC-BH-101, JM-12-6, and Pusa Bold-11 were found resistant.

Keywords: Disease incidence, Genotypes, Mustard, White rust

INTRODUCTION

The rapeseed mustard is the world's third most important source of edible oil after soybean and palm oil. Mustard (*Brassica juncea* L.) belongs to the family Brassicaceae, a cross-pollinated crop, amphidiploid with chromosome number 2n=36 (Warwick *et al*., 2006). Globally rapeseed mustard occupies an area of 36.59 million hectares with production and productivity of 72.37 million tons and 1.98 tons/ha, however, in India, the area, production, and productivity of rapeseed mustard was 6.42 million hectares, 6.33 million tonnes, and 1025 kg/ha, respectively (Anonymous, 2019). The crop is affected by many biotic and abiotic stresses which limit its production and productivity. Among biotic stresses, four diseases *viz*., white rust (*Albugo candida*), white rot (*Sclerotinia sclerotiorum*), Alternaria blight (*Alternaria brassica,e*), and powdery mildew (*Erysiphe cruciferarum*) are of great economic concern (Kolte, 1985). White rust caused by *Albugo candida* is the most destructive and widespread disease of mustard around the world. This disease causes yield losses of 20-90 per cent throughout the world and in India, 17-

*Corresponding author email id: amrishvaid@gmail.com

34 per cent. The pathogen is an important soil and seed-borne obligate parasite of cruciferous species, belonging to the family Albuginaceae of the order Peronosporales in the class Oomycetes. *A. candida* produces a short cub–shaped sporangiophore which on maturity breaks and produces several sporangia on top of the sporangiophore. During the later stages of growth, the pathogen forms resting structures in form of oospores through which it survives in soil and infected plant debris for 20 years (Gupta *et al.*, 2004). The disease causes yield losses of 20-90 per cent throughout the world (Mishra *et al.*, 2009) and in India, 17-34 per cent (Yadava and Gupta, 2011 and Pandey *et al.*, 2013). Symptoms were observed on all the plant's aerial plant parts, leaves, stems, and pods. Local infection was characterized by the formation of small, round spots, creamy whitish pustules, or "blisters" that were raised on the under surface of leaves and the spots conjoined, and pustules developed on the upper side of the leaves as well as on the stem and tender shoots. Systemic infection symptoms included distortion, hypertrophy, hyperplasia, and inflorescence sterility (Gupta *et al.*, 2002). In Jammu Division, this disease appears in moderate to severe form depending upon the genotypes, climatic conditions, and cultural practices.

MATERIALS AND METHODS

A Survey of major rapeseed mustard growing areas of different districts *viz.*, Jammu, Reasi, Samba and Kathua was conducted during *Rabi* 2020-21 to ascertain the status of white rust disease in mustard. The disease incidence and severity were recorded from the appearance of disease symptoms till the crop was harvested. A total of 36 locations were surveyed, five fields from each location were selected randomly and disease severity and incidence were recorded.

Using the quadrant rule (1 m^2 quadrant, five plots were selected randomly) infected plants were selected from each field randomly and observed for the presence of symptoms of white rust.

Symptomatology: During the survey of major mustard growing areas of the Jammu division *viz.,* Jammu, Samba, Reasi and Kathua, the characteristic symptoms of white rust disease were recorded during the initial period of the disease in the field. The disease is distinguished by the manifestation of both local and systemic symptoms. Observations were recorded based on the leaf area affected and the severity of the disease. The shape, size, color and arrangement of the pustules were also recorded on diseased plants. In severe conditions, from local infection to systemic infection, the observations were recorded on different plant parts *viz.,* leaf, stem and inflorescence.

Screening of mustard genotypes against white rust disease: Seventeen genotypes of rapeseed-mustard (procured from the Division of Plant Breeding and Genetics, SKUAST-Jammu) were screened for their level of resistance against white rust under field conditions at the experimental field of the Division of Plant Pathology, SKUAST-J, during *Rabi* 2020-21. The experiment was laid on 23rd October 2020 in random block design (RBD) and the highly white rust susceptible genotype (Kranti) was repeated after every three genotypes in three replications and the plot size was $2\times1m^2$. The genotypes were classified into highly resistant (HR), resistant (R), moderately resistant (MR), moderately susceptible (MS), susceptible (S), and highly susceptible (HS). Data were recorded at the appearance of disease symptoms and three observations of disease severity were taken at fifteen days of intervals.

RESULTS AND DISCUSSION

White rust is a major disease of rapeseed-mustard in surveyed districts of the Jammu division *viz.,* Jammu, Reasi, Samba, and Kathua (Table 1). During the survey, it was observed that disease incidence varied in all the surveyed areas and also increases progressively with time. During the survey (January-March) it was observed that the highest mean disease incidence (49.92%) was recorded in March and the lowest mean disease incidence (28.48%) was recorded in January. In January, the highest mean disease incidence (39.24%) was observed in district Samba, followed by Jammu and Kathua with disease incidence of 28.87 and 27.45 per cent, respectively. However, the lowest mean disease incidence (18.17%) was recorded in Reasi. In February, the highest mean disease incidence (53.76%) was observed in district Samba, followed by Jammu and Kathua with disease incidence of 43.09 and 37.54 per cent, respectively. However, the lowest mean disease incidence (25.60%) was recorded in Reasi. In March, the highest mean disease incidence (67.19%) was

Table 1: Disease incidence of white rust of rapeseed mustard in Jammu division during *Rabi* 2020-21

District	Tehsil/Block	Location	Disease Incidence (%)		
			January	February	March
Jammu	Jammu	Chatha	30.09	44.91	54.77
		Mandal	31.50	47.01	57.33
		Khandwal	34.61	51.66	63.00
		Hakal	33.66	50.24	61.27
	RS Pura	Samka	37.58	56.09	68.40
		Badyal	27.58	41.16	50.20
		Kotli	25.14	37.52	45.76
		Kullian	34.34	51.25	62.50
	Bishnah	Kheri	23.62	35.26	43.00
		Nandpur	24.54	36.63	44.67
		Kanhal	21.66	32.33	39.43
		Shibuchack	22.15	33.05	40.31
	District Mean ± S.E. (m)		28.87±1.57	43.09±2.35	52.55±2.87
	Range		21.66-37.58	32.33-56.09	39.43-68.40
	S.D.		5.47	8.16	9.95
Reasi	Reasi	Doglahkalan	21.17	29.81	38.22
		KashiPatta	14.58	20.54	26.33
		Panasa	16.55	23.31	29.89
		Bidha	18.58	26.17	33.55
	Pouni	Kolsar	20.49	28.86	37.00
		Jadh	18.03	25.40	32.56
		Gan	20.02	28.23	36.15
		Nagar	15.94	22.45	28.78
	District Mean ± S.E. (m)		18.17±0.82	25.6±1.16	32.81±1.49
	Range		14.58-21.17	20.54-29.81	26.33-38.22
	S.D.		2.34	3.3	4.23
Samba	Samba	Bidi	35.76	48.98	61.23
		Samlah	33.52	45.92	57.40
		Samba	46.62	63.86	79.83
		Raiyan	40.92	56.05	70.06
	Bari Brahmana	Jatwal	38.39	52.59	65.74
		Sangar	36.00	49.32	61.65
		Purmandal	43.99	60.26	75.32
		Palli	38.73	53.06	66.32
	District Mean ± S.E. (m)		39.24±1.55	53.76±2.13	67.19±2.66
	Range		33.52-46.62	45.92-63.86	57.40-79.83
	S.D.		4.41	6.04	7.55
Kathua	Kathua	Badholi	27.77	37.98	46.32
		Rasoon	32.17	44	53.66
		Manjli	24.91	34.07	41.55
		Dilwan	25.04	34.24	41.76
	Hiranagar	Gara	26.59	36.36	44.34
		Maila	33.11	45.28	55.22
		Stoora	24.58	33.61	40.99
		Bhayia	25.45	34.81	42.45
	District Mean ± S.E. (m)		27.45±1.19	37.54±1.63	45.79±1.98
	Range		24.58-33.11	33.61-45.28	46.99-55.22
	S.D.		3.37	4.61	5.63
	Grand Mean		28.48	40.34	49.92
	S.D.		8.23	11.39	13.92

observed in district Samba, followed by Jammu and Kathua with mean disease incidence of 52.55 and 45.79 per cent, respectively. However, the lowest mean (32.81%) disease incidence was recorded in Reasi.

Cultural management: To study the effect of the different sowing dates on disease incidence and severity, a field experiment was conducted using the variety Kranti, sown on four different dates, 15th Oct, 25th Oct, 5th Nov and 15th Nov with four replications during *Rabi* 2020-21.

Effect of different sowing dates on disease incidence of white rust in rapeseed mustard: Results revealed that sowing one crop on 15th Oct. recorded the minimum disease incidence at all the growth stages of the crop *viz.,* 55 DAS, 70 DAS, 85 DAS and 100 DAS, which was 8.54, 10.12, 13.52 and 22.23 per cent respectively. The second best treatment was 25th Oct. with disease incidence of12.67, 14.89, 19.23 and 27.37 per cent at 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. However, the maximum disease incidence was recorded on 15th Nov. where disease incidence of 20.21, 23.18, 28.28 and 37.17 per cent followed by the 5th Nov. with 17.80, 18.34, 23.43 and 32.23 per cent, for 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively (Table 2).

The lowest mean disease incidence (13.60 %) was recorded on 15th Oct. followed by 25th Oct. and 5th Nov. with mean disease incidence of18.54 and 22.95 per cent, respectively. However, the maximum mean disease incidence of 27.21 per cent was recorded on 15th Nov. (Table 2).

Effect of different sowing dates on disease severity of white rust in rapeseed mustard: The results presented in Table 3 revealed that minimum disease severity was observed crop sown on 15th Oct. in all the stages *viz.,* 55 DAS, 70 DAS, 85 DAS and 100 DAS where it was 1.80, 3.86, 5.87 and 18.34 per cent, respectively. The second best treatment 25th Oct. with disease severity of 2.89, 5.45, 7.27 and 18.36 per cent at 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. However, the maximum disease severity was observed on 15th Nov. where disease severity of 6.56, 12.33, 14.66 and 26.56 per cent followed by 5thNov. with 3.57, 7.34, 10.56 and 22.67 per cent, for 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. The lowest mean disease severity (7.47%) was recorded in 15th

Table 2: Effect of different sowing dates on disease incidence of white rust in mustard

Sowing Date	**Disease Incidence (%)**					**Yield**
	55 DAS*	**70 DAS**	**85 DAS**	**100 DAS**	**Mean**	**(q/ha)**
15th 0ct	8.54(16.99)	10.12(18.55)	13.52(21.57)	22.23(21.57)	13.60(21.26)	16.08
25th Oct	12.67(20.85)	14.89(22.70)	19.23(26.01)	27.37(31.35)	18.54(25.51)	15.17
5thNov	17.80(24.96)	18.34(25.36)	23.43(28.95)	32.23(34.59)	22.95(28.62)	14.27
15th Nov	20.21(26.72)	23.18(28.78)	28.28(34.59)	37.17(37.57)	27.21(31.44)	13.14
SE(m)±	0.34	0.29	0.28	0.37	0.28	
CD (p= 0.05)	0.90	0.72	0.68	0.96	0.90	

*DAS = days after sowing

Table 3: Effect of different sowing dates on disease severity of white rust in mustard

Sowing Date	**Disease Incidence (%)**					**Yield**
	55 DAS	**70 DAS**	**85 DAS**	**100 DAS**	**Mean**	**(q/ha)**
15th 0ct	1.80(7.71)	3.86(11.33)	5.87(14.02)	18.34(25.36)	7.47(15.86)	16.08
25thOct	2.89(9.79)	5.45(13.50)	7.27(15.64)	18.36(25.37)	8.49(16.92)	15.17
5thNov	3.57(10.90)	7.34(15.72)	10.56(18.96)	22.67(28.43)	11.03(19.40)	14.27
15th Nov	6.56(14.82)	12.33(20.56)	14.66(22.51)	26.56(31.02)	15.03(22.81)	13.14
SE±	0.22	0.17	0.19	0.23	0.31	
CD (p= 0.05)	0.78	0.60	0.56	0.81	1.21	

Oct. followed by 25th Oct. and 15thNovwith mean disease severity of 8.49 and 15.03per cent disease severity, respectively. However, the maximum mean disease severity of 11.03 per cent was recorded crop sown on 5th Nov.

To study the effect of the row to row spacing on disease development, treatments consisted of three-row spacings (20, 30, and 40 cm) using variety kranti during the cropping season *Rabi* 2020-21. The results obtained in respect of the effect of row spacing dates on white rust incidence, severity and seed yield are depicted in the following paragraphs.

Effect of the row to row spacing on disease incidence of white rust in mustard: The results presented in Table 4 indicate that 40 cm row spacing recorded minimum disease incidence at all the crop growth stages *viz.,*55 DAS, 70 DAS, 85 DAS and 100 DAS, where it was 10.20, 12.37, 16.63 and 24.71 per cent, respectively. The second best treatment was 30 cm row spacing which recorded disease incidence 11.56, 14.20, 18.23and 26.89 per cent at 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. However, maximum disease incidence of 13.44, 16.03, 20.73 and 29.01 per cent was recorded in 20 cm row spacing at all the stages of crop *viz.*, 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively.

The lowest mean disease incidence (15.98%) was recorded in 40 cm row to row spacing followed by 30 cm row spacing where disease incidence of17.72 per cent was recorded. The maximum mean disease incidence of 19.80 per cent was recorded in 20 cm row to row spacing (Table 4).

Effect of the row to row spacing on disease severity of white rust in mustard: The results presented in Table 5, depicted that the minimum disease severity was recorded in 40 cm row spacing at all the stages of the crop *viz.,*55 DAS, 70 DAS, 85 DAS and 100 DAS where it was 2.80, 4.30, 7.89 and 14.74 per cent, respectively. The second best treatment in dates of sowing was 30 cm row spacing which recorded disease severity of 3.10, 6.10, 8.15 and 16.24 per cent at 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. However, maximum disease severity of 3.87, 7.24, 9.65 and 17.88 per cent was observed in 20 cm row spacing at all the stages of *viz.,* 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. The lowest mean disease severity (7.43%) was recorded in 40 cm row to row spacing followed by 30 cm row spacing with 8.40 per cent.

Table 4: Effect of different spacing on disease incidence of white rust in mustard

Row Spacing	Disease Incidence (%)					Yield
	55 DAS	70 DAS	85 DAS	100 DAS	Mean	(q/ha)
20 cm	13.44(21.51)	16.03(23.60)	20.73(27.08)	29.01(32.59)	19.80(26.42)	14.28
30 cm	11.56(19.88)	14.20(22.19)	18.23(25.28)	26.89(31.24)	17.72(24.89)	15.34
40 cm	10.20(18.62)	12.37(20.59)	16.63(24.07)	24.71(29.81)	15.98(23.56)	14.54
SE(m)±	0.32	0.28	0.34	0.22	0.25	
CD(p=0.05)	1.32	0.98	1.21	0.65	0.84	

Figures in parenthesis arc sine values; Average of five replications

Table 5: Effect of different spacing on white rust disease severity in mustard

Row Spacing	Disease Incidence (%)					Yield
	55 DAS	70 DAS	85 DAS	100 DAS	Mean	(q/ha)
20 cm	3.87(11.30)	7.24(15.61)	9.65(18.09)	17.88(25.02)	9.67(18.12)	14.28
30 cm	3.10(10.14)	6.10(14.29)	8.15(16.89)	16.24(23.76)	8.40(16.85)	15.34
40 cm	2.80(9.63)	4.30(11.96)	7.89(16.31)	14.74(22.58)	7.43(15.82)	14.54
SE(m)±	0.20	0.24	0.27	0.22	0.39	
CD(p=0.05)	0.65	0.78	0.85	0.67	1.89	

Figures in parenthesis arc sine values; Average of five replications.

Maximum disease severity was recorded in 20 cm row spacing which was 9.67 per cent.

Screening of rapeseed mustard genotypes against white rust: To identify resistant genotypes against white rust, seventeen genotypes of mustard were screened under field conditions in the experimental field of the Division of Plant Pathology, SKUAST-J, during *Rabi* 2020-21.

Based on per cent disease severity mustard genotypes were grouped into six categories. Out of the total seventeen genotypes, none of the genotypes was found free from leaf infection. Five genotypes, *viz.*, RSPR-01, RSPR 69, NRC-BH-101, JM-12-6 and Pusa Bold-11 were found resistant. Five genotypes *viz.*, PM-21, PM-195, RSPR-03, NPS-183 and RH-1209 were found moderately resistant. Whereas, four genotypes *viz.*, DRMR-541-44, PM-25, PM-123 and Kranti were found susceptible and three genotypes *viz.*, DRMR-15-5, DRMR-15-85 and PM-26 were found highly susceptible (Table 6).

In the present investigation four districts of the Jammu Division *viz.*, Jammu, Reasi, Samba and Kathua were surveyed to assess the disease incidence and severity of white rust. Among all the surveyed months (January-March) it was observed that the highest mean disease incidence (49.92%) was recorded in March and the lowest mean disease incidence (28.48%) was recorded in January. During January, the highest mean disease incidence (39.24) was observed in district Samba followed by Jammu and Kathua with disease incidence of 28.87 and 27.45 per cent, respectively. However, the least mean disease incidence (18.17%) was recorded in Reasi. During February it was observed that the highest mean disease incidence (53.76%) was observed in district Samba, followed by Jammu and Kathua with disease incidence of 43.09 and 37.54 per cent, respectively. However, the least mean disease incidence (25.60%) was recorded in Reasi. During March, it was observed that like January and February highest mean disease incidence (67.19%) was observed in district Samba and the least mean disease incidence (32.81%) was recorded in Reasi. When the fields were surveyed regarding the disease severity it was observed that the disease severity increases progressively with time (month). Among all the surveyed months it was observed that the highest mean disease severity (35.07%) was recorded in March and the lowest mean disease severity (21.78%) was recorded in January. During January, the highest mean disease severity (30.67%) was observed in district Samba, and the lowest mean disease severity (13.11%) was recorded in Reasi. During February it was observed that the highest mean disease severity (39.65%) was observed in district Samba, and the lowest mean disease severity (16.72%) was recorded in Reasi. For March, it was observed again like that of the other two months (January and February) that the highest mean disease severity (48.95%) was observed in district Samba, followed by Jammu and Kathua, and the lowest mean disease incidence (21.61%) was recorded in Reasi.

Table 6: Screening of mustard genotypes against white rust under field conditions

Genotype	Disease severity (%)	Reaction
DRMR-15-5	67.50	Highly Susceptible
DRMR-15-85	55.21	Highly Susceptible
DRMR-541-44	32.15	Susceptible
PM-21	23.76	Moderately Resistant
PM-25	43.21	Susceptible
PM-26	55.41	Highly Susceptible
PM-123	33.45	Susceptible
PM-195	22.65	Moderately Resistant
RSPR-01	9.24	Resistant
RSPR-03	19.54	Moderately Resistant
RSPR-69	8.90	Resistant
NRC-BH-101	9.37	Resistant
NPS-183	21.54	Moderately Resistant
JM-12-6	9.33	Resistant
Pusa Bold-11	8.87	Resistant
RH-1209	17.65	Moderately Resistant
Kranti	47.68	Susceptible

There was an increase in the incidence and severity of white rust with a delay in sowing time. Results indicated that the least disease incidence was recorded in the crop sown on 15th Oct (D_1) (13.60%) followed by 25th Oct and 15th Nov *i.e.,* D_2 and D_3 sowing respectively where disease incidence was 18.54 and 22.95 per cent, respectively. A maximum disease incidence of 27.21 per cent was recorded on 15th Nov (D_4). The epidemic development of white rust depends on the aggressiveness of races, the amount of initial inoculums and prevailing weather conditions. These factors regulate the incidence and severity of disease and as well as yield loss (Singh *et al.*, 2003). In the present investigation severity of white rust on leaves as well as the floral infection was remarkably less in the rapeseed mustard crop when sown on the first fortnight of October resulting in significantly higher seed yield and there was a subsequent increase in disease severity with consequent yield decrease beyond that period. Similar results were observed by Dange *et al.* (2003); Singh and Singh (2005): Kaur *et al.* (2006); Kumar (2009) and Subhasinghe *et al.* (2009).

The effect of the row to row spacing on white rust of mustard variety Kranti was studied with three-row spacing of 20cm, 30cm and 40 cm. Row to row spacing of 40 cm (S_3) recorded minimum disease incidence of 10.20, 12.37, 16.63 and 24.71 per cent and disease severity of 2.80, 4.30, 7.89 and 14.74 per cent at 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. Row to row spacing of 20 cm (S_1) recorded maximum disease incidence of 13.44, 16.03, 20.73 and 29.01 per cent and disease severity of 3.87, 7.24, 9.65 and 17.88 per cent at 55 DAS, 70 DAS, 85 DAS and 100 DAS, respectively. Plant density treatment displayed a significant effect on the mustard variety Kranti. Among these different spacing, $S_3$was found most effective recorded the least disease incidence and severity. Disease incidence, as well as severity values, were found to increase in S_1 whiles they decreased in S_3 than S_2 treatment. The reduction in incidence and severity may be attributed due to more diversion of nutrient uptake in wider spacing between rows and therefore proper utilization growth of the crop was facilitated by more space available around the crop. Our results confirm with Devi (2017) who studied the incidence and severity of white rust in mustard varieties for different spacing viz., 20 × 5cm^2, 30 × 10 cm^2 and 40 × 15 cm^2. Out of the seventeen genotypes of rapeseed-mustard screened against the white rust disease, none of the genotypes was found immune. Five genotypes *viz.*, RSPR-01, RSPR-69, NRC-BH-101, JM-12-6 and Pusa Bold-11 were resistant. Five genotypes *viz.*, PM-21, PM-195, RSPR-03, NPS-183 and RH-1209 were moderately resistant. Whereas, four genotypes *viz.,* DHMR-541-44, PM-25, PM-123 and Kranti were susceptible and three genotypes *viz.*, DHMR-15-5, DHMR-15-85 and PM-26 were highly susceptible. Our results corroborate the findings of Malik (1989), Katiyar and Chopra (1990), Paladhi *et al.*, (1993), Velazhahan and Thiyagarajan (1994) and Pathak and Godika (2002).

CONCLUSION

In the Jammu division, district Samba recorded the highest disease incidence and severity of white rust and therefore appears to be a major disease problem of mustard *(B. juncea)* affecting the crop throughout the region in varying proportions. Five genotypes of mustard RSPR-01, RSPR-69, NRC-BH-101, JM-12-6 and Pusa Bold-11 were found resistant to white rust disease. The late sown crop showed more disease prevalence than the early one. Narrow spacing with row to row spacing of 20 cm was found less effective than the wider spacing of 40 cm in managing the disease.

REFERENCES

Anonymous, 2019. ICAR-Directorate of Rapeseed-Mustard Research. Available at: https://www.drmr.res.in. Accessed on 28 September, 2021.

Dange, S. R. S., Patel, R. L., Patel, S. I. and Patel, K. K. 2003. Effect of planting time on the appearance and severity of white rust and powdery mildew disease of mustard.*Indian Journal of Agricultural Research*, 37:154-156.

Devi, Y. P. 2017. Effect of traditional agronomic practices on white rust of rapeseed-mustard under organic farming system in Manipur.*Current Agriculture Research Journal,* 3: 276-279.

Gupta, K. and Saharan, G. S. 2002. Identification of pathotypes of *Albugo candida* with stable characteristic symptoms on Indian mustard. *Journal of Mycology and Plant Pathology,* 32: 46-51.

Gupta, K. D., Prem, M. S. and Negiand A. A. 2004. ISSRs: An efficient tool to screen interspecific F1 hybrids in Brassicas. In Proceedings: *4th International Crop Science Congress*, 26th Sept - 1st Oct. 2004, Brisbane, Australia.

Katiyar, R. K. and Chopra, V. L. 1990. Somaclonally induced earliness in a *Brassica juncea* germplasm accession. *Plant Breeding*, 104: 262-264.

Kaur, N., Grewal, R. K. and Munshi, G. D. 2006. Effect of date of sowing and weather parameters on development of stag head in Raya due to white rust. *Plant Disease Research*, 21: 51-52.

Kotle, S.J. 1985. *Disease of Annual Edible Oilseed Crop. Rapeseed Mustard and Seasame Disease*, Vol. 2, C.R.C. Press, Boca Raton, Florida, U.S.A. p 320.

Kumar, A. 2009. Eco-friendly options for the management of white rust in Indian mustard under mid hill conditions of North-Western India. *Indian Phytopathology*, 62: 44-48.

Malik, R. S. 1989. Seed yield and oil contents of cultivated species of Brassica in relation to aphid and white rust infestation. *Annals of Agricultural Research*, 10: 178-181.

Mishra, K. K., Kolte, S. J., Nashaat, N. I. and Awasthi, R. P. 2009. Pathological and biochemical changes in *Brassica juncea* (mustard) infected with *Albugo candida* (white rust). *Plant Pathololog*y, 58: 80-86.

Paladhi, M. M., Prasad, R. C. and Bhagwan, D. 1993.Inheritance of field reaction to white rust in Indian mustard.*Indian Journal of Genetics and Plant Breeding*, 53: 327-328.

Pandey, P., Tewari, A. K. and Awasthi, R. P. 2013. Morphological and pathogenic variability of *Albugo Candida* isolates causing white rust in rapeseed mustard. Disease of mustard in mid-eastern India.*International Journal of Life Sciences*, 8: 835-838.

Pathak, A. K. and Godika, S. 2002. Multiple disease resistance in different genotypes of rapeseed-mustard.*Cruciferae Newsletter*, 24: 95-96.

Sangeetha, C. G. and Siddaramaiah, A. L. 2007. Epidemiological studies of white rust, downy mildew and Alternaria blight of Indian mustard (*Brassica juncea* (Linn.) Czern.andCoss.). *African Journal of Agricultural Research*, 2: 305-308.

Singh, D., Kumar, R., Yadav, R. C., Thakral, N. K. and Singh, A. 2003.Advances in white rust (*Albugo candida*) resistance in oilseed Brassica.*Indian Phytopathology,*5: 12-24.

Singh, R. B. and Singh, R. N. 2005. Spray schedule for the management of alternaria blight and white rust of Indian mustard (*Brassica juncea*) under different dates of sowing. *Indian Journal of Agricultural Sciences*, 76: 575-579.

Subasinghe, H. M. P., Bains, G. S. and Mohan, C. 2009.Effect of sowing date and meteorological parameters on development of white rust disease in Indian mustard (*Brassica juncea*L.). *Plant Disease Research*, 24: 166-169.

Velazhahan, R. and Thiyagarajan, K. 1994. Mustard genotypes resistancare e to white rust.*Madras Agricultural Journal*, 81: 459-460.

Warwick, S. I., Gugel, R. K., McDonald, T. and Falk, K. C. 2006. Genetic variation of Ethiopian mustard (*Brassica carinata* A. Braun) germplasm in western Canada. *Genetic Resources and Crop Evolution,* 53: 297-312.

Yadav, M. S., and Gupta, P. P. 2011. Magnitude of losses in yield and management of Alternaria blight of rapeseed and mustard. *Haryana Agriculture university journal Research,* 17: 14-18.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 553-558

Importance of Agricultural Marketing and Pricing in India: An Overview

Poonam Parihar* and Jamyang Lahmo
Division of Agricultural Extension and Education, SKUAST –Jammu (UT, J&K)

ABSTRACT

Agriculture, in the broadest sense means activities aimed at the use of natural resources for human welfare, and marketing connotes a series of activities involved in moving the goods from the point of production to the point of consumption. Specification, the subject of agricultural marketing includes marketing functions, agencies, channels, efficiency and cost, price spread and market integration, producer's surplus etc. The agricultural marketing system is a link between the farm and the non-farm sectors. In India Agriculture was practiced formerly on a subsistence basis; the villages were self sufficient, people exchanged their goods, and services within the village on a barter basis. With the development of means of transport and storage facilities, agriculture has become commercial in character; the farmer grows those crops that fetch a better price. Marketing of agricultural produce is considered as an integral part of agriculture, since an agriculturist is encouraged to make more investment and to increase production. Thus there is an increasing awareness that it is not enough to produce a crop or animal product; it must be marketed as well as agricultural marketing involves in its simplest form the buying and selling of agricultural produce. The activity of marketing was of an activity of distribution. As the means of transportation and communication improved and the economic operations of the countries became more and more complex, the process of marketing of agricultural produce also became more and more complex. Pricing is a fundamental aspect of product management and is one of the four Ps of the marketing mix, the other three aspects being product, promotion, and place (Wiki, 2021). Importance of pricing are flexible element of marketing mix, Price Creates first impression, vital element of sales promotion, purchase decision, etc. (ED, 2021). Agricultural prices derive their meaning and significance from the stage of marketing to which they relate that include: producer prices, wholesale prices, retail prices, export prices, prices paid by farmers.

Keywords: Agricultural Marketing, Commodity, Marketing, Pricing, Marketing Mix

INTRODUCTION

India is predominantly an agrarian economy, with agricultural sector engaging about half of the workforce (GoI 2016a). According to a survey conducted by NABARD in 2016-17, about 48% households in India are agricultural households, whose monthly income is Rs. 3140 from crop cultivation alone (NABARD 2018). On supply-side, India is global leader in production of pulses and Indian agriculture has become increasingly market oriented and commercialized. In the early 1950s, about 30-35% of food grains output was marketed, which has increased to more than 70% in recent years (Sharma & Wardhan 2015). At the same time, there are huge post-harvest losses, 10-25% for perishables like milk, meat, fish and eggs. The estimated losses in fruits and vegetables are even higher, 30-40%. These adversely affect the Indian economy (Hegazy 2013). Milk, second in fruits and vegetables, tea, sugarcane and cotton and third in cereals (GoI 2016b). Agriculture sector needs structured and functional markets, preferably in vicinity of farmers, to drive growth, employment, remunerative price and economic prosperity in rural areas of the country. Enabling mechanism were also required to be put in place for procurement of agricultural commodities directly from farmers' field and to establish effective linkage between the farm production, the retail chain

*Corresponding author email id: pparihar2003@yahoo.co.in

and food processing industries. The term agricultural marketing is composed of two words-agriculture and marketing. It implies selling of goods and services by the farmers and ranchers. It includes various functions viz, assembling, transportation, storing, buying, selling, standardisation, grading, processing, sales and promotion.

Agriculture, in the broadest sense, means activities aimed at the use of natural resources for human welfare, i.e., it includes all the primary activities of production. But, generally, it is used to mean growing and/or raising crops and livestock. Marketing connotes a series of activities involved in moving the goods from the point of production to the point of consumption. It includes all the activities involved in the creation of time, place, form and possession utility. Agricultural marketing is the study of all the activities, agencies and policies involved in the procurement of farm inputs by the farmers and the movement of agricultural products from the farms to the consumers. The agricultural marketing system is a link between the farm and the non – farm sectors. It includes the organization of agricultural raw materials supply to processing industries, the assessment of demand for farm inputs and raw materials, and the policy relating to the marketing of farm products and inputs.

Importance of Agricultural Marketing

Optimization of Resource use and Output Management: An efficient agricultural marketing system leads to the optimization of resource use and output management. An efficient marketing system can also contribute to an increase in the marketable surplus by scaling down the losses arising out of inefficient processing, storage and transportation. A well-designed system of marketing can effectively distribute the available stock of modern inputs, and thereby sustain a faster rate of growth in the agricultural sector.

Increase in Farm Income: An efficient marketing system ensures higher levels of income for the farmers by reducing the number of middlemen or by restricting the commission on marketing services and the malpractices adopted by them in the marketing of farm products. An efficient system guarantees the farmers better prices for farm products and induces them to invest their surpluses in the purchase of modern inputs so that productivity and production may increase. This again results in an increase in the marketed surplus and income of the farmers. If the producer does not have an easily accessible market-outlet where he can sell his surplus produce, he has little incentive to produce more. The need for providing adequate incentives for increased production is, therefore, very important, and this can be made possible only by streamlining the marketing system.

Widening of Markets: A well-knit marketing system widens the market for the products by taking them to remote corners both within and outside the country, i.e., to areas far away from the production points. The widening of the market helps in increasing the demand on a continuous basis, and thereby guarantees a higher income to the producer.

Growth of Agro-based Industries: An improved and efficient system of agricultural marketing helps in the growth of agro-based industries and stimulates the overall development process of the economy. Many industries depend on agriculture for the supply of raw materials.

Price Signals: An efficient marketing system helps the farmers in planning their production in accordance with the needs of the economy. This work is carried out through price signals.

Adoption and Spread of New Technology: The marketing system helps the farmers in the adoption of new scientific and technical knowledge. New technology requires higher investment and farmers would invest only if they are assured of market clearance.

Employment: The marketing system provides employment to millions of persons engaged in various activities, such as packaging, transportation, storage and processing. Persons like commission agents, brokers, traders, retailers, weighmen, hamals, packagers and regulating staff are directly employed in the marketing system. This apart, several others find employment in supplying goods and services required by the marketing system.

Addition to National Income: Marketing activities add value to the product thereby increasing the nation's gross national product and net national product.

Better Living: The marketing system is essential for the success of the development programmes which are designed to uplift the population as a whole. Any plan of economic development that aims at diminishing the poverty of the agricultural population, reducing consumer food prices, earning more foreign exchange or eliminating economic waste has, therefore, to pay special attention to the development of an efficient marketing for food and agricultural products.

Creation of Utility: Marketing is productive, and is as necessary as the farm production. It is, in fact, a part of production itself, for production is complete only when the product reaches a place in the form and at the time required by the consumers. Marketing adds cost to the product; but, at the same time, it adds utilities to the product. The following four types of utilities of the product are created by marketing:

Form Utility: The processing function adds form utility to the product by changing the raw material into a finished form. With this change, the product becomes more useful than it is in the form in which it is produced by the farmer. For example, through processing, oilseeds are converted into oil, sugarcane into sugar, cotton into cloth and wheat into flour and bread. The processed forms are more useful than the original raw materials.

Place Utility: The transportation function adds place utility to products by shifting them to a place of need from the place of plenty. Products command higher prices at the place of need than at the place of production because of the increased utility of the product.

Time Utility: The storage function adds time utility to the products by making them available at the time when they are needed.

Possession Utility: The marketing function of buying and selling helps in the transfer of ownership from one person to another. Products are transferred through marketing to persons having a higher utility from persons having a low utility.

Current scenario of agricultural marketing in India

- ✓ Presently, markets in agricultural products are regulated under the Agricultural Produce Market Committee (APMC) Act enacted by State Governments.
- ✓ An Agricultural Produce Market Committee (APMC) is a marketing board established by state governments in India to ensure farmers are safeguarded from exploitation by large retailers, as well as ensuring the farm to retail price spread does not reach excessively high levels. APMCs are regulated by states through their adoption of Agriculture Produce Marketing Regulation (APMR) Act.
- ✓ There are 6,946 regulated wholesale APMC mandis as on March 2018 and out of 6946 mandis only 1000 have joined e-NAM platform (Jadhav, 2021). Two APMC mandis from Jammu and Kashmir have joined e-NAM.
- ✓ National Agriculture Market (e-NAM) is a pan-India electronic trading portal that inter-connects the existing Agricultural Produce Market Committee (APMC) mandis to create a unified national market for agricultural commodities.
- ✓ It was launched by Prime Minister Narendra Modi on 14 April, 2016. e-NAM is completely funded by the Central Government and is implemented by Small Farmers Agribusiness Consortium (SFAC), under the aegis of Ministry of Agriculture and Farmers' Welfare.
- ✓ It seeks to leverage the physical infrastructure of the mandis through an online trading portal, enabling buyers situated even outside the Mandi/ State to participate in trading at the local level (GoI, 2021).

Pricing

- ➢ Pricing is the method of determining the value a producer will get in the exchange of goods and services. Simply, pricing method is used to set the price of producer's offerings relevant to both the producer and the customer (Wiki, 2021).
- ➢ Pricing is a fundamental aspect of product management and is one of the four Ps of the marketing mix, the other three aspects being product, promotion, and place.
- ➢ Price is the only revenue generating element

amongst the four Ps, the rest being cost centers. However, the other Ps of marketing will contribute to decreasing price elasticity and so enable price increases to drive greater revenue and profits.

- Pricing decisions can have very significant consequences for the organization.
- It is one of the first considerations for many customers and it determines the profit margin on products.

Pricing is important due to the following factors:

Flexible Element of Marketing Mix

- Price is the most adjustable aspect of the marketing mix. Prices can be changed rapidly, as compared to other elements like product, place or promotion. Changes in product design or distribution system would take a long time to be implemented.
- Bringing about changes in advertisements or promotional activities is also a time-consuming task. But price is very flexible and can be changed according to the needs of the situation. Therefore, it is a very important component of marketing mix.

Right Level Pricing

- The wrong price decision can bring about the downfall of a company. It is extremely significant to fix prices at the right level after sufficient market research and evaluation of factors like competitors' strategies, market conditions, cost of production, etc.
- Low prices may attract customers in the initial stages, but it would be very hard for the company to raise prices on a future date. Similarly, a very high price will ensure more profit margins, but lesser sales. So, in order to maintain balance between profitability and volume of sales, it is important to fix the right price.

Price Creates First Impression

- Often price is the first factor a customer notices about a product. While the customer may base his final buying decision on the overall benefits offered by the product, he is likely to compare the price with the perceived value of the product to evaluate it.
- After learning about the price, the customers try to learn more about the product qualities.
- If a product is priced too high, then the customer may lose interest in knowing more. But if he thinks that a product is affordable, then he would try to get more information about it. Therefore, price is a critical factor that influences a buyer's decision.

Vital Element of Sales Promotion

- Being the most flexible component of marketing mix, price is the most important part of the sales promotion. In order to encourage more sales, the marketing manager may reduce the price.
- In case of goods whose demand is price sensitive, even a small reduction in price will lead to higher sales volume. However, prices should not be fluctuated too frequently to stimulate sales.
- Price is the most important factor for a consumer when it comes to making a purchase decision. Rarely will it be otherwise. As such, the right kind of pricing strategy can help achieve organisational goals.
- Price can be easily changed and is flexible thereby helping the organisation to respond quickly to marketplace changes.
- Price can also be used as a differentiating factor to set aside the said product from other products in the same category.
- And, last but not the least; price is the only element of the marketing mix that fetches revenue for the organisation.

Agricultural Prices: After an agricultural product leaves the farm-gate, it may pass through anyone of a number of different marketing and distribution channels before reaching the ultimate consumer.:

- It may move directly to the consumer (if the producer himself sells at the farm-gate, at the roadside or in a local village market); it may be sold by the producer directly to a retailer, to an exporter, or to a manufacturer particularly production under contract); or the producer may sell directly to a government controlled official marketing board which will pay fixed prices that may have been determined well in advance of harvesting, for example.

- Alternatively, the producer may sell to a wholesaler who will then resell to any of the buyers mentioned above either directly or through other wholesalers or middlemen.
- All combinations are possible. In the same way, a farmer buying the requisites of agricultural production may deal directly with retailers, wholesalers, manufacturers or importers.
- Thus, agricultural prices derive their meaning and significance from the stage of marketing to which they relate.
- They may, therefore, in accordance with the above, be prices received by farmers, wholesale prices, retail prices, or export prices (for produce sold); and import prices, wholesale prices, retail prices or prices actually paid by farmers (for the purchased means of production).

Agricultural Price Policy in India (ICAR, 2017)

- ✓ In India, the price policy was first introduced in 1947 with the formation of Food grains Policy Committee which recommended a policy of progressive decontrol, reduction of imports or food grains and substantial increase in the production of food grains.
- ✓ Again in 1950, Food grains Procurement Committee was appointed which introduced the system of rationing and control in the supply of food grains in the country.

The main objective of the price policy in India was to protect the interests of consumers

- In this policy no attention was paid to provide incentive price to farmers.
- It was only in 1964, a clear-cut policy was introduced for providing incentive price to farmers. The Third Plan document rightly observed that, "The producer of food grains must get a reasonable return. The farmer, in other words, should be assured that the prices of food grains and the commodities that he produces will not be allowed to fall below reasonable minimum." Accordingly, the food grains Price Committee was appointed in 1964.

The various agencies involve in Agricultural Pricing are

CACP (Commission for Agricultural Costs and Prices)

- ✓ The Commission for Agricultural Costs & Prices (CACP) is an attached office of the Ministry of Agriculture and Farmers Welfare, Government of India. It came into existence in January 1965.
- ✓ It is mandated to recommend minimum support prices (MSPs) to incentivize the cultivators to adopt modern technology, and raise productivity and overall grain production in line with the emerging demand patterns in the country.
- ✓ CACP submits its recommendations to the government in the form of Price Policy Reports every year, separately for five groups of commodities namely Kharif crops, Rabi crops, Sugarcane, Raw Jute and Copra.
- ✓ Before preparing aforesaid five pricing policy reports, the Commission draws a comprehensive questionnaire, and sends it to all the state governments and concerned National organizations and Ministries to seek their views. Subsequently, separate meetings are also held with farmers from different states, state governments, National organizations like FCI, NAFED, Cotton Corporation of India (CCI), Jute Corporation of India (JCI), trader's organizations, processing organizations, and key central Ministries.
- ✓ The Commission also makes visits to states for on-the-spot assessment of the various constraints that farmers face in marketing their produce, or even raising the productivity levels of their crops.
- ✓ Based on all these inputs, the Commission then finalizes its recommendations/reports, which are then submitted to the government. The government, in turn, circulates the CACP reports to state governments and concerned central Ministries for their comments.

- ✓ After receiving the feed-back from them, the Cabinet Committee on Economic Affairs (CCEA) of the Union government takes a final decision on the level of MSPs and other recommendations made by CACP. Once this decision is taken, CACP puts all its reports on the web site for various stakeholders to see the rationale behind CACP's price and non-price recommendations.

***FCI (Food Corporation of India)*:** The Food Corporation of India or the FCI was set up on 14 January 1965 headquarters at Chennai (later shifted to Delhi) under the Food Corporations Act 1964 to implement the following objectives of the National Food Policy:

- ✓ Effective price support operations for safeguarding the interests of the poor farmers
- ✓ Distribution of food grains throughout the country for Public Distribution System (PDS)
- ✓ Maintaining a satisfactory level of operational and buffer stocks of food grains to ensure National Food Security
- ✓ Regulate market price to provide food grains to consumers at a reliable price

FCI's Objectives are:

- To provide farmers remunerative prices
- To make food grains available at reasonable prices, particularly to vulnerable section of the society
- To maintain buffer stocks as measure of Food Security
- To intervene in market for price stabilization
- To facilitate procurement of food grains, FCI and various State Agencies in consultation with the State Government establish a large number of purchase centers at various mandis and key points. The number of centers and their locations are decided by the State Governments, based on various parameters, so as to maximize the MSP operations.

CONCLUSION

Agriculture marketing on large scale is the need of the hour, it will solve the twin problem of unemployment and less returns in agriculture. Price is not only a mean but an end of agriculture production also. Agriculture price policy of India is continuously evolving but it needs more frequent reforms. The more efficient agricultural marketing system and famer's centered agricultural policy can help in achieving doubling farmers income.

REFERENCES

Acharaya, S.S. and Agarwal, N.L. 2014. Agricultural Marketing in India, Oxford & IBH Publishing Co. Pvt. Ltd. p. 554.

Dastagiri, M.B. And Sindhuja, P.V.N. Global agricultural prices and policies during WTO regime: Explorative research to price policy advocay. *Word Food Policy,* 7: 6-25.

ED. 2021. Importance of Pricing. Economic Discussions (ED). Available at: https://www.economicsdiscussion.net/pricing/importance-of-pricing/31838. Accessed on 15 December, 2021.

FAO. 2021. Prices. Food and Agriculture Organization of United States (FAO). Available at: https://www.fao.org/prices/en/. Accessed on 2 December, 2021.

GoI. 2021. E-Nam Overview. Government of India (GOI). Available at: https://www.enam.gov.in/web/. Accessed on 17 December, 2021.

ICAR 2017. Market Led Agricultural Extension-Concept & Practices. ICAR Research Complex for Eastern Region, Patna. p. 192.

Wiki. 2021. Pricing. Wikipedia (Wiki). Available at: https://en.wikipedia.org/wiki/Pricing. Accessed on: 22 November 2021.

WTO. 2021. Agriculture: Fairer Markets for Farmers. World Trade Organization (WTO). Available at: https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm3_e.htm. Accessed on 22 December, 2021.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 559-562

Yield, Quality and Nutrient Content in Knolkhol (*Brassica oleracea var gonylodes* L.) as Influenced by Differential Substitution of Nutrients Through Organics in J&K

Monika Banotra*, B.C. Sharma, Brij Nandan, Rakesh Kumar, Rohit Sharma and Amit Mahajan
Division of Agronomy Sher-e-Kashmir University of Agricultural Sciences & Technology Jammu-180009, J&K

ABSTRACT

The field experiment was conducted for two consecutive years during rabi 2016 and 2017 at research farm of division of Agronomy, at main campus Chatha to evaluate the effect of differential substitution of nutrients through organics on yield, quality and nutrient content of knolkhol (*Brassica oleracea var gonylodes* L.) in J&K. The pooled result of two-year study on knolkhol revealed that yield and quality parameters of knolkhol were significantly influenced by differential substitution of nutrients through organics. Significantly higher knolkhol yield (723.57q/ha) was recorded with treatment 100% NPK (Recommended dose of fertilizer) where as significantly lowest knolkhol yield (469.68 q/ha) was recorded with treatment 100% N through FYM. On the other hand, significantly pooled higher quality parameters viz., relative chlorophyll content (50.74) and ascorbic acid (40.45 mg/100g) were recorded with treatment 100% N through FYM followed by treatment 100% N through Vermicompost and 100% N through FYM and Vermicompost (1:1) whereas numerically mean highest total nitrogen content (0.287), total phosphorus content (0.093) and total potassium content (0.387) in knolkhol (knob and leaves both) were recorded with treatment 100% N through FYM where as numerically lowest value of all these parameters were recorded with treatment 100% NPK (Recommended dose of fertilizer).

Keywords: FYM, Knolkhol, Nutrient content, Quality, Vermicompost and Yield

INTRODUCTION

Cole crops are the important cool season vegetable crops. Among the different cole crops, knol-khol (*Brassica oleracea var gonylodes* L.) is the important fast growing, short duration crop originated from the coastal countries of mediterranean region (Choudhary, 1967). In India, cultivation, of knol-khol is popular in West Bengal and some parts of South India. Knol-khol is a vegetable crop of prime importance in the traditional food habits of Jammu and Kashmir. It is known in India by the names, like 'Navalkol' and 'Ganth Gobi'. Knolkhol is a stout, round tuberous vegetable. The fleshy edible portion is an enlargement of stem, which develops entirely above ground and is used as a vegetable. It is characterized by the formation of knob (tuber) which arises from the thickening of the stem tissue above the cotyledons. The swollen stem stores edible food material specially starch and sugars. It is regarded as important functional food due to its high nutritional value. In the past decades, the cultivation of knol-khol increased after the discovery of the presence of glycosylates compound which has strong anti-carcinogenic properties (Johnson, 2002). Knolkhol can be grown from seeds, but frequently it is cultivated from transplants, especially for early market supply. Further inadequate and unbalance use of chemical fertilizer had deteriorated the quality of crops. Increased health awareness among the people had increased the demand of organic vegetables but it is impossible for farmer community to shift directly from inorganics to organics due to shrinkage of land resources and increased demand for food to feed the burgeoning population. This may become possible through the progressive substitution of organic sources

*Corresponding author email id: monikabanotra6@gmail.com

of nutrients in place of in organics to meet crop nutrient requirement for attaining higher and stable crop yield of better quality with an improvement in soil health. Therefore, the research problem Impact of differential substitution of nutrients through organics on Yield, Quality and Nutrient content of knolkhol (*Brassica oleracea var gonylodes* L.) in J&K was framed.

MATERIALS AND METHODS

The experimental site was conducted for two consecutive years from *rabi* 2016 and *rabi* 2017 at research farm of division of Agronomy located at 32°40' N latitude and 73° 64' E longitude at an elevation of 293 meters above mean sea level. Initially, soil of the experimental site was sandy clay loam in texture with sand (62.52%), silt (11.73%) and clay (25.75%). Also, soil of the experimental field was low in organic carbon (0.45 percent) and available nitrogen (249.88 kg/ha) but medium in available phosphorus (13.79 kg/ha) and potassium (148.45 kg/ha). The experiment consists of sixteen treatments including T_1-100% NPK (Recommended dose of fertilizer); T_2 - 75% NPK+25% N through vermicompost; T_3 -50% NPK+50% N through vermicompost; T_4-25% NPK+75% N through vermicompost; T_5-100% N through vermicompost; T_6 - 25% yearly replacement of RDF through vermicompost on N basis; T_7 - 75% NPK+ 25% N through FYM; T_8- 50% NPK+50% N through FYM; T_9 - 25% NPK+75% N through FYM; T_{10}-100% N through FYM; T_{11}-25% yearly replacement of RDF through FYM on N basis; T_{12} - 75% NPK+25% N through vermicompost and FYM (1:1); T_{13}- 50% NPK+50% N through Vermicompost and FYM (1:1); T_{14} -25% NPK+75% N through vermicompost and FYM (1:1); T_{15} -100% N through vermicompost and FYM (1:1); T_{16}-25% yearly replacement of RDF through vermicompost and FYM (1:1) on N basis. Variety 'G40' of knolkhol was used in the experiment during both the years. The nursery of knolkhol was raised to produce seedlings to be transplanted in an area of 1 hectare using a seed rate @ 1 kg/ha. The Knolkhol seedlings of 36 days old were transplanted in the experimental plots on 12th Feb 2016 and 18th Feb 2017 at spacing of 30 cm × 20 cm in the main field during both the years. Watering was done immediately after transplanting for the better survival of knolkhol seedlings. The recommended dose of nutrients for knolkhol was N (100 kg/ha), (50 kg/ha), K (50 kg/ha) and FYM (30t/ha) as per the recommended package of practice. The source of inorganic nutrients were Urea, DAP and MOP whereas organic sources were FYM and Vermicompost. The nutrients were applied as per the treatments. The harvesting of knolkhol was done manually with sickles when the swollen stem of the knolkhol attained the diameter of 5-7.5 cm. Knolkhol yield was recorded from each net plot net plot and then converted in to quintal per hectare. The quality parameters viz., relative chlorophyll content in leaves of knolkhol was estimated by using SPAD meter and Ascorbic acid content in knob of knolkhol was calculated by standard procedure done by (Ranganna, 1986). Further, treatment wise samples of knolkhol (knob and stem) were oven dried at 65±5°C for 24 hours, dried samples were ground in to 40 mesh size. The nutrient content in knolkhol was estimated by Modified Kjeldhal's method given by (Jackson, 1967) for N content, Vanadomolybdo Phosphoric acid yellow colour given by (Jackson, 1967) for P content and Ammonium acetate method given by (Hanway and Heidel, 1952) for K content estimation. The analysis was done by statistical analysis according to procedure outlined by Cochran and Cox (1963).

RESULT AND DISCUSSION

The pooled result of two-year study on knolkhol presented in Table 1 revealed that significantly highest knolkhol yield (723.57 q/ha) was recorded with treatment T_1 which was found statistically at par with knolkhol yield recorded with treatment T_{12}, T_{16}, T_2, T_6 and T_7 whereas significantly lowest knolkhol yield (469.68 q/ha) was recorded with treatment T_{10} which was found statistically at par with knolkhol yield recorded with treatment T_5(473.31 q/ha), T_{15} (482.80 q/ha), T_9 (484.45 q/ha), T_4 (487.16 q/ha) and T_{14} (492.10 q/ha) in the ascending order. On the other hand, treatment T_{13} (595.79 q/ha), T_3(589.89 q/ha) and T_8 (584.99 q/ha), were found significantly different from all the treatments in the decreasing order. The highest yield with treatment T_1, T_{12} and T_{16} was might be due to the reason of sufficient amount of plant nutrient supply throughout the crop growth period especially at critical crop growth stages and efficient combination of inorganic fertilizers and organic manures not only release essential nutrients but also prevents the losses of chemical fertilizers through denitrification, volatilization and leaching by binding the nutrients and release them with the passage of time. Also, inorganic manure in combination with organic manure (Vermicompost and FYM) have provided the micronutrients such as Zinc, Iron and Manganese etc in the optimum level whereas iron is involved in the chlorophyll synthesis pathway. Vermicompost and FYM activate many species of living organism, which release phytohormones and stimulate the knolkhol growth and absorption of essential nutrients. Similar results were also reported by Asghar *et al.* (2006) and Ouda *et al.* (2008).

The pooled result of two consecutive years on knolkhol presented in Table 1 revealed that quality parameters of knolkhol viz., relative chlorophyll content in leaves and ascorbic acid content in knob of knolkhol were significantly influenced by differential substitution of nutrients through organics. Significantly highest relative chlorophyll content in leaves and ascorbic acid content in knob of knolkhol (50.74 and 40.45 mg/100g) was recorded with treatment T_{10} which was found statistically at par with relative chlorophyll content in leaves and ascorbic acid content in knob of knolkhol recorded with treatments T_5(50.62 and 39.25mg/100g), T_{15}(50.19 and 38.94mg/100g), T_9(50.04 and 38.59 mg/100g), T_4 (49.95 and32.77 mg/100g) and T_{14} (49.68 and37.76 mg/100g) in the descending order whereas treatment T_8(42.06 and 32.83mg/100g), T_3(41.91 and32.77 mg/100g) and T_{13}(41.81 and 31.51mg/100g) were found statistically different from all the other treatments in relative chlorophyll content of knolkhol. On the other hand, lowest relative chlorophyll content in knolkhol was recorded with treatment T_1(33.24 and 25.56mg/100g) which was found statically at par with relative chlorophyll content recorded with treatment T_{12}(33.70 and 26.01 mg/100g), T_{16}(33.87 and26.07 mg/100g), T_2(34.08 and 26.19 mg/100g), T_{6} (34.13 and 26.41mg/100g) and T_7(34.20 and26.51 mg/100g) in the increasing order. The highest relative chlorophyll content in these treatments was might be owed to reason that application of organic manures on decomposition add ed the appreciable quantities of magnesium and nitrogen where nitrogen and magnesium are constituent of chlorophyll molecule. Moreover, nitrogen is the main constituent of all amino acids in proteins and lipids that acting as a structural component of the chloroplast. These results were in agreement with the findings of Sanwal *et al.* (2007). On the other hand decrease in ascorbic acid concentration in differential substitution and RDF treatment was might be due to reason that when knolkhol plants are exposed to more nitrogen, it increases the protein production and reduces carbohydrate synthesis. Since ascorbic acid is synthesized from carbohydrates, its levels are also reduced. Similar, results were also reported by Bhadur *et al.* (2003).

Table 1: Effect of differential substitution of nutrients through organics on yield and quality of knolkhol during *rabi* 2016 and 2017 (Pooled data of 2 years)

Treatment	Knolkhol yield (q/ha)	Relative chlorophyll Content (SPAD meter)	Ascorbic acid (mg/100g)
T_1	723.57	33.23	25.56
T_2	698.70	34.08	26.19
T_3	589.89	41.91	32.77
T_4	487.16	49.95	38.48
T_5	473.31	50.62	39.25
T_6	696.68	34.13	26.41
T_7	684.98	34.20	26.51
T_8	584.99	42.06	32.83
T_9	484.45	50.04	38.59
T_{10}	469.68	50.74	40.45
T_{11}	684.09	34.74	26.71
T_{12}	716.69	33.70	26.01
T_{13}	595.79	41.81	31.51
T_{14}	492.10	49.68	37.76
T_{15}	482.80	50.19	38.94
T_{16}	711.94	33.87	26.07
SEm (±)	21.27	2.39	1.64
CD(p=0.05)	60.16	6.91	4.73

The mean data two-year nutrient content of knolkhol presented in Table 2 revealed that numerically highest value of total nitrogen content (0.287), total phosphorus content (0.093) and total potassium content (0.387) in knol khol (knob and stem) was recorded with treatment T_{10} followed by treatment T_5, T_{15}, T_9, T_4, T_{14}, T_8, T_3, T_{13}, T_{11}, T_7, T_6, T_2, T_{16}, T_{12} and T_1 with lowest total nitrogen content (0.198), total phosphorus content (0.061) and total potassium content (0.279) in

Table 2: Effect of differential substitution of nutrients through organics on total nutrient content after the harvest of knolkhol during *rabi* 2016 and 2017 (mean data of 2 years)

Treatment	Nutrient content (%)		
	Nitrogen	Phosphorus	Potassium
T_1	0.198	0.061	0.279
T_2	0.218	0.072	0.342
T_3	0.249	0.081	0.363
T_4	0.273	0.088	0.369
T_5	0.284	0.092	0.383
T_6	0.223	0.072	0.346
T_7	0.226	0.073	0.351
T_8	0.254	0.082	0.367
T_9	0.276	0.089	0.372
T_{10}	0.287	0.093	0.387
T_{11}	0.233	0.074	0.354
T_{12}	0.211	0.069	0.331
T_{13}	0.247	0.081	0.360
T_{14}	0.268	0.087	0.364
T_{15}	0.278	0.090	0.375
T_{16}	0.213	0.070	0.334

knol khol (knob and stem). This was might be due to reason that addition of organic matter increased the cation exchange capacity of the soil and also increased the microbial activity. These results were in conformity with the findings of Harencia *et al.* (2007). The increase in total nutrient content in knolkhol with 100% organic was also reported by (Mishra 2014).

CONCLUSION

Based on to year study it was concluded that among the sixteen treatments recommended dose of nutrient by enlarge found to be the best practice as compared to all other fertility treatments. It was further observed that treatment T_{10} where 100% N was applied through FYM followed by treatment T_5-100% N through Vermicompost and T_{15}-100% N through Vermicompost and FYM (1:1) were found to be relatively better in improving the quality traits of knolkhol.Further, for substitution of nutrients, for immediate shifting from in organics to organics combination of Vermicompost and FYM (1:1) can be the best option for early realization of yield at par with recommended dose of fertilizer.

REFERENCES

Asghar, H.N.; M. Ishaq; Z.A. Zahir; M. Khalid and M. Arshad. 2006. Response of radish to integrated use of nitrogen fertilizer and recycled organic waste. *Pakistan Journal of Botany,* 38(3): 691-700.

Bhadur, A.; J. Singh; A.K. Upadhyay and K.P. Singh. 2003. Effect of organic manures and biofertilizers on growth and yield and quality attributes of broccoli (*Broccoli oleracea var. italica*). *Vegetable Science*, 30(2): 192-194.

Choudhary, B. 1967. Vegetable, National Book Trust of India. New Delhi. pp 72-73.

Cocharn, G. and G.M. Cox. 1963. Experimental design. Asia Publishing House, Bombay, India.

Hanway, I.J. and H. Heidel. 1952. Soil analysis and methods as used in Iowa State College. Soil Testing Laboratory. *Iowa Agriculture*, 57: 1-31.

Herencia, J.F.; J.C. Ruiz-Porras; S. Merelo and C. Maqueda. 2007. Effect of organic versus mineral Fertilization in soil fertility, macronutrients content in crop and yield. *Agronomy Journal*, 99: 973-983.

Jackson, M.L. 1967. Soil Chemical Analysis. Prentice-Hall, New York, U.S.A. pp. 375.

Johnson, I.T. 2002. Glucosinolates in human diet. Bioavailability and implication for health. *Phytochemistry Reviews*, pp 183-188.

Mishra, P.P.; A.K. Das and N. Mishra. 2014. Effect of Integrated nutrient management on yield, quality and economics of Knol-khol (*Brassica oleracea L. cv. gongylodes*). *The Asian Journal of Horticulture,* 9(2): 382-385.

Ouda, B.A. and A.Y. Mahadeen. 2008. Effect of fertilizers on growth, yield components, quality and certain nutrient contents in broccoli (*Brassica oleracea var. italica*). *International Agriculture Biology*, 10: 627-632.

Ranganna, S. 1986. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products. 2nd ed. Hill Publishing Company Limited, New.

Sanwal, S.K.; K. Lakinarayana; R.K. Yadav; N. Rai and B. Mousumi. 2007. Effect of organic manures on soil fertility growth, physiology, yield and quality and turmeric. *Indian Journal of Horticulture,* 64(4): 444-449.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 563-567

Problems and Prospects of Direct Seeded Rice in Punjab

Ramandeep Kamboj, Dharminder Singh* and T.S. Riar
Department of Extension Education, Punjab Agricultural University, Ludhiana-141004, Punjab

ABSTRACT

The present study was conducted to ascertain the problems and prospects of Direct Seeded Rice in Punjab. Personal interviews were conducted to collect data from randomly selected 210 farmers from three districts representing different agro-climatic regions of Punjab. Majority of the respondents belonged to the age group of 43-61 years, matriculate and respondents possessed medium size of operational land holdings. Study revealed that farmers desired to increase the area under DSR because they got almost similar yield as that of transplanted rice apart from saving in labour and time. Majority of respondents (84.76%) found it easy to practice DSR technology and very few respondents (11.91%) has faced moderate level of difficulty. Poor crop stand and rodent attack were the main problems reported by the farmers. Problems of weed infestation, untimely rains, deficiency of micronutrients and lesser yield were also faced by the respondents. Study emphasises extension interventions through training, demonstrations and campaigns along with provisioning of relevant literature, increase availability of seed drills and strengthening advisory services.

Keywords: Direct seeded rice, Problems, Prospects, Adoption, Technology

INTRODUCTION

India is the second largest producer of rice in the world being superseded only by China in the gross annual output. India is covering an area of 43.79 million hectares under paddy with a total production of 112.91 million tons. Punjab stands first position in productivity of rice in India and the area under paddy during *kharif* season in 2020 was 31.42 lakh hectares with a record production of 189.18 lakh tonnes of paddy (Anonymous 2021). Rice has been staple nourishment for the greater part of population but a water guzzler crop and has 1800 mm irrigation requirements. It is commonly grown by transplanting seedlings into puddled soil. The continuous cultivation of rice-wheat cultivation has resulted in overexploitation of the two most important natural resources i.e. soil and water (Baweja *et al.,* 2017 and Dhingra *et al.,* 2019). To meet the food requirements of the country, the area under rice and wheat was increased in Punjab, but more extraction of water from the groundwater leads to underground water depletion (Sharma *et al.,* 2012). Due to the assured procurement policy, minimum support price and subsidized power supply by the government, the farmers are not willing to replace rice with other crops. The average water table depth was 7.32 m in 1998 which has been decreased to 12.79 m in 2012 (Gupta *et al.,* 1995 and Baweja *et al.,* 2017). Number of tube wells in the Punjab state has increased from 1.92 Lakh in 1970-1971 to 14.75 Lakh in 2011-2012 (Baweja *et al.,* 2017 and Anonymous, 2020). A different water saving technologies have been developed and recommended by Punjab Agricultural University, Ludhiana such as direct seeded rice, zero tillage in wheat, laser leveller and tensiometer etc. Direct-seeded rice is a possible alternative to conventional puddled transplanted rice, where rice crop was sown through direct seeding in non-puddled fields (Singh *et al.,* 2009). Direct seeded rice technology also help in reducing green-house gases emissions and adapt to climate risks. Direct seeded rice is a cost-effective option and appropriate management method that produces equivalent yields. As a result, the overall cost of producing rice is reduced (Mitchell *et al.,* 2004). Tar-wattar direct seeded rice is an improved version of

*Corresponding author email id: dharminder@pau.edu

existing DSR technology, in which the pre-sowing irrigation is applied after laser levelling the field. An important variation from the earlier direct seeded rice technology is delaying the first irrigation to 21 days (Singh *et al.,* 2021). In different districts, significant area was sown under rice with this technique in Punjab. So, the present study was organized to study the adoption status of direct seeded rice, level of recommended package of practices and the problems faced by the farmers in the adoption of direct seeded rice technology.

MATERIALS AND METHODS

Study was conducted in Punjab state and one district from each of three agro-climatic regions was selected for the study. Sangrur district from central plain, Gurdaspur from sub-moutain undulating and Fazilka from south western region were selected for the present study. List of farmers practising DSR was obtained from Department of Agriculture and Farmer Welfare and respective Krishi Vigyan Kendras. Further, 70 farmers were selected randomly from each selected district for the present study. Thus, total sample size for the present study was 210 farmers. Data were collected by using personal interview with direct seeded rice growers by constructing an interview schedule. Interview schedule so prepared was pre-tested on twenty respondents from the non-sampled area. On the basis of information obtained through pre-testing, necessary modifications were made in the schedule after thorough discussion with the advisory committee members so as to remove the ambiguities and make it comprehensive and easy for recording the data. The response of the respondents was transferred on the excel sheets and were tabulated according to the objective of the study. The data were analysed with the help of appropriate statistical tools such as frequencies percentage, mean score and range method.

Table 1: Distribution of respondents according to their socio-personal characteristics (n=210)

Category/Range	Frequency	Percentage
Age (Years)		
24-42	80	38.10
43-61	106	50.48
62-80	24	11.43
Family type		
Joint	119	56.67
Nuclear	91	43.33
Education		
Illiterate	12	5.71
Primary	14	6.67
Matriculation	91	43.33
Senior secondary	65	30.95
Graduate or above	28	13.33
Operational land holding(Acres)		
Marginal (<2.5)	2	0.95
Small (2.5-5)	30	14.29
semi- medium (5-10)	53	25.24
Medium (10-25)	82	39.05
Large (> 25)	43	20.48
Mass Media exposure (Score)		
Low (0-6)	15	7.14
Medium (7-13)	124	59.05
High (14-20)	71	33.81
Extension contacts (Score)		
Low (2-5)	50	23.81
Medium (6-9)	133	63.33
High (10-13)	27	12.86
Farming experience (years)		
Low (4-23)	70	33.33
Medium (24-43)	115	54.76
High (44-63)	25	11.90

RESULTS AND DISCUSSION

Data presented in Table 1 revealed that age of farmers varied from 24-80 years. Many of the respondents 50.48 per cent belonged to the age group of 43-61 years followed by 38.10 per cent in category of 24-42 years and remaining of the farmers 11.43 per cent fell in the age group of 62-80 years.

It can be observed from the data presented in Table 1 that 56.67 per cent of respondents had joint families and rest of 43.33 per cent had nuclear families. It is clear from the data that joint family system still exists in rural area. The data presented in Table 1 pertaining to education of the respondents showed that 43.33 per cent of respondents were matriculate and about 5.71 per cent respondents were illiterate, about 6.67 per cent of respondents had gained education up to primary and 30.95 per cent of respondents were found to have education up to senior secondary level, while 13.33 per cent of respondents were graduated or above. The respondents were categorized into five groups on basis of their operational land holding. Data presented in Table 1 showed that a significant proportion (39.05%) of the respondents had medium size of operational land holdings for crop production, and about 25.24 per cent of the respondents had semi-medium size of operational land holdings, 20.48 per cent of the respondents had large size of operational land holdings. Only 0.95 per cent of the respondents had marginal size of land and 14.29 per cent of the respondents had small size operational land holding. So, it was observed that most of the farmers had in the category of medium size of land holdings. Mass media exposure plays a significant role in the development of agricultural sector. Mass media is the back bone of agricultural extension through which agricultural universities and agricultural experts can easily disseminate the new knowledge to the farmers. The respondents were grouped into three categories by using range method and data presented in Table 1 indicated that 59.05 per cent of the respondents had medium mass media exposure and 33.81 per cent of respondents had high mass media exposure. About 7.14 per cent of respondents had low mass media exposure. Extension contacts play a significant role in the adoption of any innovation. It not only helps the farmers to get new information but also change the mindset of the farmers towards innovation. Data presented in the Table 1 showed that 23.81 per cent of the respondents had low extension contacts. Further, 63.33 per cent of respondents had medium level of extension contacts and only 12.86 per cent respondents had high level of extension contacts. It might be due to the poor farmer extension linkage and infrequent visit of the respondents to the various agricultural organizations such as PAU, Krishi Vigyan Kendra (KVKs). Farming experience influences knowledge as well as adoption of innovative technologies. Most of the respondents 54.76 per cent were found to have experience of 24-43 years. Only few 11.90 per cent of the respondents were having rich experience of about 44-63 years and 33.33 per cent of respondents were found with experience of 4-23 years

Reasons for adoption of DSR technology: Reasons were asked from the respondents about adoption of DSR technology. All the major reasons given by the respondents were presented in Table 2. Most of the respondents (65.71%) was adopted DSR technology due to less labour requirement, which led them to adopt DSR technology. Other major reasons were motivated by fellow farmers (62.86%) and saving of their efforts on growing rice nursery (51.43%) whereas 48.10 per cent of the farmers were opined that DSR require less water and would help in saving of irrigation water. Reduction in cost of cultivation was perceived by 39.05 per cent of the respondents. The reason for reduced cost of cultivation was not only due to less labour or water requirement but also due to less expenditure on preparation of fields. However, increased profit margin was opined by 32.38 per cent of the respondents.

Table 2: Distribution of respondents according to reasons for adopting DSR technology (n=210)

Reasons for adoption	Frequency*	Percentage
Motivated by fellow farmers	132	62.86
Less labour requirement	138	65.71
Less water requirement	101	48.10
Reduced cost of cultivation	82	39.05
Increased profit margin	68	32.38
Save efforts on growing nursery	108	51.43
Gives more yield than transplanting	90	42.86

**Multiple Response*

The data in Table 3 revealed that majority of the respondents (48.10%) would likely to increase their area under DSR. The farmers increased the area under DSR because they got almost similar yield as that in transplanted rice. Farmers also said that DSR

Table 3: Distribution of respondents according to prospects and difficulties level in direct seeded rice technology (n=210)

Category	Frequency	Percentage
Prospects		
Increase the area	101	48.10
Keep the area constant	65	30.95
Decrease the area	44	20.95
Difficulties level		
Easy	178	84.76
Moderate	25	11.91
Difficult	7	3.33

Table 4: Problems faced by respondents in adopting DSR technology (n=210)

Problems in direct seeded rice	Frequency*	Percentage	Rank
Rodents attack	190	90.48	I
Gap filling is required	168	80.00	II
More infestation of weeds as compared to puddled rice.	143	68.10	III
More expenditure on herbicides	124	59.05	IV
Difficulty in weed management	105	50.00	V
Incidence of rain during early stage (crust formation)	100	47.62	VI
Difficulty in maintaining proper depth of seed	79	37.62	VII
Decrease in yield	52	24.76	VIII
Inadequate knowledge about cultivation practices of direct seeded rice	43	20.48	IX
Less yield of short duration of varieties	36	17.14	X
Iron deficiency	35	16.67	XI
Non availability of labour for hand hoeing/weeding	24	11.43	XII
Off type plants or variety mixture in crop	22	10.48	XIII

**Multiple Response*

technology helps in labour and time saving. Around 30.95 per cent of the respondents wished to keep the area constant under direct seeded rice cultivation. As many as 20.95 per cent of farmers wanted to decrease area under DSR as they encountered different problems during DSR cultivation.

It also shows that majority of respondent (84.76%) found it easy to practice DSR technology. However, it shows that 11.91 per cent has faced moderately level of difficulty and only 3.33 per cent respondents found DSR technology difficult to practice. The low level of difficulty in understanding DSR technology implies that DSR can be easily disseminated among farmers.

Problems faced by the respondents: As it is imperative with any practice, farmers do face a number of problems in DSR. Problems faced by respondents were studied with the help of structured as well as open ended questions. The analysed response is given in the Table 4. It is clear from the table that rodents attack was the main problem reported by 90.48 per cent of the farmers. Other problem faced by the 80.00 per cent of respondents was lesser germination and patchy crop which require gap filling. Around (68.10%) of respondents was faced the weed problem. Many farmers reported the problems that there was more expenditure on herbicides and difficulty in weed management, which were faced by 59.05 per cent and 50.00 per cent of respondents, respectively. Another problem which was encountered while practicing DSR was Iron deficiency as reported by 16.67 per cent of respondents which is otherwise negligible in case of puddled rice.

This weed management problem was so cumbersome that respondents did try to manage it with hand hoeing in addition to use of chemicals, but here also they faced problem of non-availability of labour (11.43%) of the respondents. Other major problem faced by respondents was difficulty in maintaining proper seed depth as given by 37.62 per cent of respondents. If proper seed depth is not maintained, then there was uneven germination of seeds. Similarly, occurrence of rain at early stage of sowing also resulted in poor germination as responded by 47.62 per cent of the respondents. In addition to these, there were some other problems which were faced by relatively lesser number of respondents. These problems include off type plants or variety mixture in crop (20.00%) and decrease in yield (24.76%) of respondents.

CONCLUSION

The continuous cultivation of rice-wheat cultivation has resulted in overexploitation of the two most important natural resources i.e. soil and water. Direct-seeded rice is a possible alternative to conventional puddled transplanted rice, where rice crop was sown through direct seeding in non-puddled fields, these fields were suitable approaches for water saving and labour. Study also revealed positive prospects of DSR in future times as farmers showed their willingness to increase area under this technology. Study also investigated various problems in further adoption of DSR technology which points out to lack of knowledge among farmers about various practices of DSR. Study underlines the importance of extension interventions like trainings, demonstrations and campaign to disseminate DSR practices for its adoption at farmers' fields.

REFERENCES

Anonymous. 2020. Handbook of agriculture, Punjab Agricultural University, Ludhiana.

Anonymous. 2021. Package of practices for *Kharif* crops of Punjab, Punjab Agricultural University, Ludhiana.

Baweja, S.; R. Aggarwal and M.S. Brar. 2017. Groundwater depletion in Punjab, India. *Encyclopedia of Soil Science*, Third Edition, pp. 1-5.

Dhingra, V.; G. Dhingra and M. Dhingra. 2019. Water economics as applied to agriculture: An overview. *Farm Management,* 4(2): 92-96.

Gupta, R.D.; G. Mahajan and B.R. Goyal. 1995. Availability and quality of groundwater in Punjab state. *Proc Water Resource Day,* pp. 18-42.

Mitchell, J.; S. Fukai and J. Basnayake. 2004 Grain yield of direct seeded and transplanted rice in rain-fed lowlands of South East Asia.In: *Proceedings of the 4th International Crop Science Congress Brisbane, Australia*. pp 81-90.

Sharma, P.; C.K. Krishnamurthy; R.S. Sidhu; K. Vatta; B. Kaur; V. Modi; R. Fishman; L. Polycarpou and U. Lall. 2012. Columbia water center white paper- Restoring groundwater in Punjab, India's bread basket: Finding agricultural solution for water sustainability. Retrieved from: http://water.columbia.edu

Singh, R.; M.S. Bhullar; J.S. Gill; S. Kaur; G.S. Buttar; A.S. Murai and J.S. Mahal. 2021. Direct Seeded Rice in Punjab-Silent Revolution during Covid-19. ICAR-ATARI, Ludhiana. pp 253.

Singh, S.K.; V. Bharadwaj; T.C. Thakur; S.P. Pachauri; P.P. Singh and A.K. Mishra. 2009. Influence of crop establishment methods on methane emission from rice fields. *Current Science,* 97: 84-89.

Received on March 2022; Revised on April 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 568-572

A Study of Drug Addicts in the De-addiction Centers in the Punjab: Reasons and Suggestions

Lakhwinder Kaur[1], Dharminder Singh[1] and Gaganpreet Kaur[2]
[1]Extension Scientists, [2]Assistant Professor, Department of Extension Education and Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, Punjab

ABSTRACT

Drug abuse is a global phenomenon, affecting almost every country. In Punjab, drug addiction is a cancer which is crippling the mental and physical well being of the youth population of Punjab. The current study is an attempt to know the profile of drug addicts, reasons and extent of use of taking drugs to get an insight into the problem. The findings of the study revealed that majority of the respondent were young, matriculate, belonged to rural background and taking drugs on the suggestions of their friends. Majority of the respondents used to take poppy husk regularly. It is observed that peer pressure is one of the major factor of drug abuse. It is therefore, suggested that parents should be careful about their wards at the age of 18-33 years. They should regularly check activities of their wards and be friendly with them.

Keywords: Drug De-Addiction Centers (DDCs), Drug Addiction

INTRODUCTION

Youth is the building block of the nations, so for all the countries the importance of youth and its welfare is considered as a vital need. The youth is the most dynamic and potential segment of the population of any country but unfortunately in Punjab, drug addiction is a cancer which is crippling the mental and physical well being of the youth population of Punjab. Consumption of alcohol, opium and cannabis etc. generally ritualized in social gatherings and found their way into the life of people and been used for social, recreational and medicinal purposes which resulted negative impact on physical and mental health, interpersonal relationship, financial status and occupation of substance users and their family (Kaur *et al.,* 2018). The Punjab Opioid Dependent Survey, 2015 estimated that Rs 7,525 crore was spent on the purchase of opioids annually, i.e. Rs 20 crore daily (Anonymous, 2020). Youth with lots of time, money and lacking parental supervision get easy lured into the drug habit, either prompted by peers or on their own.

Punjab has already recorded a staggering 23 deaths from an overdose of drugs month of June 2020. In a heart-wrenching video that went viral recently, a helpless woman can be seen wailing next to the lifeless body of her son, a drug addict, asking him to get up so that she can make rotis for him (Anonymous, 2020).

Drug abuse is the use of illicit drug or misuse of legitimate drug resulting into physical or psychological harm. It includes smoking ganja or hashish, taking heroin or cocaine, injecting morphine, drinking alcohol and so forth. These are sometimes referred to as being high on speed or trip or getting kicks (Ahuja 2011, Advani, 2013). Addiction to a drug means that the body become so dependent to the toxic effects of the drug that one just cannot live without it. Drug addiction causes immense human distress, and the illegal production and distribution of drugs have spawned crime and violence worldwide. Today, there is no part of the world that is free from the curse of drug trafficking and drug addiction. Millions of drug addicts, all over the world, are leading miserable lives, between life and death. (Kulsudjarit, 2004). Drug abuse affects the life of every member of the family, the close ones the worst. It leads to family disputes, broken marriages, divorces, debt on the families, loss of lives and in many cases welcomes the havoc causing diseases like HIV/ AIDS due to needles used in injecting intravenous drugs

(Kaur, 2017).This study is an attempt to study the profile of patients and the major reasons behind taking drugs to get an insight into the problem.

MATERIALS AND METHODS

This study was conducted in state of Punjab in year 2018 in three districts of Punjab. *viz.* Gurdaspur, Ludhiana and Bathinda. Two de-addiction centers from each district was taken into account. From Bathinda, namely Nasha Mukti Kendra, and Aasra Drug Rehab Centre were selected. Further, Red cross society and Navjeevan Drug Treatment Centre from Gurdaspur and lastly, Jeewnan Jot Nasha Chadau Punar Niwas Kendra and Mind Plus Retreat from Ludhiana were taken up for the study. Twenty drug addicts each from all the selected six centre's were selected randomly making a sample of 120 respondents. Survey was planned to collect data who were admitted to de-addiction centres with the help of self developed questionnaire keeping in view with the objectives to study the profile of the respondents and reasons for taking the drugs. The data was collected without hurting anybody. The data were analyzed with the help of frequencies and percentages. The extent of use was measured on two point continuum i.e. regularly and sometime with the scoring of 2 and 1 respectively.

RESULTS AND DISCUSSION

The relevant discussion on socio-characteristics has been presented in Table 1. Out of 120 respondents who were interviewed, 66.67 per cent of them belonged to the age group of 35-50 years while 20.83 per cent were in the age range of 20-35 years. Only 12.5 per cent of the respondents were in the age of 50-65 years. Kapoor *et al.* (2019) in their research reported that average age of patients was 39 to 40 years whereas Sharma *et al.* (2019) found that majority of the patients belonged to age group 18–30 years.

It was observed that 75 per cent of the respondents belonged to rural families while 25 per cent of the respondents belonged to urban families. The findings were in line with various researchers who (Kalra and Bansal, 2012 and Sharma *et al.,* 2019) reported that majority (85.5%) drug addicts residing in rural areas Contrarily, Mohan *et al.,* 2004 found that 55% drug addicts belonged to urban area and 45% were from rural background.

Furthermore 69.16 per cent of the respondents belonged to joint family whereas 30.83 per cent of the respondents belonged to nuclear family. The results were in track with the findings of Latha and Chandrakumar (2012), Baite (2014) and Sharma *et al.* (2018) which shows that joint family system is still widely prevalent in rural areas.

The perusal of data in Table 1 revealed that 41.66 per cent of the respondents were matriculate. The findings were in tune with study conducted by Gupta *et al.* (2013) which stated that most of patients were educated upto matric. Contrarily Kumar *et al.* (2013) and Sharma *et al.* (2018) in their studies reported that most of drug addicts were educated up to primary level. Sixteen per cent of the respondents had educational qualification till senior secondary whereas 12.5 per cent of the respondents were middle school passed. Small percentage of respondents i.e.4.16 completed diploma in agriculture.

A close look at the Table 1 further pointed out that fathers of 29.16 per cent respondents were educated upto middle level while 25 per cent were illiterate. Fathers of 4.16 per cent respondents were graduate. The data further revealed that that mothers of 46.66 per cent respondents were illiterate while 20 per cent were educated upto secondary level. It is therefore observed that fathers were educated up to middle level whereas mothers were illiterate.

The scrutiny of data in Table 1 revealed that age of starting drugs range between 18-63 years with a view that 73.33 per cent of the respondents started taking drugs in the age range of 18-33 years while 18.33 per cent in the age group of 33-48 years. The findings were in line with Only 8.34 per cent of the respondents started taking drugs in the age range of 48-63 years. Kadri et al (2003), Raju (2005) found that 46.4% of the people between 18-23 years started taking the drugs. Kaur *et al* 2016 reported that the mean age of initiation of all types of drug use was 20 years,

The data in Table 1 revealed that parents of 76.66 per cent respondents used to discuss home problems with them while 23.33 per cent respondents reported that their parents did not discuss home problems with them. As far as financial matters are concerned, 78.33 per cent of the respondents reported that their parents

Table 1: Socio-characteristics of the respondents (n=120)

Socio-characteristics/ Categories	Freq.	%tage
Age		
20-35	25	20.83
35-50	80	66.67
50-65	15	12.5
Family background		
Rural	90	75
Urban	30	25
Family type		
Nuclear	37	30.83
Joint	83	69.16
Educational qualification		
Illiterate	8	6.66
Primary	10	8.33
Middle	15	12.5
Matric	50	41.66
Secondary	20	16.66
Graduate	12	10
Diploma in agriculture	5	4.16
Education qualification (father)		
Illiterate	30	25.0
Primary	20	16.66
Middle	35	29.16
Matric	24	20.0
Secondary	6	5.0
Graduate	5	4.16
Education qualification (mother)		
Illiterate	56	46.66
Primary	19	15.83
Middle	10	8.33
Matric	7	5.83
Secondary	24	20
Graduate	4	3.33
Age of starting drugs		
18-33	88	73.33
33-48	22	18.33
48-63	10	8.34
Family discuss home problems		
Yes	92	76.66
No	28	23.33
Family discuss financial problems		
Yes	94	78.33
No	26	21.66

discussed financial matters with them while 21.66 per cent of the respondents reported that their parents did not discuss financial matters with them.

There appears to be a number of reasons for Punjab currently in the midst of a drug epidemic such as rampaging unemployment, easy availability of drugs etc. The perusal of data in Table 2 indicated large majority (81.66%) of the respondents were indulged in drug use due to suggestion of friends. The findings were in tune with the study conducted by various researchers (Farrel and White, 1998, Verma, 2010, Basu *et al.,* 2012, Gupta *et al.,* 2013, Anonymous, 2019) who also concluded that peer pressure among the youngsters was an important initiating factor. Frustration as a reason for taking drugs was reported by 70.83% respondents followed by marital disharmony (66.66%) unemployment (54.16%) and to increase physical performance (41.66%) respectively. Twenty five per cent of the respondents reported family grief and depression as main reasons for taking drugs.

As regards as consumption of drugs is concerned, a large majority of the respondents (92.5%) used to take poppy husk while 81.66% per cent of the respondents consumed opium. Nagaraj *et al.* (2018) found that around 84% patients were abusing afim/ bhukki as source of opioid addiction. An equal percentage of respondents i.e. were in habit of taking alcohol and smoking cigarette. The findings were in conformity Chauhan *et al.* (2019) and Sharma *et al.*

Table 2: Reasons for taking drugs (n=120)

Reasons	Frequency	Percentage
Suggestion of friends	98	81.66
Curiosity	35	29.16
Frustration	85	70.83
Unemployment	65	54.16
Family grief	30	25
Easy availability	20	16.66
Increase physical performance	50	41.66
Imitation of father	20	16.66
Imitation of siblings	12	10
Marital disharmony (divorce, force marriage)	80	66.66
Depression	30	25

*multiple response

(2018) who reported that most common substance abused was alcohol. On further examining the data, it was found 25 per cent used to inhale smack.

CONCLUSION

This study shows that youth of Punjab is falling in vicious trap of drug abuse at early age with due to more peer pressure. The parents should have close and friendly relationship with their children so that they can discuss their problems freely with their parents. There is urgent need to bring awareness to warn the youth population against drugs. Educated youth is falling in bad habit of drug abuse which is an alarming situation and due to this, his/her studies is affected and whole academic carrier is destroyed. Support for substance abuse education, prevention and treatment must come from all sides including families, community groups, schools, policymakers, and health professionals. The government should also make efforts to ban all the harmful drugs and strict laws should be imposed on drug peddlers in order to save future of our youth. A vocational rehabilitation like training in tailoring, carpenting or computer courses must be financed and supported at all DDCs to reintegrate the de-addicted persons into social mainstream. It is recommended that all DDCs should be supervised periodically by government authorities from the office of Civil Surgeon/Deputy Commissioner.

RECOMMENDATIONS

Government should plan to increase the number of de addiction and rehabilitation centers with recreational facilities for these addicts. Various nongovernment organizations and nonprofit organizations can be involved to initiate vocational training and other employment programs for unemployed addicts. Appropriate linkages between health workers, community leaders, religious leaders, and teachers for planning prevention and rehabilitation activities for drug abuse should be established. Periodic outreach awareness camps for antidrug abuse activities in the community and government schools should be undertaken.

ACKNOWLEDGEMENT

I express my gratitude to all Project Directors of Drug De-Addiction Centers for their co-operation and to all the patients undergoing treatment at these Drug De-Addiction Centers who volunteered to participate in this study.

REFERENCES

Advani R (2013) Factors Driving Drug Abuse in India's Punjab. https://pdfs.semanticscholar.org/bce6/68d2998b90603565f55d14ab4298c64c2f2f.pdf

Anonymous (2019) Punjab Opioid Dependence Survey: Brief Report http://pbhealth.gov.in /scan0003%20(2).pdf

Anonymous 2020. Punjab's approach to problem lopsided, dependency on alcohol more common than on opioids. The Indian Express. https://indianexpress.com/article/india/india-news-india/punjabs-approach-to-problem-lopsided-dependency-on-alcohol-more-common-than-on-opioids-6231631/

Chauhan B S, Garg R, Das S, Puri S and Banavaram A A(2019) Prevalence of substance use disorders in Punjab:Findings from National Mental Health Survey.149(4):489-96.

Baite, D. J. (2014). *Impact analysis of Progressive beekeepers association of Punjab.* Ph.D.. Dissertation, Punjab Agricultural University, Ludhiana, Punjab. India.

Basu D, Aggarwal M, Das PP, Mattoo SK, Kulhara P, Varma VK(2012).Changing pattern of substance abuse in patients attending a de-addiction centre in north India (1978-2008). Indian J Med Res, 2012; 135:830-836.

Farrel DA, White SK. Peer influences and drug use among urban adolescent: Family structured and parent-adolesecnt relationship as protective factors. Journal of consulting and clinical psychology. 1998;16(2):248-58.

Gupta V K, Kaur P, Singh G, Kaur A and Sidhu B S (2013) A study of profile of patients admitted in the drug de-addiction centers in the state of Punjab. *International Journal of Research in Health Sciences.*1(2): 53-61

Kadri AM, Bhagyalakhsmi A, Kedia G (2003) A study of Socio-demographic profile of substance abusers attending a Deaddiction center in Ahmedabad city. *Indian J Community Med* 28 : 2.

Kalra, I and Bansal, P D, 2012, Socio demographic Profile and Pattern of Drug abuse among Patients Presenting to a De addiction Centre in rural area of Punjab, *Delhi Psychiatry Journal*, 15 (2):327-331.

Kapoor A, Kohli K, Sharma P, Kapoor and Jose N (2019) Prevalence and pattern of opioid addiction in Haryana, Punjab and Rajasthan. *International Journal of Advanced Research* 7(4):697-701.

Kaur A, Maheshwari S K, Sharma A (2018) Trends and patterns of drug abuse in select population of Punjab in year 2016-201. *Indian J Psy Nsg* 15:13-7 Available from: http://www. ijpn.in/text.asp?2018/15/1/13/262499

Kaur K (2017) Drug abuse: Problems is intense in Punjab, India. *Human Biology Review* 6(1):20-29.

Kaur L and S.K.Saini (2012) Study of drug addicts regarding the extent of use and reasons for taking the drugs. *Indian Journal of Social Research* 53(6): 469-476

Kulsudjarit K. Drug problem in southeast and southwest Asia. Ann N Y Acad Sci. 2004;1025:446–57.

Kumar V, Nehra DK, Kumar P, Sunila GR (2013) Prevalence and pattern of substance abuse: A study from de addiction center. Delhi. *Psychiatry J* .16:110 4.

Latha, M. and Chandrakumar, G. (2012). A study on agricultural women Self Help Groups (SHGs) members' micro credit analysis in Trichy district, Tamil Nadu.

Mohan C, Dhar V, Lal B : "A study of 1 de addiction clinic at GMC (Psychiatry hospital) Jammu (J&K)"; Indian J Psychiatry abstract supplement 2004 ; 34 : 23.

Nagaraj M, RS Deepak, Kaur R, Kaur R (2018) A study of pattern of opioid users in a southern district of Punjab state, India. JDMS 17(11);44-8.

Prakash B (2010) Role of family in detection, leveling motivation, detoxification and rehabitation of heroin addicts. Indian Journal of Social work:64.

Raju, S, 2005, Gender Differentials in Access to Higher Education, in Thorat, S, *Higher Education in India: Issues Related to Expansion, Inclusiveness, Quality and Finance,* New Delhi: University Grants Commission, p.90.

Sharma B, Arora A, Singh K, Singh H and Kaur P (2018) Drug abuse: Uncovering the burden in rural Punjab. *Journal of Family Medicine and Primary Care* 6(3): 558-562.

Sharma P, Kaur L, Mittal R, Kaur S and Kaur S (2018) Relationship of socio-economic characteristics with level of awareness of farmers. *Indian Journal of Extension Education* 54(2):26-31

Sharma A, Sharma A, Gupta S and Thapar S (2019) Study of family burden in substance dependence: A tertiary care hospital-based study. *Indian Journal of Psychiatry*. 61(2):131-38.

Verma P S (2010) Drug abuse on rise in State. The Tribune April 17, 2010.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 573-583

Rhizophagus irregularis Dominating Mycorrhizal Inoculation Modulates Root Morphology, Phosphorus Nutrition and Alleviates Drought Stress in Different Wheat Genotypes

Seema Sangwan* and Garima Saxena
Division of Microbiology, ICAR-Indian Agricultural Research Institute, New Delhi-110012

ABSTRACT

An investigation was undertaken to explore the effects of *Rhizophagus irregularis* (RI), an arbuscular mycorrhiza fungus (AMF) dominating formulation on the growth, root morphology, and phosphorus uptake of three winter wheat cultivars (HD2967, HD3043 and HD3086), grown under non-stressed and drought-stress conditions. Mycorrhizal infection was comparatively higher (36 to 38%) in the roots of non-stressed plants of all three cultivars, while under drought stress conditions, more pronounced effect on stem, root and total dry matter in HD3043 and HD3086 genotypes was recorded. Comparatively, among the cultivars, AMF-inoculated HD3086 showed significantly greater increase in the shoot (0.60 g plant^{-1}), root (0.23 g plant^{-1}) and leaf (0.73 g plant^{-1}) dry matter, along with an increase in root length, surface area and the number of root hairs, under both non-stressed and drought conditions (upto 35.2 and 24.24% increase respectively). RI inoculated plants exhibited increase from 68 to 134 mm in terms of root length, while stressed plants exhibited an increase from 49 to 54 mm, across all three genotypes. The interactions of drought stress, AMF and genotype were significant in terms of P accumulation in leaves, stem and flower heads. AMF colonization can have an ameliorating effect on drought stress, with the potential to alter the root functioning and architecture, besides improving P uptake and its translocation to shoot, leaves, and flower heads, in all the three genotypes. This represents the first report on the promise of using RI dominating AMF formulation for combating drought stress, with better P uptake in important wheat genotypes.

Keywords: Mycorrhiza; Wheat; Drought; Root colonization; Root volume; P uptake

INTRODUCTION

Various environmental stresses hamper the growth, development, and yield of agricultural crops. Worldwide, climate changes with unreliable rainfall and extended drought have manifold effects on sustainable agricultural production. Water availability is one of the major components limiting plant productivity, with drought stress leading to yield losses of more than 50% for major crops in the world (Selvakumar *et al.*, 2012). The exposure of crop plants to various abiotic stresses leads to progressive morphological, cellular, physiological, and molecular changes, which are mainly initiated in the rhizosphere. Overall, metabolic dysfunction due to water stress causes reduced crop growth and fertility, premature senescence, leading to low yield of crops (Paul *et al.*, 2017).

Presently, numerous strategies are being used to sustain crop production under abiotic stress, and besides breeding efforts, engineering the rhizosphere using microorganisms has provided promising results. However, most reports focus on the utilization of the plant growth-promoting rhizobacteria, as an option to mitigate abiotic stresses in crop plants, while arbuscular mycorrhizal fungi (AMF) are less investigated (Manjunatha *et al.*, 2019; Rejeb *et al.*, 2014). Most of these bacteria and AMF colonize the rhizospheric and endorhizospheric regions of plants and promote plant growth and crop yield. Among the beneficial group of microorganisms, AMF have been documented for their important role in imparting resilience, along with improvement in crop yield, to diverse abiotic stresses, including drought (Begum *et al.*, 2019). The symbiosis

*Corresponding author email id:

of AMF with the roots of higher plants is known to be very promising in augmenting the productivity of various agricultural and horticultural crops (Gholamhoseini *et al.*, 2013; Chitarra *et al.*, 2016; Al-karaki *et al.*, 2004; Zhou *et al.*, 2015; Zardak *et al.*, 2018). A lack of host specificity is often documented (Lee *et al.*, 2013); although many reports have shown that AM infection exhibits a dependency on the host and is a heritable trait (Helgason *et al.*, 1998; Vandenkoornhuyse *et al.*, 2003; Torrecillas *et al.*, 2012; Van-der-Heijden *et al.*, 2015). Almost, 90% of total plant species implicating angiosperm plants, bryophytes, and ferns can build up interdependent connections with AMF (Ahanger *et al.*, 2018). AMF form vesicles, arbuscules, and hyphae in roots, and spores and hyphae in the rhizosphere. Formation of hyphal network by the AMF with plant roots improves the access of roots to a greater soil surface area, thereby leading to improvement in plant growth and health (Bowles *et al.*, 2016). They can improve water and nutrient uptake in exchange for carbon from the host by producing a very extensive network of hyphae, which links plant roots and soil (Khalvati *et al.*, 2005; Owens *et al.*, 2012).

In India, wheat is the second most important staple food crop after rice both in area and production. About 14% of the total cropped area in the country is under wheat cultivation. In various arid and semi arid regions of the world, where wheat is usually grown under rainfed conditions, drought can occur any time during the growing season. Although breeding for new genotypes is an ongoing process, exploring the potential of AM fungal colonization for enhanced nutrient uptake in wheat could be a significant step towards sustained yields even under adverse conditions (Al-Karaki and Al-Raddad, 1997; Augé *et al.*, 2015; Dar *et al.*, 2015).

A wide variation in the response among wheat genotypes to AM colonization and response to drought stress is reported (Zhu *et al.*, 2001; Singh *et al.*, 2012). The genotypes used in the present investigation being new, their response to AMF inoculation is not documented, to our knowledge. Also, there is limited information documented on the effects of AMF colonization on root characteristics and phosphorus translocation in drought stressed wheat genotypes. With this background, the objectives of the present conducted experiment were: (1) to evaluate the differential response of three wheat cultivars to AM fungal inoculation under water surplus and deficit regimes (2) assess root colonization (%), root morphology and related agronomic traits in the wheat cultivars, as influenced by AMF inoculation and (3) analyze how AM fungal inoculation influences P uptake in the three wheat cultivars grown under and deficit regimes.

MATERIALS AND METHODS

Wheat cultivars: In the present study, three durum wheat genotypes namely, HD 2967 (PUSA Sindhu Ganga), HD 3043 (PUSA Chaitanya) and HD 3086 (PUSA Gautami) were used for AM inoculation experiments under drought stressed and non-stressed conditions. The seeds of these wheat genotypes were collected from the Division of Genetics, ICAR-IARI, New Delhi, (India). These selected wheat cultivars are adapted to different geographical areas e.g., HD 2967 is a widely adopted variety especially in rainfed northern and eastern agro ecological zones, whereas HD 3043 is a high yielding variety which is widely favored by bread making industries and HD3086 is a new wheat variety, especially for timely sown condition of northwestern plains zone of India.

AMF culture and maintenance: The AM fungal formulation constituting *Rhizophagus irregularis* as most dominating species was used in the study and obtained from the germplasm of AMF, Division of Microbiology, ICAR-IARI, New Delhi, India. This is a commercial formulation of ICAR-IARI, New Delhi, sold under the name of "PUSA Mycorrhiza" in which three different genera of endomycorrhizal AMF are maintained as a consortium as well as pure cultures. These are maintained in earthen pots, having 65-68 spores per g^{-1} soil, along with 75-78% AM-colonized root fragments of host crop i.e., Bahia grass (*Paspalum notatum*) where *Rhizophagus irregularis* is the highest richness index constituting 82% population.

Greenhouse pot experiment

Potting media, AMF inoculation and seed sowing: The pot experiment was designed as a randomized complete block design with three wheat genotypes, two different treatments (non-stressed and drought-stressed) and two RI related treatments (with/without RI inoculation), generating a 3*2*2 factorial with three replications for each treatment. A total of 36 pots were used for conducting the experiment in a naturally illuminated greenhouse (temperature 25±4 ^{0}C) during the winter season of November 2019 at the Division of Microbiology, ICAR-IARI, New Delhi (India). Soil-sand mixture in proportion of 1:1 (v/v) was used as potting media (in pot size with diameter of 8 inches) for growing wheat plants. Soil was obtained from the experimental field and sieved prior to its use. The physicochemical properties of soil used in potting media comprised of sand-63.5%; silt-18.1%; clay-18.4%; bulk density-1.48 mg m^{-3}; infiltration rate-1.07 cm h^{-1}; field capacity-18.4%, w/w; pH-7.5; electrical conductivity- 0.35 dS m^{-1}; oxidizable soil organic C-0.51%; available N- 173.2 kg ha^{-1}; available P-11.5 kg ha^{-1}; and available K-244.9 kg ha^{-1}. The soil was sterilized by autoclaving (at 121°C under 105 Pa) for two consecutive rounds of 1 h each. Following this, the earthen pots were filled with 5.5 kg soil pot^{-1} without any external input of P fertilizer. The inoculation soil filled pot with AMF was done by placing mixed inoculum consortium of *Funneliformis mosseae* , *Rhizophagus irregularis* and *Scutellospora* sp. 4 to 5 cm deep in the upper layers of soil. The RI inoculum comprising 65-68 spores per g air-dried soil along with colonized root fragments (75-78% AM-colonized bahi grass).

Control pots for each treatment were inoculated with an equivalent weight of sterilized soil and no RI inoculum. Seed sowing of durum wheat cultivars HD 2967, HD 3043 and HD 3086 was done manually in the pots. Prior to sowing, seeds were treated with 10% H_2O_2 solution for 10 minutes and then in 1% filtered sodium hypochlorite solution for 1 minute. After rinsing properly with sterile distilled water, seeds were then placed on moist filter paper in petri dishes and allowed to incubate for five days at 28 °C (Miche and Balandreau, 2001). In each pot, uniform seedlings along with 50 g RI inoculum were placed in 5 cm soil depth. After one-week, extra seedlings were thinned and only four plants per pot were maintained. All the pots were watered thrice a week for next 3 weeks, after which drought stress treatments were imposed.

Enforcement of drought stress conditions: For imposing the drought stress, water was withheld from pots, till the soil water potential of –0.12 MPa, which was achieved in almost 12-15 days. In non-stressed pots, soil water potential was maintained near field capacity of –0.05 MPa (Al-Karaki and Al-Raddad, 1997). To determine the soil water content and maintain drought stress, soil samples were weighed before and after drying at 110 °C for 24 h and soil water potential was measured using tensiometer (Universal Tensiometer P1.63).

Estimation of different parameters

Estimation of AMF root colonization: After 75 days of growth, wheat plants were carefully removed with intact roots and further separated as shoots, root and leaves. After washing with distilled water, they were oven dried at 80 ^{0}C for 24 h and weighed. A subsample of the fresh roots was kept separately to study the root system after rinsing thoroughly with distilled water to remove the adhering soil. Remaining root samples were chopped into 1cm fragments. After keeping a portion of fresh samples of roots to determine RI colonization, remaining root samples were dried and weighed. RI colonization in roots was assessed by the method described by Phillips and Hayman (1970) i.e., clearance of roots using 10% (w/v) KOH and staining with 0.05% (v/v) trypan blue in lactophenol. These root fragments were microscopically (Olympus CX21i Microscope at 40X) examined to study total root colonization using the frequency distribution method in terms of percent root length colonized with mycorrhiza in a sample of 25 root segments (1 cm each).

Percent colonization = Frequency of distribution / number of fragments examined * 100

Plant biometric parameters: All the plant parameters were observed 75 days after sowing (DAS). Different plant growth related observations such as shoot, root, leaves and total dry matter were recorded. Dry matter content of the leaves, stem and root samples were estimated by grinding and passage through a 0.5-mm sieve, which was further weighed and kept overnight at 550 ^{o}C in a muffle furnace (5300A30/F6010-TS/Thomas Scientific) to derive ash (Al-Karaki et al, 2004). The results were expressed as g plant^{-1}.

Measurement of root morphology and related parameters: Root morphology and related root system parameters were scanned using a Regent LA2400 scanner. Images were analyzed using Win

RHIZO Pro to determine total root length, root sur-face area, root volume, average root diameter, and length of the roots with different diameter. Roots with diameter 0-0.5 mm were defined as fine, and those with diameter between 0.5–1.5 mm were defined as coarse. For root hair measurements, three root segments (1cm) per plant were also stained using 0.05% trypan blue dye. Root segments were immersed in distilled water to suspend the root hairs. Images were captured using a stereomi-croscope (Leica EZ4W, Wetzlar, Germany), and root hair length and number were also determined.

Estimation of phosphorous (P) uptake in different parts of wheat: After 75 days of sampling, total phosphorus concentration in leaves, stem and head were determined calorimetrically by Malachite green method (Motomizu *et al.* 1983), after digestion of ground material in hot concentrated HNO3:HClO4 (3:1). The results were expressed as mg g^{-1} dry matter (DM).

Statistical analysis: Data was statistically analyzed (analysis of variance; ANOVA) using a SAS 9.3 statistical package (SAS Institute Inc., 2011). Mixed model ANOVA was performed and means pair wise differences were calculated by the Tukey-Kramer method. Probabilities of significance were used to test for significance among treatments and interactions, and least significant differences (LSDs; P~0.05) were used to compare means.

RESULTS AND DISCUSSION

The symbiotic association between plant roots and arbuscular mycorrhizae involves beneficial interactions involving stimulation of various physiological processes under drought stress e.g., increased osmotic potential, chlorophyll content and fluorescence, activities of antioxidant enzymes, and contents of mineral nutrients especially P (Rani, 2016; Begum *et al.*, 2019). AMF inoculation helps to ameliorate such adverse changes that affect crop growth and development and lead to reduction in crop yield. Most of the abiotic stresses are associated with osmotic imbalance and dehydration in crop plants. Numerous reports also suggest improved resistance to a variety of stresses including drought, due to AM fungal symbiosis (Salam *et al.*, 2017). In the present investigation, three selected wheat cultivars with different characteristics and distinct geographical niche areas were evaluated for their interactions with RI dominating AMF formulation and response to drought stress. HD2967 has a high adoption, especially in rainfed northern and eastern zones, whereas HD 3043 is a high yielding variety, suitable more for bread making and HD 3086 is a new wheat variety, suited for the timely sown conditions of Northwestern Plains Zone of India.

Drought stress led to a significant reduction in mycorrhizal infection in all the three genotypes, while no AMF colonization was found in the roots of non-inoculated wheat plants. Under both stressed and non-stressed conditions, HD3086 and HD3043 showed a significantly higher AMF colonization than the roots of HD2967. AMF structures such as arbuscules and vesicles were more abundant in inoculated than non-inoculated wheat plants root system, as illustrated in Figure 1.

There was a significant difference in terms of percent root colonization of different wheat genotypes under non-stress and drought stress conditions. Upon AMF inoculation, the wheat genotype HD 3086 showed the highest root colonization of 64.96 % and 27.25% under non-stressed and drought stressed conditions, respectively (Figure 2). Among the wheat genotypes, percent root infection of 56.39% under non-stressed and 26.36% % under drought stress conditions was recorded with the inoculated AMF in the cultivar HD 2967. In general, wheat seedlings grown under non-stressed conditions possessed a greater proportion of their roots infected with AMF, than the drought stressed situation. The greater increase in plants grown under non-stressed conditions, as compared to drought stress, has been reported earlier (Al-Karaki *et al.*, 2004; Asrar *et al.* 2012).

Under drought stress with no AM inoculation, shoot dry matter was reduced to approximate 50% lower (1.25-2.86 g $plant^{-1}$) than under non-stressed conditions (3.8–4.2 g $plant^{-1}$). AMF inoculation increased the shoot dry matter under both stressed and non-stressed plants. Interaction between variables - drought stress, AMF inoculation and different genotypes was highly significant in terms of their beneficial effect on various plant parameters, particularly, shoot and leaf dry matter. Among the three genotypes, HD3086 showed the maximum increase

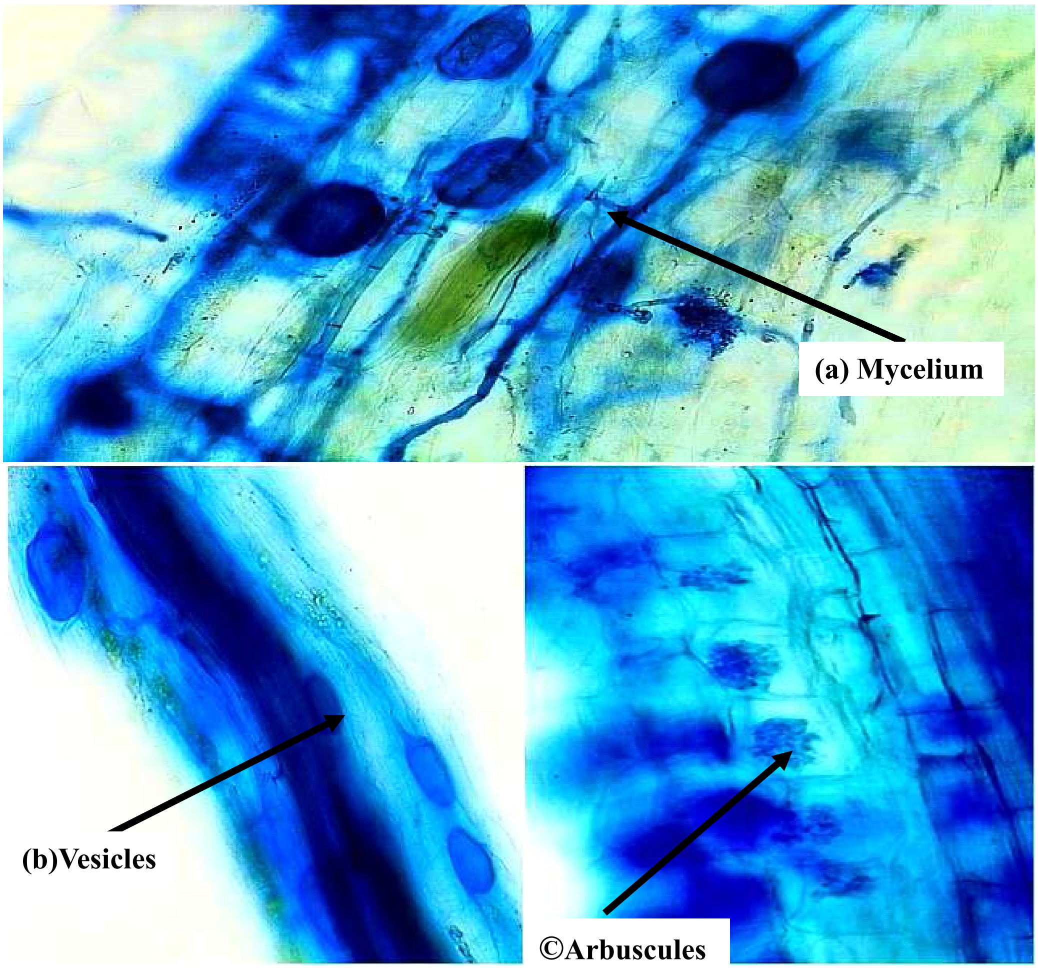


Figure 1: Light microscopic images of colonization (40X magnification) by the inoculated Arbuscular mycorrhiza fungi (AMF) of wheat root tissues (a) formation of mycelia structure by AMF (b) Formation of root vesicles by AMF. (c) Formation of arbuscules like structures by inoculated AMF

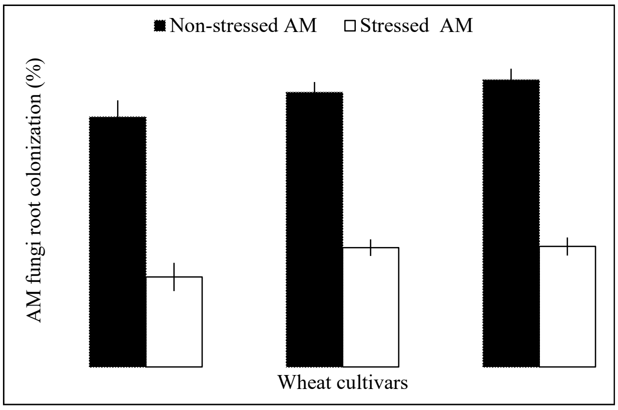


Figure 2: Colonization of different wheat genotype root system by the inoculated arbuscular mycorrhizal fungi (AMF) under non-stressed and drought stress conditions

in shoot dry matter (2.31–2.92 g plant^{-1}) when inoculated with Arbuscular Mycorrhizal fungi (AMF) under drought stress, as compared HD3043 (2.86–3.20 g/plant) and HD2967 (1.25-1.77 g plant^{-1}). Root and leaf dry matter also showed a similar decreasing trend when exposed to drought stress, but AM inoculation brought about a significant increase in both root and leaf dry matter, in both stressed and non-stressed plants, as compared to un-inoculated pots. The interaction of drought stress and genotypes was found to be significant along with interaction between AMF inoculation and wheat genotypes. However, the interaction between all the three factors i.e., drought stress, AMF inoculation and genotypes was non-significant for all the parameters. AMF inoculation led to-a significant increase in shoot (0.61 g plant^{-1}), root (0.23 g plant^{-1}) and leaves (0.72 g plant^{-1}) dry matter in HD 3086, as compared to the other two genotypes especially under drought conditions (Table 1). In the non-stressed plants, total dry matter was found to be highest in HD 3086 (8.94 g plant^{-1}) followed by HD

Table 1: Effect of arbuscular mycorrhizal fungi (AMF) inoculation on dry matter content of the wheat cultivars under non-stressed and drought stressed conditions

Treatment	AMF status	Wheat cultivars	Shoot dry matter (g plant^{-1})	Root dry matter (g plant^{-1})	Leaves dry matter (g plant^{-1})	Total dry matter (g plant^{-1})
Non-stressed	Non-AMF inoculated	HD 2967	3.87±1.23	1.17±0.36	1.93±1.25	7.89±1.39
		HD 3043	4.19±0.93	1.37±1.12	1.87±2.27	8.760±0.83
		HD3086	4.24±0.82	1.21±0.92	1.99±0.32	8.94±0.92
	AMF inoculated	HD 2967	5.00±0.11	1.55±0.78	2.80±1.35	11.76±1.21
		HD 3043	6.53±1.23	1.72±1.24	3.04±1.74	11.94±0.94
		HD 3086	5.78±1.98	1.63±0.61	3.00±0.98	12.05±0.76
Drought Stressed (DS)	Non-AMF inoculated	HD 2967	1.25±0.23	0.79±1.33	1.37±1.24	3.78±1.21
		HD 3043	2.86±1.36	1.05±0.16	1.74±1.96	4.94±0.78
		HD3086	2.31±0.63	0.94±1.95	1.38±0.16	4.77±0.84
	AMF inoculated	HD 2967	1.77±0.82	1.01±2.01	1.69±1.25	5.72±0.69
		HD 3043	3.20±1.35	1.13±1.25	1.97±1.15	5.25±1.06
		HD 3086	2.92±1.17	1.17±1.34	2.10±0.12	5.93±2.17
Significance						
Stressed (DS)			0.290	0.022	0.110	0.312
AM			0.312	0.019	0.112	0.310
DS*AM			0.411	0.031	0.162	0.441
Genotype (G)			0.360	0.027	0.141	0.382
DS*G			N.S.	0.038	N.S.	N.S.
AM*G			N.S.	0.034	N.S.	0.55
DS*AM*G			N.S.	N.S.	N.S.	N.S.

*NS- values are non-significant.

3043 and HD 2967; a similar trend in genotypes was recorded in plants exposed to drought conditions, but the values were almost decrease by 40-50%. AMF inoculation led to an increase in dry matter by 3-4 g plant^{-1} under non-stressed conditions, and 1-2 g plant^{-1} increments under stress conditions. In general, all the plants showed a significant increase in total dry matter when inoculated with AMF under both conditions. Here also, all the three variables - drought stress, AMF inoculum and genotypes were significant along with the interaction between drought stress*AMF and AMF*genotypes. AM inoculation significantly improved the root, shoot, leaf and so the total dry matter in all the wheat varieties when exposed to drought stress.

Root morphological characteristics were distinctly improved due to AMF inoculation. Root length was reduced in all the three wheat varieties under water limiting conditions. However, AM inoculation improved the root length in all the three wheat varieties: an increase from 68 to 134 mm in case of non-stressed plants and 49 to 54 mm in stressed plants (Figure 3). Highest and most significant effects were recorded in HD 3086. Here, the interaction between all the three variables i.e., genotypes, AMF and stress was found to be very significant for the root length but not for root surface area, volume and number of root hairs. The overall effects of AMF colonization on the root morphology of stressed and non-stressed plants are summarized in Table 2. AMF inoculation increased the root surface area under water stress conditions to a greater extent than non-stressed plants. HD 2967 and HD 3086 had higher increase in root surface area than HD 3043 after AMF inoculation under non-stressed and drought stress treatments. However, root volume and number of root hairs were not much stimulated by AMF inoculation in all the genotypes, as the changes

Table 2: Interactive effect of drought stress and arbuscular mycorrhizal fungi (AMF) on different morphological attributes of wheat roots

Treatment	AMF inoculation status	Wheat cultivars	Root surface area (cm^2)	Root volume (mm^3)	Number of root hairs
Non-stressed	Non-AMF inoculated	HD 2967	30.50±3.16	0.28±0.06	46.33±3.39
		HD 3043	37.30±2.12	0.37±0.09	60.89±4.12
		HD3086	35.08±3.74	0.36±0.11	59.51±2.46
	AMF inoculated	HD 2967	35.10±2.45	0.36±0.04	58.00±2.57
		HD 3043	37.68±2.79	0.47±0.03	68.00±4.86
		HD 3086	37.16±1.47	0.49±0.23	62.33±2.47
Drought Stressed (DS)	Non-AMF inoculated	HD 2967	23.81±3.27	0.15±0.01	46.33±3.96
		HD 3043	29.52±2.37	0.26±0.04	66.66±2.14
		HD3086	28.20±1.37	0.23±0.01	58.66±2.98
	AMF inoculated	HD 2967	28.18±2.11	0.21±0.02	51.00±2.48
		HD 3043	32.87±3.12	0.29±0.01	64.66±3.56
		HD 3086	32.34±2.36	0.28±0.01	61.33±3.13
Significance					
Stressed (DS)			0.662	0.012	N.S.
AM			0.573	0.014	2.221
DS*AM			0.936	0.017	3.141
Genotype (G)			0.811	0.015	2.720
DS*G			N.S.	N.S.	N.S.
AM*G			1.147	N.S.	N.S.
DS*AM*G			N.S.	N.S.	N.S.

*NS- values are non-significant.

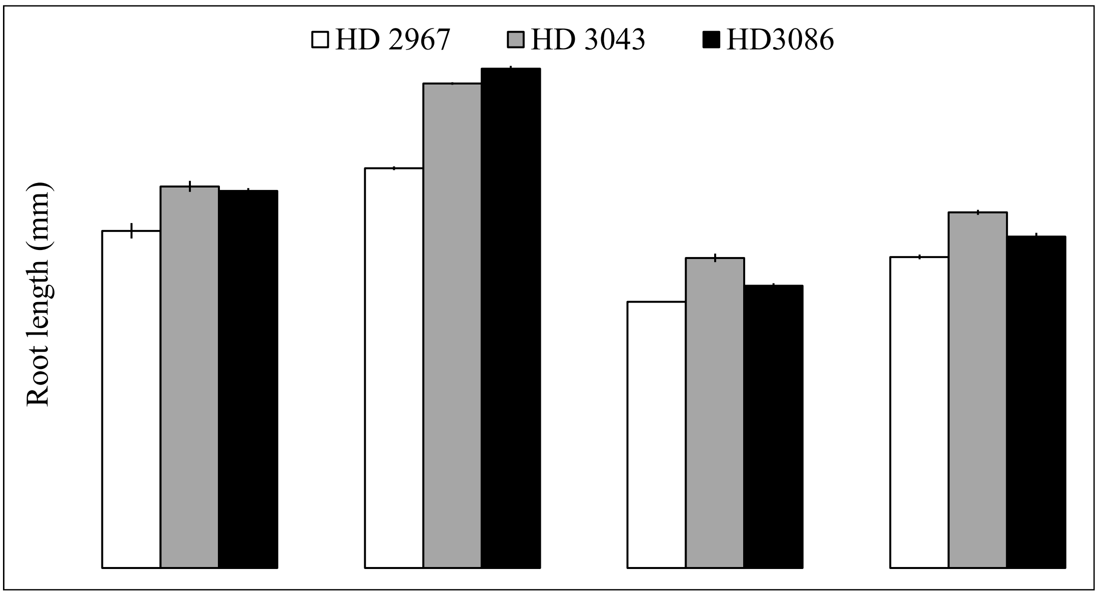


Figure 3: Effects of arbuscular mycorrhizal fungi (AMF) inoculation on the root length of different wheat cultivars under non-stressed and drought stress conditions. Values are mean of three replication ± standard errors of mean (SEM)

were not very much significant. The number of root hairs was only affected by AMF inoculation and genotypic differences, irrespective of water stress. The significant interaction between stressed plants and AMF was noted for the all the parameters, including root length, surface area, volume and number of root hairs. Interaction between genotypes and AM inoculation was more prominent in root surface area than root volume and number of root hairs.

Plants grown under drought stress are known to be detrimentally affected by low levels of P accumulation (Farooq *et al.*, 2009). The phosphorus content of stem, leaves and flower heads was enhanced by AM inoculation in all the three genotypes of wheat, independent of stress imposition (Figure 4 and Table 3). In both mycorrhizal and non-mycorrhizal plants, a reduction in P concentration was observed in leaves, stem and flower heads, when exposed to drought stress. Drought stress ×AM, AM × genotype and drought stress × AM × genotype interactions were significant in terms of P accumulation in leaves, stem and flower heads. P content in stem, leaves and flower heads increased in all genotypes due to AM inoculation under both non-stressed and stress conditions. Table 3 and Figure 4 clearly illustrate that HD3086 had more P than HD3043 and HD2967 in all the three parts of the plants evaluated. Plants inoculated with AMF showed a higher increase in shoot, root and total dry matter and an enhancement in P uptake by the better network of arbuscular mycorrhizae in the roots. It can be justified by the fact that P content was higher in AMF inoculated plants parts, whether it was stem, leaf or flower head; similar reports are available (Smith *et al.*, 2011; Abdel-Salam *et al.*, 2018). Enhanced uptake of P in the plants leads to an increase in root density, leaf number, leaf area and photosynthesis, visibly observed as the increased growth recorded in plants (Al-Karaki and Al-Raddad, 1997; Abdel-Fattah *et al.*, 2013). This supports our observations as higher values in terms of colonization of AMF in the roots of HD 3086 plants was observed along with P levels, thereby supporting the potential of AMF in the protection of plants against drought stress. Although some reports also documented similar results for other plants (Garcés-Ruiz *et al.*, 2017; Wang *et al.*, 2018), for these important wheat genotypes, this is a first report.

In the present investigation, HD 3086 and HD 3084 showed greater plant growth response to AM inoculation under drought conditions than HD 2967. AMF inoculation is known to confer drought tolerance to hosts under moisture stress (Lazareviæ *et al.*, 2018), however genotypic influences are critical. The results obtained in our study concluded that although drought stress has a detrimental effect on growth of wheat,

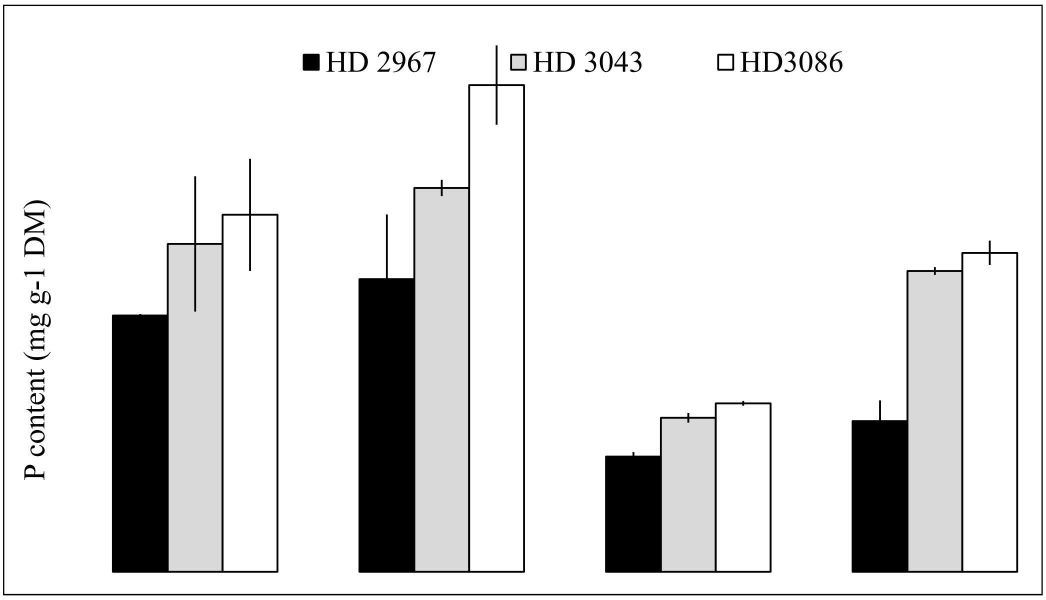


Figure 4: Effects of AM fungi inoculation and drought stress on P uptake in the flower heads of wheat plants, under non-stressed and drought stress conditions. Values are the mean of three replications ± standard errors of mean (SEM)

Table 3: Influence of AM fungi inoculation on phosphorus (P) concentration in different plant parts of wheat cultivars, grown with and without drought stress

Treatment	AMF status	Wheat cultivars	Plant leaves (mg g^{-1} DM)	Plant stem (mg g^{-1} DM)
Non-stressed	Non-AMF inoculated	HD 2967	1.84±0.25	3.23±0.67
		HD 3043	1.74±0.12	3.56±1.08
		HD3086	2.12±0.99	5.23±0.92
	AMF inoculated	HD 2967	3.65±1.21	7.34±1.32
		HD 3043	5.25±1.74	8.14±0.62
		HD 3086	8.16±2.35	10.32±2.98
Drought Stressed (DS)	Non -AMF inoculated	HD 2967	0.83±0.03	1.23±0.72
		HD 3043	1.01±0.16	2.13±0.32
		HD3086	1.33±0.22	2.45±0.82
	AMF inoculated	HD 2967	1.43±0.25	2.12±0.21
		HD 3043	1.56±0.99	3.51±1.06
		HD 3086	1.93±0.11	4.78±1.52
Significance				
Stressed (DS)			0.142	0.062
AM			0.501	0.021
DS*AM			0.312	0.032
Genotype (G)			0.451	0.046
DS*G			0.213	0.017
AM*G			0.342	0.056
DS*AM*G			0.261	0.013

*NS- values are non-significant.

AM inoculated wheat plants showed significantly better growth parameters, than non-mycorrhizal plants. Therefore, the results suggest that AMF colonization in the roots can provide a protective shield against the deleterious effects of drought by altering the root morphology, promoting root branching and development of fine root hairs, increasing surface area and volume of roots and improving P nutrition by better accumulation and translocation to shoot, leaves and flower heads.

CONCLUSION

Drought stress leads to severe effects on plant growth, through modulation of several physiological and biochemical processes in many arid and semi-arid regions of the world. One of the major factors attributed is the low nutrient uptake by the plant under such conditions, and AMF inoculation can be a promising option. The beneficial effects of AMF inoculation were more distinct under non-stressed conditions, although it brought about significant amelioration of the drought stress in plants. AMF colonization strengthened the root structure, increases P uptake, overall growth and yield in the different wheat cultivars. All these cumulative effects ultimately led to increased tolerance to drought stress in the different wheat cultivars. This symbiotic association between AMF and wheat needs to be encouraged as a strategy for wider application in wheat crop, especially in drought affected areas. Taken together, this study enhances our knowledge of AM-induced drought tolerance in wheat and its promise as a bioagent for enhancing crop productivity under stressed conditions. Future research should be directed exploring in-depth, the physiology of the plant system to identify key enzymatic pathways influenced by AMF inoculation, for sustaining the plant growth and development in environments under stress.

ACKNOWLEDGEMENT

This research was supported through funds provided by the Division of Microbiology, Indian Agricultural Research Institute, New Delhi, for which, the authors are thankful.

REFERENCES

Abdel-Fattah, G.M., Ibrahim, A.H., Al-Amri, S.M., Shoker, A.E., 2013. Synergistic effect of arbuscular mycorrhizal fungi and spermine on amelioration of salinity stress of wheat (*Triticum aestivum* L. cv. Gimiza). Aust. J. Crop Sci. 7, 1525–1532.

Abdel-Salam, E., Alatar, A.E., El-Sheikh, M.A., 2018. Inoculation with arbuscular mycorrhizal fungi alleviates harmful effects of drought stress on damask rose. Saudi J. Biol. Sci. 25, 1772–1780.

Ahanger, M.A., Alyemeni, M.N., Wijaya, L., Alamri, L.A., Alam, P., Ashraf, M., 2018. Potential of exogenously sourced kinetin in protecting *Solanum lycopersicum* from NaCl-induced oxidative stress through up-regulation of the antioxidant system, ascorbate–glutathione cycle and glyoxalase system. PLoS One 13, 0202–0175.

Al-Karaki, G.N., Al-Raddad, A., 1997. Effects of arbuscular mycorrhizal fungi and drought stress on growth and nutrient uptake of two wheat genotypes differing in drought resistance. Mycorrhiza 7, 83–88.

Al-Karaki, G., McMichael, B., Zak, J., 2004. Field response of wheat to arbuscular mycorrhizal fungi and drought stress. Mycorrhiza 14, 263–269.

Asrar, A.A., Abdel-Fattah, G.M., Elhindi, K.M., 2012. Improving growth, flower yield, and water relations of snapdragon (*Antirhinum majus* L.) plants grown under non-stressed and water-stress conditions using arbuscular mycorrhizal fungi. Photosynthetica 50, 305–316.

Augé, R.M., Toler, H.D., Saxton, A.M., 2015. Arbuscular mycorrhizal symbiosis alters stomatal conductance of host plants more under drought than under amply watered conditions: a meta-analysis. Mycorrhiza 25, 13–24.

Begum, N., Qin, C., Ahanger, M.A., Raza, S., Khan, M.I., Ashraf, M., Ahmad, N., Zhang, L., 2019. Role of Arbuscular Mycorrhizal fungi in plant growth regulation: implications in abiotic stress tolerance. Front. Plant Sci. 10, 1–15.

Bowles, T.M., Barrios-Masias, F.H., Carlisle, E.A., Cavagnaro, T.R., Jackson, L.E., 2016. Effects of arbuscular mycorrhizae on tomato yield, nutrient uptake, water relations, and soil carbon dynamics under deficit irrigation in field conditions. Sci. Total Environ. 566, 1223–1234.

Chitarra, W., Pagliarani, C., Maserti, B., Lumini, E., Siciliano, I., Cascone, P., 2016. Insights on the impact of arbuscular mycorrhizal symbiosis on tomato tolerance to water stress. Plant Physiol. 171, 1009–1023.

Dar, Z.M., Masood, A., Asif, A., Malik, M.A., 2015. Review on Arbuscular Mycorrhizal Fungi: An Approach to Overcome Drought Adversities in Plants. Int. J. Curr. Microbiol. Appl. Sci. 7, 1040–1049.

Farooq, M., Wahid, A., Kobayashi, N., Fujita, D., Basra, S.M., 2009. Plant drought stress: effects, mechanisms and management. Agron. Sustain. Dev. 29, 185–212.

Garcés-Ruiz, M., Calonne-Salmon, M., Plouznikoff, K., Misson, C., Navarrete-Mier, M., Cranenbrouck, S., 2017. Dynamics of short-term phosphorus uptake by intact mycorrhizal and non-mycorrhizal maize plants grown in a circulatory semi-hydroponic cultivation system. Front. Plant Sci. 8, 1471.

Gholamhoseini, M., Ghalavand, A., Dolatabadian, A., Jamshidi, E., Khodaei- Joghan, A., 2013. Effects of arbuscular mycorrhizal inoculation on growth, yield, nutrient uptake and irrigation water productivity of sunflowers grown under drought stress. Agric. Water Manag. 117, 106–114.

Helgason, T., Daniell, T.J., Husband, R., Fitter, A.H., Young, W., 1998. Ploughing up the woodwide web? Nature 394–431.

Khalvati, M.A., Hu, Y., Mozafar, A., Schmidhalter, U., 2005. Quantification of water uptake by arbuscular mycorrhizal hyphae and its significance for leaf growth, water relations, and gas exchange of barley subjected to drought stress. Plant Biol. 7, 706–712.

Lazareviæ, B., Lošák, T., Manschadi, A.M., 2018. Arbuscular mycorrhizae modify winter wheat root morphology and alleviate phosphorus deficit stress. Plant Soil Environ. 64, 47–52.

Lee, E.H., Eo, J.K., Ka, K., Eom, A.M., 2013. Diversity of Arbuscular Mycorrhizal Fungi and their Roles in Ecosystems. Mycobiology 41, 121–125.

Manjunatha, B.S., Paul, S., Aggarwal, C., 2019. Diversity and Tissue Preference of Osmotolerant Bacterial Endophytes Associated with Pearl Millet Genotypes Having Differential Drought Susceptibilities. Microbiol. Ecol. 77, 676–688.

Miche, L., Balandreau, J., 2001. Effects of rice seed surface sterilization with hypochlorite on inoculated *Burkholderia vietnamiensis*. Appl. Environ. Microbiol. 67, 3046–3052.

Motomizu, S., Wakimoto, T., Toei, K., 1983. Spectrophotometric determination of phosphate in river waters with molybdate blue and malachite green. Analyst 108, 361-367.

Owens, H., LaFantasie, J., Adler, P.B., 2012. Mycorrhization rates of two grasses following alterations in moisture inputs in a southern mixed grass prairie. Appl. Soil Ecol. 60, 56–60.

Paul, S., Dukare, A.S., Bandeppa, G., Manjunatha, B.S., Annapurna, K., 2017. Plant growth promoting rhizobacteria for abiotic stress alleviation in crops In: Adhya, T.K., Mishra, B.B., Annapurna, K., Kumar, U., (Eds.), Advances in Soil Microbiology: Recent trends and future prospects, Volume 2: Soil-Microbe-Plant-Interaction, Springer Nature, Singapore, pp. 57-79.

Rani, B., 2016. Effect of arbuscular mycorrhiza fungi on biochemical parameters in wheat *Triticum aestivum* L. under drought conditions. Doctoral dissertation CCSHAU, Hisar.

Rejeb, I., Pastor, V., Mauch-Mani, B., 2014. Plant responses to simultaneous biotic and abiotic stress: molecular mechanisms. Plants 3, 458–475.

Salam, E.A., Alatar, A., El-Sheikh, M.A., 2017. Inoculation with arbuscular mycorrhizal fungi alleviates harmful effects of drought stress on damask rose. Saudi J. Biol. Sci. 25, 1772–1780.

Selvakumar, G., Panneerselvam, P., Ganeshamurthy, A.N., 2012. Bacterial mediated alleviation of abiotic stress in crops. In: Maheshwari, D.K., (Ed), Bacteria in agrobiology: stress management. Springer, New York, pp. 205–224.

Singh, A.K., Hamel, C., DePauw, R.M., Knox, R.E., 2012. Genetic variability in arbuscular mycorrhizal fungi compatibility supports the selection of durum wheat genotypes for enhancing soil ecological services and cropping systems in Canada. Can J. Microbiol. 58, 293–302.

Smith, S.E., Jakobsen, I., Grønlund, M., Smith, F.A., 2011. Roles of arbuscular mycorrhizas in plant phosphorus nutrition: interactions between pathways of phosphorus uptake in arbuscular mycorrhizal roots have important implications for understanding and manipulating plant phosphorus acquisition. Plant Physiol. 156, 1050–1057.

Torrecillas, E., Alguacil, M.M., Roldán, A., 2012. Host preferences of arbuscular mycorrhizal fungi colonizing annual herbaceous plant species in semiarid Mediterranean prairies. Appl. Environ. Microbiol. 78, 6180–6186.

Van-der-Heijden, M.G.A., Martin, F.M., Selosse, M.A., Sanders, I.R., 2015. Mycorrhizal ecology and evolution: the past, the present, and the future. New Phytol. 205, 1406–1423.

Vandenkoornhuyse, P., Ridgway, K.P., Watson, I.J., Fitter, A.J., Young, J.P.W., 2003. Co-existing grass species have distinctive arbuscular mycorrhizal communities. Mol. Ecol. 12, 3085–3095.

Wang, Y., Wang, M., Li, Y., Wu, A., Huang, J., 2018. Effects of arbuscular mycorrhizal fungi on growth and nitrogen uptake of *Chrysanthemum morifolium* under salt stress. PLoS One 13, 1-14.

Zardak, S.G., Dehnavi, M.M., Salehi, A., Gholamhoseini, M., 2018. Effects of using arbuscular mycorrhizal fungi to alleviate drought stress on the physiological traits and essential oil yield of fennel. Rhizosphere 6, 31-38.

Zhou, Q., Ravnskov, S., Jiang, D., Wollenweber, B., 2015. Changes in carbon and nitrogen allocation, growth and grain yield induced by arbuscular mycorrhizal fungi in wheat (*Triticum aestivum* L.) subjected to a period of water deficit. J. Plant Growth Regul. 75, 751–760.

Zhu, Y.G., Smith, S.E., Barritt, A.R., Smith, F.A., 2001. Phosphorus (P) efficiencies and mycorrhizal responsiveness of old and modern wheat cultivars. Plant Soil 237, 249–255.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 584-588

Maternal Health Status in Punjab: Indications from NFHS 4 & 5

Nishu Sarma[1], Shalini Sharma[2] and Gaganpreet Kaur[3]
[1]Research Scholar, [2]Professor, [3]Assistant Professor, Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, Punjab

ABSTRACT

Maternal health refers to a woman's health and well-being before, during, and after pregnancy and encompasses aspects of physical, mental, emotional, and social health. There is a significant disparities between men and women in terms of access to adequate nourishment, healthcare, and reproductive facilities, as well as issues of basic personal safety and integrity. Constructed on two rounds of the National Family Health Surveys of India (NFHS 4 and 5), this paper studies the effect of maternal characteristics on women's likelihood of using prenatal and delivery healthcare services among women in Punjab state. The data revealed that there was a growth of half per cent was observed in NFHS-5 about women with age group 15-19 years who were already mother or pregnant at the time of survey. Female sterilization is given more pressure as male sterilization is almost negligibly found in Punjab state. It was observed from NFHS-5 that there was drop of 7.1 % mothers who had an antenatal check-up in the first time. However, it was also revealed from data that mothers whose last birth was protected against neonatal tetanus 3.1% decreased comparative to NFHS-4. The institutional delivery in Punjab has increased substantially as reported by NFHS-5 compared to NFHS-4. However, maternal health status is testimony of the fact that mothers are still at the receiving end, compromising their own health and medical needs to the deep rooted patriarchal system of rural Punjab.

Keywords: Indications, Maternal health, NFHS 4, Punjab

INTRODUCTION

Maternal health refers to a woman's health and well-being before, during, and after pregnancy and encompasses aspects of physical, mental, emotional, and social health. The World Health Organization defines maternal health as "the health of women during pregnancy, childbirth, and the postnatal period." The decreasing trend in the sex ratio, from 972 in 1901 to 933 in 2001 and 943 in 2011, implies that women's status in society is declining. Biological research showed that women are more illness resistant than men. Women in our country have a life expectancy of 65.27 years, while men have a life expectancy of only 62.36 years. Women have a greater death rate till the age of 34, but their chances of survival increase after that. As a result, females over 60 had a higher ratio than males. Health and well-being refer to the significant disparities between men and women in terms of access to adequate nourishment, healthcare, and reproductive facilities, as well as issues of basic personal safety and integrity. According to the World Health Organization, 585,000 women die every year from reasons associated to pregnancy and childbirth, with over 1,600 dying every day (2013 Nazia, Census 2011 GOI). WHO global database on anemia for 2019 estimated a global prevalence of anemia among the women of reproductive age at 29.9% equivalent to over half a billion women aged 15-49 years. Prevalence was 29.6% in non-pregnant women of reproductive age, and 36.5% in pregnant women (Stevens *et al.*, 2013; WHO, 2021).

It is directly or indirectly associated with women socio-economic status. In terms of antenatal checkups women visited by health workers received less services compared to women who visited a health facility. Home visits were biased towards the household with a better standard of living (Garg *et al.,* 2010). In spite of the fact that marriage before the age of 18 is banned in India but still many young women marry and begin having children during their adolescent years. Contraceptive methods were not widely used and there is a noteworthy unmet need for family planning (FP).

As a result, new government programmes have been launched to enhance youth participation in sexual and reproductive health services. However, there is a scarcity of evidence specific to this age range. It was examined that contraceptive usage among married teenagers, and the findings had substantial policy implications for promoting adolescent reproductive health. The practice of contemporary contraception had increased. The slow rate of development in contraceptive used among adolescents in low and middle-income countries was noted during the 2017 Family Planning Summit (Singh *et al.,* 2021).

Contraception is one of the most chief predictors of fertility transition and one of the proximate drivers of fertility. The choice of contraceptive method was influenced by a flock of interconnected demographic, cultural, economic, and social factors. Contraception practice among different demographics of women characteristics in terms of demographics, economics, culture, and society. The distinctions in contraceptive use pattern across different groups of women reflected the skewed demand for and restricted supply of family planning services Chourasia (2014).

Anemia in pregnant and lactating mothers remains an important concern for public health policy in India. Despite the existence of various policies and programmes anemia still prevails. The primary goal of this research was to look at the prevalence and determinants of anaemia in pregnant and lactating women versus non pregnant non lactating (NP-NL) women. Under this, data was analyzed based on data from the National Family Health Survey (NFHS3), which was conducted in 2005-2006. Anemia was shown to be more common in nursing mothers (63%) and pregnant women (59%) than in NP-NL women (Siddiqui *et al.,* 2017).

The National Family Health Survey (NFHS) is a multi-round, large-scale survey that is undertaken in a representative sample of Indian households. Since the first study in 1992-93, there have been five rounds of the survey. The study collects data on fertility, infant and child mortality, family planning use, maternal and child health, reproductive health, nutrition, anaemia, and the use and quality of health and family planning services in India. Each cycle of the NFHS has had two primary goals. Firstly, to provide Ministry of Health and Family Welfare and other agencies with crucial data on health and family welfare for policy and programme reasons and secondly to offer information on key emerging health and family welfare concerns. The Ministry of Health and Family Welfare (MoHFW), Government of India has designated the International Institute for Population Sciences (IIPS) Mumbai, as the nodal agency for providing coordination and technical guidance for the survey. (NFHS-5). So, the study espoused a narrative description in which the NFHS fact sheets (NFHS-4 & 5) of both these states were obtained from appropriate sources and compared for various maternal health indicators. Constructed on two rounds of the National Family Health Surveys of India (NFHS 4 and 5), this paper studies the effect of maternal characteristics on women's likelihood of using prenatal and delivery healthcare services among women in Punjab state (Table 1).

The status of women with 10 or more years of schooling has improved slightly comparatively to men. The sex ratio of total population has also increased to 938 females per 1000 males under NFHS-5 survey and it was 905 females per 1000 males in NFHS 4. Women age group 20-24 married before 18 years of

Table 1: Characteristics of Adults (age 15-49 years)

Characteristics	NFHS-5 (PUNJAB)	NFHS -4 (PUNJAB)
Women with 10 or more years of schooling (%)	56.0	55.1
Men with 10 or more years of schooling (%)	58.7	59.8
Sex ratio of the total population (females per 1,000 males)	938	905
Women age 20-24 years married before age 18 years (%)	8.7	7.6
Men age 25-29 years married before age 21 years (%)	11.4	11.1
Women age 15-19 years who were already mothers or pregnant at the time of the survey (%)	3.1	2.6

(NFHS-4 and 5 Punjab)

Table 2: Anaemia status of women in Punjab

Characteristics	NFHS – 5(PUNJAB)	NFHS – 4(PUNJAB)
Non-pregnant women age 15-49 years who are anaemic (%)	58.8	54.0
Pregnant women age 15-49 years who are anaemic (%)	51.7	42
All women age 15-49 years who are anaemic (%)	58.7	53.5

(Resource: NFHS-4 and NFHS-5 factsheet Punjab)

age was 8.7 % and it was found 11.4 % among men in Punjab. Growth of half per cent was observed in NFHS-5 about women with age group 15-19 years who were already mother or pregnant at the time of survey (Table 2).

The prevalence of Anaemia is increasing among pregnant women. Under NFHS-4 data non-pregnant women with age group 15-49 years was 54 % which increased in 2019-2020 survey to 58.8 percent. Pregnant women with same age group has drastic increase in anaemia status. It was 42 % in NFHS-4 data and 51.7 in NFHS-5 survey in Punjab. About 63. 5% of pregnant women in the age group of 15-49 years were anaemic. Due to low nutritious food low body mass index reflexed in Bihar. There was emphatic evidence under household level which exposed the picture of inequal distribution of food supply among those women who have higher work responsibilities (Parthasarathy and Choudhary, 2007).

In India burden of family planning still cascades on women. It was due to obstinate gender restrictive norms and inequalities, as well as kinship structures and other cultural contextual factors (Malhotra, Vanneman, and Kishor 1995). According to NFHS-5 any method used for family planning has dropped down to 66.6 % which was 75.8 % under NFHS-4 survey. It was also observed that consumption 2020of modern method for family planning has also decreased to 50.5 % in 2019-20. Female sterilization is given more pressure as male sterilization is almost negligibly found in Punjab state. According to NFHS-5 drop of 14.7 % found in female sterilization as compared with NFHS-4 survey data in Punjab. Usage of condoms was found 22.2 % which was revealed 18.9 % in National Family Health Survey conducted in 2014-15 respectively (Table 3).

Antenatal check-up is an important part during pregnancy.it is beneficial for maternal healthcare. There are 4 mandatory ANC visits required for optimal maternal care (Pallikadavath *et al.,* 2004) examined that there were some indications from the study of disparities in the provision of components of treatment at clinics. Health care workers to be visited at their homes of pregnant women from time to time. Iron and folic acid supplements for pregnant women could be given more priority. Pregnant women from poor and uneducated backgrounds, with at least one child were the most dubious to receive antenatal check-ups and facilities in the four large north Indian states. Basic antenatal care components were effective means to prevent complications during pregnancy. The findings indicated that socio-economic and cultural barriers were the main barriers to the health care facilities. It was observed from NFHS-5 that there was drop of 7.1 % mothers who had an antenatal check-up in the first time. However, it was also revealed from data that mothers whose last birth was protected against neonatal

Table 3: Maternity Care (for last birth in the 5 years before the survey)

	NFHS-5 (PUNJAB)	NFHS-4 (PUNJAB)
Mothers who had an antenatal check-up in the first trimester (%)	68.5	75.6
Mothers whose last birth was protected against neonatal tetanus (%)	89.7	92.9
Mothers who consumed iron folic acid for 100 days or more when they were pregnant (%)	55.4	42.6
Registered pregnancies for which the mother received a Mother & Child Protection card (%)	96.9	95.1
Mothers who received postnatal care from a doctor/nurse/LHV/ANM/midwife/other health personnel within 2 days of delivery (%)	86.2	87.2

(Resource: NFHS-4 and NFHS-5 factsheet Punjab)

Table 4: Delivery Care (for births in the 5 years before the survey)

	NFHS-5	NFHS-4
Institutional births (%)	94.3	90.5
Institutional births in public facility (%)	53.9	51.7
Home births that were conducted by skilled health personnel (%)	2.6	4.5
Births attended by skilled health personnel (%)	95.6	94.1
Births delivered by caesarean section (%	38.5	24.6
Births in a private health facility that were delivered by caesarean section (%)	55.5	39.7
Births in a public health facility that were delivered by caesarean section (%)	29.9	17.8

(Resource: NFHS-4 and NFHS-5 factsheet Punjab)

tetanus 3.1% decreased comparative to NFHS-4. Punjab managed to increase in consumption of iron folic acid for 100 days or more when they were pregnant. Registrations during pregnancies for which the mother received a mother and Child Protection (MCP) card has also improved (Table 4).

During the period 2004–2008, the average out-of-pocket (OOP) cost of a delivery in an Indian public health facility was US$39, compared to US$139 in a private health facility. The estimated cost of a caesarean delivery was six times more than the cost of a regular delivery. The propensity and rate of OOP expenditure increases as mothers' economic position and educational level improves, correlating higher OOP expenditure to higher care quality. Adjusting for inflation, out-of-pocket expenditures in public health Centres has decreased over time, probably due to increasing spending under the National Rural Health Mission. The institutional delivery in Punjab has increased substantially as reported by NFHS-5 compared to NFHS-4. This may be due to focused execution of JSY. However, institutional deliveries in public health facilities have risen from 51.7 % to 53.9 % in Punjab. Home births that were conducted by skilled health personnel have dropped down to 2.6 % compare to 4.5 in NFHS-4.Births in a private health facility that were delivered by caesarean section (CS) in Punjab has ascended. However, there is high rate of CS deliveries being conducted in private facilities i.e. 55.5 % comparatively 29.9 % in than in public facilities in Punjab.

CONCLUSION

This paper provides screening of maternal health and come up with anaemia, contraceptive usage and timely health treatment are major areas of concern in Punjab state. Proper consumption of Iron and Folic Acid Tablet intake should be identified. Age at marriage, foetal loss and nutritious intake were main cause behind anaemia. Besides this, Family planning is a straightforward procedure. The availability of a variety of contraceptive options can be beneficial. Utilization of family planning methods plays a critical role in population growth stabilization. Furthermore, increased male involvement as active partners and increased accountability towards this can be attained by those who carry the concern C-section should be deeply evaluated in terms of overuse of medical technology and private practices in public hospitals should be restricted. Awareness about family planning should be open and clearly explained and identified.

REFERENCES

Agarwal, K. N., Agarwal, D. K., Sharma, A., Sharma, K., Prasad, K., Kalita, M. C., & Kumari, P. (2006). Prevalence of anaemia in pregnant & lactating women in India. *Indian journal of medical research*, *124*(2), 173.

Chaurasia, A. R. (2014). Contraceptive use in India: a data mining approach. *International Journal of Population Research*, *2014*.

Choudhary, N., & Parthasarathy, D. (2007). Gender, work and household food security. *Economic and Political Weekly*, 523-531.

Dehury, R. K., & Samal, J. (2016). Maternal health situation in bihar and madhyapradesh: a comparative analysis of state fact sheets of National Family Health Survey (NFHS)-3 and 4. *Journal of clinical and diagnostic research: JCDR*, *10*(9), IE01.

Family Planning 2020 |. https://www.familyplanning2020.org/. Accessed 15 Jul 2021.

http://rchiips.org/nfhs/NFHS-5_FCTS/Punjab.pdf https://www.cnbctv18.com/healthcare/national-family-health-survey-points-to-rising-anemia-lower-fertility-rate-11586522.htm

https://www.drishtiias.com/to-the-points/Paper2/national-family-health-survey-5-1

https://www.researchgate.net/publication/359002656_National_Family_Health_Survey_NFHS-5_India_Punjab

https://www.who.int/health-topics/maternal-health#tab=tab_1

K. Davis and J. Blake, "Social structure and fertility: an analytical framework," Economic and Cultural Change, vol. 4, pp. 211– 235, 1956.

Malhotra, A., Vanneman, R., & Kishor, S. (1995). Fertility, dimensions of patriarchy, and development in India. *Population and development review*, 281-305.

Mejía-Guevara, I., Cislaghi, B., & Darmstadt, G. L. (2021). Men's attitude towards contraception and sexuality, women's empowerment, and demand satisfied for family planning in India. *Frontiers in Sociology*, 219.

Mohanty, S. K., & Srivastava, A. (2013). Out-of-pocket expenditure on institutional delivery in India. *Health policy and planning*, *28*(3), 247-262.

National family health survey - 4 India Factsheet. Mumbai: IIPS; 2015-2016. International Institute for Population Sciences. [Google Scholar]

Pallikadavath, S., Foss, M., & Stones, R. W. (2004). Antenatal care: provision and inequality in rural north India. *Social science & medicine*, *59*(6), 1147-1158.

Rajesh, G., Deepti, S., Tejbir, S., & Singh, P. A. (2010). Study on delivery practices among women in rural Punjab. *Health and Population-Perspectives and Issues*, *33*(1), 23-33.

Siddiqui, M. Z., Goli, S., Reja, T., Doshi, R., Chakravorty, S., Tiwari, C., ... & Singh, D. (2017). Prevalence of anemia and its determinants among pregnant, lactating, and nonpregnant nonlactating women in India. *Sage Open*, *7*(3), 2158244017725555.

Singh, I., Shukla, A., Thulaseedharan, J. V., & Singh, G. (2021). Contraception for married adolescents (15–19 years) in India: insights from the National Family Health Survey-4 (NFHS-4). *Reproductive health*, *18*(1), 1-10.

Zaveri, A., Paul, P., Saha, J., Barman, B., & Chouhan, P. (2020). Maternal determinants of low birth weight among Indian children: Evidence from the National Family Health Survey-4, 2015-16. *PloS one*, *15*(12), e0244562.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 589-592

Knowledge of Applicators about Pesticide Use and Handling in Vegetable Crops

Stanzin Yangsdon*, P.S. Slathia, Rajinder Peshin and Rakesh Kumar
Division of Agricultural Extension Education, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

ABSTRACT

Pesticides consumption causes serious environmental and public health problems. Due to the steep competition and large demand, many farmers and applicators are resorting to extensive and rather over use of pesticides to increase their agricultural yields. The applicators who are involved in the spraying activities of pesticides in fields get the direct exposure of pesticides due to unsafe and non-preventive work practices. They hardly use the safety masks, gloves and other protective measures during the spraying of pesticides which result into the access of pesticides in the blood stream through inhalation and dermal exposure which can adversely affect their eyes, skin and the respiratory system. Keeping in view a study was conducted in vegetable growing areas of Jammu district with the objective of assessing the knowledge of applicators about pesticide use and handling in vegetable crops. Data was collected from pesticide applicators as to test the knowledge of applicators regarding pesticide and its hazards. It was evident from the study that 67 per cent of applicators possessed **medium level** of knowledge about pesticides and their use. Linear regression model was applied to find out the effect of different independent variables on knowledge of the applicators; it was found that **education** and **family size** were affecting the knowledge of the applicators. On the basis of the study, it is suggested that appropriate awareness and training programmes should be organized on regular basis for applicators regarding rational use of pesticide and proper handling of pesticides.

Keywords: Health hazards, Knowledge, Pesticide, Use & handling, Environment sustainability

INTRODUCTION

Use of pesticides has definitely increased the production of vegetable crops but simultaneously has resulted into various ill-effects. Rapid increase in the application of pesticides has posed threats to the environment and adverse health effects on farmers (Snelder et.al 2008). A proportion of the pesticide that is not absorbed by the plants will be moved and transferred to the environment through wind, water and soil (Igbedioh, 1991). In relation to this, various reports of ill health associated with those applying pesticides has been reported by Food and Agricultural Organization (FAO, 2014).In J&K pesticide use by weight (a.i) has increased exponentially from 142 MT 90.155kg/ha) in 1994-95 to 1711 MT (2.410 kg/ha) in 2011-12 (DPPQS, 2013) which is an increase of 1105% with a slope of 217.5 tones/year (R^2=0.69) (Peshin et. al. 2014).Vegetable growers/applicators heavily rely on chemical pesticides for controlling insect pests. The average pesticide use in vegetable crops is 1.274kg/ha (Peshin et. al. 2014) which is approximately 150 % more than the world average of 500 grams per hectare (Betne, 2011). World Health Organization estimates that every year, 3 million farmers/applicators in developing world experience severe poisoning from pesticides, about 18,000 of whom die (Banjao *et al.,* 2010). Pesticides that are being used in agricultural fields spreads into the environment and come in human contact directly or indirectly. Agricultural laborers are working in unsafe occupational environment (Mancini *et al.* 2005). The applicators who are involved in the spraying activity of pesticides in fields get the direct exposure of pesticides due to unsafe and non-preventive work practices. They do not use the safety masks, gloves and other protective gears during the spraying of pesticides which results into the access of

*Corresponding author email id: syangsdon@gmail.com

pesticides in the blood stream through inhalation and dermal exposure which can adversely affect their eyes, skin and the respiratory system.

The criteria for the safe and effective use of pesticides established through research in laboratories tend to be far-removed from the farmer's everyday decisions and practices in both industrialized and less industrialized states. The complex variables involved in the use of pesticides by farmers do not eliminate the need to understand their reasons for their overuse, or adoption of unsafe practices. To address these issues, two main positions can be identified. One is based on in presupposition that farmer/applicators lack the correct or sufficient information about health and environmental risks, as well as to take rational calculation of input cost. The emphasis here is on the ignorance of farmer/applicators versus the knowledge of experts, management practices and the need to diffuse more information about adequate farming practices i.e. analysis of farmer's knowledge and their perceptions as they exist in the dynamics of legitimization of pesticide use. Therefore in order to assess the knowledge of pesticide applicators about different aspects of pesticide use under actual field conditions, its use and safe handling and possible health hazards of different pesticides was undertaken.

MATERIAL AND METHODS

A list of the vegetable growers was obtained from the Department of Agriculture, Jammu. From the villages where the randomly selected vegetable growers reside, the pesticide applicators operating in that village, the pesticide applicators either sample respondent himself using pesticide or the professional applicators in a particular village was interviewed under the study randomly from each block. Thus 33 pesticide applicators was selected purposively for the study in 2016.

Data was collected by using pre-structured schedule employing face to face interview method. The recommended dosages of different pesticides as given in package of practices issued by SKUAST-JAMMU (www.skuast.org) were taken as basis for comparing the knowledge of applicators about dosages of different pesticides. Appropriate statistical procedures applied for the analysis of collected data.

RESULTS AND DISCUSSION

It is evident from the Table 1 that overall 67 per cent applicators had medium level of knowledge (12-27) followed by 18 per cent in low level category (0-15) and only 15 per cent in high level knowledge category (above 27). Average knowledge score of applicator was 21.03 (±5.91).

With regard to sources of information, the main source of information was pesticide retailers, with overall 91 per cent. Friends and neighbors' were source of information for 21 per cent of the respondents whereas 47 per cent respondents contacted Agriculture office. A share of 10 per cent respondents' contacted Agriculture University (SKUAST of Jammu) and Krishi Vigyan Kendra (KVK).

Linear regression model was applied to analyze the factors affecting the knowledge of the applicators regarding pesticide use in Jammu district (Table 3). The knowledge of applicators was against various independent variables (age, education, family size, occupation, landholding, and distance from retailer shop, pesticide practices, personal protective equipment and perception). It was revealed that among all the factors family size (t=-2.644; p= 0.015) and education (t= -2.341; p= 0.029), were negative and statistically significant. Further, the R^2 value of the model was 0.491 with F value of 5.797 and p value of 0.000, which

Table 1: Overall knowledge level and mean knowledge score of the applicators about the pesticide use and handling

Parameter	Applicators			
Knowledge level/score	**R.S. Pura (n =12)**	**Marh (n =10)**	**Bishnah (n =11)**	**Overall (n =33)**
Low (below 15)	25	20	9	18
Medium (12-27)	58	60	82	67
High (above 27)	17	20	9	15
Mean overall knowledge	Mean=21.75 ±=6.99 Range=15-29	Mean=21.10 ±=5.98 Range=12-23	Mean=20.18 ±=5.05 Range=15-26	Mean=21.03 ±=5.91 Range =15-27

Table 2: Information source utilization by the applicators

Source of information	R.S.Pura (n =12)	Marh (n =10)	Bishnah (n =11)	Overall (n =33)
SKUAST-Chatha/ KVK	17	10	9	10
Department of Agriculture	25	70	45	47
Input dealers	0	0	0	0
Pesticide retailers	100	80	91	91
Neighbors'	33	20	9	21
Friends	33	20	9	21

Table 3: Factors affecting the knowledge of applicators regarding pesticide use

Dependent variables	Independent Variable	Coefficient (B)	S.E.	*t-value*	*significance*	Model Summary
Knowledge	(Constant)	14.087	5.100	2.762	.011	R^2 =.491
	Age	.040	.078	.517	.610	F=5.797
	Education	-.333	.142	-2.341	**.029***	p=0.000
	Family size	-.567	.214	-2.644	**.015***	
	Occupation	1.152	2.142	.538	.596	
	Landholdings	.661	.603	1.096	.285	
	Distance from retailer shop	-.079	.096	-.829	.416	
	Personal protective equipment	.649	.217	2.984	.007	
	Perception	.169	1.020	.165	.870	

p<0.05 indicates significant

indicates that there is 49 per cent variation in the knowledge as explained by the variables selected for the analysis.

CONCLUSION

The present study confirmed that applicators possessed adequate knowledge regarding pesticides and its health hazards. With regard to level of knowledge almost three fourth of the applicators possessed the knowledge regarding pesticide use and its health hazards. The results are in line with studies conducted by Sharaniya and Loganathan, (2015) Parveen, and Nakagoshi, (2001) who reported that 69 per cent respondents were having medium level of knowledge regarding pesticide use. The study, suggested that appropriate awareness and training programmes should be organized on regular basis for applicators regarding rational use of pesticide and proper handling of pesticides.

REFERENCES

Banjao, A. D., Aina, S. A. and Rije, O. I. 2010. Farmers' knowledge and perception towards herbicides and pesticides usage in Fandama area of Okun-Owa, Ogun state of Nigeria. *African Journal of Basic & Applied Sciences,* 2(5-6): 188-194.

Betne, R. 2011. Indian vefetables : Nutrition Pack with Toxic Cocktail. *Published in toxics links,* 12 of January, 2011.

DPPQS. 2013. Directorate of plant protection, quarantine and storage, Govt. of India. http//:gov.in/ipm pest main. htm. assessed on 3, march, 2014.

FAO, http://www.fao.org/agriculture [Accessed May, 17th 2014].

Igbedioh S.O. 1991 Effects of agricultural pesticides on humans, animals and higher plants in developing countries.Arch Environ Health. 46:218.

Parveen, S. and Nakagoshi, N. 2001. An analysis of pesticide use for rice pest management in Bangladesh. *Journal of international development and cooperation,* 8(1): 107–126.

Peshin, R., Kranthi, K.R. and Sharma, R. 2014. Pesticide use and experiences with Integrated Pest Management Programs and Bt cotton in India.In:Peshin,R. and Pimentel,D.(Eds)Integrated Pest Management: Experiences with Implementation:Global Oberview Vol.4,Springer,Dordrecht The Netherlands.pp269-306

Mancini, F., Ariena, H. C., Bruggen, V., Jiggins, J. L. S., Ambatipudi, A. C. and Murphy, H. 2005. Acute pesticide poisoning among female and male cotton growers in India. *International Journal of Occupational medicine and environmental health*, 11: 221-232

Snelder, D. J., Masipiqueña, M. D. & De Snoo, G. R. 2008. Risk assessment of pesticide usage by small holder farmers in the Cagayan Valley (Philippines). Crop Protection, 27, 747-762.

Sharaniya, S. and Loganathan, P. 2015. Vegetable growers' perception of pesticide use practices and health effects in the vavuniya district. *American-eurasian Journal of Agriculture and Environmental Sciences,* 15(7): 1479-1485.

WHO. 2004. World Health Organization, recommended classification of pesticides by hazard and guidelines to classification. Geneva, Switzerland.

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 593-598

Agriculture in Crisis during Covid-19: Restrictions in Mobility and Employment faced by Internal migrant

Atinder Pal Kaur[1]* and Gaganpreet Kaur[2]
[1,2]Assistant Professor (Sociology), Department of Economics and Sociology, Punjab Agricultural University, Ludhiana

ABSTRACT

The worldwide lockdown due to pandemics has increased restrictions in mobility and shortage of food, which creates a hue and cry among migrants and their families. The sudden demand increase of labourers in the agricultural sector during paddy plantation. However, Lockdown and government restrictions during paddy plantation bring a big question in front of the farmer and labourers about their survival. Keeping this scenario in view, data was collected from 14 villages of Punjab through random sampling for the present study. From each village, ten farmers and ten migrant labourers were interviewed with the help of snowball sampling. The total sample comprises 140 farmers and 140 migrant labourers, i.e., a representative sample of 280 respondents. A qualitative method was used to define the result with the help of a case study. The study found that survival and food security have more fear in farmers and labourers than fear of dying with the pandemic. The labourers were ready to take life risks and work on low wages rather than dying with hunger in their host states. So, there is a strong need for a governmental policy to deal with such a situation if it arises.

Keywords: Restrictions, Mobility, Employment, Migrants, Pandemic

INTRODUCTION

The covid -19 pandemic restricts movement with severe lockdown, creating a hue and cry among the migrants and increasing their vulnerability**.** It was already difficult for migrants to sustain their livelihood in the pre-pandemic period. After lockdown, the conditions became more miserable as no regular income and security directly affected their left-behind families because migrant families are more or less dependent upon remittances for their survival. Migration is a strategically well-planned decision for the family members' financial enrichment and social welfare staying behind (Stark and Bloom, 1985). In this way, family remittances are a significant agent in integrating societies worldwide, both economically and socially (Massey *et al.*, 1993).

However, the pandemic has a worldwide impact on the job sector. The effect is mainly observed on migrants working in the informal sectors. The challenges faced by these migrant workers were related to food, shelter, loss of wages, and remitting back to their families (Bhagat and Shaoo, 2020). For example, in India, the government implemented immediate lockdown and quarantine rules, resultant lack of jobs, restrictions on travel that increased financial insecurity, and inability to take care of daily expenses (Kaur *et al.*, 2020). International Labor Organization (2020) estimated that more than 25 million jobs are at risk globally, and a global workforce of 3.3 billion people is currently affected by the lockdowns in developed and developing countries.

In the agricultural sector, seasonal migration during paddy plantation is a norm in India. Agricultural migration labour usually starts visiting different parts of India during the Kharif crop season. Migration during paddy plantation became a ritual in Punjab, and such labour was circular in many pockets of Punjab and neighbouring states. According to the crop pattern, these agricultural migrant labours usually start visiting before wheat harvesting near the end of March and stay till August (paddy plantation) in Punjab after that migration to other adjoining states for paddy plantation.

*Corresponding author email id: atinder30@pau.edu

As a result, Punjab is known as one of India's agriculturally most developed states.

The green revolution brought phenomenal production growth in the agricultural sector and increased the flow of agricultural labour migration in Punjab. The changing crop pattern and widely accepted wheat –rice plantation that increased demand for agricultural labour resultant there has been an influx of migrant agricultural labour to Punjab from the neighbouring states, especially from Uttar Pradesh, Bihar, Rajasthan etc. (Singh and Bohgal, 2014; Sidhu and Singh, 1998; Kaur *et al.*, 2011). The increasing crop production also increased the demand for labour; thus, farmers of the Punjab state need to depend upon the migratory agricultural labourers for various agricultural activities, especially during peak season (Sidhu *et al.*, 1997). Moreover, the pull factor, including the availability of work and wages (Tadaro, 1984), i.e. economic factor, played a significant role to attract agricultural labour migration to Punjab (Kaur *et al.*, 2001). Though the social factors include migration networks (Massey *et al.*, 1993) and family friends are the other reasons for migration in the agricultural sector in Punjab. Studies also mentioned that floods, drought, non-availability of employment, poverty and indebtedness at the native place might be other causes of migration (Gupta and Bhakao, 1980; Gupta 1991).

Moreover, the number of agricultural labourers increased from 11.32 lakh in 1981 to 13.56 lakh in 1991, 14.08 lakh in 2001, and 14.74 lakh in 2011 (Singh and Boghal, 2014). The green revolution increased technological advancement and mechanization in the agricultural sector. Still, the cereal bowl state like Punjab depends highly on migrant labour during paddy plantations. The shortage of labour during lockdown Punjab has employed the local workforce under MNREGA to fill the seasonal flow of migrants. It is a challenging time for farmers of Punjab because, for paddy plantation, farmers are dependent on migrant labourers as paddy transplantation and sowing is skilful jobs, and migrants are apt to do it (Krar, 2020).

MATERIALS AND METHODS

Based on hypotheses, the present study was initiated in Punjab's districts (from June to September 2020) to know the present scenario of crops plantation and use of labour. The data was collected from two regions of Punjab (Malwa and Doaba), the rationale behind choosing Malwa as a big belt comprising 14 districts. On the other side, the Doaba region is known for fertile land between two rivers, Sutlej and Beas. Further, based on crop plantation, 7 districts were chosen through purposive sampling, i.e., Ludhiana, Moga, Sangrur, Patiala, Fatehgarh Sahib, Bathinda and Hoshiarpur. Further from every district, two villages were selected through a random sampling method. To solve the purpose of the study, data was collected from a structured interview schedule, i.e. including both farmers and labourers. At the meso level, we tried to find the linkage between farmers and labour. How they communicate and work together during the pandemic. So from each village, 10 farmers were interviewed through a random sampling method to know their situation and perspective on Kharif crops plantation. The study also includes migrant labour from each selected village through a snowball sampling method. From each village, equal proportions of labour include 10. The total sample comprises 140 farmers and 140 migrant labourers, i.e., a representative sample of 280 respondents. Data was also collected on total farmers, categories of the farmer, available irrigable land, crop pattern and use of labour. Data was defined through sub-topics, and a narrative method was used that was collected from fieldwork. The paper is divided into thematic forms based on data obtained after fieldwork. To maintain the anonymity of the respondents, pseudonyms were used throughout the paper.

RESULTS AND DISCUSSION

The Overview of the villages was taken into account to know their total population, total farmers, and the number of farmers in different categories like large, medium, semi-medium, small and marginal and total land under irrigation/acre. Table 1 shows that in the Malwa region, village Ghuddan of Bathinda had a maximum population, i.e., 5320, followed by Sherpur village of Ludhiana, which had a total population of 5041 people. Along with this, Kaleke village of Moga district has 4516 of the total population, and Chuggh Kallan of Bathinda has 3955. The least populated villages were village Khunde of Hoshiarpur, i.e., 253and 429 of the population was in Tehalpur village of Patiala. Regarding the total farmers in selected villages, the maximum farmers were recorded in Ghuddan (300), followed by Kaleke (285 farmers). Further, the number of farmers according to their categories was also seen. As regard to total land under irrigation, it was recorded that village Chuggh Kallan had the maximum area under irrigation i.e. 9773.0 acres of land followed by Ghuddan 4670.2 acres of land. The least landholding area was in BadoshiKalan of Fatehgarh Sahib District, i.e. 202.6 acres and village Khunde had 449.7 acres of land under irrigation. Overall it was found that the villages of Bathinda had the highest total population and the highest land under irrigation/acre (Table 1).

Pattern of migration and social background of migrant agricultural labourers

The study revealed that 90% of migrant labour belonged to Bihar state, and about 10% were from Uttar Pradesh. The major reason behind the migration of the labour force was the extreme poverty and lack of employment opportunities in their home state. It may be mentioned that Bihar has the highest poor ratio and is followed by Uttar Pradesh; it also comes under the BIMARU states category. The study indicated that 80% of the labour force (migrant) fell in the most labour productive age group of 25-40 years. About 86.5% of them belong to the lower castes. Among this group, about 70% were scheduled caste, and 30% belonged to backward caste (migrant agricultural labour). About 85% of the migrant labourers were married. None of the migrant labourers brought families along with them. A vast majority of migrants were unable to read and write. Furthermore, out of 140 migrant labourers, 80 had some land at their native places, and of those who owned land, about 72% had land holdings up to 2 acres.

Constraints faced by migrants during pandemic

The local people of various castes such as Boria, Majhbi, ravidas, ramdassia Sikhs and many other persons of other occupations like painters, orchestra, waiters, MNREGA workers, tarkhan, mistri etc. worked as agricultural labourers during the lockdown. In order to sustain their livelihood, they shifted their occupations and worked as agricultural labourers during paddy plantations. Various studies emphasized that there was no availability of agricultural labourers during the pandemic as all migrant agricultural labourers went back to their native villages, and there they had the agenda "Marenge to Apna Desh ja k hi marenge". The present study found an overflow of labour in the agricultural sector during paddy plantation because of the shut down of other occupations. This scenario was not on one side; the farmers also faced problems with wages fluctuation in available labour. Moreover, they faced difficulty in high prices in paddy plantations due to lockdown as local labour increased the rate of wages per acre & demanded a high price of paddy plantations.

Table 1: Overview of Selected Villages

District/ Block	Name of The Village	Total Population	Total Farmers	Total land under irrigation/ acre
Ludhiana	Sherpur Kallan	5047	250	2567.4
	Sadarpura	1335	100	911.8
Moga	Manawan	3194	265	2639.0
	Kaleke	4516	280	2624.2
Barnala	Chappan	3520	217	2359.8
Sangrur	Dasaundha Singh Wala	2029	264	2505.6
Patiala	Tehalpur	429	112	266.8
	Nandpur Kesho	1383	42	837
Fatehgarh Sahib	Rurki	2015	55	1929.8
	Badoshi Kallan	2890	85	202.6
Bathinda	Chughh Kallan	3955	176	9773.0
	Ghuddan	5320	300	4670.2
Hoshiarpur	Khunde	253	22	449.7
	Kantia	1206	36	1302.2

Question to survival and food security for migrant labourers

The question of food was not only in farmers' minds, but the migrant labourers were in the same vein. They both had the same stress and tension in their minds. After lockdown, most of the agricultural labour had no work, and they were wholly dependent upon paddy plantation for livelihood. However, it becomes difficult for them during the lockdown period.

Naresh came to village Manawa with his other village agricultural migrant labour after the government announced that labour could come to work, especially during paddy plantation states. So, his old contractor, his SardaarJi (Manawa village farmer), was also ready to call them back to his village during the peak season of the plantation.

Naresh mentioned. "I am permanent labour in Sardaarji's (Owner) field. I usually visit him from March to August from wheat harvesting to Paddy plantation. Then we usually move to Jammu or some time to Haryana according to other farmers' call for paddy plantation. This time it was difficult for us. All routes were closed. Our income depends on paddy plantation, and our families are also dependent on us for their basic food necessities and the money that we earn by doing labour. So, we thought that this time we would die with hunger."

The question of food was the biggest problem, but secondly, the fear of covid-19 was another fight. Both farmers and labourers were in fear of what will happen? They would be able to call labour for paddy plantation; on the other hand; labour was also on the same track that they would be able to survive one with covid and second with unemployment they were facing.

Naresh migrant agricultural labour from Bihar was mentioned. "We have been free for the last 4 months. We usually come during potato cultivation and stay here till rice plantation. However, it became difficult to come back to Punjab with a sudden lockdown for us. When the government allowed us to come for paddy plantation, we called our Sardarji and talked about coming back for paddy plantation. SardarJi was also waiting for us during the peak season of the paddy plantation. Though we feared covid-19, we had more fear of dying with hunger. So to die with hunger was more scared than dying with Corona. Our Roji Roti is dependent on this work and repeatedly questions in our minds how we will survive when we do not have any income."

Our respondents, mainly migrant agricultural labour, focused on livelihood and food scarcity, which were more critical than covid as they were all the daily wagers and were living on agricultural work. Without having work from them, it would be not easy to survive. So, in such a scenario, the prime concern was about food and having some financial security. They knew that without such things, their survival was not possible.

Hari mentioned. "*Sahib Hum to Har Sal SardarJi ke pass Aate Hain jhona (Rice) lgane ke liye. Uske bad Ham Haryana Jaate Hain. Inka Aur Hamara bahut purana Rishta Hai.* (we came to Sardar Ji during paddy plantation and then migrated to Haryana. We have years of migration and relation with him) *S*ardaarji was ready to give advance, and they wanted us to be in the village. We also knew that without their help, we could not survive. This time our economic survival is more important than Corona. *Marna he Tu Paise Kama Kar Hi mare Hamare ghar wale to Jinda Rah payenge na."(it is better to die after earning our livelihood, at least without income, our family members may survive).*

Hari also mentioned. "When lockdown started, they were in their native village, they usually visited Punjab in April to August, till paddy plantation and later on moved to Haryana. Sudden lockdown created fear, and their contractor (middleman) was also not ready to return to Punjab. When SardarJi (Farmer) called as he would arrange a bus in which all (Bhai) migrant labourers, those who were ready to come, called their sardars. He paid Rs 1500, and his Sardarji paid the other Rs 1500. When they reached the Punjab border, there was a covid-19 checkup, and they allowed us to enter Punjab. He feared that if results came positive, the police would send him back. What will he do? Covid had great fear in his mind."

Despite government announcements and economic assistance provided by their owners, migrant labourers did not visit their respective villages in Punjab. Every hour they counted what would happen if they were all sent back to their native places. Such fear created tension, and also, the issue of dying and dying with hunger remains the concern.

Government restrictions and scarcity of labour Among farmers

Covid conditions bring the biggest question in front of farmers about their farming and labour arrangement during the pandemic. For paddy plantations, Punjab always remains dependent on migrant labour because it is cheap than local labour. Secondly, migrant labours were more skilled in plantation techniques and less time-consuming. However, lockdown and government restrictions increased the farmers' difficulties finding the labour at a low price. Covid restriction also increased the scarcity of labour in villages during the peak season of paddy plantations.

Dheer Singh mentioned issues he faced during the lockdown. "During wheat cultivation, for preparation of wheat straw, he used local labour that was also difficult to arrange because all village people were also using the same labour for wheat cultivation. Secondly, the labour rates were also high, but the major problem was not wheat harvesting. Somehow it was manageable using combines, but paddy plantation was the real issue. He had to wait for the government announcement about paddy plantation during covid. After that, the major question of labour was in front of him because paddy plantation was wholly dependent on agricultural migrant labour. So, when the government announced that farmers could call migrant labour, only paddy plantations became possible. Other than that biggest challenge was, bringing labourers to the village from the UP and Bihar border. The fear of covid was the one, but fear of our income reduction was main because agriculture was the only source of income."

Harjinder Singh from village Kalke mentioned. "For paddy plantation, he was usually dependent on migrant agricultural labour, and he has permanent labour that visits him every year during wheat harvesting to paddy plantation. When covid started, people got stuck in lockdown and had to maintain social distancing. It created a fear in his mind that this year his field will remain without crops and what his family will eat."

Harminder Singh from Rurki village mentioned. "It became difficult to call labour. Earlier, he used local labourers to make wheat straw which was very costly. He had to pay 5600 rs. per trolley and after two days labour did not come. Because of higher wages, the village labour refused to work on low wages and shifted to other farmers' farms. So, he had to wait for them and paid a higher price to remain work completed. Despite that, bad weather had also increased issues. For the paddy plantation, he called his friend and brought labour from Hoshiarpur, but they also ran away. So, again he has to wait, and also his mental tension increased that how will he work in such conditions."

Pandemic created problems for the farmers on the labour front. They had to depend on local labour for wheat straw management, which was very costly and non-reliable. Suppose labours were able to get a higher price than they started running for higher wages from one farmer to another farmer. On the other hand, the restrictions put by the government also create a panic situation for the migrant agricultural labour. It became difficult for them to visit villages working as seasonal migrant agricultural labourers. Therefore, covid aroused many questions in the minds of labourers and farmers. Punjab farming is entirely dependent on seasonal migrant labour and having restrictions on borders and maintaining social distancing were the biggest hurdles for farmers and labourers.

CONCLUSION

Covid-19 created fear about dying with pandemic rather than dying with hunger, especially in-migrant agricultural labour. Farmers were completely dependent upon seasonal agricultural migrant labourers, and their livelihood was on paddy plantations for labourers. During the lockdown, the question of staying safe was the main agenda by the government. However, for migrant agricultural labour, the main focus was on their livelihood. Though staying safe was a priority, it was difficult to survive without food and economic resources. The question of having good food to survive was the government's motto, but that could be achieved only with sufficient economic resources. Such resources depended on the wages that they were earning every year during paddy plantation. So, during the pandemic, the labourers visited their places of work to earn their livelihoods after facing many difficulties and problems. However, despite all these hurdles, they just had one thing in their minds: they must provide food and financial security to their families.

The long and last question exists in the mind of labourers about livelihood. Labourers admitted that they could not sustain themselves and their families without food and money. So for them, *roji roti* becomes the need of the hour rather than being scared of the pandemic. Fear in my mind was not about covid rather than dying with hunger. So, they wanted to return to their places of work as seasonal agricultural migrant labour because they did not have any other employment as a source of income. Moreover, migrant agricultural labour was their permanent employees; their paddy plantation would also hamper without them. So, in both cases, livelihood was the prime issue during the pandemic. When the government provided relaxation during paddy plantation season, these migrant agricultural labourers decided to visit back to Punjab to earn their livelihood. Also, the farmers benefited from the availability of labourers. The migrant agricultural labour and the farmers are both sides of the coin that cannot exist independently, and during the pandemic, both were in the same boat and fighting for their livelihoods.

So there is a need for the hour that the government should make better policies during a pandemic that migrant agricultural labourers and farmers should not suffer during the peak hour of crop plantation and harvesting and from financial problems. There is a need for ground-to-level linkage in policy to provide better opportunities to farmers and labourers. During paddy plantation, there was a strong need for transportation facilities based on social distancing so that labourers could visit their places of work during paddy plantation before facing economic fear. Secondly government should make provide guidelines and policies to deal with immediate situation.

REFERENCES

Bhagat, R. B., Reshmi, R. S., Sahoo, H., Roy, A. K., & Govil, D. (2020). The COVID-19, Migration and livelihood in India: challenges and policy issues. *Migration Letters*, 17(5), 705-718.

Gupta, A.K (1991) Migration of Agricultural Labour from Eastern to North-Western Region. *Social Change,* 21(6), 85-90.

Gupta, A.K and Bhakoo, A.K (1980) Rural to rural migration and characteristics of migration in Punjab, *Social Change,* 10 (3-4): 18-22.

ILO (2020) COVID-19: Protecting workers in the workplace. https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_738742/lang—en/index.htm

Kaur *et al.*, (2011) Causes and Impact of Labour Migration: A Case Study of Punjab. *Agriculture Agricultural Economic Research Review,* 24, 459-466.

Kaur, G., Kaur, A. P., & Kaur, L. (2020). Knowledge, attitude and practices during Covid 19: Interventions and preventions. *Indian Journal of Positive Psychology,* 11(3), 241-244.

Krar (2020) Labour migration likely to hurt Rabi, Kharif crop output. The Economics Times. https://economictimes. indiatimes.com/news/economy/agriculture/labour-migration-likely-to-hurt-rabi-kharif-crop-output/articleshow/75310093.cms?from=mdr

Massey, D. S., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A., & Taylor, J. E. (1993). Theories of international migration: A review and appraisal. Population and development review, 431-466.

Singh, S., &Bhogal, S. (2014). Punjab's Small Peasantry: Thriving or Deteriorating? *Economic and Political Weekly,* 95-100.

Sidhu M.S *et al.* (1998) an Economic Profile of Migrant Agricultural Labour in Punjab. *Productivity,* 38(4), 668-677.

Sidhu M.S. *et al.* (1997) A Study on Migrant Agricultural Labour in Punjab. Research Bulletin, Department of Economics and Sociology, Punjab Agricultural University, Ludhiana, 1-62.

Stark, O., & Bloom, D. E. (1985). The new economics of labor migration. *The American Economic Review*, *75*(2), 173-178.

Todaro, M. P. (1969). A model of labor migration and urban unemployment in less developed countries. *The American economic review,* 59(1), 138-148.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 599-603

Subsidiary Occupations for Rural Development: Constraints and Challenges

Gaganpreet Kaur[1], Atinder Pal Kaur[2] and Saloni Charak[2]
[1]Assistant Professor and [2]Research Scholar, Department of Economics and Sociology, Punjab Agricultural University, Ludhiana

ABSTRACT

In the present age, the agrarian community has been pursuing various types of subsidiary occupations apart from their primary agricultural activity. Thus, the subsidiary occupation plays a very significant role in transformation of the agrarian structure. So this study is taken up to examine the subsidiary occupations content in people at the farms in Punjab state with following objectives i) to highlight the type of subsidiary occupations adopted by the farmers ii) to study attitude of the respondents while pursuing subsidiary occupations. The study was conducted in Abohar district of Punjab. From the district one block and further two villages namely, Gobindgarh and Bangala were selected. Total sample of 100 farmers who have adopted subsidiary occupations were taken up. The results revealed that, the respondents were young, having income up to 5 lac, educated upto 10+2 and owned 5-10 acres of land. Study revealed that major profitable subsidiary occupation remained dairy farming because milk is the part of our daily diet. The utilization of debt was also seen and the data showed that 24.00 percent of the respondents repaid their old debts, whereas 20.00 percent of the respondents used money for expanding the business and same number invested money in taking health facilities. The apps which are in phones such as YouTube, WhatsApp and Face book were playing a positive role to get information on subsidiary occupations and widely used by the respondents. 88.00 percent stated that subsidiary occupations are need of an hour and every farmers had to take shift from traditional occupation to subsidiary occupations 68.00 percent stated that subsidiary occupation gave a positive image to a farmer and same number perceived it as more profitable than agriculture. Overall, the respondents found these occupations as need of an hour and stated that every farmer must have these occupations along with primary occupation.

Keywords: Challenges, Constraints, Occupations, Rural development, Subsidiary

INTRODUCTION

Agriculture plays a vital role in India's economy, engaging about 55 percent of the total workforce in agricultural and allied sector activities and accounting for 17.8 percent of the country's Gross Value Added at current prices for 2019-20 (Anonymous, 2020). However, most Indian youth still live in rural areas where agriculture is the dominant and default source of livelihood by inheritance. The low productivity in agriculture, lesser employment opportunities, and fragmentation of land holdings have forced most small farmers to strive under poverty. Unemployment in a rural area is gradually increasing, for which promotion of subsidiary occupation is of vital importance (Kaur, 2002). Agriculture is dying, not as food production but as a desirable profession (Tongia, 2021). Estimates derived from the unit-level data from the Employment and Unemployment Survey (EUS) of 2004-05 and the Periodic Labour Force Survey (PLFS) for 2018-19 by (Mahambare *et al.*, 2021) indicated that there had been a dramatic reduction in prime working-age Indians (20 to 59 years) engaged in agriculture, with their share falling to 23.3 percent in 2018-19 from 40 percent in 2004-05. Even in rural India, only one in three prime working-age adults was employed in the sector in 2018-19. All these points towards shifting from basic farming to more efficient, sustainable, and productive farming.

In the agrarian state of Punjab, less than 15 percent of the prime working-age population is directly employed in a**griculture in rural areas (Mahambare *et al.*, 2021). This c**hallenge becomes more arduous keeping in view the dominance of the paddy-wheat cycle, a more minor increase in output prices than input prices, fall in the water table, higher pests and diseases, and more significant climate variability affecting productivity-enhancing the cost of production. However, there are many avenues and opportunities to enhance farmers' income. Subsidiary occupations can play a vital role in rural development for harvesting better and improved livelihood. These auxiliary occupations help an individual supplement his income and perform the primary occupation and thus help in transforming the socioeconomic structure of a family, community, and society (Dehingia, 2020). One of the subsidiary occupations, dairying, was considered a self-generating occupation for getting stable and continuous farm income and higher employment opportunities on smaller farms and a significant role for women in the dairy industry (Mohpatra*et al.,* 2012).

MATERIALS AND METHODS

The study was conducted in the Malwa region of Punjab. First, one district, i.e., Abohar, was selected for the study. Further, one block, namely Abohar, was taken up for the study. After that, two villages, i.e., Gobindgarh and Bangala, were chosen from block Abhor. A total sample of 100 farmers who have adopted subsidiary occupation and farming from these two villages was contacted. The selected respondents were approached with an interview schedule prepared to collect data in their settings.

RESULTS AND DISCUSSION

Table 1 reveals that most of the respondents who adopted subsidiary occupation were 30-40 years old, followed by 40-50 years of age group respondents. Only 8 percent of the respondents were above 50 years. Regarding the occupation, about one-third of the respondents were educated upto 10+2, followed by 28.00 percent were graduates. Only 6.00 percent were postgraduates. It was seen that 46.00 percent of respondents had six and above family members, and a large number, i.e., 76.00 percent owned pucca houses. The respondents also said they were earning well with the subsidiary occupations, so 68.00 percent had income upto 5 lac per annum. It was seen that most of the children, i.e., 76.00 percent, were going to private schools. The landholding of the respondents reveals that 42.00 percent of the respondents had 5-10 acres of land with them. So, overall, the respondents were young, having income upto 5 lakh, educated upto 10+2, and owned 5-10 acres of land. The earnings from subsidiary occupations increase their overall income and improve living standards.

Table 1: Distribution of the respondents according to their Socioeconomic background

Particulars	Percentage
Age (years)	
Upto 30	10.00
30-40	52.00
40-50	30.00
50 and above	8.00
Education	
Illiterate	8.00
Upto middle	16.00
Metric	16.00
Upto +2	34.00
Graduation	28.00
Post-graduation	6.00
No. of family members	
Upto 4	12.00
4-6	42.00
6 and above	46.00
Type of house	
Kutcha	
Semi pucca	24.00
Pucca	76.00
Income /annum	
Upto 5 lac	68.00
2-5 lac	16.00
Less than 2 lac	16.00
Schooling of children	
Government school	24.00
Private school	76.00
Land Holding	
More than 10 acres	30.00
5-10	42.00
Upto 5 acres	28.00

The livestock sector can play an essential role in poverty alleviation, income enhancement, and risk

Table 2: Type of subsidiary occupation adopted by the respondents

Subsidiary Occupation	Percentage
Dairy	64.00
Vegetable growers	32.00
Piggery	8.00
Jaggery making	12.00
Flour mill	36.00
Agri Implements shop	10.00
Orchids	12.00
Beekeeper	20.00

reduction for poor rural households. Livestock is one of the fastest-growing subsectors of agriculture and allied activities. So, livestock farming is often cited as a viable option for household income growth. Table 2 reveals that 64 percent of the respondents involve in dairy farming. The second primary subsidiary occupation (36%) in which respondents involve is a flour mill. Beekeeping was adopted by 20.00 percent of the respondents as a subsidiary occupation. Very few respondents adopted the occupation of piggery and jaggery production as their subsidiary occupation. The study revealed that the primary profitable subsidiary occupation remained dairy farming because milk is part of our daily diet. Secondly, flour is also a significant diet as wheat is our staple food in daily consumption. Respondents revealed that they want to invest in those subsidiary occupations which are in demand in the day-to-day life of people. Similar results were given by Sarkar 2020 and Kashish 2017, who studied that the diversification of income and employment portfolio is crucial for sustainable rural livelihoods and stated that dairy farming as a subsidiary occupation contributes to farmers' income, particularly the small landholders.

Table 3 revealed that the majority (90 percent) of the respondents took debt on the name of starting a subsidiary occupation. The utilization of debt was also seen, and the data showed that 24.00 percent of the respondents repaid their old debts, whereas 20.00 percent of the respondents used the money for expanding the business, and the same number invested money in taking health facilities. Also, 8.00 percent used loans in performing the social ceremonies. So, overall, it was noticed that loans were not utilized for the purpose for which they were taken. Instead, they were used for fulfilling day to day needs of the respondents

Table 3: Distribution of respondents according to debt taken by them and reasons for taking debt

Debt taken	Percentage
Yes	90.00
No	10.00
Purpose of taking debt	
Payment of old debts	24.00
Purchase of fertilizers	16.00
Expanding business	20.00
Social ceremonies	8.00
Health problems	20.00

Table 4: Profitability of subsidiary occupation

Profitability	Percentage
Yes	90.00
No	10.00

The respondents' perceptions regarding the profitability of the subsidiary occupation were also seen. Almost all the respondents felt this was profitable. However, according to the study conducted by Kale (2011), 99.00% of farmers who committed suicide did not have any subsidiary occupation or any other allied activity. Further, he added that the subsidiary occupations are essential and are regarded as profitable for farmers in today's era.

People in today's time are abreast with social media. Data in Table 5 shows that many of the respondents, i.e., 96.00 percent, were citing YouTube for becoming progressive farmers. It was stated that many respondents were using Facebook and WhatsApp in their daily lives to get helpful information about the subsidiary occupations. Newspapers and T. V were also used as a medium to acquire information as 76.00 percent and 72.00 percent, respectively. The print media that included the reading material

In books, magazines were used by 68.00 percent of the respondents. So, in a nutshell, the apps on phones such as YouTube, WhatsApp, and Facebook played a positive role in getting information on subsidiary occupations and were widely used by the respondents. Similar views were given by (sonam *et al.,* 2020) and (Thanga, 2013), who stated that social networking sites such as Facebook, WhatsApp, and Twitter and video sites such as YouTube and blogs media act as a

Table 5: Distribution of the Respondents According to their Social and MassMedia Exposure

Mass and Social media	Percentage
Print media	68.00
Newspaper	76.00
T V	72.00
WhatsApp	88.00
Facebook	92.00
You tube	96.00

communication tool that allows young farmers to join the online conversation and clear their doubts in new ventures.

The perceptions of the respondents towards subsidiary occupation were noted. Table 6 shows that a large number, i.e., 88.00 percent, stated that subsidiary occupations are need of an hour and every farmer had to take the shift from traditional occupation to subsidiary occupations whereas 70.00 percent had different views and they felt subsidiary occupation as labour intensive, and 68.00 percent stated that subsidiary occupation gave a positive image to farmer and the same number perceived it as more profitable than agriculture. Further, 64.00 percent said that if the farmer has much experience in a subsidiary occupation, he should only start the new venture. Nearly one-third, i.e., 36.00 percent of the respondents, felt it was difficult to obtain information regarding new ventures, and 40.00 percent stated there is a lack of subsidies for these occupations.

Suggestions by the farmers practicing the subsidiary occupation were taken into account. The cursory observation of the data presented in the Table 7 explained that provide a better price for their output (96.00%) followed by making available the credit facilities on time (94.00%) and imparting training programs to learn skills by the government (84.00%) were the suggestions of the practicing subsidiary occupations.

Table 7: Suggestions by the farmers Practicing Subsidiary Occupation to overcome their Problems

Statements	Percentage
Providing Better prices for output	96.00
Providing credit facility	94.00
Organizing the training programs to learn special skills to practice	84.00
Availability of inputs when required	74.00

These suggestions help in taking remedial measures and formulating suitable options. Due to their suggestions, a favorable atmosphere can significantly encourage farmers to practice subsidiary occupations. The findings have similarities with the findings of Narinder *et al.* 2016 and Ponnusamy 2015.

CONCLUSION

The subsidiary occupation is need of an hour, and majority of farmers have started practicing these occupations along with the traditional occupations. The farmers who adopted these occupations perceived them to be profitable but at the same time felt it as labour-intensive. It is found that respondents with subsidiary occupations can enhance their wellbeing and increase their efficiency other than traditional occupations. Social media has played an essential role in making respondents aware about subsidiary occupation and adopting it as a trusted path to gain

Table 6: Perceptions of respondents towards the subsidiary occupation

Statements	Percentage
Subsidiary occupation gives a positive image to a farmer or household	68.00
Local markets for subsidiary occupation are available	44.00
Subsidiary occupation is more profitable than agriculture	68.00
Obtaining information regarding subsidiary occupation is difficult	36.00
Subsidiary occupations are labor-intensive	70.00
There is a lack of subsidies for subsidiary occupations	40.00
Traditional activities have changed, so subsidiary occ is need of an hour	88.00
A farmer with a lot of experience should use these new allied activities and farming.	64.00

first-hand information in occupational opportunities. The study also revealed that dairy farming is one of the most profitable and adopted by the respondents among all subsidiary occupations. It also revealed that in dairy farming women's participation was more visible than other subsidiary occupations. The study also examined that debt that the respondents took to utilize in subsidiary occupation in most of the cases were unutilized for household consumption and other activities. Last but not the least, in the surveyed households, the subsidiary occupation is more time-consuming and needs proper guidance. The farmers also suggested that better prices for their output followed by the making available credit facilities on time should be there to promote subsidiary occupations.

REFERENCES

Anonymous. 2020. Annual Report 2020-21. Ministry of Agriculture and Farmers' Welfare, Department of Agriculture, Cooperation and Farmers' Welfare, Directorate of Economics and Statistics, Government of India, New Delhi.

Anupam Sarkar. 2020. Role of Livestock Farming in Meeting Livelihood Challenges of SC Cultivators in India, https://doi.org/10.1177/0973703020923863

Dehingia, T. 2020. Role of Subsidiary Occupation in Transforming Agrarian Structure: The study based on No. 1 Gazpuria Village in Dibrugarh District of Assam, India. *International Journal of Advanced Science and Technology,* 29(5): 5618-5622.

Kale, N.M. 2011. Availability of subsidiary occupations and agriculture infrastructure with suicidal farmers in Karnataka. *Journal of Agricultural Sciences*, 24(3): 340–342.

Kashish, K.M.; M.K. Sekhon and V. Dhawan. 2017. Impact of dairying on income and income distribution of small holder dairy farmers in Punjab. *Indian Journal of Dairy Science,* 70: 781- 788.

Kaur, G. 2002. Entrepreneurship in district Ludhiana in Punjab. M.Sc thesis, Punjab Agricultural University, Ludhiana, India.

Mahambare, V.; S. Dhanaraj and S. Sharma. 2021. Agriculture Employment in India: An update https://www.greatlakes.edu.in/chennai/assets/greatlakes/pdf/agri-employment-report.pdf

Mohapatra, A.S.; R. Behera and Sahu. 2012. U.P. constraints faced by Tribal Entrepreneurs in dairy farming enterprise, *International Journal of Physiology and Social Science*, 2: 171-184.

Narinder, P.; S.K. Pawan; V. Vishaw and V. Gupta. 2016. Future Strategies for Sustainable Livelihood of small and marginal farmers in Rajouri district of Jammu and Kashmir, *International Journal of Agriculture Environment and Biotechnology,* 9(6): 1015.

Ponnusamy, K.; K. Kishore and A.K. Shukla. 2015. Studies on sustainable livelihood of farmers in horticulture-based farming systems. *Indian Journal of Horticulture,* 72(2): 285.

Sonam, M.; S. Kala; H. Hans and J. Bisen. 2020. Impact assessment of mushroom cultivation on livelihood of women mushroom growers of Samastipur District of Bihar.www.researchgate.net/publication/341941567

Thanga Thamil Vanan, N. Kumaravelu, B. Nishanth, P.R. Nisha. 2013. Impact assessment of dairy farming on livelihood of poor rural farmers. *International Journal of Research in Social Sciences,* ISSN: 2249-2496

Tongia, R. 2021. TIF (TheIndiaForum) India's Biggest Challenge: The Future of Farming. *A Journal magazine on Contemporary issues*: 1-8.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 604-610

Growth Rate of Cost of Cultivation of Soybean Rajasthan States of India

Veena Rathore[1], Yamini Raut[2], R.K. Narvariya[3] and H.O. Sharma[4]
[1]Ph.D., Department of Agricultural Economics and Farm Management, College of Agriculture, JNKVV, Jabalpur, MP
[2]RKVY-RAFTAAR Project, AEABM, SKUAST-Jammu, J&K
[3]Assistant Professor, Department of Agricultural Economics and Farm Management, College of Agriculture Powarkheda, JNKVV, Jabalpur, Madhya Pradesh
[4]Director of Agro-Economic Research Centre, J.N.K.V.V. Jabalpur, Madhya Pradesh

ABSTRACT

In India, area of soybean is 11.67 million hectares, with total production of 6.93 million metric tons with an average yield of 0.59 metric tons per ha (Singh, 2018). The other soybean producing countries are as follows - China, Paraguay, Canada, Ukraine, Bolivia and Uruguay. Madhya Pradesh (also known as soya state), Rajasthan and Maharashtra are the major soybean growing states of India. Soybean cultivation is practiced in different states of India and comparing all states, three states were selected for comparative study. Twenty years of data were collected for the study. The area, production, and productivity, cost of cultivation, gross income, factors affecting the profitability of soybean by collected from secondary data. Secondary data was collected from different publications. The analytical tools used were absolute change, relative change, simple growth rate, compound growth rate and coefficient of variation. To understand the dynamics of production and profitability of soybean crop in India, Rajasthan were studied for the period 1995-96 to 2015-16. For the states Rajasthan the growth rates in area was found positive and highly significant. Similarly, the production growth rates were also significant and positive. While analyzing the growth rate of the productivity of the crop, it was shown that it was negative and non- significant for the states throughout the study period. The results points that there was commendable increase in the area and production of soybean during the study period but the productivity has declined.

Keywords: Area, Production, Productivity, Variability, Growth

INTRODUCTION

In India soybean was important oilseed crop because of its unique quality and fulfills the vegetable oil demand of population. Soybean is a legume cum oilseed crop which belongs to legume family and is believed to be originated in China as early as 11th century. Written records of soybean farming are dated from 2200BC. The emperor Sheng-Nung named it as one of the five sacred grains. Thus, soybean has been cultivated in china for more than 4,000 years (Hymowitz, 1970). Soybean was grown in India from early 1800s. Black soybean was grown for ages in low Himalayan hills, in the foot hills and also some scattered regions of central India. Thus, Soybean being both legume and oilseed gained it's significance of fats and protein in Indian dietary (Bisaliah, 1986). Attempts to explore the possibility of developing it as a commercial crop were initiated in the country in the 1960's. Most of the literature shows that the commercial cultivation of Soybean started in the country in 1970's. The expansion of soybean cultivation has happened rapidly compared to many other crops in India. Soybean crop has replaced other crops and made its important position because it give more profit to farmer as compared to other crops due to it's higher returns (Sharma *et al.* 2005). The area of soybean increased tremendously due to shift of area from cotton, groundnut, cereals, etc. (Nahatkar *et al.* 2005) and in the different country of world soybean substituted other crop like sunflower in Argentina, cotton in United states and utilizing pasture land in Argentina and Brazil and expanded area of soybean (Masuda and goldsmith, 2009). Madhya Pradesh (also known as soya state), Rajasthan and Maharashtra are the major soybean growing states of India. The Soybean crop showed big change in Indian agriculture due to its increased area in these three states of India. In the year 1986-87, area of Soybean was 1209.6, 54.6, and 52 Thousand Ha in Madhya Pradesh, Maharashtra and Rajasthan respectively which increased to 4741.6, 1620.0, and 601.0 Thousand Ha respectively in 1999-20. The Production and productivity also increased similarly except for some years. The area of soybean in Rajasthan cultivates soybean in an area of 3.70 and 1.20 million hectares with a production of 2.06 and 1.00 million tonnes with an average yield of 557 and 833 million kg/ ha respectively (Agricultural statistical at a glance 2016). Cost of cultivation of a commodity is the total expenditure incurred on various operations and inputs that are used in the production of the commodity. Correct identification of these input and their measurements is crucial for realistic assessment of cost incurred in the production of the commodity (Jaiswal and Hugar, 2011). The operational cost of soybean cultivation had increased gradually indicated that soybean cultivation was turning capital intensive. Growth in real cost of cultivation of soybean outpaced the growth in real returns from soybean in major states. (Sharma P.2016). Due to inflation and the other economic factors, the cost of cultivation has increased but the farmer's are not getting enough returns to cover up the costs incurred.

MATERIALS AND METHODS

Different objective of study secondary data was used. It was mainly collected from Agriculture Statistics of India including Maharashtra with other published and unpublished records like web site of Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, Cost of Cultivation of Principal Crops in India, New Delhi Ministry of Agriculture. The states wise time series secondary data were collected for the period of 20 years from 1996-97 to 2015-16. The whole study period was broke in to three sub periods, Period I(1996-97 to 2005-06), Period II(2006-07 to 2015-16),the pooled data also used for study of entire period (1996-97 to 2015-16). To assess the percent contribution of different components in cost and gross income of soybean, the time series secondary data for the period of 1996-97 to 2015- 16 has been used.

RESULTS AND DISCUSSION

The trend and growth of labour cost incurred in cultivation of soybean in Rajasthan during the period under study the contribution of different types of labour viz. human labour, bullock labour and machine labour in different points of the study have been analyzed and presented in Table 1.

It was observed from the table that the total cost of labour used in cultivation of soybean was found 49.42 and 324.12 per cent more in the 2005-06 and 2015-16 as compared to 1996-97(Rs.3693.24/ha). The total labour cost which increased at the growth rate of 7.37 per cent per year with the magnitude of Rs.518.64 per year during the period from 1996-97 to 2015-16. Among the different components of total labour cost, the cost of human labour constituted 67.65 percent followed by machine labour (26.76%) and bullock labour (5.59%) in 2015-16. But in 1996-97, the cost of bullock labour constituted 17.68 per cent and machine labour constituted 21.33 per cent of the total labour cost in Rajasthan. The expenditure of total human labour increased from Rs.2252.53 per ha in 1996-97 to 3458.02 per ha in 2005-06 marking a percentage change of 53.51 over 10 years. But in 2015-16, the costs increased to Rs.10597.02 per ha marking a percentage change of 370.44 over 20 years.

The expenditure on total bullock labour was found to decreased from Rs.652.86 (1996-97) to Rs.291.41 (2005-06), while it was found to be increased 875.54 in the 2015-16 compared to 1996-97. It was found to be decreased with the magnitude of Rs.-19.4 per year with the growth of -3.81 per cent per year during the period of 1996-97 to 2015-16.The expenditure on machine labour was found to be increased to 124.55 and 432.02 per cent in the year 2005-06 and 2015-16 respectively from the year 1996-97 (Rs.787.85 /ha). The expenditure on machine labour was found to be increased the magnitude of Rs. 174.03 per ha per year with a significant growth of 8.89 per cent per year during the period of 1996-97 to 2015-16. Amongst the hired and owned machine labour the expenditure on hired and owned human labour was found to be increased with the magnitude of Rs.137.86 and 36.37 per ha per year during the period 1996-97 to 2015 . The growth of hired machine labour (8.30 %per year) and (12.91% per year) was found to significant. The

Table 1: Trend and growth of labour cost incurred in cultivation of soybean in Rajasthan at different point of time. (Rs/ha)

Particulars	Point of time			Percentage change over in 1996-97		Trend (b)
	1996-97	2005-06	2015-16	2005-06	2015-16	
Human Labour						
Family	1618.14(43.81)	1952.80(35.38)	7253.49(46.31)	20.68	348.26	221.90**/(8.00)/
Attached	71.80(1.95)	35.59(0.65)	250.26(1.60)	-50.43	248.55	2.69/(2.22)/
Casual	562.59(15.23)	1469.63(26.63)	3093.27(19.74)	161.22	449.82	141.53**/(9.19)/
Sub Total	2252.53(60.99)	3458.02(62.66)	10597.02(67.65)	53.51	370.44	365.79**/(8.2)/
Bullock Labour						
Hired	77.55(2.10)	58.38(1.06)	188.85(1.21)	-24.71	143.52	-2.10/(-2.21)/
Owned	575.31(15.58)	233.03(4.22)	686.69(4.38)	-59.49	19.35	-19.62/(-3.48)/
Sub Total	652.86(17.68)	291.41(5.28)	875.54(5.59)	-55.36	34.10	-19.4/(-3.81)/
Machine Labour						
Hired	775.87(21.01)	1670.14(30.26)	3252.74(20.77)	115.26	319.23	137.86**/(8.30)/
Owned	11.98(0.32)	99.01(1.80)	938.78(5.99)	726.46	7736.22	36.37**/(12.91)/
Sub Total	787.85(21.33)	1769.15(32.06)	4191.52 (26.76)	124.55	432.02	174.03**/(8.89)/
Total Labour cost	3693.24(100)	5518.58(100)	15664.08(100)	49.42	324.12	518.64**/(7.37)/

Figure in parenthesis show percentage to total, while in slashes show growth rate.
** Significant at 1% level of probability; * Significant at 5% level of probability

contribution of total machine labour to total labour cost was found to be increased from 21.33 (1996-97) to 32.06 (2005-06) ,while it was found to be decreased 26.76 per cent in the year 2015-16 in different point of time of the study. The contribution hired machine labour to total labour cost was found to be increased from 21.01 (1996-97) to 30.26 (2005-06), while it was found to be decreased 20.77% in the year 2015-16.

The percentage share of owned machine labour was found to be increased from 0.32 (1996-97) to 1.80 (2005-06) and 5.99 (2015-16) per cent in cultivation of soybean in different points of time of the study in Rajasthan. The trend and growth rates of labour cost in Rajasthan showed that about 68 per cent of the costs were incurred in human labor followed by machine labour. Over the years' bullock labour was substituted by machine labour indicating that the soybean growing has become more mechanized in Rajasthan. The trend and growth of different labour units in cultivation of soybean (Table 2).

The growth rate of labour units of both human labour (-1.02%) and bullock labour (-10.98%) was negative and non significant during the study period. In both the cases ,there was increase in labour unit rates from 1996-97 to 2005-06 but it shows decreased at 2015-16.The unit rates of labour showed an significantly positive growth rate for human labour (9.48%) and bullock labour (9.24%).The growth rate in the cost of bullock labour and human labour even though the labour units were decreasing was due to the increasing labour units for both human and bullock labour. Decrease in the labour units for the cultivation of one hectare of land in Rajasthan over the study period shows that the marginal productivity of labour in soybean cultivation was increasing which was desirable.

Increase in the labor cost was due to the increase in the unit labor rate. The bullock labour units were also showed a decreasing trend during the study period but the unit rate was increasing. The various items of input cost of Rajasthan viz. cost of seed, fertilizer and manures, plant protection chemicals, irrigation charges, miscellaneous expenditure and interest on working capital across points of time of the study and per cent change over the base year (1996-97) in 2005-06 and 2015-16 with trend and growth have been analyzed

Table 2: Trend and growth of labour units in cultivation of soybean in Rajasthan at different point of time

Particulars	Point of time			Percentage change over in 1996-97		Trend (b)
	1996-97	2005-06	2015-16	2005-06	2015-16	
Labour unit (man Hr/ha)						
Human Labour	397.63	408.40	338.47	2.70	-14.87	-3.70/(-1.02)/
Bullock Labour	46.53	10.99	8.94	-76.38	-80.78	-2.07/(-10.98)/
Rate per unit (Rs.)						
Human Labour	5.66	8.47	31.31	49.64	453.18	1.22**/(9.48)/
Bullock Labour	14.03	26.51	97.91	88.95	597.86	3.60**/(9.24)/

Figure in parenthesis show percentage to total, while in slashes show growth rate.
** Significant at 1% level of probability; * Significant at 5% level of probability

Table 3: Trend and growth of input cost incurred in cultivation of soybean in Rajasthan at different point of time. (Rs/ha)

Particulars	Point of time			Percentage change over in 1996-97		Trend (b)
	1996-97	2005-06	2015-16	2005-06	2015-16	
Seed	1648.72(77.41)	1592.59(73.35)	5099.31(66.53)	-3.40	209.28	235.18**/(9.41)/
Fertilizer and Manures	345.57(16.23)	138.31(6.37)	577.63(7.54)	-59.97	67.15	21.85*/(6.06)/
Plant Protection Chemicals	0	165.38(7.62)	1238.32(16.15)	0	0	76.77**/(18.87)/
Irrigation Charges	8.12(0.38)	101.07(4.66)	262.29(3.42)	1144.70	3130.17	0.48/(0.53)/
Miscellaneous	0	0	0	0	0	0
Interest on Working Capital	127.42(5.98)	173.85(8.00)	487.13(6.36)	36.43	282.30	19.80/(8.50)/
Total Input Cost	2129.83(100)	2171.2(100)	7664.68(100)	1.94	259.87	354.08**/(9.86)/

Figure in parenthesis show percentage to total, while in slashes show growth rate.
** Significant at 1% level of probability; * Significant at 5% level of probability

for the study and presented 3. It was observed from the data that the per ha input cost which was found to be incurred Rs.2129.83 per ha in 1996-97 increased 1.94 and 259.87 per cent in 2005-06 (2171.2/ha) and 2015-16(Rs.7664.68/ha) respectively with the magnitude of Rs.354.08ha/year and growth rate of 9.86 per cent per year in the period under study in cultivation of soybean in Rajasthan. Amongst different items of input cost the maximum expenditure was found to be incurred in seed (66.53%) followed by fertilizer and manures (7.54%) and plant protection chemicals (16.15%) to total input cost (Rs.7664.68/ha)in cultivation of soybean in the year 2015-16.The percentage share of all these items of input cost found to be similar with minor variation in the year 1996-97 and 2005-06 however, expenses on plant protection chemicals (18.87%) increased with higher growth rate as compared to seed (9.41%) and fertilizer and manure (6.06%).

The expenses on irrigation was Rs 8.12 per ha in 1996-97 which increased to Rs 101.07 per ha in 2005-06 with a percentage change of 1144.70 and increased to Rs 262.29 per ha in 2015-16 with a percentage change of 3130.17 over 20 years. The interest on working capital found to be increased with an annual growth of 8.50 percent with magnitude of Rs. 19.80 per ha per year in the period under study. Trend and growth of major inputs indicated that seed, plant protection chemicals, fertilizers and manures and irrigation were the major inputs used in Rajasthan. The highest growth rate was observed in plant protection chemicals which further depicted the increasing use of chemicals in pests and disease management or increasing incidence of pests and disease in soybean cultivation. Followed by, growth rate of costs of seed and fertilizer and manures also increased in Rajasthan. An attempt was also made to find out the trend and growth of quantity of inputs and its unit rate and was presented in Table 4.

It was observed from the table that there was a significant and positive growth rate in the application of seed rate but non-significant and positive growth rate in the manure application in Rajasthan. The rate of fertilizer showed negative and non significant growth rate. The unit rate of all the inputs showed a positive and significant growth rate for manure (5.98%) which was positive but non-significant. The highest growth rate was observed for seed rate (8.56%) followed by fertilizer rate (6.56%). The quantity of seed was increasing but fertilizers used per hectare were decreasing during the study period in Rajasthan. Similar to Madhya Pradesh and Maharashtra, the unit rates for the inputs were increasing resulting in the increase in the input costs. Thus, the increase in the expenses of fertilizers and manures were due to the increase in the unit rates even though the quantity applied per hectare were decreasing. The increase in the cost of seed incurred can be due to use of hybrid seed. The growth rate of quantity of manure used and its unit rate was positive but non-significant in Rajasthan. Trend and growth rate of various fixed costs incurred in cultivation of soybean in Rajasthan was examined and presented in Table 5.

The total fixed cost per ha was Rs.7469.3 per ha in 2015-16 which increased from Rs. 2031.47 in 1996-97 and Rs. 3412.25 in 2005-06 at a percentage change of 69.96 and 267.67 respectively. The growth rate of total

Table 4: Trend and growth of variable units in cultivation of soybean in Rajasthan at different point of time

Particulars	Point of time			Percentage change over in 1996-97		Trend(b)
	1996-97	2005-06	2015-16	2005-06	2015-16	
Quantity (Per ha)						
Seed (kg)	97.07	96.66	101.09	-0.42	4.14	0.72**/(0.75)/
Fertilizer (kg)	29.79	5.59	15.30	-81.23	-48.64	-0.58/(-4.18)/
Manures (q)	0	1.32	0	0	0	0.03/(1.72)/
Rate Rs. per unit						
Seed (/kg)	16.98	16.48	50.44	-2.94	197.05	2.16**/(8.56)/
Fertilizer (/kgNutrients)	11.60	15.31	37.76	31.98	225.51	1.19**/(6.56)/
Manures (/q)	0	40.00	0	0	0	1.64/(5.98)/

Figure in parenthesis show percentage to total, while in slashes show growth rate.
** Significant at 1% level of probability; * Significant at 5% level of probability

Table 5: Trend and growth rate of fixed cost incurred in cultivation of soybean in Rajasthan at different point of time. (Rs/ha)

Particulars	Point of time			Percentage change over in 1996-97		Trend (b)
	1996-97	2005-06	2015-16	2005-06	2015-16	
Rental value of owned Land	1355.41(66.72)	2043.35(59.88)	4363.14(58.42)	50.75	221.90	209.25**/(7.25)/
Rent Paid for Leased -in –land	331.29(16.31)	412.19(12.08)	81.78(1.09)	24.41	-75.31	-19.26/(-9.01)/
Land Revenue Cesses and Taxes	8.13(0.40)	10.36(0.30)	7.71(0.10)	27.42	-5.16	-0.08/(-0.92)/
Dep. on Implements and Farm Builinding	103.96(5.12)	253.41(7.43)	363.31(4.87)	143.75	249.47	11.95**/(5.35)/
Interest on Fixed Capital	232.68(11.45)	692.94(20.31)	2653.36(35.52)	197.80	1040.34	119.22**/(11.05)/
Total Fixed cost	2031.47(100)	3412.25(100)	7469.3(100)	67.96	267.67	321.09/(7.28)/

Figure in parenthesis show percentage to total, while in slashes show growth rate.
** Significant at 1% level of probability; * Significant at 5% level of probability

Table 6: Total cost incurred in cultivation of soybean in Rajasthan at different point of time (Rs/ha)

Particulars	Point of time			Percentage change over in 1996-97		Trend (b)
	1996-97	2005-06	2015-16	2005-06	2015-16	
Total Labour Cost	3693.24(46.02)	5518.58(49.71)	15664.08(50.86)	49.42	324.12	518.64**/7.37)/
Total Input Cost	2129.83(26.12)	2171.2(19.56)	7664.68(24.88)	1.94	259.87	354.08**/(9.86)/
Total variable Cost	5823.07(74.14)	7689.78(69.27)	23328.76(75.74)	32.05	300.62	872.72/(8.21)/
Total Fixed Cost	2031.47(25.86)	3412.25(30.73)	7469.3(24.26)	67.96	267.67	321.09/(7.28)/
Total Cost of cultivation	7854.54(100)	11102.03(100)	30798.06(100)	41.34	292.10	1196.95/(7.95)/
Cost of production (Rs./q)	1251.76	1014.88	3653.47	-18.92	191.86	135.65**/(8.35)/

Figure in parenthesis show percentage to total, while in slashes show growth rate.
** Significant at 1% level of probability; * Significant at 5% level of probability

fixed cost during the study period was 7.28 which were positive and non- significant. In total fixed cost, the percentage share of rental value of land (58.42%) was found to be highest as compared to interest on fixed capital (35.52%), depreciation on implements and farm building (4.87%) and land revenue cesses and taxes (0.10%) in the year 2015-16. All the items of fixed cost shown an increasing trend i.e. rental value of land (Rs.209.25/ha/year), depreciation on implements and farm building (Rs.11.95/ha/year), interest on fixed capital (Rs.119.22/ ha/year) except land revenue cesses and taxes (Rs.-0.08/ha/year) and rent paid for leased in land (Rs.-19.26/ha/year)from 1996-97 to 2015-16. Thus, all the cost components like labour costs, input costs and fixed costs were increasing during the study period making the farmer to invest more in the same piece of land. Trend and growth rate of total cost incurred in cultivation of soybean in Rajasthan was presented in Table 6.

It was found that the soybean grower invested Rs. 7854.54 for cultivation of soybean in a hectare of land. This cost of cultivation showed a percentage change of 44.12 and 290.03 in year 2005-06 and 2015-16 respectively with the annual growth of 7.95 per cent during the period under study. The cost of cultivation of soybean was found to be increased with the magnitude of Rs.1196.95per ha per year. In Rajasthan, above half of the total cost of cultivation was on the labour expenses and 25 per cent of the cost of cultivation was incurred in buying the inputs and rest for the fixed costs. The cost of producing a quintal of soybean in Rajasthan in 2015-16 was Rs.3653.47 and it showed a positive and significant growth rate of 8.35 per cent during the study period.

CONCLUSION

The trend and growth rates of labour cost in Rajasthan showed that about 68 per cent of the costs were incurred in human labor followed by machine labour. Over the years' bullock labour was substituted by machine labour indicating that the soybean growing has become more mechanized in Rajasthan. Decrease in the labour units for the cultivation of one hectare of land in Rajasthan over the study period shows that the marginal productivity of labour in soybean cultivation was increasing which was desirable. Increase in the labor cost was due to the increase in the unit labor rate. The bullock labour units were also showed a decreasing trend during the study period but the unit rate was increasing. Trend and growth of major inputs indicated that seed, plant protection chemicals, fertilizers and manures and irrigation were the major inputs used in Rajasthan. The highest growth rate was observed in plant protection chemicals which further depicted the increasing use of chemicals in pests and disease management or increasing incidence of pests and disease in soybean cultivation. Followed by, growth rate of costs of seed and fertilizer and manures also increased in Rajasthan. The quantity of seed was increasing but fertilizers used per hectare were decreasing during the study period in Rajasthan. Similar to Madhya Pradesh and Maharashtra, the unit rates for the inputs were increasing resulting in the increase in the input costs. Thus, the increase in the expenses of fertilizers and manures were due to the increase in the unit rates even though the quantity applied per hectare were decreasing. The increase in the cost of seed incurred can be due to use of hybrid seed. The growth rate of quantity of manure used and its unit rate was positive but non-significant in Rajasthan. Trend and growth rate of various fixed costs incurred in cultivation of soybean in Rajasthan showed that the total fixed cost per ha was increasing at a growth rate of 7.28 per cent. Thus, the total cost of cultivation of Soybean in Rajasthan was increasing during the study period at a growth rate of 7.95 per cent. Similarly, the cost of producing per quintal of soybean increased at a growth rate of 8.35 per cent. In Rajasthan, above half of the total cost of cultivation was on the labour expenses and 25 per cent of the cost of cultivation was incurred in buying the inputs and rest for the fixed costs. Thus, all the cost components like labour costs, input costs and fixed costs were increasing during the study period making the farmer to invest more in the same piece of land.

REFERENCES

Ahirwar RF, Mishra PK, Rajak SK. 2005. Status and performance of oilseed production in India. International conference on sustainable crop production in stress environments. Management and Genetic Option, pp 345-346.

Ahirwar RF, Nahatkar SB, Sharma HO. 2006. Growth and supply response of soybean in Malwa plateau of Madhya Pradesh. *Soybean Research,* 4: 49-53.

Ahirwar RF, Nahatkar SB, Sharma HO. 2007. Profitability and input use resource efficiency in cultivation of soybean in Malwa Plateau of Madhya Pradesh. Soybean Research, 5: 43-49.

Bisaliah S. 1984. Soybean development in India. Research report The CGPRT Centre.

Hymowitz T. 1970. On the domestication of the soybean. Economic Botany, 24(4): 408-421.

Masuda T, Goldsmith PD. 2009. World soybean production: area harvested, yield and long term projections. *International Food and Agribusiness Management Review,* 12(4): 143.

Nahatkar SB, Sharma HO, Patidar M. 2005. Soybean production as across different agro-climatic region of Madhya Pradesh – An appraisal. *JNKVV Research Journal,* 39(2):46-52.

Narvariya R, Ashok CS, Shahu M, Raghuvanshi JS, Narvariya D. 2015. Profitability in cultivation of soybean production in Narmadapuram division of Madhya Pradesh. *Eco. Env. & Cons.,* 21 (December Suppl.) pp S175-S177.

Sharma HO, Yadav R, Nahatkar SB. 2005. Adoption pattern and constraints of soybean production technology in Malwa agro-climatic zones of Madhya Pradesh: An appraisal, JNKVV Research Journal, 39: 46-52.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 611-616

Existing Marketing System and Price Spread of Fish Marketing in the Jammu Division of JK-UT

Prem Kumar[1]*, Sudhakar Dwivedi[2], Vikas Kumar[3] and Sushma Sharma[4]
[1]Krishi Vigyan Kendra Jammu, J&K
[2&3]Division of Agricultural Economics and Agri-Business Management, SKUAST-J
[4]GDC, Samba

ABSTARCT

The present study was conducted for existing fish marketing system and price spread of fish marketing in the Jammu division of Jammu and Kashmir UT which would be helpful to policy makers to understand the present scenario of the fish industry and the underlying fish marketing constraints. If fish marketing would be made more efficient, it will be helpful in fishermen's socioeconomic development as well as ensuring nutritional security at affordable costs. The primary data was collected from fish farmers with the help of a survey, which used a pre-planned schedule and questionnaire. Data was collected by interviewing individuals and fish farmers and liaising with various mediators involved in the marketing and disposal of fish. To investigate various support services and market-related information, a random sample of market operators and retailers were taken. Retailers were selected and the necessary information was obtained from them. In the fish market, it was found that the majority of the fish was sold to retailers, who sell directly to consumers. The market chain from manufacturers to consumers goes through many intermediaries i.e. local retailers, agents / suppliers, retailers and re-retailers. Study of price distribution, limitation and market efficiency for the three main marketing channels revealed that Channel-II was the largest fish marketing channel in the Jammu District where the producer received 88.31 percent share of consumer's money while the marketing efficiency of channel-I and channel-II was 2.99 and 7.55, respectively. Channel III showed the highest marketing efficiency of 36.48 and the producer received maximum price for his produce accounting for 97.33 per cent of the consumer price but this channel is having lowest share in marketing. The study revealed that the price of fish is generally determined by the market structure, the quality of the fish, fish species, locally caught or imported, demand, fish size and weight.

Keyboards: Fish production, Marketing channels, Fish marketing efficiency

INTRODUCTION

Fish farming is playing an important role in India's economy. In addition to being a great source of protein, it provides cash and work to millions of fishermen and farmers, particularly in coastal areas. Over the years, the development of fishing has become an important activity because it has been known as a rich source of cheap nutritious food and as a powerful income and generator of jobs. Due to the increasing number of malnourished children in India, the demand for protein-rich food is increasing. The consumption of fish oil and its derivatives is very beneficial and in demand. Fish oil contains more unsaturated acids than animal fats. Since polyunsaturated fatty acids are helpful in maintaining the level of cholesterol in the blood, fish oil is considered useful in this regard as well. Moreover, fish is an excellent provider of calcium, phosphate, iodine, and other nutrients. Fish scales and fishing waste can be used to make organic fertilizer.

Aquaculture is promoted worldwide due to the limitations of fishery production. According to the State of World Fisheries and Aquaculture (FAO, 2020), the total number of fisheries and aquaculture production has reached 178.5 million metric tonnes

*Corresponding author email id: fish9897@gmail.com

(MT) with a combined inclusion of 96.4 MT from fisheries and 82.1 MT from aquaculture in 2018. From 1961 to 2017, the average annual growth in global fish food consumption exceeded that of human growth. This astonishing growth rate was mainly due to the improved production of fish (FOA, 2019). Indian fishermen are the world's second-largest fish and aquaculture producers, contributing 1.1 percent to GDP and to agriculture 4.5 percent. In 2018-19, India produced 137.58 lakh tonnes of fish, increasing at a yearly pace of roughly 9%. The fishing sector earns $334.41 billion in export earnings each year. Fish and mussel products from more than 50 distinct species are shipped to 75 countries worldwide. Fish and fish products are now India's greatest agricultural export, with a diverse range of resources from the deep ocean to the land.

J&K State, with its 27781 km river and canal network, 0.07 lac ha of lakes, 0.17 lac ha of tanks and lakes, 0.06 lac ha of idle lakes and 0.30 lac ha of local inland water bodies contributes significantly to the development and promotion of fisheries in the J&K province. The total fish production in J&K during 2020-2021 is 21.34 thousand metric tons (www.statista). In addition to such capacity, large quantities of fish are still imported from neighbouring states, especially during the winter months, when there is a high demand for fish (DoF, 2018). Fisheries in Jammu tend to increase today, but there are some factors that reduce the efficiency of fish production in Jammu. Efforts should therefore, be made to utilize the full potential of resources to overcome protein deficiency in J&K UT to reduce the people suffering from malnutrition. Many people around the globe make living in the fisheries sector. The fisheries sector contributes a significant amount to national GDP of India. The consumption of fish is also considerably high in India. The fisheries sector in rural India faces many challenges. Preserving fish for a longer period of time is quite difficult due to its perishable nature. Insufficient infrastructure and inferior transportation both are also the major stumbling blocks for supplying and delivering fish in the rural areas.

The success of any aquaculture programme depends not only on increased production, but also on the existence of a well organised and efficient marketing system (Shang, 1990). Fish has been a major source of animal protein with ever increasing demand. Capture fisheries have so far been the mainstay of fish production. But production from capture fisheries becomes more or less stagnant in several areas on account of exploitation reaching the maximum sustainable level due to over exploitation (Sukumaran, 1992). Therefore more and more attention are now being given to fish production through aquaculture. Aquaculture production and marketing are very closely interlinked. Efficient marketing along with sufficient infrastructure faculties to handle the products without perish ability can ensure sustenance of aquaculture production in the long run. Amongst other marketing factors, role of intermediaries, share of producer in consumer rupee and marketing expenses in each distribution channel are the major determinants which decide the profitability of any aquaculture project. However, in India, only few works have been done on the marketing of fishery products,

The channel or distribution of products or goods or services is one of the vital components of the marketing mix (Craig and Douglas, 2011). The marketing channel acts as a middleman to transfer the product from the producer to the consumer (Acharya and Agrwal, 2001). The primary role of the marketing channel is to make the product or service available to the consumers for use or consumption purposes. In the fish marketing channel, the fish sold through several marketing intermediaries starting from fish farmer to the ultimate customer (Solanke, 2013). The short-lived nature of fish, no proper storage facility, and consistent price fluctuation are also the primary concerns of the fish marketing channels (Ravindranath, 2008). The price variation is quite higher in the fisheries sector in comparison with other food sectors and the costs of fish production and transportation play a major role in the fish price fluctuation (Sathiadas *et al.*, 2009; 2011). The availability and freshness of the fish are the primary determinants of the fish price in the market (Salim, 2008). The fish price goes high due to the presence of a large number of middlemen in the fish the marketing channel (Bishnoi, 2005). The price of the fish varies from one species to another and from the freshwater fish to the sea fish. The sea fish is usually costlier than the pond or river fish.

Marketing is the key to aquaculture developments. The appropriate development of marketing should help the producer to get returns and the consumer to get the fish at a reasonable price. The entire mechanism of aquaculture product marketing needs a change to ensure that farmers do not make distress sales at the time of harvest. Producers, especially small and marginal farmers by and large, are continued to be exploited by the middlemen. It is in this background that the marketing study on aquaculture products has a significant role to play. Marketing co-operatives are bound to assume greater importance in the coming years in the context of increase in aquaculture production through the latest methods of intensive fish farming.

In the present study an attempt has been made to identify the critical issues of marketing channels of farmed fish in rural India and analysis the present level of trade through different marketing channels of different marketing systems, price spread at various stages of its movement and share of producer in consumer's rupee has been evaluated which will be helpful to formulate further strategies for the development of aquaculture Industry.

MATERIALS AND METHODS

Locale of study: Jammu district was purposefully chosen as the district has the highest level of fish production in Jammu region. Other reasons for choosing the Jammu district was more number of ponds in this area, good communication facilities and relatively homogeneous physio-graphic conditions. The list of fish pond owners was taken from the Department of Fisheries, Jammu. A total of 50 fish pond owners were selected randomly for the present study.

Collection of data: The primary data was collected from fish farmers with the help of a survey, which used a pre-planned schedule and questionnaire. Data was collected by interviewing individuals and fish farmers and liaising with various mediators involved in the marketing and disposal of fish. To investigate various support services or market-related information, a random sample of market operators, retailers and small retailers was selected and the necessary information was obtained from them. The secondary data was collected from various published sources, including letters from the Department of Agriculture, Government of J&K, and the Directorate of Economics and Statistics, Government of J&K.

Data analysis: Following the collection of data from respondents, the data was tabulated. In order to produce relevant information in a consistent manner, suitable statistical measures in tabular form were used to calculate the cost of fish production cultivation in the study, operation by operation and item by item.

Marketing Efficiency

Shepherd's method: Efficiency of supply chain was calculated with the help of the following formula. The higher this ratio, higher would be the efficiency and vice versa. This can be expressed in the following form:

$$ESC = [(V/I)-1]$$

Where
ESC- Index of efficiency of supply chain
V- Value of goods sold
I- Total marketing cost

Acharya's method: According to Acharya (2001), an ideal measure of marketing efficiency, particularly for comparing the efficiency of alternate market channels should take account of total marketing cost, net marketing margin, price received by farmer and price paid by the consumer of different marketing channels. The following formula is suggested by Acharya

Marketing Efficiency (ME)=FP/ (MC+MM)

Where,

1. Total marketing cost (MC)
2. Net marketing margin (MM)
3. Prices received by the producer/farmer (FP)
4. Prices paid by the consumer (RP)

These four variables have well defined relationship which is 1+2+3=4 and any three of these variables could be used to measure for comparing the marketing efficiency of different channels.

RESULT AND DISCUSSION

Table 1 shows that the sale through Channel-II i.e. Producer, Retailer, Consumer was the most common way of sale, accounting for 58 percent of total fish marketing in the Jammu district. Through Channel-I, 24 percent sale take place while Channel-III, direct sales to consumers contributed just 18 percent.

Table 1: Marketing channels of fish

Channels	Number of Respondents	%tage
Producer >Wholesaler>Retailer > Consumer	12	24.00
Producer >Retailer>Consumer	29	58.00
Producer >Consumer	9	18.00
Total	50	100.00

Table 2 show the marketing and pricing line distributed in different channels in Jammu district. Channel-I put two market mediators, namely, wholesalers and retailers, between the producer and the major consumer. Producer/farmers received Rs.12000/q for their produce which accounted for 74.95%. After that wholesaler add some margin cost and market cost then the price of the fish reached Rs 14270/q, the retailer add some margin cost as well like transportation charges, loading and unloading charges etc. and the seller sold the product to the final buyer. In this process, the marketing costs incurred by the seller were Rs.16010/q.

Table 2: Price spread of fish marketing in channel-I

Particulars	Jammu District	
	Rs/q	Percent
Net price received by producer/ purchase by wholesaler	12000.00	74.95
Cost incurred by wholesaler		
1. Market fee & other charges	240.00	1.49
2. Loading and unloading charges	80.00	0.49
3. Grading & sorting	90.00	0.56
4. Spoilages	450.00	2.81
5. Storage	330.00	2.06
6. Other charges	130.00	0.81
Sub – total (1 to 6)	1320.00	8.24
Net margin of wholesaler	950.00	5.93
Sale price of wholesaler/purchase price of retailer	14270.00	89.13
Cost incurred by the retailer		
1.Transportation charges	140.00	0.87
2. Loading and unloading charges	40.00	0.24
3. Sorting & storage cost	180.00	1.12
4. Packing material	90.00	0.56
5. Other charges	140.00	0.87
Sub-total (1 to 5)	590.00	3.68
Net margin of retailer	1150.00	7.18
Sale price of retailer/purchase price of consumer	16010.00	100.00
Marketing efficiency		2.99

Table 3 show marketing margins, price spreads and costs under channel-II. Traders buy fish directly from the farmer and sell it to buyers in various parts of nearby cities or elsewhere in selected regional industries. In this channel, there is only one mediator namely the sellers involved between the producer and the buyer. The producer's share as a percentage of consumer price was 88.31 percent. In the various regions, the variance in the budget for consumers was not so great in this channel. The marketing costs incurred by the sellers were Rs. 520/q represents 3.52 percent of consumer shares. The major marketing costs incurred by retailers were filtering and storage costs of Rs. 180/q followed by Rs. 130/q and 80/q for transport, and packing costs, respectively. The price of 14720/q obtained by the sellers and the price paid by the buyers, the sellers received a limit of Rs. 1200/ q (8.15 per cent of consumer rupee).

Table 4 show that this was the shortest channel in the fish trade. At this channel, there are no intermediaries between the producer and the consumer involved. The producer sells their product at farm gate directly to consumers. The producer received the full price of Rs. 13500/q accounting for 97.33 per cent of the

Table 3: Price spread of fish marketing in channel-II

Particulars	Jammu district	
	Rs/q	Per cent
Net price received by producer	13000.00	88.31
Cost incurred by the retailer		
1. Transportation charges	130.00	0.88
2. Loading and unloading Charges	40.00	0.27
3. Sorting & storage cost	180.00	1.22
4. Packing material	80.00	0.54
5. Other charges	90.00	0.61
Sub–total (1 to 5)	520.00	3.52
Net margin of retailer	1200.00	8.15
Sale price of retailer/purchase price of consumer	14720.00	100.00
Marketing efficiency		7.55

Table 4: Price spread of fish marketing in channel-III

Particulars	Jammu district	
	Rs/q	**Per cent**
Net price received by producer	13500.00	97.33
Cost incurred by the producer		
1. Catching cost.	280.00	2.01
2. Packing material	90.00	0.66
Sub–total (1 to 2)	370.00	2.67
Sale price of producer/purchase price of consumer	13870.00	100.00
Marketing efficiency by Achariya method		36.48

consumer price. By comparing the results, presented through various channels, it was observed that the producer's share of consumer money was highest when it was sold directly compared to other channels involving various market mediators The marketing performance of this channel was 36.48.

The marketing and pricing line distributed in different channels in Jammu district. Channel-I put two market mediators, namely, wholesalers and retailers, between the producer and the major consumer. Producer-farmers received Rs.12000/q for their produce which accounted for (74.95%). after that wholesaler add some margin cost and market cost then the price of the fish reached Rs 14270/q the retailer add some margin cost as well as market cost like transportation charges, loading and unloading charges etc. and the seller sold the product to the final buyer. In this process, the marketing costs incurred by the seller were Rs.16010/q. The price spread of fish through various marketing channels was studied by Devi and Singh (2015), who found that the percentage of the producer's share in the rupee of the consumer was highest in channel-III (98.18%) and then channel-II (86.25 per cent).

In Channel-II, the producer's share as percentage of consumer's price was 88.31 per cent from the price of Rs. 13000/q of fish. The marketing cost incurred by the retailers was Rs. 520/q. The net margin received by the retailer was Rs.1200. The marketing efficiency worked out of this channel was 7.55. The value is much greater than Channel-I which indicated an efficient market channel and service rendered by different marketing agencies in transferring the produce from producer to consumer was cheaper. In channel-II middlemen were less as compared to channel-I, therefore, market cost and margin was less and it is more efficient. Ambulkar *et al.* (2015) conducted research on the fresh water fish marketing system of Nagpur's largest wholesale market, Bhoipura fish market where Catla, mrigal, silver carp, and common carp were sold at a wholesale price of 60/kg, while rohu was sold at a slightly higher price of 70/kg. The retail selling price ranged from Rs100 to Rs120 per kilogramme. The marketing margin between wholesaler and retailer for catla, rohu, and mrigal was 50/kg, despite the fact that rohu had a higher rate than catla and mrigal, the marketing margin was the same but the minimum margin for common and silver carp was 40/kg.

Channel III was the shortest channel in the fish trade. At this channel, there are no intermediaries between the producer and the consumer involved. The producer sells their product at farm gate directly to consumers. The producer received the full price of Rs. 13500/q accounting for 97.33 per cent of the consumer price. By comparing the results, presented through various channels, it was observed that the producer's share of consumer money was highest when it was sold directly compared to other channels involving various market mediators The marketing performance of this channel was 36.48. Kumar *et al.* (2008) studied domestic fish marketing in India – Changing structure, conduct performance and policies in which the total marketing costs of auctioneer, wholesaler, retailer, vendor and fishermen cooperative society were found to be 0.98, 8.89, 6.61, 4.50, 6.00 and 3.51, respectively. The marketing efficiency was found more in the case of marine species than freshwater species, since the latter travelled longer distances from the point of production to consumption centre, passing many intermediaries as compared to the farmer.

Locally produced fish had a higher marketing efficiency than fish imported from other states. The percentage of the fisherman in the consumer's rupee varied depending on the marketing channel and was higher for fish produced and sold locally. The prices also varied depend upon the quality of the fish, fish species, locally caught or imported, demand, fish size and weight.

The study concluded that Channel-II was the largest fish marketing channel in the Jammu District where the producer received 88.31 percent consumers. The marketing efficiency of channel-I and channel-II was 2.99 and 7.55, respectively while the commercial performance of channel-III was best with 36.48 due to the lack of middlemen.

REFERENCES

Acharya, S. S. and Agarwal, N. L. 2001. Agricultural marketing in India, Oxford and IBH publishing Co., New Delhi.

Ambulkar, R., Sateesh, A., Sharma, A., Ghosh, S., Kureel., and Keshave J.V. 2015. Wholesale fish market of Nagpur, Maharashtra: A case study. *Journal of Progressive Agriculture*, 6.

Bishnoi, T. K. 2005. Marketing of Marine Fisheries. Sonali Publication, New Delhi, pp. 74-76.

Devi, S.Z., and Singh, N.R. 2015. Potentiality of fishery towards its sustainable production and marketing – A case study in Manipur. *ZENITH International Journal of Multidisciplinary Research*, 5(8): 160-166.

DoF. 2018. Department of Fisheries, Government of Jammu and Kashmir. Available at: www.indianenvironmental portal.org.in.

Douglas, S. P. and Samuel Craig, C. 2011. The role of context in assessing international marketing opportunities. International Marketing Review, Vol. 28 No. 2, pp. 150-162. https://doi.org/10.1108/02651331111122641

FAO. 2019. The State of World Fisheries and Aquaculture, Sustainability in Action. Food and Agriculture Organization (FAO), Rome, United Nations.

FAO. 2020. The State of World Fisheries and Aquaculture, Sustainability in Action. Food and Agriculture Organization (FAO), Rome, United Nations.

Kumar, B.G., Datta, K.K., Joshi, P.K., Katiha, P.K., Suresh, R., Ravisankar, T., Ravindranath, K. and Menon, M. 2008. Domestic Fish Marketing in India – Changing Structure, Conduct, Performance and Policies. *Agricultural Economics Research Review*. Vol 21, pp 345-354.

Salim, S. 2008. Fish marketing in Uttar Pradesh: An overview, In: Souvenir, National Workshop on Development of Strategies for Domestic Marketing of Fish and Fishery Products, 7-8 Feb. 2008, at CoF.Sc., SVV University, Muthukur.

Sathiadhas, R., Najmudeen, T.M., and Prathap, S. 2009. Break-even analysis and profitability of aquaculture practices in India. *Asian Fisheries Science*, 22: 667-680.

Sathiadhas, R., Narayana K.R., and Aswathy, N. 2011. Efficiency of domestic marine fish marketing in India-A macro analysis. *Indian Journal of Fish,* 58(4): 125-131.

Shang, Y.C. 1990. Aquaculture Economic Analysis: An Introduction Marketing Infrastructure and systems. *Advances in world Aquaculture*. Vol. 2, pp 133 – 138.

Solanke, S.S., Krishan, M., Sardha, C., Devi, B.N., Shivaraman, and Debnath, B. 2013. Production, price spread and marketing efficiency of farmed shrimp in Thane district of Maharashtra. *Indian Journal of Fish*, 60(3): 47-53.

Statista. 2021. Fish production volume across Jammu and Kashmir in India. Statista. Available at: https://www.statista.com/statistics/735878/fish-production-volume-jammu-and-kashmir-india/. Accessed on 23 August, 2021.

Sukumaran, C.T. 1992. Marine products Export from India - A development Prospective. 9th Indian seafood Trade. Feb 92, Souvenir, 7-9 Feb, 1992 pp 1-6.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 617-620

Performance of Cluster Frontline Demonstrations (CFLDs) on Oilseeds in Kathua District of Union Territory of J&K

Berjesh Ajrawat, Vishal Mahajan*, Pawan Kumar Sharma, Anamika Jamwal, Vishal Sharma and Ashu Sharma
Krishi Vigyan Kendra, Kathua; Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu

ABSTRACT

India is the fourth largest producer of oilseeds accounting for about 20 percent of the global area and 10 percent of the global production. The oilseeds have registered significant growth in area and production in last thirty years. However compared to cereals like paddy and wheat, the growth rate of area and production of oilseeds is insignificant with wide variability in their yield in different states of the country. It has explored the growth performance and dynamics of major oilseed crops in the country. Reduction in yield gap and adoption of new technologies can improve India's oilseed production and make India Atamnirbhar (Self-sufficient) in oilseeds. The present study was undertaken in Kathua district of Union Territory of Jammu & Kashmir to analyze the status of oilseed production technology, Constraints in its cultivation and the possibilities of increasing production. A fundamental problem to overcome insignificantly increasing oilseed production is to change the prevailing perceptions of their status as a subsistence crop and to consider as a commercial crop. This will require aggressive on farm demonstration of the viable technical options, to alleviate the gaps in technology of production of oilseed crops. It emphasizes dissemination of improved varieties and low-cost, environmental friendly crop husbandry techniques. Keeping this in view, Cluster Frontline Demonstrations (CFLDs) on Gobhi Sarson were conducted during rabi 2017-18 and 2018-19 and proved immensely useful in increasing the production and productivity of the oilseed crops in the district. The improved practice produced 52.2 and 58.8 percent higher returns of Gobhi Sarson than the crop grown by themselves in the year 2017-18 and 2018-19.

Keywords: Performance, Impact, Oilseeds and CFLDs

INTRODUCTION

India is endowed with a wide variety of agro-climates and soils that enable cultivation of variety of oilseeds crops. In the agricultural economy of India, oilseeds are next only to food grains in terms of acreage, production and value. Oilseed production assumes great importance in India because of the huge gap in demand and supply which has resulted in import of vegetables oil worth millions of rupees every year. The NITI AYOG has projected demand of 46.0 million tonnes of oilseeds in the current year against the projected supply of 34.0 million tonnes at the current growth rate. Nine oilseeds crops are grown in the country which include seven edible viz soybean, groundnut, rapeseed mustard, sunflower, sesame, safflower and Niger and two non-edible oilseeds namely castor and linseed. India ranks first in the production of most of the minor oilseeds (Niger, safflower, sesame and castor). In India, different oilseeds are grown on nearly 27 million hectares area across the length and breadth of the country during *kharif* (June-July to October-November), *rabi* (October-November to March-April) *and summer/spring* season (January-March to April-May).

The total area under oilseeds crops (groundnut, sesame, sunflower and rapeseed mustard) was 12.79 million hectares during 2015-16 which increased 13.46 million hectares during 2016-17. The total production showed increase in year 2015-16 i.e. 14.80 million tonnes to 16.38 million tonnes during period from

*Corresponding author email id: vishalmahajan1@gmail.com

36.92 qtl/ha to 38.10 qtl/ha in 2016-17. In India rapeseed mustard occupies the highest area among oilseeds. It is grown in diverse agro-climatic conditions ranging from north eastern/northern-western hills to down south under irrigated/rain fed, timely/late sown, intercropping and mixed cropping systems. The rapeseed mustard is produced in India mainly for domestic consumption and mostly consumed in the northern, central and eastern part of the country.

Rice-Wheat is the important cropping system of irrigated areas of district Kathua. The issue of crop diversification is now a day, getting very popular as the adverse impacts of rice-wheat system is being realized not only by the scientists but also by the farmers. The oilseed crops are well adapted to our agro ecological conditions and its cultivation can play a crucial role in crop diversification. The water requirement of Gobhi Sarson is also less as compared to rabi cereals and has better adaptability on account of its peculiar growth habit and ability to sustain low temperature regime by restricting above ground plant biomass and prolonging the vegetative phase. Moreover, it ensures regular utilization of farm labour because of earlier maturity of crop i.e. fifteen days before wheat harvesting and this period can also be utilized for timely sowing of summer moong which usually takes 60 days for maturity.

The cultivation of oilseed crops has been known traditional practice of the country but this practice has declined in recent decades with the increased production of major cereals crops like rice and wheat. Frontline Demonstrations (FLDs) have proved immensely useful in increasing the production and productivity of oilseed crops. The major objective of these FLDs to demonstrate the productivity potentials and profitability of the latest and improved oilseed production technologies under farm conditions. These technologies include whole package, component technologies like improved cultivars, recommended dose of fertilizers, plant protection measures, thinning, method of sowing, irrigation, weed management, disease management and cropping system involving oilseeds. In view of this an attempt has been made to review the progress pertaining to the productivity potentials and profitability of the technologies that are recommended for oilseeds production and existing extension gaps in adoption of these improved production technology under field conditions. The objective for conducting CFLDs was to show the production potential of notified oilseeds varieties and technologies generated by ICAR and State Agricultural Universities (SAUs) in oilseeds for higher production, better productivity and profitability for the farmers. The project was implemented through ICAR-ATARI by Krishi Vigyan Kendra, Kathua SKUAST-Jammu.

MATERIALS AND METHODS

To increase the production and productivity of oilseed crops in the country, Ministry of Agriculture and Farmers Welfare, Government of India sanctioned a project on "Cluster Frontline Demonstrations of Oilseeds" under National Mission on Oilseeds and Oil Palm (NMOOP) implemented through ICAR-Agricultural Technology Application Research Institute (ATARI) all over India. The NMOOP was launched in April 2014 keeping in view the achievements of the previous schemes namely Integrated Scheme on Oilseeds, Oil Palm and Maize (ISOPOM), Tree Borne Oilseeds (TBOs) and Oil Palm Area Expansion programme implemented during 11th five-year plan (from 2007 to 2012).

The district is predominantly rural in its demography with a spread of over 2502 sq. kms. It lies between 17 degree and 15 degree North latitude and 70 degree and 16 degree East longitude. The district is surrounded by Punjab in south east, Himachal Pradesh in north east, district Doda and Udhampur in North and North West, district Samba in West and Pakistan in the South-West. The district falls under Sub-tropical to Temperate zone of Agro-climatic zone of J&K. The different blocks having assured irrigation of district Kathua of J&K selected for the study. Krishi Vigyan Kendra conducted Cluster Frontline Demonstrations on Gobhi Sarson cv. DGS-1 (recommended variety of SKUAST-Jammu) during 2017-18 and 2018-19.

RESULTS AND DISCUSSION

The results of Cluster Frontline Demonstrations (CFLDs) conducted on Gobhi Sarson clearly revealed its good scope in crop diversification. The seed of variety Gobhi Sarson DGS-1 was identified as the most critical input. The demonstration with recommended

Table 1: Performance of CFLDs on Gobhi Sarson in Kathua district during *rabi* 2017-18 and 2018-19

Year	Variety	No. of Demos	Area (ha)	Yield (q/ha)		Increase (%)	Net return (Rs/ha)		B:C ratio	
				Check	Demo		Check	Demo	Check	Demo
2017-18	DGS-1	25	10.0	7.33	11.21	52.8	13800	37400	2.10	3.88
2018-19	DGS-1	37	10.0	7.90	12.50	58.2	22550	43250	2.70	4.32

technology produced on an average 11.21 and 12.50 q/ha seed yield of Gobhi Sarson during the year 2017-18 and 2018-19. The improved practice produced 52.8 and 58.2 percent more seed yield than the crop raised with existing technology. This was mainly attributed to more seed yield in improved practices as a result of application of gypsum, proper inter and intra plant spacing through thinning at 21-25 days after sowing.

The Table 1 also clearly depicts that the net return obtained with recommended technology were Rs.37400/= and Rs.43250/= which were 52.8 and 58.2 percent higher than that of existing technology in the year 2017-18 and 2018-19 respectively. In case of economics of CFLDs the net returns obtained with the recommended technology were to the tune of Rs 37400/= and 43250/= during both the years respectively.

Farmers in general procured seed from local seed shops. They do not have the habit to take seed from unauthorized seed like certified seed from Government approved agencies. They rely on local dealers for every agri-input like seeds, fertilizers, insecticides, pesticides and other chemicals. Besides all, farmers usually go for broadcast sowing of this crop rather than line sowing due to which only intercultural operations get difficult but also optimum plant population cannot achieved which leads undue competition between plants. For application of Phosphatic fertilizers, preference should be given to Single Super Phosphate (SSP) than that of Di-ammonium Phosphate because SSP contains sulphur which is desirable nutrient for majority of oilseed crops. As far as the plant protection measures are concerned farmers use plant protection measures without taking care of the economic threshold level (ETLs which increases the cost of cultivation per unit area) Economic threshold level is the below which the insect population will not cause any harm to the crop. Farmers in general purchased pesticides available with local companies without taking care of any brand name and status of manufacturing company.

Table 2: Major Components of demonstrated technologies of Gobhi Sarson in Kathua district

S. No	Components
1.	Improved Variety (DGS-1)
2.	Seed treatment with PSB culture @10g/Kg of seed and Carbendazim @ 3g/kg seed
3.	Use of Single Super Phosphate (SSP) as source of Phosphorus
4.	Integrated Pest and diseases Management (IDM/IPM)
5.	Foliar Application of Sulphur

Different extension activities under CFLDs included farmer's trainings, field days, group discussions, seed treatment campaigns, Kissan Ghosties and group meetings. These activities were organized by the Krishi Vigyan Kendra, Kathua during the implementation of the project in *rabi* seasons for the benefits of the farmers of the adopted village and adjoining areas. During these programmes the technical literature pertaining to the improved package of practices generated by Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, Punjab Agricultural University Ludhiana and Krishi Vigyan Kendra was also distributed among the farmers for adoption of Good Agricultural Practices (GAP) to boost the production and productivity of Oilseed crop in general and Gobhi Sarson in particular.

CONCLUSION

The Government of India (GOI) launched Integrated Scheme for Oilseeds, Oil palm, pulses and maize development programme (ISOPOM) to provide flexibility to the states in implementation based on regionally differentiated approach to promote crop diversification. Recently government has started Pradhan Mantri Annadata Aay Sanrakshan Abhiyan (PM-AASHA) scheme to promote robust procurement mechanism and ensure remunerative prices to farmers. This scheme will incentivize farmers to produce oilseed crops. Under make in India, large processing plants should be mandated as well as incentivized to establish backward linkages to produce more oilseeds in the country. These processing plants can work in partnership with Farmer Producers Organizations (FPOs) to boost oilseeds output. FPOs can play a critical role in efforts to boost domestic oilseeds production.

REFERENCES

Ajrawat, B.; A.M. Parmar and M. Jamwal. 2013. Impact of frontline demonstration of oilseeds crops in transfer of improved technology in India. *Agriculture Update,* 8(1&2): 174-176.

Ajrawat, B.; P.K. Sharma; A. Vaid; V. Mahajan; V.K. Sharma; S. Gupta and R.K. Arora. 2017. *Gaps in adoption of production technologies in Gobhi Sarson, Maharashtra Journal of Agricultural Economics,* 20(2): 66-69.

Kumar, V. and A. Tiwari. 2020 Sparking Yellow revolution in India Again, *Rural Pulse June-July XXXIV,1-5, Department of Economic Analysis and Research NABARD*

Roy, B.R.; S.K. Singh and A.K. Singh. 2010. Gap in adoption of improved pulse production technologies in Uttar Pradesh. *Indian Research Journal of Extension Education,* 10(1): 99-104.

Walia, S.S.; Rajni; S. Singh; C.S. Aulakh and R.S. Gill. 2013 Assessment of adoption gaps in Gobhi Sarson (*Brassica Napus* L.) production technologies. *Indian Journal of Extension Education,* 49(3&4): 83-85.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 621-630

Digital and Precision Agriculture: Adoption of New Technologies in Fruit Crops

Uzma Gulzar[1]*, Mahital Jamwal[2], Prebhdeep Singh[3], Munaza Gulzar[4], Tajalee Gulshan[5] and Tahira Kosser[6]

[1,2,3]Division of Fruit Science, [4]Division of Plant Pathology, [5]Division of Agronomy, [6]Division of Agroforestry, SKUAST Jammu, J&K

ABSTRACT

The increasing connectivity in rural areas, as well as its better integration with data from sensor systems, remote sensors, equipment, and cellphones, has cleared the way for new Agriculture 4.0 or Digital Agriculture concepts. One solution for producing high quality, highly productive fruit, which relies heavily on human activity from time to time, is to create a system of accurate and accurate automatic production in the fields. These include three key technologies: - Agricultural transformation, mechanization and precision farming. Among them, mechanical engineering and precision are at the heart of a broader system that uses automated technology. New technologies such as Global Positioning Systems (GPS), sensors, satellites or aerial photographs and Geographical Information Systems (GIS) are used to assess and analyze variations in agricultural and agricultural production. Sensor networks plays a key role in managing water resources, assessing the optimal harvesting environment, balancing fertilizer requirements and predicting crop performance more accurately. Accurate farming adopts a set of very accurate procedures for technology users to meet the needs of individual areas and plants.

Keywords: Adoption, Agriculture, Digital, Precision, Technologies

INTRODUCTION

Digitalization, the socio-technical process of applying digital innovations, is an increasingly ubiquitous trend. Digitalization comprises phenomena and technologies such as big data, internet of things (IoT), augmented reality, robotics, sensors, 3D printing, system integration, ubiquitous connectivity, artificial intelligence, machine learning, digital twins, and blockchain among others (Alm *et al.*, 2016; Smith, 2018; Tilson *et al.*, 2010). Digitalization is expected to radically transform everyday life (Yoo, 2010) and productive processes in agriculture and associated food, fibre and bioenergy supply chains and systems (Poppe *et al.*, 2013; Smith, 2018) and initial signs of transformation are already visible (Di Silvestre *et al.*, 2018; Leviakangas, 2016; Rotz *et al.*, 2019). In the agricultural sector, several concepts have emerged to express different forms of digitalization in agricultural production systems, value chains and more broadly food systems. These include *Smart Farming* (Blok and Gremmen, 2018; Wolfert *et al.*, 2017), *Precision Agriculture or Precision Farming* (Wolf and Buttel, 1996; Eastwood *et al.*, 2017), *Decision Agriculture* (Leonard *et al.*, 2017), *Digital Agriculture* (Keogh and Henry, 2016; Shepherd *et al.*, 2018), *Agriculture 4.0* (Rose and Chilvers, 2018). Regardless of the exact term used, digitalization implies that management tasks on-farm and off-farm (in the broader value chain and food system) focus on different sorts of data (on location, weather, behaviour, phytosanitary status, consumption, energy use, prices and economic information, etc.), using sensors, machines, drones, and satellites to monitor animals, soil, water, plants and humans. The data obtained is used to interpret the past and predict the future, to make more timely or accurate decisions, through constant monitoring or specific big data science enquiries (Eastwood *et al.,* 2017; Janssen *et al.*, 2017; Wolfert *et*

*Corresponding author email id: gulzaruzma1@gmail.com

al., 2017). Digitalization in agriculture is thus expected to provide technical optimization of agricultural production systems, value chains and food systems.

Digital innovation in agriculture represents, according to the United Nations Food and Agriculture Organization (FAO, 2020), a great opportunity to eradicate poverty and hunger and mitigate the effects of climate change. Through digitalization, all parts of the agri-food production chain will be modified, since connectivity and the processing of large amounts of information in an instant allows for more efficient work, greater economic return, greater environmental benefits, and better working conditions in the field. However, implementing these changes will require governments to increasingly strengthen rural infrastructure and promote the development of rural communities (FAO, 2020) and small rural businesses, so that they can adopt and implement innovative solutions.

In this context of innovation, Digital Agriculture (DA) is part of the so-called "fourth industrial revolution", and its conceptual bases address aspects associated with Agriculture 4.0 Rose *et al.* (2018), which derives from the Industry 4.0, and refers to the use of cutting-edge technology in food production. More recently, the term "Smart Farming" has also been used from the perspective of a development that emphasizes the use of information and communication technologies in the digital farm management cycle, through the intensive use of new technologies such as the Internet of Things, cloud computing, artificial intelligence, and big data Wolfert *et al.* (2017). In general, the conceptual basis of "Smart Farming" or "Digital Agriculture" comes from scientific knowledge, techniques, and equipment from Precision Agriculture Wolf *et al.* (1998) started from 1990's decade.

The digital agriculture can be understood and encompasses communication, information, and spatial analysis technologies that allow rural producers to plan, monitor, and manage the operational and strategic activities of the production system. In addition to the technologies already consolidated, such as field sensors (Reyns *et al.,* 2002; Adamchuk *et al.,* 2004; Kayad *et al.*, 2020), orbital remote sensors (Mulla *et al.*, 2013; Mogili *et al.*, 2018) and also embedded in UAV-Unmanned Aerial Vehicle (Oliveira *et al.*, 2020), global positioning systems, telemetry and automation (Suciu *et al.,* 2019), digital maps-soil relief, production, productivity (Suciu *et al.,* 2019), digital agriculture also involves the Internet and connectivity in crops (Havlin *et al.*, 2009; McKinion *et al.*, 2004), cloud computing, big data, blockchain and cryptography (Lin *et al.*, 2017; Chen *et al.*, 2020), deep learning (Liakos *et al.,* 2018; Kamilaris *et al.,* 2018; Castro *et al.,* 2020), Internet of Things (IoT) (Verdouw *et al.,* 2019), mobile applications and digital platforms (Michels *et al.*, 2019; Michels *et al.*, 2020), and artificial intelligence (Ampatzidis *et al.,* 2020). All these technologies support pre and post-production decisions and greater sustainability of production systems (Bongiovanni *et al.,* 2004; Saiz-Rubio *et al.*, 2020), in addition to access to a differentiated market benefiting short marketing chains.

Thus, Digital Farming combines the "consistent application of the methods of "Precision Farming and Smart Farming", internal and external networking of the farm and use of web-based data platforms together with Big Data analyses". They feel that through greater use of sensory analysis within the context of the 'Internet of Things' and remote sensing data, farmers would be able to respond better to unforeseeable natural phenomenon such as weather conditions, biotic and abiotic factors in agricultural production processes. They also cite literature to state that profitability analysis tools enjoy the top priority among digitization tools closely followed by applications for machinery control, for Big Data analyses and for transferring data to public authorities.

Smart Farming tools with precision

1. Remote sensing: It is the process of obtaining information about the earth, water, or object without any physical contact between the sensor and the subject of analysis (Remote - Not Related to Object and Hearing - Acquiring Information). It has a good promise of accurate farming because it has the ability to monitor spatial fluctuations over time with high resolution.

Digital Remote sensor applications

Xujun *et al.* (2007) developed mathematical models to predict the yield of citrus trees in their canopy features obtained from airborne hyper spectral imagery recorded for three consecutive years using nine air missions at the beginning of each growing season. The models have performed well, showing their ability to predict the yield of oranges a few months before the harvest season. In addition, Liakos *et al.* (2011) found a link between the first season of NDVI and the harvest on apple trees for two consecutive years. Suarez *et al.* (2008) used an aerial hyper spectral camera on olive or-chard and found a correlation between leaf-level steady-state fluorescence and PRI of similar trees directing crowns to calculate plant indication. To create a canopy map, chlorophyll fluorescence of stable condition was used to measure chlorophyll and water content (Ac *et al.,* 2015), whereas chlorophyll fluorescence kinetic analysis remains a challenge in automated measurements. Hsiao *et al.* (2010) developed a flexible fluorescence index using measurements from a multi-spectral fluorescence imaging system to measure the water stress conditions of cabbage sprouts.

To quantify the water situation, Berni *et al.* (2009) used a high-resolution imagery using UAS for two years to map the canopy conductance and crop water stress index (CWSI) on olive trees. Additionally, Cohen *et al.* (2012) used an air-conditioned thermometer to measure CWSI in palm trees for two consecutive years in three drip irrigated areas. They have been able to successfully develop a water-based mapping variant protocol that can be used to plan irrigation. In vegetables, Clarke (1997) used a hot airborne image to detect insufficient watering rate, water leakage and malfunction in muskmelon drip irrigation.

2. Geographic Information System (GIS): It is aptly named the brain for precision farming. It assists in agriculture in two ways: One is in coordinating and compiling GIS data (soil, crop, climate, field history etc.) and simulation models. Another support is the engineering part of designing GPS-enabled devices. This program integrates computer hardware, software and processes designed to support the integration, storage, retrieval and analysis of feature features and location data to produce maps. GIS links information to one location for extraction when needed. Computer-based GIS maps are different from conventional maps and contain a variety of information sources (e.g; yield, soil mapping, rainfall, vegetation, soil nutrient levels and insects).

3. Global Positioning System (GPS): GPS enables real-time data collection that generates accurate position information. GPS is essential for finding the exact location in a field to assess location variability and direct site usage in inputs. GPS is a satellite-based navigation system that helps users record location information (latitude, longitude and altitude) with an accuracy of between 100 and 0.01 m. GPS allows farmers to find the exact location of field information, such as soil type, insect occurrence, weed infestation, water holes, boundaries and barriers. There is an automatic control system, with a light or audio control panel (DGPS), antenna and receiver. GPS satellites transmit signals that allow GPS receivers to calculate their location.

4. Variable Rate Technology (VRT): VRT integrates farm equipment with the ability to accurately control the rate of application of various crops in their use, usually including fertilizer, weed control, pest control, crop value and irrigation. In agriculture it is used to increase inputs or to increase crop yields at a given unit rate. Variable (VRT) technology is automated and can be used in many agricultural applications. VRT systems set the rate of delivery of farm inputs depending on the type of soil identified on the soil map. The information released on the GIS can control processes, such as planting, fertilizer application and pesticides, herbicide selection and flexibility in the right place at the right time. VRT is probably the most widely used PFS technology in the United States.

Variable Rate Applications

Variable Rate (VR) application is a major goal of PA. All information collected must result in modified management of defined areas. In Florida orchards, an ultrasonic canopy of a tree or a laser scanner was associated with production. This structure was used to modify fertilizer application (Zaman *et al.*, 2005, 2006). In spraying, the sensors can detect missing trees and stop the outflow of nozzle. Additionally, this automatically stops the spray discharge at high altitudes and aids user activity. Some sensors detect congestion and height of trees using laser, ultrasonic or photoelectric sensors (Giles *et al.*, 1988) and adjust the bombing method to reduce off-field spray.

Uzma *et al.* (2022) demonstrated in book that in olive trees, Lopez-Granados *et al.* (2004) created site-specific fertilizer maps based on leaf variability in leaf composition. They found that consistent savings on N, K and P fertilizers could be achieved if a different fertilization program was based on a local change in the leaf structure of tree species. Fountas *et al.* (2011) is also applied manually to each olive tree P, K and pH based on the maps provided by the physician in soil analysis.

In apples, Aggelopoulou *et al.* (2010) used soil analysis data and nutrient removal in crops to prepare physician fertilizer maps. Farooque *et al.* (2012) designated areas of nitrogen fertilization in blue-berry through soil compaction and fruit harvesting. Physician maps may be based on age-related factors. Aggelopoulou *et al.* (2011) found a high correlation between flowering and crop distribution in apple orchards. This information can be used to manage the effects of sorghum as the requirements for trees with a high crop load differ from trees with a low crop load.

The recent development of the bulk flow sensor works on the principle of transmitting microwave power beams and measuring a portion of that return energy after hitting the seed flowing into the chute. At all harvest monitors, GPS receivers are used to record crop location data and create crop maps. Some crop monitoring systems include plant-based resources to keep track of weight, moisture and other information per bale.

Precision Nutrient Management

Site Specific Nutrient Management (SSNM): Site Specific Nutrient Management (SSNM) is a way of providing plants with nutrients to fully meet their local and temporary additional nutritional needs using various SSNM tools such as remote sensing, GPS, GIS systems, VRT, crop monitoring. In horticultural plants, poor fertilization can lead to loss of yield and over-fertilization can be harmful to the environment. With the advent of SSNM, it has become possible to manage soil nutrient variability throughout the field by applying a doctor-prescribed fertilizer. Pressure control is another area where SSNM can help Indian farmers. Most of the cultivated soil in India is acidic, and the local variability in pH is high. Recognizing nutrient stress using remote sensing and data integration in GIS can aid in specific field applications of fertilizers and soil amendments. This will increase the efficiency of the fertilizer and reduce the loss of nutrients. Sensors can be used on the farm / greenhouse to automatically control the water supply.

Volatile Biomarker Discovery: Provides a quick detection of plant diseases. This method offers unique benefits that can be very helpful in diagnosing citrus disease. Several studies are available showing the potential for a few sensing techniques near and far to detect huanglongbing in citrus. Similarly, a few forums have been used to test sensors from hand-held / nearby device in aerial imagery. Challenges in the diagnosis of huanglongbing include a variety of symptoms of chlorosis between the leaves at different stages of growth, different levels of infection and similarity to other conditions (deficiency, chemical damage etc.). Typically, using hand-held or under-controlled sensors, the accuracy of diagnostics was much higher than in aerial applications.

Potential of Drones in Farm monitoring

Drones with hyper-spectral, multispectral or thermal sensors can detect which part of the field is dry or in need of development. Once the crop has grown, the drones allow the calculation of the crop index, which describes the life of the plant and shows the temperature signature, the number of heat plants that come out.

Drone types used in horticulture: Opportunities for additional use of nearby drones. Investing in drones means reaching out to dangerous areas. They are able to plant successfully with a team of 2 operators and 10 drones capable of planting 400,000 plants per day.

Weeding drones: Weed control is an ongoing struggle for farmers. San Francisco recently launched, developed a weed-based agricultural robot using a 100% organic method of extraction. Using computer vision and machine tools. One smart robot on the Farm can remove plants to feed a middle-class city of about 400,000 reported by Sebstian Boyer company C.E.O.

Spraying drones: Similar to planting robots using smart sprayers paired with computer-enabled cameras to detect weeds used in targeted herbicides.

Picking drones: One of the Agri Bot is designed to pick strawberries. Agri Bot uses machine learning technology to detect and measure maturity and cut fruit more than just calyx. In this way the reaper never comes in contact with the fruit thus reducing damage or scratches.

Drone pollination: one of the most widely used drone polishing technology is drone cooling technology. Researchers in the Netherlands and Japan are making small drones capable of silencing plants.

Harvesting drones: Another innovation called soft harvesting where machines are fitted with soft suction cups or pressed grabbers to protect the fruit during harvest. In 2016 the developers of Abundant Robotics built the first vaccine harvest. This uses a computer concept to identify apples and then suck them through a soft tube with the amount of apples per second.

New Improvements in the Spray System

CASA Sprayer: The most advanced fruit field spray made so far is the ISAFRUIT Crop Adapted Spray Application (CASA). Its purpose is to ensure the accurate, effective and safe spraying of orchards, taking into account the real needs of the crop and minimizing the impact on the environment. It does this with the help of 3 sub-programs:

- Crop Health Sensor (CHS) identifies the health status of the plant
- The Crop Identification System (CIS) determines the canopy size of a tree and its density
- The Environmental Dependent Application System (EDAS) identifies environmental conditions at the time of spraying. These systems are connected to GPS to alert the controller to pre-determined water channels, field edges and other sensitive areas.

6. Canopy sensors: These sensors are available from many leading manufacturers as additional options. They use infrared or ultrasound to detect the presence of canopy, length and density to adjust the spray volume accordingly. Infrared sensors appear reliable and inexpensive. If possible the sensors should be connected to a tractor cab so that they can be used to apply flexible fertilizer.

Use of Accurate Farming Methods in Grape Production: Robert L. Wample, Lynn Mills and Joan R. Davenport Published in 1999. Commercial grape harvesting monitoring system was developed in partnership with Harvest Master, in 1996 to further a long-term research program that began in 1997 to assess the effect of mechanical pruning and mechanical reduction on yield and quality of grapefruit juice produced in Yakima. Valley of Washington State. Five pruning trees were used in the 10-ac block of Concord grapes. Following pruning, the number of shoots per vine was determined and the number of clusters per vine was estimated using sample statistics. Collection weight estimates made in late June, including the number of clusters per vine were used to estimate potential yield and the required mechanical reduction rate. Mechanical reduction occurred in early July. Vine harvest map reveals the difference in pruning and reduction of treatment and the area-related differences in the vineyard. Vegetable growth, yield, yield components, and fruit quality data will be presented.

Grapevine estimates were recorded in flowering and 1200 GDD (approximately 50% final weight of berry) in data veins. These measurements include the length of the shoot, the number of leaves, and the location of the cane leaves. Solid soluble substances and the accumulation of berry weight have been determined by the weekly version until harvested. These same samples were later analyzed for fruit quality (color [absorption at 430 nm and 520 nm], pH, and acid [equivalent to tartaric acid]). Data vineyards were harvested by hand to determine crop yields: yield per vine, clusters per grape, grape harvest yield, berries per cluster, and berry weight. The basic configuration of the crop monitoring unit is described in Schneider *et al.* (1996).

Other Fruit Crops: However, many horticultural plants are not harvested mechanically so many customized methods for certain horticultural plants have been tested to obtain a harvest map. In Florida's orange groves, Schueller *et al.* (1999) used a pallet drum measurement system in which oranges were collected. Each worker received a hand-picked fruit bag. After filling, the bags were poured into a nearby bathtub or pail bins placed between the trees (Whitney *et al.*, 1999). The drums were extracted with water-driven height, which used load cells to measure, and GPS to record the location of the drum. It was thought that each barrel represented a crop of surrounding trees. Reasonable consideration as workers unloaded their bags into a nearby bin. Yield was calculated by dividing the weight by the area covered by each barrel. Position and yield were used to edit crop maps. The diversity of the crop area was seen in the 3.6 ha dry dried orchard. Results were confirmed in the growing Mediterranean regions in grapefruit (Unlu *et al.*, 2014; Peeters *et al.*, 2015).

For apple orchards, Aggelopoulou *et al.* (2010) a mapped crop, in which apples are picked by hand and placed in 20 kg plastic bins next to rows of twisted trees. Each drum was measured and geoled using DGPS. Barrels, consisting of 5 or 10 trees, were assembled to represent their harvest. The average yield of each tree did not occur due to the spinning structure, where the branches of nearby trees met. The program benefited the workers, who were constantly picking fruit, and the harvest map did not interfere with their work. A similar crop mapping process was performed with pears in a small field under 1 hectare by Vatsanidou *et al.* (2015).

Fountas *et al.* (2011) variations in average yields in olive groves. Ordinary olives were harvested by beating the fruit branches with sticks. The olives fell into the plastic piles under each tree. The olives were packed in bags and left in groups for filling, to be loaded onto a podium. Each bag was measured and considered geo-reference using DGPS. Each group of bags was considered to represent the harvest of the surrounding trees and was the basis for mapping the crop. Spatial variability was observed.

Ampatzidis *et al.* (2009) yields mapped to peaches with RFID markings on barrels. The measuring device was integrated with the RFID and GPS reader to record the weight and location of each drum. Similarly, Taylor *et al.* (2007) used barcodes in barrels to measure yields with quilts. Collected data was used to produce orchards for orchards.

As for palm trees, Mazloumzadeh *et al.* (2010) created crop maps as follows: a few days before harvest dates, tree areas were explored and placed as x-y links, located in the southwest corner of the forest. Numbers were assigned to all the trees in the tree and, at harvest time, the yield of each tree was recorded.

In plum, hand-picking was done in barrels that were moved to the laboratory to process one fruit. Crop local soil and soil pattern ECa was found in a 180-tree garden occupying 0.37 ha. The results point to a lower correlation of height, ECa of soil and the growth of productive plants (Kathner and Zude-Sasse, 2015).

Konopatzki *et al.* (2015) Selected crop of 36 trees with recorded fruit weight, height and width, and soil structures. Results showing a high yield variation with a coefficient of variation = 77 per cent, as well as a relatively low correlation with soil properties.

Perry *et al.* (2010) have mapped the pear harvest by measuring the weight of the fruit collected on each tree. They found that the crop was highly geographically integrated, suggesting management as possible geographically.

Pozdnyakova *et al.* (2005) analyzed crop yield variability in cranberry growing areas. They used 0.3 x 0.3 m frames to measure the amount of fruit before harvesting. Using mean berry mass, they measured the yield. High local diversity is also seen here.

Fountas *et al.* (2015) average yield of watermelons separating the field by blocks and the average yield of each block weighing the platforms carrying watermelons in each block. Saldana *et al.* (2006) developed a field yield monitoring system that is used as an aid to broccoli harvesting. The platform had a measuring system consisting of four load cells that measured the accumulated product. Yield variations from 1 to 8 t ha^{-1} were observed. The yield monitor that combines harvester and digital camera system was detected by blueberries (Zaman *et al.*, 2008) by calculating the blue pixels in the images.

Artificial intelligence: Essentially, AI in agriculture is segmented into robotics, soil and crop management, and animal husbandry, and is designed to make farming easier, more accurate, more profitable, and more productive for the farmer. It is estimated that AI and connected farm services can impact 70 million Indian farmers by 2020, thereby adding US$ 9 billion to farmer incomes. In 2017, the global AI in agriculture market size was US$ 240 million, and is expected to reach US$ 1.1 billion by 2025 (Maher, 2018). Furthermore, issues such as population growth, climate change, and food security demand innovative ways to improve crop yield. Therefore, understanding the use of AI in agriculture becomes compelling.

Applications of Artificial Intelligence in Agriculture

Soil Analysis and Monitoring: Artificial Intelligence can be used to monitor soil health with the help of sensors, cameras, and infrared rays that scan the soil for its nutritional properties (Sennaar, 2019; Baruah, 2018).

Case Study: AI-backed soil health monitoring used in Raleigh, North Carolina, USA, led to huge efficiency gains in the use of agro-inputs by cutting the use of chemical fertilisers by nearly 40% (Sennaar, 2019). Furthermore, the spatial analysis capabilities of geographic information system (GIS) technologies helps in efficient water management during irrigation. For instance, in Alfalfa in Riverdale, California, GIS technologies in irrigation helped increase the per acre crop output by up to 37.5%, and reduced water usage by 20% (Fictchett, 2013).

Crop Sowing

Case study: In 2016, Microsoft, in partnership with ICRISAT (The International Crop Research Institute for the Semi-Arid Tropics), initiated a pilot project in Devanakonda Mandal in the Kurnool district of Andhra Pradesh. The pilot had a sample base of 175 farmers who were alerted on their mobile phones about suitable cropping dates, land preparation, and soil test-based fertiliser utilisation. This helped increase crop output by around 30%. In 2017, this project was expanded to cater to approximately 3,000 farmers in Karnataka and Andhra Pradesh during the *Kharif* cycle for a host of crops like groundnut, *ragi*, maize, rice, and cotton, among others. The increase in crop yield following the AI intervention ranged from 10-30% across all crops (Nagpal, 2017).

CONCLUSION

Horticultural plants are an emerging and challenging field of agricultural technology and management. From many reported studies, local variability in yields was confirmed even in small fields, where most horticultural crops are grown as countrary to cultivated crops. Variation of growth factors affecting yield is the concept of precision horticulture, which is the definition of variety management. However, there are no standard technologies or techniques for measuring yield in orchard and vegetable production yet, while this review may encourage new research on other horticultural plants using the automated method require for yield mapping. Quality management is a major component of horticultural plants. Methods for measuring fruit quality in production are required. Advanced strategies introduced in the experimental work to measure fruit quality in the area Finally, as many horticultural crops are located on small plots of land in large parts of the world, small-scale technologies and techniques must be developed for small, economically viable and easy-to-use small-scale farmers. This, together with the large amount of data obtained, will be a major challenge for accurate agricultural use in horticultural crops.

REFERENCES

Ac, A.; Z. Malenovsky; J. Olejnickova; A. Gallel; U. Rascher and G. Mohammed. 2015. Meta-analysis assessing potential of steady- state chlorophyll fluorescence for remote sensing detection of plant water, temperature and nitrogen stress plant. *Remote Sensing of Environment* 168: 420–436.

Adamchuk, V.I.; Hummel, J.W.; Morgan, M.T.; Upadhyaya, S.K. 2004. On-the-go soil sensors for precision agriculture. *Comput. Electron. Agric*, 44; 71–91.

Aggelopoulou, K., Bochtis, D., Fountas, F., Swain, K.C., Gemtos, T. and Nanos, G.(2011. Yield prediction in apples based on image processing. *Precision Agriculture,* 12: 448–456.

Aggelopoulou, K., Castrignanò, A., Gemtos, T.A., and De Benedetto, D. 2013. Delineation of management zones in an apple orchard in Greece using a multivariate approach. *Computers and Electronics in Agriculture,* 90: 119–130.

Aggelopoulou, K.D., Wulfsohn, D., Fountas, S., Gemtos, T.A., Nanos, G.D., and Blackmore, S. 2010. Spatial variation in yield and quality in a small apple orchard. *Precision Agriculture,* 11: 538–556.

Alm, E., N. Colliander, F. Lind, V. Stohne, O. Sundström, M. Wilms, M. Smits. 2016. Digitizing the Netherlands: How the Netherlands Can Drive and Benefit from an Accelerated Digitized Economy in Europe. *Boston Consulting Group*

Ampatzidis, Y.G., Vougioukas, S.G., Bochtis, D.D. and Tsatsarelis, C.A. 2009. A yield mapping system for hand-harvested fruits based on RFID and GPS location technologies: field testing. *Precision Agriculture*, 10: 63–72.

Bellon-Maurel, V. and C. Huyghe. 2016. Innovation technologique dans l'agriculture. Goconomie, 80: 159-180.

Berni, J.A.J., Zarco-Tejada, P.J., Sepulcre-Cantó, G., Fereres, E., and Villalobos, F. 2009. Mapping canopy conductance and CWSI in olive orchards using high resolution thermal remote sensing imagery. *Remote Sensing of Environment*, 113: 2380–2388.

Blok, V. and Gremmen. B. 2018. Agricultural technologies as living machines: toward a biomimetic conceptualization of smart farming technologies. *Ethics Policy Environment.* 21: pp. 246-263

Bolfe, E.L., Jorge, L.A.D.C., Sanches, I.D.A., Luchiari Júnior, A., da Costa, C.C., Victoria, D.D.C., Inamasu, R.Y., Grego, C.R., Ferreira, V.R. and Ramirez, A.R., 2020. Precision and digital agriculture: Adoption of technologies and perception of Brazilian farmers. *Agriculture*, 10(12): 653.

Chen, Y., Li, Y., Li, C. 2020. Electronic agriculture, blockchain and digital agricultural democratization: Origin, theory and application. *J. Clean. Prod.*, 268: 122071.

Clarke, T.R. 1997. An empirical approach for detecting crop water stress using multispectral airborne sensors. *Horticultiural Technology,* 7: 9–16.

Cohen, Y., Alchanatis, V., Prigojin, A., Levi, A. and Soroker, V. 2012. Use of aerial thermal imaging to estimate water status of palm trees. *Precision Agriculture,* 13: 123–140.

Davis, G. and Massey, R. 2005. Precision agriculture: An introduction. www.muextension.missouri.edu/ explore/envqual/ wq0450.htm.farming – with special Reference to Indian Situation *Scientific Note.*

Di Silvestre, M.L.; S. Favuzza, E. Riva Sanseverino and G. Zizzo. 2018. How Decarbonization, Digitalization and Decentralization are changing key power infrastructures. *Renewable Sustainable Energy Rev.,* 93: 483-498

Farooque, A.A., Zaman, Q.U. and Schumann, A.W. 2012. Delineating management zones for site-specific fertilization in wild blueberry fields. *Applied Engineering in Agriculture,* 28: 57–70.

Food and Agriculture Organization (FAO). Digital Agriculture. Available online: http://www.fao.org/digital-agriculture/en/ (accessed on 10 July 2020).

Fountas, S., Aggelopoulou, K., Bouloulis, C., Nanos, G.D., Wulfsohn, D., Gemtos, T.A., Paraskevopoulos, A., and Galanis, M. 2011. Site-specific management in an olive tree plantation. *Precision Agriculture,* 12: 179–195.

Fountas, S., Aggelopoulou, K., Bouloulis, C., Nanos, G.D., Wulfsohn, D., Gemtos, T.A., Paraskevopoulos, A. and Galanis, M. 2011. Site-specific management in an olive tree plantation. *Precision Agriculture,* 12: 179–195.

Fountas, S., Anastasiou, E., Xanthopoulos, G., Lambrinos, G., Manolopoulou, E., Apostolidou, S., Lentzou, D., and Tsiropoulos, Z. (2015). Precision agriculture in watermelons. 10th European Conference on Precision Agriculture, Tel Aviv, Israel,

Giles, D.K., Delwiche, M.J., and Dodd, R.B. (1988). Electronic measurement of tree canopy volume. *Transactions of the ASAE*, 31(1): 264–272.

Goodwin, I., O'Connell, M., and Whitfield, D. (2008). Optimising irrigation management units in a nectarine orchard. *Australian Fruit-grower,* 2: 28–30.

Gulzar., U., Gulzar, U., Jamwal, M., Singh, P., Kour, K. and Bhat, Deep J.I. 2022. Precision farming in fruit crops. Sustainable development, material, energy and environment: Key issues, opportunities and challenges. Vol. II: 167-180.

Havlin, J.L. and Heiniger, R.W. 2009. A variable-rate decision support tool. *Precis. Agric.,* 10: 356–369.

Kathner, J., and Zude-Sasse, M. 2015. Interaction of 3D soil electrical conductivity and generative growth in *Prunus domestica*. *European Journal of Horticultural Science,* 80(5): 231–239.

Kayad, A.; Paraforos, D.S.; Marinello, F. and Fountas, S. 2020. Latest Advances in Sensor Applications in Agriculture. *Agriculture*, 10: 362.

Keogh, M. and M. Henry. 2016. The Implications of Digital Agriculture and Big Data for Australian Agriculture. Australian Farm Institute, Sydney, Australia.

Klerkx, L., Jakku, E. and Labarthe, P. 2019. A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS-Wageningen Journal of Life Sciences*, 90, p.100315

Konopatzki, M.R., Souza, E.G., Nóbrega, L.H., Bazzi, C.L. and Rocha, D.M. 2015. Spatial variability of chemical attributes of the soil, plant and yield in a pear orchard. *Journal of Plant Nutrition,* 39(3): 323–336.

Leviakangas. P. 2016. Digitalisation of Finland's transport sector. *Technol. Soc.,* 47: 1-15.

Liakos, V., Tagarakis, A., Aggelopoulou, K., Kleftaki, X., Mparas, G., Fountas, S., and Gemtos, T. 2011. Yield prediction in a commercial apple orchard by analyzing RGB and multi-spectral images of trees during flowering period. In Precision Agriculture, Proceedings of the 8th European Conference on Precision Agriculture, J. Stafford, ed. (Prague: Czech Centre for Science and Society). pp. 617–627.

Lin, Y.P., Petway, J.R., Anthony, J., Mukhtar, H., Liao, S.W., Chou, C.F., Ho, Y.F. Blockchain: 2017. The Evolutionary Next Step for ICT E-Agriculture. *Environments*, 4: 50.

Maes, W.H., and Steppe, K. 2012. Estimating evapotranspiration and drought stress with ground-based thermal remote sensing in agriculture. *Journal of Experimental Botany,* 63: 4671– 4712.

Mann, K.K., Schumann, A.W. and Obreza, T.A. 2010. Delineating productivity zones in a citrus grove using citrus production, tree growth and temporally stable soil data. *Precision Agriculture*, 12: 457–472.

Mazloumzadeh, S.M., Shamsi, M. and Nezamabadi-pour, H. 2010. Fuzzy logic to classify date palm trees based on some physical properties related to precision agriculture. *Precision Agriculture,* 11: 258–273.

McKinion, J.M.; Turner, S.B.; Willers, J.L.; Read, J.J.; Jenkins, J.N.; McDade, J. 2004. Wireless technology and satellite internet access for high-speed whole farm connectivity in precision agriculture. *Agric. Syst.,* 81: 201–212.

Mendez, V., Rosell-Polo, J.R., Sanz, R. 2014. Deciduous tree reconstruction algorithm based on cylinder fitting from mobile terrestrial laser scanned point clouds. *Biosystems Engineering,* 124: 78–88.

Mogili, U.; Deepak, B. 2018. Review on application of drone systems in precision agriculture. *Procedia Comput. Sci.,* 133: 502–509.

Mulla, D.J. 2013. Twenty five years of remote sensing in precision agriculture: Key advances and remaining knowledge gaps. *Biosyst. Eng.,* 114: 358–371.

Official U.S. Government Information about the Global Positioning System (GPS) and Related Topics. Available online: https://www.gps.gov/applications/agriculture/ (accessed on 8 September 2020).

Oliveira, M.V.N.; Broadbent, E.N.; Oliveira, L.C.; Almeida, D.R.A.; Papa, D.A.; Ferreira, M.E.; Zambrano, A.M.A.; Silva, C.A.; Avino, F.S.; Prata, G.A.; *et al.* 2020. Aboveground Biomass Estimation in Amazonian Tropical Forests: A Comparison of Aircraft- and GatorEye UAV-borne LiDAR Data in the Chico Mendes Extractive Reserve in Acre, Brazil. *Remote Sens.,* 12: 1754.

Panda, S.S., Hoogenboom, G. and Paz, J.O. 2010. Remote sensing and geospatial technological applications for site-specific management of fruit and nut crops: A review. *Remote Sensing*, 2(8): 1973–1997.

Peeters, A., Ben-Gal, A., Gebbers, R., Hetzroni, A., Zude, M. 2015. Getis-Ord's hot- and cold-spot statistics as a basis for multivariate spatial clustering of tree-based data. *Computers and Electronics in Agriculture,* 111: 140–150.

Perry, E.M., Dezzani, R.J., Seavert, C.F. and Pierce, F.J. 2010. Spatial variation in tree characteristics and yield in a pear orchard. *Precision Agriculture,* 11: 42–60.

Poppe, K.J., S. Wolfert, C. Verdouw, T. Verwaart. 2013. Information and communication technology as a driver for change in agri-food chains. *Euro Choices,* 12: 60-65

Pozdnyakova, L., Giménez, D., and Oudemans, P.V. 2005. Spatial analysis of cranberry yield at three scales. *Agronomy Journal,* 97: 49–57.

Primicerio, J., Di Gennaro, S.F., Fiorillo, E., Genesio, L., Lugato, E., Matese, A., and Vaccari, F.P. 2012. A flexible unmanned aerial vehicle for precision agriculture. *Precision Agriculture*, 13: 517–523.

Ray, S.S., Panigrahy, P. and Parihar, J.S., 2001. Role of Remote Sensing for precision farming with special refrence to Indian situation scientific note SAC. *Space Applications Center (ISRO),* 200(1): 1-5

Reyns, P.; Missotten, B.; Ramon, H.J.; De Baerdemaeker, J. 2002. A review of combine sensors for precision farming. *Precis. Agric*, 3: 169–182.

Richardson, A.D., Duigan, S.P., and Berlyn, G.P. 2002. An evaluation of non-invasive methods to estimate foliar chlorophyll content. *New Phytologist,* 153: 185–194.

Rose, D.C. and J. Chilvers. 2018. Agriculture 4.0: Broadening Responsible Innovation in an Era of Smart Farming. Frontiers in Sustainable Food Systems pp. 87

Rotz, S.; E. Gravely, I. Mosby, E. Duncan, E. Finnis, M. Horgan, J. LeBlanc, R. Martin, H.T. Neufeld, A. Nixon, L. Pant, V. Shalla, E. Fraser. 2019. Automated pastures and the digital divide: how agricultural technologies are shaping labour and rural communities. *J. Rural Stud.,* 68: 112-122.

Saldana, N., Cabrera, J.M., Serwatowski, R.J., and Gracia, C. 2006. Yield mapping system for vegetables picked up with a tractor-pulled platform. *Spanish Journal of Agricultural Research,* 4(2): 130–139.

Schueller, J.K., Whitney, J.D., Wheaton, T.A., Miller, W.M., and Turner, A.E. 1999. Low-cost automatic yield mapping in hand-harvested citrus. *Computers and Electronics in Agriculture,* 23: 145–153.

Shepherd, M.; J.A. Turner, B. Small, D. Wheeler. 2018. Priorities for science to overcome hurdles thwarting the full promise of the 'digital agriculture' revolution. Journal of Science and Food Agriculture.

Smith. M.J. 2018. Getting value from artificial intelligence in agriculture. Animal Production Science. 10.1071/AN18522

Suarez, L., Zarco-Tejada, P.J., Sepulcre-Canto, G., Perez-Priego, O., Miller, J.R., Jiménez-Munoz, J.C., and Sobrino, J. 2008. Assessing canopy PRI for water stress detection with diurnal airborne imagery. *Remote Sensing of Environment,* 112: 560–575.

Suciu, G.; Marcu, I.; Balaceanu, C.; Dobrea, M.; Botezat, E.2019 Efficient IoT system for precision agriculture. *Eng. Mod. Electr. Syst.,* 173–176.

Taylor, J.A., Praat, J.P., and Bollen, A.F. 2007. Spatial variability of kiwifruit quality in orchards and its implications for sampling and mapping. *Horticulture Sci.,* 42: 246–250.

Tilson D., K. Lyytinen, C. Sorensen. 2010. Research commentary—digital infrastructures: the missing IS research agenda. *Inf. Syst. Res.,* 21: 748-759

Unlu, M., Kanber, R., Koc, D., Ozekici, B., Kekec, U., Yesiloglu, T., Ortas, I., Unlu, F., Kapur, B., Tekin, S., Käthner, J., Gebbers, R., Zude, M., Ben-Gal, A. and Peeters, A. 2014. Irrigation scheduling of grapefruit trees in a Mediterranean environment throughout evaluation of plant water status and evapotranspiration. *Turkish Journal of Agriculture and Forestry,* 38: 908–915.

Usha, K., and Singh, B. 2013. Potential applications of remote sensing in horticulture. *Scientia Horticulturae,* 153: 71–83.

Vatsanidou, A., Fountas, S., Nanos, G., and Gemtos, T. 2014. Variable Rate Application of nitrogen fertilizer in a commercial pear orchard. *International Journal of American Farm School of Thessaloniki,* 1(1): 1-8

Walklate, P.J., Cross, J.V., Richardson, G.M. 2002. Comparison of different spray volume deposition models using LIDAR measurements of apple orchards. *Biosystems Engineering,* 82: 253– 267.

Weng, J.H., Liao, T.S., Hwang, M.Y., Chung, C.C., Lin, C.P., and Chu, C.H. 2006. Seasonal variation in photosystem II efficiency and photochemical reflectance index of evergreen trees and perennial grasses growing at low and high elevations in subtropical Taiwan. *Tree Physiology,* 26: 1097–1104

Whitney, J.D., Miller, W.M., Wheaton, T.A., Salyoni, M. and Schueller, J.K. 1999. Precision farming applications in Florida citrus. *Applied Engg. Agric.,* 15: 399–403.

Wunsche, J.N., Palmer, J.W., and Greer, D.H. 2000. Effects of crop load on fruiting and gas-exchange characteristics of 'Braeburn'/M.26 apple trees at full canopy. *Journal of American Society for Horticultural Science,* 125: 93–99.

Wolf, S.A. and F.H. Buttel. 1996. The political economy of precision farming. *American Journal Agricultural Economics,* 78: 1269-1274

Wolfert, S.; GE, L.; Verdouw, C.; Bogaardt, M.J. 2017 Big Data in Smart Farming—A review. *Agric. Syst.* 153: 69–80.

Xujun, Y., Sakai, K., Manago, M., Asada, S., and Sasao, A. 2007. Prediction of citrus yield from airborne hyperspectral imagery. *Precision Agriculture,* 8: 111–125.

Yoo. 2010. Computing in Everyday Life: A Call for Research on Experiential Computing. MIS Quarterly, p. 34

Zaman, Q.U., and Salyani, M. 2004. Effects of foliage density and ground speed on ultrasonic measurement of citrus tree volume. *Applied Engineering in Agriculture,* 20: 173–178.

Zaman, Q.U., Schumann, A.W., and Hostler, H.K. 2006. Estimation of citrus fruit yield using ultrasonically-sensed tree size. *Applied Engineering in Agriculture,* 22: 39–44.

Zaman, Q.U., Schumann, A.W., and Miller, W.M. 2005. Variable rate nitrogen application in Florida citrus based on ultrasonically-sensed tree size. *Applied Engineering in Agriculture,* 21: 331–335.

Zaman, Q.U., Schumann, A.W., Percival, D.C., and Gordon, R.J. 2008. Estimation of wild blueberry fruit yield using digital color photography. *Transactions of the ASABE,* 51: 1539–1544.

Zhang, C., and Kovacs, J.M. 2012. The application of small unmanned aerial systems for precision agriculture: a review. *Precision Agriculture,* 13: 693–712.

Zhou, R., Damerow, L., Sun, Y., and Blanke, M.M. 2012. Using colour features of cv. 'Gala' apple fruits in an orchard in image processing to predict yield. *Precision Agriculture*, 13: 568–580.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 631-636

Membership and Shareholding in Farmer Producer Organizations (FPOs): Analyzing Probability using Logit Model

J.P. Sharma[1], S.K. Gupta[2], Pawan Kumar Sharma[3]*, Anil Bhat[4] and Rakesh Sharma[5] and Berjesh Ajrawat[6]
[1]Vice Chancellor, Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu [2]Director Extension, [3]Scientist (Agricultural Economics), [4]Assistant Professor (Agricultural Economics), [5]Associate Professor (Agricultural Extension), [6]Scientist (Agricultural Extension), Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu, J&K

ABSTRACT

Farmers Producers Organization (FPO) is a scheme that intends to provide support to small and marginal farmers with end-to-end services. The scheme covers almost all aspects of cultivation from inputs arrangement to processing and marketing. In the union budget 2019, Government of India has set a target to form and promote 10,000 FPOs in next five years. The task of promoting such a big number of FPOs needs special effort from all stakeholders. The initial step in the formation of FPO involves registration either under the Companies Act or Cooperative Societies Act. However, the core activity remains the mobilization of farmers for enhancing membership and stakeholders. The farmers' decision to become member and stakeholder of FPOs depends upon their understanding about group dynamics, cooperative structure and socio-economic features. SKUAST-Jammu as a Cluster Based Business Organization (CBBO) has been entrusted with promotion of FPOs in different districts of Jammu region of J&K UT. Large number of farmers was mobilized under the scheme but the actual members and stakeholders in the registered FPOs were limited. The purpose of this study was to identify the factors affecting the farmers' decision to become member and further the shareholder of the FPO. The binay logit regression was employed to predict the likelihood of mobilized farmers to become member ans shareholder of FPOs. Farmers with larger land holdings are more likely to join FPOs. The social/political involvement is also the crucial factor in determining the participation of mobilized farmers as members and stakeholders in FPOs.

Keywords: Farmer Producer Organization (FPO), Jammu & Kashmir, Logit model, Group dynamics

INTRODUCTION

As per the Agriculture Census 2015-16, there are 14,64,53,741 operational holdings in India. Out of these total operational holdings, 17.62% and 68.45% are small and marginal, respectively (Department of Agriculture & Farmers Welfare 2015-16). In order to enhance the capabilities of these small and marginal farmers in terms of agriculture infrastructure, there is a need to implement cooperative approach (Dwivedi, 1996). Group dynamics is considered to be a fruitful strategy for uplifting the socio-economic status of the small holders through opening of new market opportunities (Singh, 2012; Sawairam, 2014) and adoption of innovative farm practices (Rani, N. 2017). The approach of Self Help Group (SHG) has contributed enormously in terms of poverty alleviation and women empowerment (Raj, 2006; Patil *et al.*, 2021). Farmer Producer Organisation (FPO) is a scheme which involves developing group dynamics by primary producers, farmers, milk producers, fishermen, weavers, rural artisans and craftsmen etc. on a relatively larger scale than SHGs. FPO assumes the status of legal entity in the form of a producer company, a cooperative society or any other form for sharing of profits/benefits among its members. In some forms like producer companies, institutions of primary producers can also become member of FPO. The main aim of FPO is to ensure better income for small producers through an organization of their own. The ownership of the FPO is with its members. A Farmer Producer Company (FPC) on the other hand, is a multi-

*Corresponding author email id: pawanvatsya@gmail.com

object entity registered under Indian Companies Act, 1956, as amended in 2013. It is a hybrid between cooperative societies and private limited companies. A Farmer Producer Company can be formed by any 10 or more primary producers or by two or more producer institutions, or by a contribution of both. They can undertake activities related to production, harvesting, procurement, grading, pooling, marketing, processing, etc., of agricultural produce. The Farmer Producer companies have democratic governance, each producer or member has equal voting rights irrespective of the number of shares held. There is a limitation on the amount that can be distributed as dividend. Profit is largely distributed on the basis of "patronage", which acts as a reward for members contributing to the business. There can be 5-15 directors and expert directors can be co-opted for professional guidance.

Keeping in view the constraints faced by farmers in forming FPOs, government has made certain changes in the scheme. The minimum number of members per FPO in case of plain areas is 300; whereas in North-Eastern and Hilly Region, it is just 100. Out of the total farmer members in a FPO, 50 per cent should be small, marginal and landless tenants with maximum possible representation from women farmers. Under the scheme, adequate support is extended to the States of North East and hilly areas to offset deficiency in specialized manpower and expertise available in such areas. As per the new guidelines, the Farmer Producer Organisations (FPOs) will be given a maximum of Rs. 18 lakh in the formative years, apart from an equity grant of up to Rs. 15 lakh and a kitty for meeting administrative expenses, including salaries of key personnel. The government has also made provisions from financially supporting CEOs and accountants appointed by these FPOs for a maximum of three years. While the CEOs can be given up to Rs. 25,000 from the funds provided by the government, accountants can draw a maximum of Rs. 10,000. FPOs are supported by central organizations such as National Bank for Agriculture and Rural Development (NABARD), Small Farmers Agribusiness Consortium (SFAC) and National Cooperative Development Corporation (NCDC).

The UT of J&K has a very limited number of functional FPOs and the problems in their growth remain the lack of awareness among farmers about their process of formation and way of functioning, lack of social participation/ cohesiveness, lack of communication and absence of startup capital. Sher-e-Kashmir University of Agricultural Sciences & Technology of Jammu (SKUAST-Jammu) has been entrusted with the responsibility of Cluster Based Business Organization (CBBO) for formation and promotion of FPOs in Jammu region. The present study analyses the factors affecting the participation of farmers as members and shareholders in these FPOs.

MATERIALS AND METHODS

The present study was conducted purposively in Jammu region of Jammu & Kashmir, involving four districts and nine blocks wherein the FPOs are being formed by SKUAST-Jammu (Table 1). The products under each FPO are selected following One District One Product (ODOP) approach. Multiple mobilization drives were organized for encouraging farmers to become an active member of these FPOs. During these mobilization drives, the data regarding the socio-economic and farm practices were also collected. This study is based on 900 farmers mobilized during the process of formation of FPOs, including 100 from each block/FPO (Table 1).

Surveys and focus group discussions were utilized to collect primary data regarding socio-economic features of farmers. Their probability of joining FPO as a member and contributing to the equity capital is determined by using the logit model based on cumulative logistic probability function (Gujarati, 2004).

RESULTS AND DISCUSSION

Farmer Producer Organisation (FPO) provides support to small and marginal farmer members with end-to-end services covering almost all aspects of farming. However, the performance of FPOs can be evaluated through impact on livelihood of their member farmers (Desai and Joshi, 2014). The participation of farmers in these FPOs also indicates the importance of such organisations in uplifting their social and economic status. The socioeconomic characteristics and factors contributing towards membership and shareholding of FPOs are discussed as below:

Socio-economic characteristics: The socio-economic characteristics of farmers are instrumental

Table 1: Detail of FPOs and farmers mobilized

District	Block	Product	No. of farmers mobilized	No. of mobilized farmers agreed to become member of FPO	No. of mobilized farmers agreed to become shareholder of FPO
Kathua	Basohli	Maize	100	56	16
Kathua	Kathua	Mushroom	100	48	14
Kathua	Hiranagar	Seed production	100	54	13
Kathua	Marheen	Honey	100	60	17
Reasi	Mahore	Walnut & Apple	100	50	13
Kishtwar	Kishtwar	Saffron	100	62	21
Kishtwar	Marwah	Rajmash	100	66	18
Poonch	Mandi	Walnut	100	64	14
Poonch	Poonch	Maize	100	55	21
Total			900	515	147

Table 2: Descriptive statistics of socio-economic variables

Variables	Description	Mean	SD	Min	Max
Age	The age of farmer mobilized (in years)	59.34	13.39	36	83
Education	Formal education of mobilized farmer in years	9.0	6.0	0.0	24
Farm size	Cultivable land owned by the farmer in hectares	0.78	0.76	0.1	5.0
Family size	Total number of members in a family	6.52	1.81	3.0	13.0
Off-farm job	=1 if farmer is involved in off-farm job= 0 otherwise	0.28	0.44	0.0	1.0
Social/political involvement	=1 if farmer is linked with social/political organization= 0 otherwise	0.18	0.38	0.0	1.0
Member of FPO	=1 if farmer becomes the member of FPO=0 otherwise	0.57	0.49	0.0	1.0
Shareholder of FPO	=1 if farmer becomes the shareholder of FPO=0 otherwise	0.16	0.36	0.0	1.0

in explaining the farmers' decision to involve in a new scheme of things. The socio-economic characteristics of farmers considered for the present study include age, education, farm size, family size, off-farm job, social/political involvement. The mean age of farmers mobilized under the FPO scheme is 59.34 years with maximum age of 83 years and minimum age of 36 years (Table 2). The average age of farmers in India is around 50.1 years which is considered to be under higher age group. The average age of 59.34 years of farmers under the present study is still higher as compared to the average age of farmers in India. The farmers were mobilized irrespective of their age for formation of FPOs. However, due to participation of majority of household heads in the mobilization drive, the average age under the study assumes higher value. The average years of formal schooling of mobilized farmers is nine, which is fairly low in relation to the average years of schooling at state level. The average size of farm is 0.78 hectares with fairly high standard deviation of 0.76, which means that there is a large variation in farm size among mobilized farmers. The maximum farm size is 5 hectares whereas the minimum is 0.1 hectare. One of the major objectives of FPO scheme is to strengthen small and marginal farmers. The farm size of mobilized farmers indicates that the farmers were mainly belonging to small and marginal category with average farm size of 0.78 hectares. The family size of respondent farmers is 6.52 with maximum 13 persons per family and minimum of three persons per family. The dummy variable for off-farm job has an average value of 0.28. This reveals that very few respondents have off-farm job available for supplementary income. Again, the mean value for dummy variable related to social and political representation is 0.18, which is relatively lower and signifies that mobilized farmers have little social and political representation in their respective areas. Further, the descriptive statistics revealed that half of the mobilized farmers become member of FPO (with mean score of 0.57) and only 16% become shareholder in the first attempt with mean score of 0.16.

Comparison of socio-economic characteristics: The mean difference between two groups i.e. members and non-members in terms of socio-economic characteristics of mobilized farmers was assessed (Table 3). The differences between members and non-members in terms of family size, off-farm job, social/political involvement was found statistically significant at 1% level whereas farm size was significant at 5% level.

Similarly, the mean difference between two groups i.e. stakeholders and non-stakeholders in terms of socio-economic characteristics of mobilized farmers was assessed (Table 4). The differences between stakeholders and non-stakeholders in terms of age, off-farm job and social/political involvement were found statistically significant at 1% level, whereas family size was significant at 5% level.

Factors affecting membership in FPOs: The minimum number of members in each FPO is fixed as 300 and 100, respectively in case of plain and hilly areas. It is essential to understand the factors affecting the participation of farmers in FPOs. The results of the binary logistic regression model (Table 5) indicate that four variables were found to have significant influence on the probability of being a member of FPO. Farm size and social/political involvement are statistically significant at 1% level and influencing positively the likelihood of becoming FPO's member. The variables such as education and family size are also statistically significant but influencing the likelihood of becoming member of FPO, negatively.

The odds ratio increases by a factor of 0.61 with every one hectare increase in farm size for participation in FPOs. Similarly, the odds ratio for membership in FPOs increases by a factor of 3.32 for members who had social/political involvement. The odds ratio of -

Table 3: Mean difference between members and non-members

Variables	Membership category				t value	p value
	Member		Non-member			
	Mean	SD	Mean	SD		
Age	59.23	0.57	59.51	0.72	1.96	0.75
Education	8.58	0.24	9.56	0.34	2.12	0.98
Family size	6.28	0.06	6.86	0.11	4.83***	0.00
Off-farm job	0.279	0.019	0.28	0.02	10.43***	0.00
Social/political involvement	0.31	0.02	0.02	0.01	9.43***	0.00
Farm size	0.83	0.03	0.71	0.03	-2.25**	0.02

Table 4: Mean difference between stakeholders and non-stakeholders

Variables	Stakeholder category				t value	p value
	Stakeholder		Non-stakeholder			
	Mean	SD	Mean	SD		
Age	63.63	13.75	58.67	10.66	-3.17**	0.001
Education	8.57	0.46	9.22	0.50	0.98	0.32
Family size	6.78	1.33	6.45	1.83	-1.78	0.07
Off-farm job	0.63	0.48	0.22	0.42	-7.38**	0.00
Social/political involvement	0.65	0.48	0.22	0.42	-6.59**	0.00
Farm size	0.80	0.76	0.76	0.67	-0.56	0.57

Table 5: Maximum Likelihood estimates of logit model for membership of FPO

	Coefficient	dy/dx	Odds ratio
Age	0.008(0.006)	0.001(0.001)	1.008(0.006)
Education	-0.036(0.013)***	-0.007(0.002)***	0.964***(0.012)
Farm size	0.61(0.125)***	0.118(0.023)***	1.84***(0.23)
Family size	-0.32(0.052)***	-0.06(0.009)***	0.724***(0.037)
Off-farm job	0.002(0.187)	0.0004(0.036)	1.002(0.188)
Social/political involvement	3.32(0.397)***	0.648(0.068)***	27.91***(11.08)
Constant	1.38(0.427)***		3.98***(1.70)

Number of observations = 900; LR $chi^2(6)$ = 218.06; Prob > chi^2 = 0.0000; Log likelihood = -505.38281; Pseudo R^2 = 0.1775

Table 6: Maximum Likelihood estimates of logit model for stakeholders of FPO

	Coefficient	dy/dx	Odds ratio
Age	0.025(0.009)***	0.002(0.0008)***	1.02***(0.01)
Education	-0.007(0.019)	-0.0006(0.001)	0.992(0.019)
Farm size	0.233(0.155)	0.019(0.013)	1.26(0.196)
Family size	-0.121(0.79)	-0.010(0.006)	0.88(0.07)
Off-farm job	2.003(0.258)***	0.16(0.02)***	7.41(1.91)***
Social/political involvement	3.10(0.252)***	0.262(0.015)***	22.40***(5.65)
Constant	-4.36(0.722)***		0.01***(0.009)

Number of observations = 900; LR $chi^2(6)$ = 288.78; Prob > chi^2 = 0.0000; Log likelihood = -256.25; Pseudo R^2 = 0.36

0.036 for education implies that other things being kept constant, the odds-ratio in favor of becoming members of FPO decrease by a factor of 0.036 as formal education increases by one year. This implies that farmers who have small land holdings are more likely to join FPOs as members. This may be considered as a good sign for the FPO scheme, as the scheme is primarily focus on small and marginal farmers.

Factors affecting stakeholders for FPOs: The results of the binary logistic regression model (Table 5) indicate that three variables were found to have significant influence on the probability of being a stakeholder of FPO. Age, off-farm job and social/political involvement are statistically significant at 1% level and influencing positively the likelihood of becoming FPO's stakeholder. Again, the family size has a negative sign for farmers becoming stakeholders of FPOs.

Education is important for understanding the modalities of FPO. However, the coefficient of variable 'education' is negative for both membership and stakeholder in FPOs. This may due to the fact that farmers with higher education are engaged in individual management of their farm outputs and did not wish to join FPO.

CONCLUSION

The scheme of FPO provides an opportunity for the farmers to initiate group activities for bringing economies of scale and developing forward and backward linkages. The higher the number of members and shareholders of FPOs, the more will be the economies of scale. The lesser percentage of conversion of mobilized farmers into members of FPOs indicates that farmers found it difficult to understand the concept and modalities of FPO. Therefore, there is a need to make them farmers' aware about the functioning of the organization. In order to enhance the membership and shareholding of FPOs, there is a need to carry out continuous dialogue with the farmers. It is also necessary to strengthen FPOs for reaping the benefits of other centrally sponsored schemes such as Atmanirbhar Bharat, TOP to Total, National Agriculture Market (e-NAM), Prampragat Krishi Vikas Yojana etc. Since self-reliance of farmers depends upon the efficiency of group dynamics, FPOs are undoubtedly the key for enhancing farmers' income and boosting agricultural growth.

REFERENCES

Department of Agriculture and Farmers Welfare. 2015-16. Agriculture Census, Ministry of Agriculture & Farmers Welfare, Govt. of India; accessed at Agriculture Census (agcensus.nic.in).

Desai, R.M. and Joshi, S. 2014. Can Producer Associations Improve Rural Livelihoods? Evidence from Farmer Centres in India. *The Journal of Development Studies,* 50(1): 64-80.

Dwivedi, R.C. 1996. Role of co-operatives in rural economy. *Indian Journal of Agricultural Economics,* 51: 713-727.

Patil, C.N.D., Patel, J.K., Bellagi, R.D. and Manunayaka, G. 2021. Relative Influence of Predictor Variables in Explaining Self Help Group Dynamics Effectiveness of Women in Gujarat. *Journal of Community Mobilization and Sustainable Development,* 16(2): 540-542.

Raj, K.S. 2006. Micro-finance and empowering rural women. *Journal of Development and Social Change,* 4(1&2): 16-21.

Rani, N. 2017. Formation of Farmer Producer Organizations and its impact on the Development of Sustainable Crop Production in Karnataka. *International Journal of Agriculture Sciences*, 9(4): 3735-3738.

Sawairam, P. 2014. Farmer Producer Organization-Solution to face challenges through linkages in value chain. *International Journal of Combined Research and Development,* 3(4):1- 9.

Singh, S. 2012. New markets for smallholders in India– Exclusion, policy and mechanisms. *Economic and Political Weekly,* 47: 95-105.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 637-641

Adoption of Organic Farming for Sustainable Livelihood and Environment Security at Indo-Pak International Boarder

Punit Choudhary, Ravneet Kour, Prem Kumar, Sheetal Badyal, Amitesh Sharma, Muneeshwar Sharma and Raju Gupta
Krishi Vigyan Kendra Jammu, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu

ABSTRACT

"Basmati" is long grain aromatic rice grown for many centuries in the specific geographical area, at the Himalayan foot hills of Indian sub-continent, and owes its origin to Jammu region. Basmati is preferential *kharif* crop for rice growing farmers of Jammu province. Grown on an area of 42 thousands ha, basmati has potential to cover acreage upto 60,000 ha if supported by innovative scientific technologies. Agro-climatic conditions of basmati growing areas of Jammu region (R. S. Pura, Bishnah, Arnia, Khour areas) develops a peculiar aroma and mouth feel taste in basmati compared to the basmati varieties grown in adjoining Punjab and other basmati growing regions of the country. Around five hundred farm families of Sucetgarh and adjoining vilages are either directly or indirectly dependent upon this Basmati 370 for their livelihood and employment however in the last two decades' excessive use of fertiliser and pesticides to increase production has also augmented the investment costs, burdening the already troubled farmers. Shifting from production centric to quality production, sustainable better soil health and quality productivity farmers of R S Pura synchronized the indigenous technology knowledge with them by adding scientifically proven organic solutions from KVK Jammu experts. KVK Jammu through Frontline demonstrations, Method demonstrations of Biofungicides and Biopesticides, Varietal On farm trials of Basmati 370 and its derivatives developed by SKUAST-Jammu, plantation and distribution of Neem saplings, capacity buildings on the use of organic fertilizers, Bio inoculants and substitution of pesticides with Crop Guard (Tricoderma), Rhizobium, Neem Oil and other organic adjuvant for seed and soil treatments provided fruitful results and sustained the scope of increasing the farmer income manifold through organic Basmati.

Keywords: Organic basmati, KVK, Farmers income, Organic farming adoption

INTRODUCTION

The Indian aromatic rice, often called 'Basmati' is nature's gift to north-west region of Himalaya. It is cultivated on the foot hills of the Himalayas in the northwestern parts of Indian sub-continent comprising the states of Haryana, Punjab, Uttaranchal, Western Uttar Pradesh, Jammu & Kashmir, Himachal Pradesh and Delhi. As regards, Jammu & Kashmir it plays an important role in the livelihood of people of this hilly and sub-mountainous state. Basmati rice is highly priced in the domestic as well as international markets. In Jammu and Kashmir State, basmati rice is being grown in Jammu region, in three districts namely, Jammu, Samba and Kathua. The area under basmati cultivation is 42 thousand hectares with production of 9.8 lakh quintals and productivity of 23.29 quintals per hectare. Most of the information we have so far is about common varieties, and our knowledge on indigenous basmati rice is still incomplete. Morerover, traditional basmati strains are so mixed with the new dwarf varieties that is is very difficult to differentiate them on the basis of phenological and morphological characters. R. S. Pura area in Jammu region of Jammu and Kashmir State is known by basmati rice. The aroma of basmati grown in this area is having appeasing fragrance but lags in export due to short grain size.

"Basmati" is long grain aromatic rice grown for many centuries in the specific geographical area, at the Himalayan foot hills of Indian sub-continent, and owes its origin to Jammu region. Basmati is preferential *kharif* crop for rice growing farmers of Jammu province. Grown on an area of 42 thousands ha, basmati has potential to cover acreage upto 60,000 ha if supported by innovative scientific technologies. Basmati rice is blessed with elongation of grain length at least twice of their original size when cooked along with characteristics of soft and fluffy texture, delicious taste, superior aroma and distinct flavor but due to short grain length and lodging during flowering did not give better returns to the farmers.

There is need to increase the basmati grain size (grain length and breadth) and shape (length/breadth ratio) so that indigenous basmati can be exported in international market. Now, modern crop production and high thoroughput molecular techniques have proved to be powerful tools in the elucidation of genetic relationships and its improvement.

Basmati rice has occupied a prominent position in R. S. Pura area of Jammu not only because of their high quality but also that they had been considered auspicious. However in an era of semi-dwarf rices where high yield has been the main focus, the traditional basmati rice accessions got ignored. Lower sub tropical part of Jammu region falls inside geographical indicator (GI) area of basmati where number of traditional basmati land races are being cultivated. These basmati land races are known to have specific adaptation and their quality is fully expressed if grown in the specific region. Genetic erosion has been more intense for these traditional basmati landraces and rate of replacement of landraces is very fast due to their poor inherent yield potential, susceptibility to prevailing diseases and insect pests, and no incentive for growing such landraces. Accordingly, these genetic wealth are disappearing from their native place and are in immediate danger. Moreover, landraces are so mixed that there is need to collect the local landraces from different basmati rice growing areas of Jammu, purify them and further release to the farmers.

Agro-climatic conditions of basmati growing areas of Jammu region (R.S. Pura, Bishnah, Arnia, Khour areas) develops a peculiar aroma and mouth feel taste in basmati compared to the basmati varieties grown in adjoining Punjab and other basmati growing regions of the country. Hence, R. S. Pura basmati rice has occupied a prominent position in J & K state because of their high quality and palatability.

MATERIALS AND METHODS

The total area of village Suchetgarh is 1500 acres of which 1000 is cultivated and 900 acre comes under Organic Basmati cultivation. The present household of Suchetgarh comprised of 180 families all are small scale farmers (>2ha. area) and involved in farming. The organic farmers now believes that the yields from organic farming are of high quality and far better than that obtained from using chemical pesticide and fertilizer.

Around five hundred farm families of Sucetgarh and adjoining villages are either directly or indirectly dependent upon this Basmati 370 for their livelihood and employment however in the last two decades' excessive use of fertiliser and pesticides to increase production has also augmented the investment costs investment costs, burdening the already troubled farmers.

The area of organic Basmati rice having considerable irrigation facilities was selected in the village Suchetgarh in union territory of Jammu and Kashmir. The farmers had formed the cluster and had initiated the organic cultivation of Basmati but they were lacking the knowledge of technical know how and application of all the organic inputs. Pre-seasonal interaction was conducted during the initiation year, 2016-17 and collected information on existing practices, yields, profits and problems faced by the farmers. Based on the collected information, technological gaps were identified and with the improved package of practices, a total area of 10.0 ha with 20 farmers was covered. Basmati fields from adjacent area in the cluster village were considered as control (farmer's practice) who were practicing their own technical know how. The demonstrations were laid out for three consecutive years from 2016-17 to 2018-19. In each year, FLD's, a preseasonal training and four trainings during the crop period were conducted to prepare the farmers on implementation of selected package of practices. The critical inputs were supplied to the farmers like seed, T. viridi, PSB were provided by KVK Jammu and remaining inputs like vermicompost and green manures were arranged by farmers on their own. Data on cost of cultivation, yield and gross returns were collected from each selected farmer as well as from non-practicing farmer for the comparison. From the collected data, mean values for cost of cultivation, yield, gross returns, net profits and B:C ratio were worked out.

RESULTS AND DISCUSSION

Considering the importance of Organic farming and its export potential at premium prices, in 2012, the Department of Agriculture, Jammu Division with technical Know-How of KVK Jammu and Scientists of SKUAST-Jammu, APEDA and other stakeholders such as Sarweshvar Rice Mills, various organic service providing agencies introduced a project to produce organic basmati rice in Suchetgarh, The first crop of organic basmati was planted in 2016. The project was named as Suchetgarh Organic Basmati Rice Cluster (SOBRC), and undertaken by three villages (Suchetgarh, Korotana Khurd and Bidipur Jattan). Now as apart of the project SOBRC cluster succeeded in encouraging 769 families comes under organic farming covering 1100 acres of the 1500 acres. However organic production requires knowledge and its management intensive. It is not simply the final product that matters but the whole production process which must be inspected and approved by certification bodies.

Table 1 describes the area production and productivity of Basmati Rice in J & K state. In terms of productivity Jammu has 55% less productivity and stands third following Kathua and Samba. Interestingly the low productivity is due to non adoption of Conventional farming. Table 2 describes the performance of 52 FLDs laid out by KVK Jammu in the year 2019 and 2020 shows an increase in average yield of 14.3% in both the years on comparison with check which shows that technologies and their dissemination through front line Demonstration is more helpful to increase the productivity.

Table 1: Area and production of rice in Jammu and Kashmir state

State/District	Area (000 ha)	Production (000 q)	Productivity (q/ha)
Rice area			
Jammu & Kashmir	265.88	4548.0	17.11
Basmati rice area			
Jammu	26.60	509.12	19.14
Samba	7.725	226.72	29.35
Kathua	6.845	236.15	34.50
G. Total	41.343	971.99	23.29

Source: Digest of Statistics, Directorate of Economics and Statistics, Govt. of J&K

Table 2: Performance of B-370 at R S Pura laid under frontline demonstration during two consecutive years by KVK Jammu

Technology Demonstrated B-370	2020	2019
No. of Farmers	18	34
Area (ha)	8.0	6.8
Highest Yield (q)	35.4	28.0
Lowest Yield (q)	30.9	15.0
Average Yield (q)	33.4	23.4
Yield of Check (q)	31.2	20.15
Increase in yield (%)	14.3	14.3
B:C ratio	2.42	2.04

ASCI certified vermicompost producer Sh Swaran Lal and his companion farmers, from Suchetgarh Jammu's R S Pura, a village situated at Indo Pakistan Border neither knows about Niti Aayog nor its CEO, but the born-farmers are working hard to get their livelihood from producing one of the finest qualities of Basmati Rice in the region and renowned in the world, with the help of Krishi Vigyan Kendra, Jammu SKUAST –JAMMU (KVK).

SOBRC cluster emerged as torch bearer in this agriculture development of the Block R S Pura. Before trainings, organic farming for tem was using cow dung, poultry manure, homemade neem extract and less production. Over the time this definition changed and farming shifted from production centric to quality production, sustainable better soil health and quality productivity. Later they synchronized the indigenous technology knowledge with them by adding scientifically proven organic solutions from KVK Jammu experts. To augment the project a success KVK Jammu conducted trainings, Frontline demonstrations, Method demonstrations of Biofungicides and Biopesticides, Varietal On farm trials of Basmati 370 and its derivatives developed by SKUAST-Jammu, planted and distributed Neem saplings. Krishi Vigyan Kendra Jammu provided training on the use of organic fertilizers, Bio inoculants and also provided Crop Guard (Tricoderma), Rhizobium, Neem Oil and other organic adjuvants for seed and soil treatments. Farmers were also provided complete training regarding preparation of vermicompost and at present most of the farmers are having their own vermicompost unit. (Choudhary *et al.,* 2021)

SOBR cluster were provided sheller on 80 % subsidy. These Mini Rice shellers will help the growers to promote their Brand organic Basamti through direct marketing and get higher returns with the elimination of middlemen. Department of Agriculture in technical consultation with KVK Jammu is providing all sort of benefits including latest machinery Biofertilizers, Bio Pesticides and establishment of Vermi compost unit etc.on subsidized costs to the farmer. The formation of FPO's (submitted to NABARD by KVK Jammu), Brand popularization and proper marketing of the organic produce of Basmati are the main aims of the intensified efforts of KVK under the SOBRC project. Moreover, exposure visits to Organic Farming Research Centre SKUAST- Jammu, demonstrations sessions and capacity building of extension functionaries through In-Service trainings were also organised for guiding team of Local Resource Persons (volunteer LRPs) representing 10 groups of SOBRC cluster and to enable them to produce true-to- type high quality aromatic Basmati Rice through organic means for improved marketability and export for higher economic returns as per Organic India standards under Participatory Guarantee System (PGS).

The impact of all the activities in last three years has also be analysed to formulate the future plan of action. It has been analysed that Organic farming may not immediately increase the crop production but it will certainly encourage sustainable farming by maintaining the health of Soil and water level. Using Dhaincha as green manure crop reduces nitrogen levels upto 20%. Now many Government Service Providing Agencies, Biofertilizer and biopesticide manufacturing companies, SKUAST-Jammu, Sudhmahadev vegetabe producer company limited, YS Sons agrotech limited, Actech Information System, Alpha Environmental Systems, International Panacea Ltd, KRIBHCO and Prathisthta (NPK organic nutritional and complete Fertilizer) and Neem India products Pvt. Ltd made interventions and demonstration their organic products and supported the project SOBR.

As the cost for production increases, the likelihood of the adoption of organic farming decreases. Intuitively, the level of costs that a certain farming system necessitates would really affect the adoption decision of an individual negatively. Table 3 shows that Benefit Cost ratio improves gradually after formation of SOBR cluster in the year 2015 to 2020 from 1.89 to 3.15 profitable. The study by Sriwichailamphan and Sucharidtham (2014) and Thiripurasundari and Divya (2015) showed the same result wherein the lower cost associated with organic farming was identified as an important reason considered in adopting organic farming. Among the factors considered to affect the adoption decision of the farmers to convert to organic farming, gender, education, farming experience, farm size, yield, and cost per hectare were the ones seen to be important.

Farmers with bigger farms tend to be less likely to adopt organic farming. In our case study All of the organic rice farmers operate at a relatively smaller scale than the conventional growers. Their areas reach no more than 2.5 ha. The studies of Khaledi *et al.* (2010) and Prashanth and Reddy (2012) showed a similar finding. Farmers with bigger land holdings are less likely to adopt organic farming practices. Probable reason could be the acknowledged fact that the management of bigger organic farms would be much more difficult due to the intensive labor requirement.

During initial stages. different organic interventions such as seed and nursery treatment with biofungicides, having mini Rice Sheller on subsidized rates, organic fertilizer (FYM, Compost Vermicompost), Vermiwash, Vermibeds to prepare Vermicompost, resultant into decrease in production which leads to less cost benefit ratio and over the period when the resource generation and production cycle from the field starts to work the organic carbon and soil ecosystem improved and

Table 3: Economic Outcome of the KVK interventions in SOBR cluster

Cultivar	Year	Net profit (Rs./ha)	C:B ratio	Adoptaion rate (%)
Basmati 370	2015	30,650	1:1.89	43.0
	2016	21,920	1:1.46	56.0
	2018	1,08,000	1:2.40	42.0
	2020	1,32,300	1:3.15	37.0

increased the net profit. Farmers who got PGS India Organic Certificate they sold their shelled basmati rice produce on remunerative rates as compare to conventional Basmati grower and Organic basmati grower without scope certificate. Additional support in the form of guidance received from KVK, SKUAST-Jammu and APEDA scientists to produce true to type seed of Basmati 370 and helping in marketing and proper branding like SS etc., till there is scope to increase manifold the farmer income through organic Basmati. Impact of Frontline demonstrations on yield, economics and adoption of marigold cultivation were also in line with the study (Kour *et al.,* 2020).

REFERENCES

Choudhary, P.; R. Sharma; P. Kumar; R. Kour; S. Badyal; V. Tandon and A. Sharma. 2021. Organic Farming: To Sustain the Livelihood and Environment at Indo-Pak International Boarder- Krishi Vigyan Kendra Jammu.

Khaledi, M.; S. Weseen; E. Sawyer; S. Ferguson and R. Gray. 2010. Factors influencing partial and complete adoption of organic farming practices in Saskatchewan, Canada. *Can J Agric Econ.,* 58: 37–56.

Kour, R.; S. Badyal; R. Kumar; P. Choudhary and P. Kumar. 2020. Impact of frontline demonstrations on yield, economics and adoption of marigold cultivation. *Journal of Krishi Vigyan*, 8(2).

Sriwichailamphan, T. and T. Sucharidtham. 2014. Factors affecting adoption of vegetable growing using organic system: a case study of Royal Project Foundation, Thailand. *International Journal of Economics & Management Sciences,* 3(2).

Thiripurasundari, K. and S. Divya. 2015. Factors determining the adoption of organic farming among the farming community in Tamil Nadu. *International Journal of Commerce, Business and Management,* 4(2): 1039–1044.

Received on May 2022; Revised on May 2022

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022: pp 642-648

Adoption of Recommended Package of Practices by the Apple Growers of Kashmir Valley

Naqeeb Raja[1], Shijaatt Hussain Bhat[1], Noor Ul Islam wani[2], Aamir Hamid Shah[1]*, Uzma Rashid[1] and Junaid Ayaz[1]
[1]Division of Agriculture Extension and Communication, FoA Wadura
[2]Department of Agriculture and Farmers Welfare, UT of J&K

ABSTRACT

The present study was carried out in five districts of Kashmir valley, viz., Kupwara, Baramulla, Pulwama, Shopian & Kulgam in Kashmir Valley owing to the majority of apple production in these areas. A sample of 410 apple growers were selected through proportional allocation method for collecting the primary data with the help of a well-structured interview schedule. The data derived from the interviewees was analyzed using suitable statistical methods. The study revealed that the majority of the respondents (50.24%) had high adoption level regarding the recommended package of practices followed by 40.24 per cent of the respondents having medium level of adoption and 9.51 per cent had low level of adoption. Further, the data revealed that in district Kupwara 50 percent respondents belonged to high level of adoption followed by (40.90%) respondents who were in medium level and (9.09%) respondents belonged to low level of adoption. Similar trends were reported from other three districts as well.

Keywords: Apple, Growers, Adoption, Respondents, Primary data, Interview schedule

INTRODUCTION

Apple is one of the most widely cultivated tree fruits. The apple is the fourth widely produced fruit in the world after banana, orange and grapes. India is ranked as the sixth largest world's apple producing country and second largest country in area. Nearly all of the Indian apples are grown in three mountainous states of north India – Himachal Pradesh, Jammu and Kashmir and Uttaranchal, where they are typically grown at an altitude of 4000 to 11,000 feet. J & K and Himachal Pradesh have almost equal area under apple plantation, but J&K has the highest average yield and accounts for 67 per cent of total apple production and 50 per cent of its exports in the country, hence a substantial foreign exchange earner for economic growth. India annually exports apple worth Rs. 400 million (Nearly US$ 10 million) out of which Rs. 200 million in apples comes from J&K's North region i.e. Kashmir. This sector occupies an important position in the farming system of the state and has assumed great importance during the last few decades (Reshi *et al.,* 2010). As far as apple production is considered, it accounts for 51% of total area of 2.72 lac hectares under all temperate fruits grown in this state. The annual apple production in the state is 13.73 lac. Metric tonnes (Anonymous, 2009).

Average yield of apple cultivars per unit area of UT of JK is highest in the country ranging between 10-12 tonnes/ha, still the yield is poor as compared to 20-30 tonnes/ha grown in horticulturally advanced countries of the world. Climate and other agro-ecological factors of Kashmir are ideally suited to the cultivation of many varieties. There has been a marked shift from agronomic crops towards the horticultural crops owing to the fact that the returns per unit area are too high. However, this sector is confronted with the challenges from the insect, pest infestation and the diseases which of late have contributed to the poor quality produce, thereby reduction in the net returns. So in order to overcome such reductions, farmers need

*Corresponding author email id: amiriari13@gmail.com

to be trained from time to time in order to achieve good quality and maximum apple production. Nature has endowed the state of Jammu and Kashmir with wide range of agro-climatic conditions which permit the production of varieties of temperate fruits. It has varied climatic features, topography and diversity in physiographic features, existence of cold arid, temperate, intermediate and sub-tropical zones within a small geographical area. Though the large diversity in agro climatic conditions of the state is conducive for propagation of diversified farming system, the terrain at the same time is tough and accessibility to a greater part of the region is poor. This causes the lot of hurdles to the inhabitants regarding the knowledge and awareness about the use of inputs, products and other farming practices. However, there are also certain factors such as alternate bearing, defective pruning and training, use of seedling rootstock of unknown performance, lack of proper nutrient and water management, deficiency of suitable pollinizers/ pollinators and ineffective control of pests and diseases which are responsible for low productivity and quality. (Deodhar *et al.*, 2006).

In order to study the extent of adoption of different recommended apple crop management practices, the present study was undertaken in a few apple growing districts of the valley which are also the leading districts in terms of apple production.

MATERIALS AND METHODS

Research Design: For carrying out the research ex-post-facto design was used. It is systematical inquiry in which the researcher does not have direct control of independent variables because their manifestations have already occurred and they cannot be manipulated. Inferences about relations among variables are made without intervention, from concomitant variation of independent and dependent variables (Kerlinger, 1983).

Pre-test-Post test control group research also known as before after design in which two equivalent groups of the same size are randomly selected from a population one group randomly given the treatment is called the experimental group and the other group for which no treatment is given, is called the control group. After the treatment is over post tests are administered to both the groups and the difference is measured. This test also makes a provision for pre-test of both experimental and control groups before the treatment is administered (Sagar Mondal and Ray, 1999).

Sampling procedure

Locale of the study: The present study was conducted in five districts of the Kashmir Valley, i.e., Baramulla, Kupwara, Pulwama, Kulgam and Shopian as majority of the apple growers are located in these districts and the KVK's are very functional in these districts.

Selection of the apple growers: A list of farmers who have undergone trainings through various KVK's were collected from the concerned KVK's and from this a list of proportionate sample of farmers was selected and proportional allocation method was adopted for the purpose.

Tools for data collection and analysis

Interview schedule: An interview schedule was constructed based upon the objectives, variables and available literature on the topic. The schedule was prepared in English language. While preparing the schedule, due care was taken to avoid questions with double meaning and contradictory statements. The language used was simple for easy understanding. The research schedule was constructed to collect the necessary information.

Pre-testing of Interview Schedule: Before finalization of the interview schedule, it was pre-tested by interviewing ten members who were not included in the sample in order to know whether the respondents furnish the required information and whether the questions are clear and easily understood by the apple growers. The confusing questions were modified so that no practical difficulties arise while filling the schedule.

Collection of data: Data was collected by personal interview method. The apple growers were assured that all the information furnished by them shall be kept confidential and shall be used for the research study only. The apple growers were contacted at their homes during their leisure time or at their respective fields. The interview was conducted in a friendly and informal manner.

Compilation of data: The qualitative data was quantified by using various statistical tools and working out different scores in order to find out the nature of relationship between dependent and independent variables.

Measurement of variables: The present study has two dependent variables and nine independent variables, the variables for this study were selected based on the review of literature and opinion of the experts. Only those variables were selected which were found to have relevance to the present investigation were included in the study. The instruments used and the procedure followed to measure the variables have been described in detail in the following pages. Considering the dependent and independent variables, the respondents were classified into different categories.

Statistical analysis: The following statistical tests and measures were used for the analysis of the data.

RESULTS AND DISCUSSION

It is evident from the Table 1 that majority 50.24 per cent of the farmers had high level of adoption followed by 40.24 per cent of the respondents having medium level of adoption and 9.51 per cent had low level of adoption. Further, the data revealed that the total frequency in the district Kupwara was 44 in which (50.00%) respondents belonged to high level of adoption followed by (40.90%) respondents who were in medium level and (9.09%) respondents belonged to low level of adoption. However, in district Baramulla the total frequency was 24 out of which (50.00%) respondents belonged to high level of adoption followed by (41.66%) respondents who were in middle level and (8.33%) respondents belonged to low level of adoption. Similarly, in district Pulwama the total frequency was 145 out of which (50.34%) respondents belonged to high level of adoption followed by (40.00%) respondents who were in medium level and (9.65%) respondents belonged to low level of adoption. Also, in district Shopian the total frequency was 97 out of which (50.51%) respondents belonged to high level of adoption followed by (40.20%) respondents who were in medium category and (9.27%) respondents belonged to low level of adoption and in Kulgam the total frequency was 100 out of which 50.00 per cent respondents belonged to high level of adoption followed by 40.00 per cent respondents who were in medium level and 10.00 per cent respondents belonged to low level of adoption.

The perusal of the data representing the Plant-production in the Table 2, indicates that majority of the respondents (90.00%) didn't adopted the management practises whereas (7.56%) of the respondents adopted fully and (2.44%) of the respondents adopted partially the management practises after receiving the trainings from KVKs on nursery management of Apple seedlings at correct time i.e.; (October-November).

Majority (51.22%) of the respondents were among those who fully adopted the management practises followed by (24.88%) of the respondents who didn't adopted and the respondents who partially adopted the management practises after receiving the trainings from KVKs on time of planting of Apple trees were (23.90%). The respondents who fully adopted the management practises after receiving the trainings from KVKs on method of propagation using grafting were (76.10%), followed by (23.41%) as respondents who partially adopted and the respondents who did not adopted the management practices were 0.49 per cent. Majority of the respondents who didn't adopted the management practises after receiving the trainings from KVKs on age of seedlings at the time of propagation were (87.80%) followed by (7.32%) and (2.68%) as the respondents who fully and partially adopted the management practices. Majority of the respondents

Table 1: Overall Adoption level of farmers (N=410)

Category	KVK's					
	Kupwara	Baramulla	Pulwama	Shopian	Kulgam	Total
Low (<26.93)	4(9.09%)	2(8.33%)	14(9.65%)	9(9.27%)	10(10.00%)	39(9.51%)
Medium (33.90 $\pm$ 6.96)	18(40.90%)	10(41.66%)	58(40.00%)	39(40.20%)	40(40.00%)	165(40.24%)
High (>33.89)	22(50.00%)	12(50.00%)	73(50.34%)	49(50.51%)	50(50.00%)	206(50.24%)
Total	44(10.73%)	24(5.85%)	145(35.36%)	97(23.65%)	100(24.39%)	410(100%)

Mean: 33.90 & S.D: 6.96

Table 2: Adoption of management practises by the farmers after receiving the trainings from KVKs. Plant-Production (N=410)

Statements	Adoption Level		
	Fully Adopted	Partially Adopted	Not Adopted
Nursery Management of Apple seedlings at correct time (October-Nov.)	31(7.56)	10(2.44)	369(90.00)
Time of planting of Apple trees (Nov.-March)	210(51.22)	98(23.90)	102(24.88)
Method of propagation you have useda. Grafting	312(76.10)	96(23.41)	2(0.49)
Age of seedlings at the time of propagation (1-2 years)	30(7.32)	11(2.68)	360(87.80)
Appropriate time for grafting in Apple (Feb-March)	318(77.56)	90(21.95)	2(0.49)
At what height you do grafting in Apple trees/seedlings (6 inch-1ft)	210(51.22)	100(24.39)	100(24.39)
At what spacing you are planting Apple trees	60(14.63)	212(51.71)	138(33.65)
Plant to plant: Old(20ft) & New(15ft)			
Row to row: (18ft)	98(23.90)	212(51.71)	100(24.39)
Do you use varieties of Apple recommended by SKUAST-K	60(14.63)	100(24.39)	250(60.98)
Method of training you follow: Open Centre	35(8.53)	47(11.47)	328(80.00)
Modified Leader system	39(9.51)	30(7.32)	341(83.17)
Have you planted pollinizers Yes/ No, if yes name the pollinizer	112(27.32)	198(48.29)	100(24.39)
How many Bee-hives are required per hectare for better pollination	7(1.71)	13(3.17)	390(95.12)

Figures in parentheses are percentages

who fully adopted the management practises after receiving the trainings from KVKs on appropriate time for grafting in Apple (Feb-March) were 77.56 per cent followed by the respondents who partially adopted the management practises were (21.95%) and the respondents who didn't adopted the management practices were 0.49 per cent. Majority of the respondents who fully adopted the management practises were 51.22 per cent followed by (24.39%) as the respondents who partially adopted the management practises and the respondents who did not adopted the management practices after receiving the trainings from KVKs on what height you do grafting in Apple trees/seedlings (6inch-1feet) were (24.39%) respectively. Majority of the respondents who partially adopted the management practices after receiving the trainings from KVKs on what spacing you are planting Apple trees plant to plant were (51.71%) followed by the respondents who didn't adopted were (33.65%) and the respondents who fully adopted the management practices were (14.63%). Majority of the respondents who partially adopted the management practices after receiving the trainings from KVKs on what spacing you are planting Apple trees in row to row were (51.71%) followed by 24.39 per cent who didn't adopted and (23.90%) were the respondents who fully adopted the management practices.

Majority of the respondents who did not adopted the management practices after receiving the trainings from KVKs on varieties of Apple recommended by SKUAST-K were (60.98%) followed by the respondents who partially adopted were (24.39%) and 14.63 per cent were the respondents who fully adopted the management practices. Majority of the respondents who didn't adopted the management practices after receiving the trainings from KVKs on Open Centre System were (80.00%) followed by (11.47%) as the respondents who partially adopted and the respondents who fully adopted the management practices were (8.53%). However, majority of the respondents who didn't adopted the management practices on Modified Centre System were (83.17%) followed by (9.51%) as the respondents who fully adopted and the respondents who partially adopted the management practices after receiving the trainings from KVKs were (7.32%).

Further, (48.29%) were the respondents who partially adopted the management practices after receiving the trainings from KVKs on planting pollinizers and the pollinizer used mostly were Golden

Delicious in all the sampled districts, followed by the respondents who fully adopted were (27.32%) and the respondents who did not adopted the management practices were (24.39%). Majority of the respondents who did not adopted the management practices after receiving the trainings from KVKs on bee-hives/ha required for better pollination were (95.12%) followed by the respondents who partially adopted were (3.17%) and 1.71 per cent were the respondents who fully adopted the management practices.

The perusal of the data representing the Orchard Management & Plant-Protection in the Table 3 indicates that the respondents who fully adopted the management practices after receiving the trainings from KVKs on recommended paste applied on large wounds after pruning were (95.37%), followed by the respondents who partially adopted were (4.63%) and the respondents who didn't adopted the management practice were (0.00%). Majority of the respondents who did not adopted the management practices after receiving the trainings from KVKs on irrigation were (97.56%) followed by the respondents who partially adopted were (2.44%) and the respondents who fully adopted the management practices on irrigation were (0.00%). Moreover, (100.00%) were the respondents who did not adopted the management practices after receiving the trainings from KVKs on drainage in Apple orchards, followed by (0.00%) as the respondents who partially and fully adopted the management practices on drainage in Apple orchards. Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on applications of manures in Apple orchard were (51.22%) followed by (24.88%) as the respondents who partially adopted and the respondents who did not adopted the management practices were 23.90 per cent. Majority of the respondents who partially adopted the management practices after receiving the trainings from KVKs on amount of urea used/tree of Apple at the age of 15 years were (76.10%) followed by (23.90%) were the respondents who fully adopted and the respondents who did not adopted the management practices were (0.00%). Majority of the respondents who partially adopted the management practices after receiving the trainings from KVKs on Disease & Pest Management were (75.12%) followed by the respondents who fully adopted were (24.88%) and the respondents who didn't adopted the management practices were (0.00%). Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on HMO to use for control of Sanjose Scale with recommended name and concentration were (65.85%) followed by (34.14%) were the respondents who partially adopted and the respondents who didn't

Table 3: Adoption of management practises by the farmers after receiving the trainings from KVKs (N=410)

Statements	Fully Adopted	Partially Adopted	Not Adopted
Orchard Management & Plant-Protection			
Do you use recommended paste applied on large wounds after pruning	391(95.37)	19(4.63)	0(0.00)
Do you apply irrigation	0(0.00)	10(2.44)	400(97.56)
Have you adopted the drainage facility in Apple orchards	0(0.00)	0(0.00)	410(100.00)
Do you apply manures in Apple orchard	210(51.22)	102(24.88)	98(23.90)
Amount of urea used/tree of Apple at the age of 15 years	98(23.90)	312(76.10)	0(0.00)
Have you adopted the management practice for disease & Pest control	102(24.88)	308(75.12)	0(0.00)
Do you recommended HMO for control of Sanjose Scale	270(65.85)	140(34.14)	0(0.00)
Do you use recommended pesticide for control of disease	260(63.41)	150(36.58)	0(0.00)
Do you use recommended insecticide for control of insects in Apple orchard	270(65.85)	140(34.14)	0(0.00)
Have you adopted the control recommended measures for Root rot/ collar rot	302(73.66)	60(14.63)	48(11.71)
Have you adopted the recommended control measures for Canker	390(95.12)	12(2.93)	8(1.95)
Do you follow spray schedule released by SKUAST-K/Hort.	290(70.73)	120(29.26)	0(0.00)

Figures in parentheses are percentages adopted the trainings on management practices were (0.00%) respectively. Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on the use of pesticide for control of disease with recommended name and concentration were (63.41%) followed by (36.58%) were the respondents who partially adopted and the respondents who didn't adopted the management practices were (0.00%). Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on the use of insecticide for control of insects with recommended name and concentration were (65.85%) followed by (34.14%) were the respondents who partially adopted the management practices and the respondents who didn't adopted were (0.00%). Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on control measures for Root rot/ collar rot were (73.66%) followed by (14.63%) were the respondents who partially adopted and the respondents who did not adopted the management practices were (11.71%). Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on control measures for Canker were (95.12%) followed by (2.93%) were the respondents who partially adopted the management practice and the respondents who did not adopted were (1.95%). Further, majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on spray schedule released by SKUAST-K/Hort. – Department were (70.73%) followed by 29.26 per cent were the respondents who partially adopted and the respondents who did not adopted the management practise were (0.00%) respectively.

The Table 4 represents that (51.22%) & (25.12%) of the respondents had fully and partially adopted the management practices after receiving the trainings from KVKs on maturity indices of Apple respectively, followed by (23.66%) as the respondents who didn't adopted the management practise. However, majority of the respondents who partially adopted the management practise on precautions for picking the Apples from trees were (73.17%) followed by (26.83%) were the respondents who did not adopted and the respondents who fully adopted the management practise were (0.00%).

The perusal of the data representing Post-Harvesting Handling of fruits in the Table 5 reveals that the majority of the respondents who fully adopted the management practices after receiving the trainings

Table 4: Adoption of management practises by the farmers after receiving the trainings from KVKs (N=410)

Statements	Adoption Level		
	Fully Adopted	Partially Adopted	Not Adopted
Harvesting			
Do you follow Maturity indices of Apple as recommended by SKUAST-K	210(51.22)	103(25.12)	97(23.66)
Do you follow precautions for picking the Apples from trees as recommended by SKUAST-K	0(0.00)	300(73.17)	110(26.83)

Figures in parentheses are percentages

Table 5: Adoption of management practises by the farmers after receiving the trainings from KVKs (N=410)

Statements	Adoption Level		
	Fully Adopted	Partially Adopted	Not Adopted
Post-Harvesting Handling of fruits			
Have you adopted the grading & Packing as per the recommendation	297(72.44)	0(0.00)	113(27.56)
Do you follow proper transportation	297(72.44)	0(0.00)	113(27.56)
Have you adopted the cold-storage	300(73.17)	0(0.00)	110(26.83)

Figures in parentheses are percentages from KVKs on grading & packing were (72.44%) followed by (27.56%) were the respondents who did not adopted and the respondents who partially adopted the management practise were (0.00%) respectively. Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on transportation were (72.44%) followed by (27.56%) were the respondents who didn't adopted and the respondents who partially adopted the management practise were (0.00%) respectively. Majority of the respondents who fully adopted the management practices after receiving the trainings from KVKs on Cold-storage chain were (73.17%) followed by (26.83%) of the respondents who didn't adopted and (0.00%) of the respondents partially adopted the trainings imparted on Cold-storage chain.

CONCLUSION

From the results obtained from the above study, it can be concluded that, majority (50.24%) of the respondents had high level of adoption. Majority (72.92%) of the apple growers had adopted recommended management practices for soil testing. It can also be concluded that more than half (56.58%) of the apple growers had adopted recommended management practices for plant populations (No. of plants maintained per kanal). Almost two-third (65.12%) of the apple growers had adopted recommended management practices for plant distance (Plant to plant). Nearly three-fourth (72.92%) of the apple growers had adopted recommended management practices for plant distance (row to row). Similar trends could be observed in case of rest of the management practices like FYM, pruning, training, fertilizer management, harvesting and even marketing of the produce. So, in general more than half of the farmers had adopted the recommended package of practices in their apple orchards thereby suggesting that the role played by the KVKs in terms of imparting of trainings has been immense in all the study areas.

REFERENCES

Anonymous, 2009. Temperate fruits: Package of Practices. Shalimar offset press, p. 1.

Deodhar, S.Y., Landes, M and Krissoff, B. 2006. Prospects for Indian Emerging Apple Market: *USA Development of Agriculture* 3: 12.

Kerlinger, F.N. 1989. Foundations of Behavioural Research, Delhi: Surjeet Pub.

Mondal, S. and Ray, G.L. Research methods in social sciences and extension education. ISBN 978_81_272_6746_9. 59-61.

Reshi, M.I., Malik, M.A and Kumar, V. 2010. Assessment of problems and prospects of apple production and marketing in Kashmir valley. *Journal of Environmental Research and Development* 4 (4): 1077-1078.

Received on May 2022; Revised on May 2022

Contd.............

Contd.............

Journal of Community Mobilization and Sustainable Development
Volume 2 (Seminar Special Issue) May 26-28, 2022

CONTENTS

Contd.............

Printed and Published by Dr. J.P. Sharma, President, Society for Community Mobilization for Sustainable Development, Division of Agricultural Extension, IARI, New Delhi-110012