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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 1200 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-

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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 slogans "go natural" and "be organic" have recently been echoed in the Indian agriculture sector for various reasons. Natural farming has gained popularity in recent years, but it has its roots in ancient Indian science, as evidenced by Surapala's Vrikshayurveda, a collection of 325 Sanskrit slokas written around 1000 years ago. Other ancient documents include the Brihat Samhita, Krishi Prashara, Krishi Sukti, Agnipurana, and Lokopkara in Sanskrit, Malayalam Tamil, Pali, and other South Indian languages, delivered the concept of natural farming. Again, in the mid-1930s, the world witnessed a movement from chemical farming to natural farming, as advocated by Mokichi Okada. The natural farming concept was propelled again in the mid-1970s by the works of Masanobu Fukuoka, as indicated in his book titled *'The One-Straw Revolution*.' The natural farming concept is built on several pillars, including nutritious food production in a safe and natural manner while adhering to production procedures that are economically and spiritually beneficial to both consumers and farmers. The revolutionary movement to implement natural farming on a national scale has been promoted as the Bharatiya Prakritik Krishi Paddhati Programme (BPKP) in 2021 under the Paramparagat Krishi Vikas Yojana (PKVY), a centrally sponsored scheme. The program's goal was to promote traditional indigenous farming practices that required little or no external inputs. According to a government directive, the Indian Council of Agricultural Research (ICAR) recognized the importance of natural farming and decided to develop a curriculum that included zero-budget natural farming in the syllabus and begin research, demonstration, and training on natural farming at various levels.

With immense happiness, I am presenting the current issues of the MOBILIZATION journal (September-December 2021) to all of you. The current issue's topics cover all aspects of the farming community's sustainable development in depth. This issue covers a wide range of topics, including agricultural experimentation, training effectiveness, public-private partnerships, governance in the COVID-19 pandemic, fisheries, dairy cooperatives, adoption constraints, impact analysis, psychometric scale construction, gender and women partnership, plant genetics, cyber extension, plant physiology, forecasting, economic feasibility analysis, floriculture, animal husbandry, post-harvest management, farm implementation, and farm implementation. It gives me great pleasure to note that the scientific community recognizes the journal's multidimensionality, as evidenced by the research contributions from various research areas.

I am grateful to the editorial team members Drs. Souvik Ghosh, S. K. Dubey, R. Roy Burman, Nishi Sharma, S.R.K. Singh, Reshma Gills, Sudipta Paul, and Sujit Sarkar for their contributions in ensuring a timely and effective editorial process and maintaining the high standards of our publications. I would like to express my heartfelt gratitude to Dr. Subhashree Sahu and Dr. Hema Baliwada for their dedication, efficient supervision, and thoughtful assistance in shaping this issue of the journal as on-line editors. Finally, I'd like to thank our incredible authors and readers. Your contributions are what allow the journal to reach new heights and remain relevant. I encourage everyone to continue sending us your valuable research findings, ideas, and comments for future improvement.

J.P. Sharma
Chief Editor

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Environmental Awareness to Rural Women for Sustainable Development

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ABSTRACT

The study was undertaken with the objective to create awareness regarding safe environment imparting environmental education and plantation of trees in the village. Participatory approach was followed. As per expert opinion from the Department of Forestry was sought regarding type of plants suitable for plantation in the selected village Gawar having sandy soil and water scarcity, nine plants were recommended. The plants under preferred category were *Acasianilotica* (Babool), *Melia composita* (Bakain), *Prosopis cineraria* (Khejari), *Azadirachta indica* (Neem) and *Tecomella undulate* (Rohida) while *Thespesia populaneai* (Bhindi tree) and *Pongamia pinnata* (Papri) were reported as under least preferred category. Majority of rural women i.e., 80 per cent were in the age group 30-40 years. Majority (75.0%) of the respondents were aware about meaning of environmental pollution in general. With respect to awareness about types of environmental pollution, it was found that majority of the respondents had awareness about air (75.0%) and water (60.0%) pollution, however, comparatively less number of them were aware of soil (30.0%) and noise pollution. Maximum (50.0%) respondents perceived transportation as the cause of environmental pollution followed by agricultural practices (45.0%). Survival rate of *Acacia nilotica* (Babool), *Melia composita* (Bakain), *Thespesia populaneai* (Bhindi tree), *Eucalyptus tereticornis* (Safeda), *Prosopis cineraria* (Khejari), *Azadirachta indica* (Neem) and *Pongami apinnata* (Papri)plant was 82 to 95%, while only 66.6 per cent of *Ailanthus excelsa* (Mahaneem) plants survived. Survival rate of *Tecomella undulate* (Rohida) plant was minimum as only 34.0 per cent plants survived.

Keywords: Environment education, Preferential choice, Environment pollution, Sustainable development

INTRODUCTION

"The earth provides enough to satisfy every man's needs, but not every man's greed" as said by 'Mahatma Gandhi'. Being aware of the natural environment and making choices that benefit the earth, rather than hurt it, is what actually the concept behind 'Conserve What our Children Deserve'. The promotion of sustainable development, fosters a sense of connection and helps in conservation of natural resources and endangered plants and other species. In recent years, deforestation has considerable and extensive negative impacts on increasing the temperature and climate change (Meyfroidt and Lambin, 2011). Native forests have been severely degraded in a considerable proportion. Therefore, the remaining native forests face the potentially rapid and extreme stress of climate change (Dale *et al.,* 2001). In order to prevent the planet from premature extinction and preventing it from global warming, planting more and more trees is the need of the hour as it reduces air pollution and greenhouse gases which is the major cause of respiratory diseases and cancer, among other problems and diseases. Restoration of forest ecosystems could directly mitigate climate change by sequestering atmospheric carbon, both above- and below-ground. Trees sequester and retain more atmospheric carbon in their biomass than do crops or pastures (Pan *et al.,* 2011). Under carbon trading or carbon emission reduction schemes, it is possible that widespread reforestation will become economically viable (Bradshaw *et al.,* 2013). Water pollution can lead to typhoid, diarrheal diseases, and other water-related diseases. Oil drilling, deforestation, production of plastic goods is the main causes for environmental destruction. Even if education has not reached the interior, awareness has. Witness as has been well depicted through Chipko and Appiko movements where tribal's, and mainly women, hugged their trees to prevent them is felled. Environmental

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education is considered as an interdisciplinary and holistic in nature and its application, is a life-long process and is concerned with the relationship between human and natural ecosystem and encourages the development of environmental protection e.g. environmental ethic awareness, understanding of environmental problems, development of critical thinking and problem-solving skills (Sengupta *et al.,* 2010). Sustainable Development is attained by protecting the environment in a judicious use of natural resources. Therefore, keeping in mind the importance of clean and protected environment the study was undertaken with the objective to create awareness regarding save environment and save earth by imparting environmental education and plantation of trees in the village.

MATERIAL AND METHODS

The study was conducted in Gawar village of Hisar district of Haryana state. Twenty rural women who were interested in plantation were selected purposively. Training was organized for creation of awareness regarding save environment save earth with the help of experts from the Department of Forestry. The experts from the department of Forestry were exposed to the village conditions (soil, weather conditions, irrigation facilities etc.) so that the suitable plants are selected for creating awareness regarding save environment save earth. As per expert opinion from the Department of Forestry was sought regarding type of plants suitable for plantation in the selected village Gawar having sandy soil and water scarcity, nine plants were recommended. The plants under preferred category were *Acasianilotica* (Babool), *Melia composita* (Bakain), *Prosopis cineraria* (Khejari), *Azadirachta indica* (Neem) and *Tecomella undulate* (Rohida) while *Thespesia populaneai* (Bhindi tree) and *Pongami apinnata* (Papri) were reported as under least preferred category. Print media in the form of leaflet was developed and distributed to be used as a reference material. Plant saplings were distributed for actual plantation of the trees/plants to the respondents.

RESULTS AND DISCUSSION

Majority of rural women 80.0 per cent were in the age group 30-40 years of age (92.0%) belonged to higher caste, cent per cent were married,76.4 per cent educated up to 10th class, 85.0 per cent had exposure to TV.

Plants recommended by experts: Expert opinion from the Department of Forestry was sought regarding type of plants suitable for plantation in the selected village Gawar. Due to sandy nature of the soil and scarcity of water for irrigation in the village, nine plants viz: *Acacia nilotica* (Babool), *Melia composita* (Bakain), *Thespesia populaneai* (Bhindi tree), *Eucalyptus tereticornis* (Safeda), *Prosopis cineraria* (Khejari), *Ailanthus excelsa* (Mahaneem), *Azadirachta indica* (Neem), *Pongami apinnata* (Papri) and *Tecomella undulate* (Rohida) were recommended by the experts for plantation in the village.

Preferential choice of the respondents for recommended plants: Data in Table 1 indicated that *Eucalyptus tereticornis* (Safeda) and *Ailanthus excelsa* (Mahaneem) plants were most preferred by the respondents. Eucalypts plantation can be used as a management tool for the restoration of degraded forest lands (Gil *et al.* 2010). Further, Hailemicael (2012) accounted that Eucalypts gives superior and versatile benefits

Table 1: Preferential choice of the respondents for recommended plants (n=20)

Plant	Most preferred (3)	Preferred (2)	Least preferred (1)	Weighted score	Weighted Mean score	Overall Preferential pattern
Acasia nilotica (Babool)	2	14	4	38	1.90	Preferred
Melia composita (Bakain)	6	8	4	38	1.90	Preferred
Thespesia populaneai (Bhindi tree)	2	8	10	32	1.60	Least Preferred
Eucalyptus tereticornis (Safeda)	11	9	—	51	2.55	Most Preferred
Prosopis cineraria (Khejari)	3	17	—	43	2.15	Preferred
Ailanthus *excelsa* (Mahaneem)	8	12	0	48	2.4	Most Preferred
Azadirachta indica (Neem)	5	15	-	45	2.25	Preferred
Pongami apinnata (Papri)	-	13	7	33	1.65	Least Preferred
Tecomella undulate (Rohida)	3	11	6	37	1.85	Preferred

(least preferred 1.00-1.66, preferred 1.67-2.33, Most preferred 2.33-3.0)

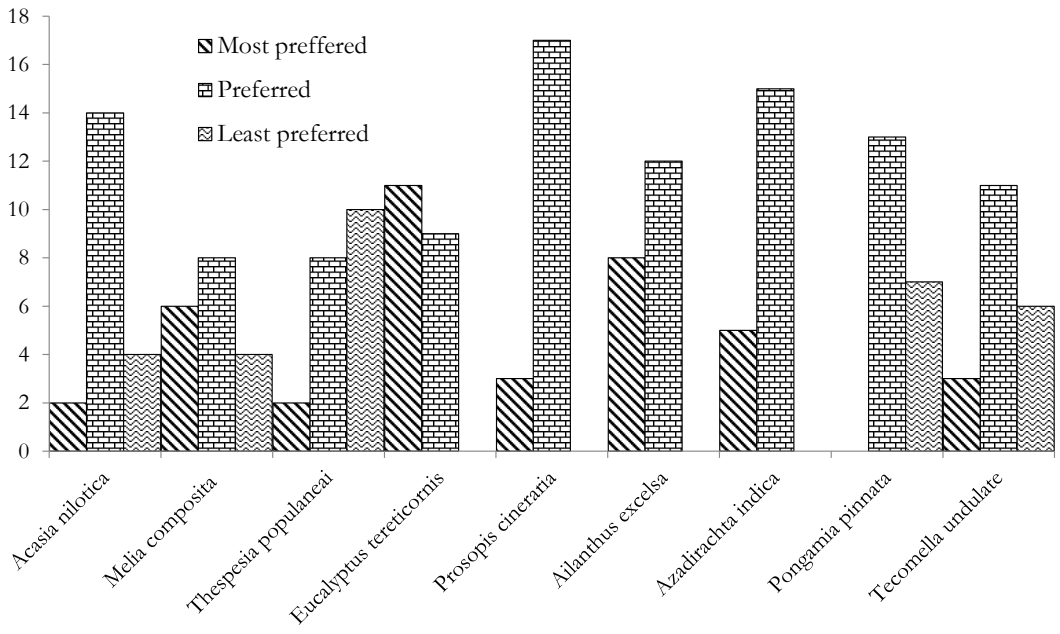


Figure 1: Preferential choice of the respondents for recommended plants (n=20)

compared to many other tree species due to the fact that farmers often choose to plant eucalyptus, particularly smallholders in tropical and subtropical regions. Eucalyptus trees have been planted in farm boundaries for multiple purposes such as fuelwood, timber, as a cash crop, boundary demarcation, fencing, soil and water conservation, and increasing crop yield (Kidanu 2004). The plants under preferred category were *Acasia nilotica* (Babool), *Melia composita* (Bakain), *Prosopis cineraria* (Khejari), *Azadirachta indica* (Neem) and *Tecomella undulate* (Rohida) while *Thespesia populaneai* (Bhindi tree) and *Pongami apinnata* (Papri) were reported as under least preferred category. Yadav *et al.,* (2008) reported that *P. cineraria* as a leguminous tree has importance in improving soil fertility through fixing atmospheric nitrogen. In this study they found that litter fall production for *P. cineraria* and decomposition rate were considered the highest comparing with other arid trees, and that build up soil organic matter contents under its canopy, increase soluble calcium and available phosphorus and decrease soil pH. Similar findings were also reported by (Gates *et al.* 1988) who stated that *P. cineraria* is widely used for sand dune stabilization program because of it is deep mass root system which enable plant not to compete with others for moisture and nutrients.

General awareness of the respondents regarding environmental pollution: Majority (75.0%) of the respondents were aware about meaning of environmental pollution in general. With respect to awareness about types of environmental pollution, it was found that majority of the respondents had awareness about air (75.0%) and water (60.0%) pollution, however, comparatively less number of them were aware of soil (30.0%) and noise pollution (10.0%). Dirr (1990) reported that *Ailanthus excels* was found most adaptable and pollution tolerant tree to mitigate climate change. This species found to be very much compatible and adapted to harsh arid ecosystem is one of the main species which act as an integrated component in farming systems of farmers, and especially during the drought (Jat *et al.,* 2011). They further stated that *Ailanthus excels* could be one of the important tree species (MPTS) for the drought period and in arid ecosystem to sustain the productivity of sheep and goats and other animals, and secure livelihoods pastoralists and farmers. Bayle (2019) reported that Eucalypts species are one of the best tree species since they are fast growing and can fix more CO_2 by the process of photosynthesis, thereby serving as a carbon sink.

Table 2: General awareness of the respondents regarding environmental pollution (n=20)

Aspects of awareness	Frequency (%)
Meaning of 'environmental pollution'	15 (75.0)
Types of environmental pollution	
Air pollution	15 (75.0)
Water pollution	12 (60.0)
Soil pollution	6 (30.0)
Noise pollution	2 (10.0)

Maximum (50.0%) respondents perceived transportation as the cause of environmental pollution followed by agricultural practices (45.0%), disposing waste into water bodies (35.0%), emission of smoke and deforestation (25.0% each), population growth (15.0%) and means of entertainment (10.0%). Results are in line with the study by Sharma *et al.* (2018) who also elaborated that respondents were somewhat aware that pollution, burning of paddy straw and deforestation were major causes of climate change. None of the respondents perceived social and religious practices as a cause for environmental pollution as they were not aware of this fact.

Table 3: Perception of the respondents regarding causes of environmental pollution (n=20)

Cause	Frequency (%)
Means of transportation	10 (50.0)
Agricultural practices	9 (45.0)
Disposing waste into water bodies	7 (35.0)
Emission of Smoke	5 (25.0)
Deforestation	5 (25.0)
Population growth	3 (15.0)
Means of entertainment	2 (10.0)
Social and religious practices	–

Environmental education through training: Environmental education is all about being conscious of the environment around us. Environmental awareness is classified into two aspects: perception of environmental problems and behavioral inclination to protect the environment. The perception is the people should have knowledge of environment and their issues. The behavior inclination is to protect the environment which further includes two major aspects: firstly, the value of environmental protection in people minds which indicated by the balance between environmental protection and economic development and also the willing to pay for the protection of the environment; secondly, attitudes about participating in the environmental protection. Considering all these things in mind trainings was planned for rural women. The print media in the form of leaflets were developed and distributed to rural women as reference material for future.

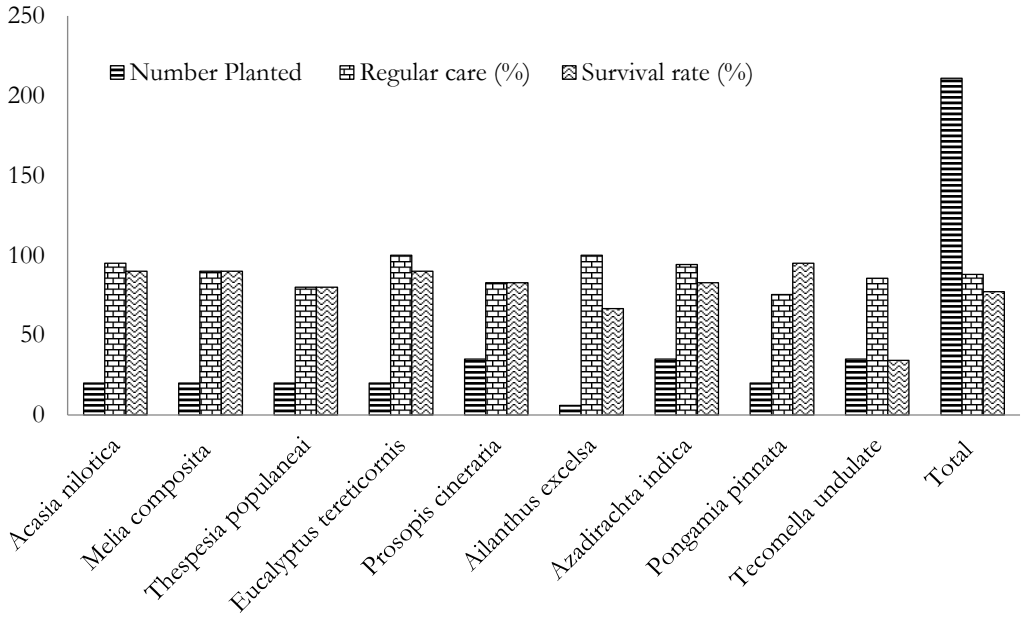
Training cum lecture demonstration for rural women was organised after assessing their awareness regarding environmental pollution and preferential pattern for the recommended plants. In order to motivate them and to create awareness plant saplings were distributed among the rural women for environment conservation and participatory approach was followed. The results are supported by Barman *et al.* (2016) who found that the trainings could motivate farmers for adopting the modern techniques in order to get more production and farm income per drop of water. Further he elaborated that majority of the trainees (73.33%) had medium level of adoption of recommended practices of water management followed by high level of adoption with 14.6 per cent of the respondents.

Plantation, care and survival of plants: As per availability of the plants with the department of Forestry, total 211 plant saplings of nine plants were distributed among the respondents. Maximum plant saplings were of *Prosopis cineraria* (Khejari), *Pongami apinnata* (Papri) and

Table 4: Plantation, care and survival of plants (n=211)

Name of the plant/tree	Number of planted	Regular care (%)	Survival rate (%)
Acasianilotica (Babool)	20	19 (95.0)	18 (90.0)
Melia composita (Bakain)	20	18 (90.0)	18 (90.0)
Thespesia populaneai (Bhindi tree)	20	16 (80.0)	16 (80.0)
Eucalyptus tereticornis (Safeda)	20	20 (100.0)	18 (90.0
Prosopis cineraria (Khejari)	35	29 (82.8)	29 (82.8)
Ailanthus excelsa (Mahaneem)	6	6 (100.0)	04 (66.6)
Azadirachta indica (Neem)	35	33 (94.2)	29 (82.8)
Pongamia pinnata (Papri)	20	15 (75.5)	19 (95.0)
Tecomella undulate (Rohida)	35	30 (85.7)	12 (34.2)
Total	**211**	**186 (88.1)**	**163 (77.2)**

Figure 2: Plantation , care and survival of plants (n=211)



Tecomella undulate (Rohida) plants (35 each) were distributed. It was ensured that each respondent get at least one plant sapling of *Acasianilotica* (Babool), *Melia composita* (Bakain), *Thespesia populaneai* (Bhindi tree), *Eucalyptus tereticornis* (Safeda) and *Pongami apinnata* (Papri). Minimum numbers of *Ailanthus excelsa* (Mahaneem) plants were distributed due to non availability.

Regular care of all *Eucalyptus tereticornis* (Safeda) and *Ailanthus excelsa* (Mahaneem) plants and majority of the rest seven plants was observed. Overall 88.1 per cent plants were being looked after regularly. Survival rate of *Acacia nilotica* (Babool), *Melia composita* (Bakain), *Thespesia populaneai* (Bhindi tree), *Eucalyptus tereticornis* (Safeda), *Prosopis cineraria* (Khejari), *Azadirachta indica* (Neem) and *Pongami apinnata* (Papri) plant was 82 to 95 per cent, however, 66.6 per cent *Ailanthus excelsa* (Mahaneem) plants survived. Survival rate of *Tecomella undulate* (Rohida) plant was minimum as only 34.0 per cent plants survived.

The reasons cited by the respondents for non survival of plants were: damage by animals, lack of irrigation facilities, high temperature, lack of timely care, poor quality of sapling.

CONCLUSION

Involving women in protecting the environment would help societies develop the sense of responsibility needed to maintain a good balance between humans and the earth's resources. Now-a-days we don't live in the environment which is serene or stable but much rather becoming unrecognizable and diminishing before our eyes. The plants, trees, flowers, birds, beautiful animals, and various other life forms are created for us to enjoy its beauty are now becoming slowly extinct. Thus there is need to protect and preserve them. There are various problems which the environment is facing today. Environmental awareness is the initial step ultimately leading to the ability to carry on responsible citizenship behavior. Environmental awareness on the other hand is "to understand the fragility of our environment and the importance of its protection".

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Effectiveness of Training Programme for Changing Farmers' Perceived Behavior Towards Adoption of Improved Agricultural Practices

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ABSTRACT

In order to know the effectiveness of training for desired changes among the trainees behaviour evaluation of effectiveness of training is essential. Keeping in this view, the study was planned to evaluate the effectiveness of farmers training. The effectiveness of training programme has been operationalized as the manner and extent to which training has influenced the behaviour of trainee farmers. The desirable change in farmers' behaviour was the focus of the study and it was measured by Behaviour Change Index (BCI), prepared by compiling the three essential part of behaviour *i.e.* Knowledge, Skill and Attitude. Correlation and Step wise multiple regression was also done to predict an outcome variable from several predictor variables. Cross validation of the model was done through adjusted R^2 using the following Steins formula. It was found that there is significant difference in three components of behaviour as a consequence of training. The perceived skill was found highly significant which may be due to incorporation of intense field oriented practical sessions in the trainings. For further inquisition eleven training aspects were considered as feedback from the trainee farmers and were recorded in five point continuum. It was revealed that as per farmers response relevancy of course content was ranked first with the mean score 4.09 followed by quality of practical field training (4.04), and adequate information provided in training as third (3.97). To be effective, training should have convey the knowledge in such way seeming very easy to trainee farmers but not compromising with information adequacy.

Keywords: Hill agriculture, Multiple regressions, Training impact, Vegetable productivity

INTRODUCTION

In this twenty first century Indian agriculture has been confronted by several problems such as scarcity of irrigation water, menace of wild animal, shortage of labour (Mukherjee, 2015) growing inter-farm as well as inter-regional disparity, low productivity and unequal household income (Mukherjee and Maity, 2015) as a combined effect of climate change and globalization. Most of the developing countries are experiencing paradigm shift from subsistence agriculture to commercialised agri-business (Mukherjee *et al.,* 2012) and from more resource intensive crops like winter rice to less resource using and remunerative vegetables (Maity *et al.,* 2013). These maladies have imposed critical implications on the farming community. Hill and mountain are one of the most important agro-ecosystem that supports life of half of the mankind directly or indirectly. The three hilly states of North West Himalaya *viz.*, Jammu and Kashmir (J&K), Uttarakhand (UK) and Himachal Pradesh (HP) of North India play a crucial role in ecology and economy of Indian agriculture. It covers ~10 per cent of total land area and ~20 per cent of population. Agriculture is the backbone of hill economy and performing an important role in livelihood security. Although as per as the production is concerned these states are far behind than other states of

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India. To increase the production level, the productivity of agricultural crops has to be increased and to increase the productivity of crop; the adoption of improved technology is a pre–requisite (Kher *et al.,* 2005; Yadav *et al.,* 2011). There is a wide yield gap in productivity of different crops in different states of India. The hilly states like Himachal Pradesh, Jammu and Kashmir and Uttarakhand are very low in productivity as compared to the plains. Other than topographical and infrastructural constraints lack of technological know-how is the most sombre constrain hindering the enhancement of productivity of these region. Although there is no dearth of improved hill crop production technologies but major problem is transfer of skills. Delivering technology is much easier than changing attitude and enhancing skills for adoption of best management practices. Adoption of innovation depends upon its influence of the technology on potential adopters (Prasad and Katteppa, 2005). Farmers' attitude which is operationalised as the degree of positive or negative feeling of farmers towards the technology determines adoption of improved technology (Chilonda and Van Huylenbroeck, 2011). Favourable attitude is essential for acceptance of any scientific innovation (Kanwat *et al.,* 2011). A systematically arranged training programme helps in bringing desirable changes in the attitude of farmers. Training is an empowerment process of creating awareness, imparting knowledge and capacity building leading to larger participation for better decision making (Punia *et al.,* 2007).

Keeping the importance of training in view the scientists of ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan (VPKAS), Almora developed three days training courses and organizing stake holder training with special focus to hill farmers regularly on off season vegetable cultivation, seed production, organic farming, natural resource management for hill crops, Improved production technologies, postharvest management, Integrated Pest Management, marketing and value chain. In three years 54 such training has been conducted in which more than 1500 hill farmers have been trained (Table 1). These trainings were sponsored by different funding agencies and encompass a lot of human as well as financial resources. Therefore, these training programmes need to be evaluated time to time in order to know the effectiveness of training in bringing desired changes among the trainees behaviour, to identify the gaps for refinement. In order to know the effectiveness of training in bringing desired changes among the trainees behaviour evaluation of impact of training is required. Keeping in this view, current study was planned to know the effectiveness of training in bringing desired changes in hill farmers' behaviour.

MATERIALS AND METHODS

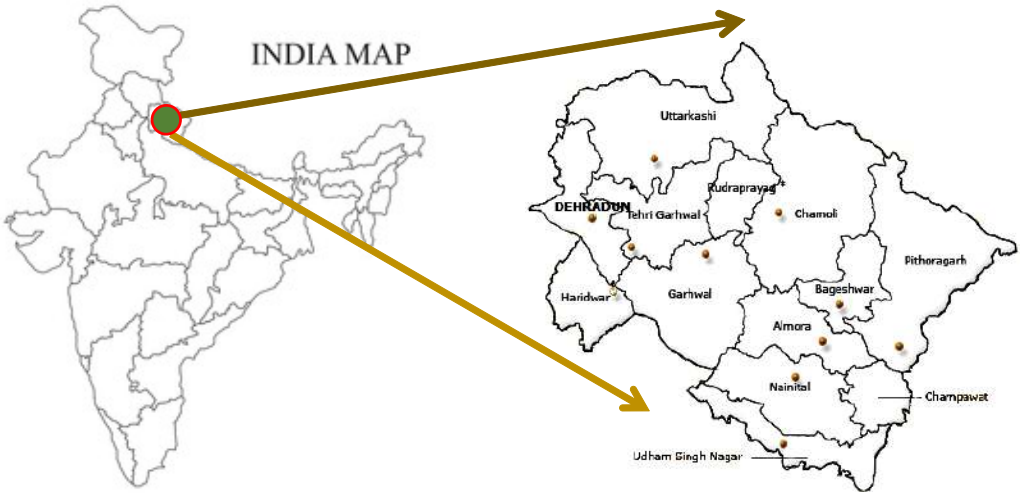
The Study was done on four training programmes conducted during 2014-15 on improved production technologies for hill crops for hill farmers of Uttarakhand (Figure 1). Duration of these courses was three days each in which ten lectures and four practical sessions with a farmers field visit was conducted. There were 110 farmers participants for the training. These trainees were taken as respondents for this study. Although due to incomplete response 14 respondents' data has been rejected and finally the analysis was carried out on 96 farmers.

In this study effectiveness of training programme has been operationalized as the manner and extent to which training has influenced the behaviour of trainee farmers. To measure the effectiveness different activities and methods in which training was imparted, were selected as indicators. Effectiveness of training was measured in term

Table 1: List of three days hill farmers trainings conducted in last three years

Training area	2013	2014	2015	Trainee farmers
Seed production techniques	2	2	2	176
Improved production technologies for hill crops	7	5	7	557
Organic farming	1	0	5	257
Off season Vegetable cultivation	4	2	3	264
Natural resource management	2	1	2	142
Postharvest technology	0	1	2	86
IPM and pest management	2	1	0	72
Total	**18**	**12**	**24**	**1554**

Figure 1: Study area Uttarakhand



of percentage gain in knowledge, skill and attitude which culminates the behaviour, level of satisfaction of trainees, usefulness of the topics covered and overall grading of training. A well-structured questionnaire was made containing the variables and it was administered to respondent before and after the conduct of training.

Gain in knowledge was measured by use of a well-structured knowledge test containing multiple choice questions on improved hill crop production technologies. In that knowledge test battery 15 knowledge items were there. The difficulty index was ranges from 43 to 79, discrimination index (0.242 to 0.606) and point-biserial correlation coefficient was 0. 268. The reliability of the knowledge test was measured by Kuder-Richardson Formula 20 and reliability coefficient was 0.654.

Behaviour Change Index (BCI): The desirable change in farmers' behaviour was the focus of the study and it was measured by Behaviour Change Index (BCI), prepared by compiling the three essential part of behaviour *i.e.* Knowledge, Skill and Attitude. For measuring the knowledge, a structured knowledge test was prepared and validated. For measuring perceived skill, a pre tested interview schedule was prepared and farmers' attitude towards improved cultivation techniques was measured by using attitude scale of Chandra *et al.* (2007) prepared on the context of hill farmers with suitable modifications. The formula of BCI is as follows:

$$BCI = \frac{\text{Score obtained}}{\text{Maximum obtainable score}} \text{ X } 100$$

$$BCI = \sum_{i=1}^{3} \{\left(\frac{SOxi}{MOSi}\right)/n\} * 100$$

Where,

SO = score obtained;

MOS = maximum obtainable score;

N = no of variable 3 (i.e. Knowledge, perceived skill and attitude towards improved cultivation techniques)

X1 represents knowledge;

X2 represents perceived skill and

X3 represents attitude towards improved cultivation techniques.

The effective ness of various aspects from training programe was assessed by selecting eleven variables *viz.* easy understanding, immediate usefulness, relevancy of course contents, adequate information provided in training, timeliness of training, quality of practical field training, clarification of doubts and queries during training, style of teaching, quality of AV Aids used, environment for encouraging discussion and training duration. Association of changes in behaviour with these aspects of training was calculated.

Correlation and Step wise multiple regression was done to predict an outcome variable from several predictor variables. Cross validation of the model was done through adjusted R^2 using the following steins formula.

Steins formula:

Adjusted R^2= [1-(n-1/n-k-1) (n-2)/n-k-2) (n+1/n)] (1-R^2)

RESULTS AND DISCUSSION

The general information about the trainee farmers are depicted in the Table 2. It was found that the majority of the training was male (91.7%) and only 8.3 per cent trainee was female. About 54 per cent trainees had undergone

Table 2: Basic information about the trainees

Variables	Frequency (%)	Mean (SD)	Minimum	Maximum	SE
Gender					
Male	88 (91.7)				
Female	8 (8.3)				
Previous training experience					
Yes	52 (54.2)				
No	44 (45.8)				
Association with group					
Yes	34 (35.4)				
No	62(64.6)				
Age (years)		41.18 (11.76)	21.00	65.00	1.20
No of years in schooling (years)		9.4 (3.76)	4.00	17.00	0.38
Land holding (Nali)		39.43 (17.21)	16.00	71.00	1.75
Irrigated (Nali)		15.49 (6.41)	6.00	26.00	0.65
Rain-fed (Nali)		23.94(11.50)	10.00	51.00	1.17
Farming experience (years)		24.25(12.06)	3.00	44.00	12.06

Note: SD- Standard Deviation; SE- Standard Error; Nali is local unit of land measurement denoted as (1 Nali = 200 meter square; 50 Nali= 1 hectare)

other trainings previously whereas 45.8 per cent trainees had not undergone any training before. Majority of the farmers (64.6%) had not associated with any groups although 35.4 per cent had associations with NGO, SHG and other farmers groups. The mean age of the whole group was recorded as 41.18 years in which the majority of the trainee was found more than 35 years. The average years of schooling was founded 9.4 years the land holding was recorded in *Nali,* the local measurement denoted as 200 metres square. It was found that the average land holding of a trainee was 39.43 *Nali* (~0.79 ha) although there was large deviation of landholding found among the farmers. As per the analysis depicted in Table 2 it was found that ~40 per cent of land was irrigated. Farming experience of the whole group was found ~24 years which indicate that the farmers are well experienced in hill agricultural settings.

The Components of behaviour i.e. knowledge in improved hill agricultural practices, farmers perceived skill and attitude towards improved cultivation practices were measured before and after the training is depicted in Table 3. It was found that there is significant difference in three components of behaviour. The perceived skill was found highly significant may be due to incorporation of intense field oriented practical sessions in the trainings.

Based on overall behaviour score the trainee-farmers were classified in to five category (Table 4) and it was found that majority of the trainee farmers had shifted from less effective (40.6%) and effective (54.1%) category to effective (30.2%) and highly effective (69.8%) category as consequence of the training programme. This indicates about the essence of effectiveness of training. For further inquisition eleven training aspects were considered as feedback from the trainee farmers and were recorded in

Table 3: Changes in components of behaviour due to the training (n=96)

Components of behaviour	Pre training		Post training		t value
	Mean	SD	Mean	SD	
Knowledge in improved hill agricultural practices	2.78	1.01	4.24	0.62	13.88*
Perceived skill	6.92	1.45	11.11	1.93	19.96**
Attitude towards improved cultivation practices	22.86	4.25	28.43	4.91	10.829*

Note: SD- Standard Deviation * and ** denotes significance at 5% and 1% level respectively

Table 4: Classification of trainee based on overall behaviour (n=96)

Criteria	Pre training	Post training
Very less effective (0-20%)	3 (3.1%)	0 (0%)
Less effective (21-40%)	39 (40.6%)	3 (3.1%)
Effective (41-60%)	52 (54.1%)	29 (30.2%)
Highly Effective (61-80%)	2 (2.08%)	67 (69.8%)
Very highly Effective (81-100%)	0 (0%)	0 (0%)

five point continuum as score 1 for very less effective, 2 for less effective, 3 for medium, 4 for high and finally 5 for very highly effective (Table 5). It was revealed that as per farmers response relevancy of course content was ranked first (mean score 4.09) followed by quality of practical field training (mean score 4.04), and adequate information provided in training as third (3.97). It may be due to the rigorous need assessment of farmers during the first interaction (micro lab) session and incorporation of the feedbacks in subsequent training programmes. The institute has been imparting training from long back, the course content, time schedule, subjects to be covered are incorporated efficiently as per farmers (trainees) expectation.

The timeliness of the training program was ranked 4th with mean score value of 3.91 followed by the style of teaching (3.80) and immediate usefulness of content (3.72). These may be due to due to the design and schedule of training program conducted by the institutes are planned before the stating of crop season. Trainings are scheduled in such manner that the knowledge can be utilised immediately after the completion of training directly in the field. The crops are also selected to talk over in training are based on the regional importance in hill area. As far as the style of teaching is concerned the trainers generally taking the lectures with supplementary photographs, videos and live samples for better comprehension and understanding. As per farmers response all these training aspects were found in a range of 3.43 to 4.09, indicates all the aspects are medium to highly effective.

To know the association of different training aspects with changes in farmers' behaviour correlation study was carried out and it was found that seven out of eleven variables *viz.* easy understanding of contents, immediate usefulness of content, adequate information provided in training, timeliness of training, relevancy of course content, quality of Practical field training and quality of AV Aids used was found significantly associated (Table 6). None of the variable was found negatively correlated with changes in farmers' behaviour. The findings are similar with the findings of Sharma *et al.* (2017) which indicated that the training intervention offered was both necessary and timely, had a beneficial impact on the farmers behaviour change.

Further the step wise multiple regression method was conducted to predict an outcome variable (changes in trainee's behaviour) from several predictor variables (aspects of training). The model ends in two steps which included easy understanding of contents and adequate information provided in training (Table 7).

The R^2 value of the model is 0.824 indicates that 82.40 per cent of variation in farmers' behaviour could be explained by 2 independent variables. The Cross validation

Table 5: Effectiveness of different aspects of training programme (n=96)

Training aspects	Very less	Less	Medium	High	Very high	Mean	SD	Rank
Easy understanding of contents	7	15	29	27	18	3.58	1.17	VIII
Immediate usefulness of content	0	7	41	20	28	3.72	0.97	VI
Adequate information provided in training	0	7	26	26	37	3.97	0.97	III
Timeliness of training	0	7	30	24	35	3.91	0.98	IV
Relevancy of course content	0	1	30	24	41	4.09	0.88	I
Quality of Practical field training	0	2	33	20	41	4.04	0.93	II
Clarification of doubts and queries during training	0	12	39	37	8	3.43	0.82	X
Style of teaching	2	3	24	51	16	3.80	0.83	V
Quality of AV Aids used	0	20	19	38	19	3.58	1.04	VIII
Environment for encouraging discussion	2	17	24	37	16	3.50	1.04	IX
Duration of training	0	6	32	44	14	3.68	0.80	VII

Table 6: Association of different training aspects with changes in farmers' behaviour

Training aspects	r
Easy understanding of contents	0.895**
Immediate usefulness of content	0.636**
Adequate information provided in training	0.832**
Timeliness of training	0.797**
Relevancy of course content	0.727**
Quality of Practical field training	0.735**
Clarification of doubts and queries during training	0.086
Style of teaching	0.171
Quality of AV Aids used	0.386**
Environment for encouraging discussion	0.161
Duration of training	0.103

Note: ** denotes significance at 1% level

Table 7: Stepwise multiple regression of changes in farmers behaviour with aspects of training

Model	Regression coefficient (b)	Std. error	β
Step 1			
(Constant)	0.038	0.010	
Easy understanding of contents	0.055	0.003	0.89**
Step 2			
(Constant)	0.006	0.013	
Easy understanding of contents	0.041	0.005	0.67**
Adequate information provided in training	0.020	0.006	0.27**

Note: R^2 = 0.802 in step 1; δ R^2= 0.824 in step 2; ** indicates p<.001; tolerance 0.298;

of the model was done through adjusted R^2 using Stain's formula the value was 0.814 indicates a considerable amount of validity. For the current model the VIF values are all well below 10 i.e. 3.36 and the tolerance statistics is above 0.2 i.e. 0.298 therefore indicates there is no collinearity within the data.

$$Y = 0.006+0.041\ X_1+0.020X_2$$

Where, Y indicates desirable behaviour change;

X_1 – ease of understanding of course content;

X_2 - adequate information provided in training.

This study found that training can significantly influence the behaviour towards adoption of improved practices of vegetable farming. The results of this study also corresponded to Leeuwis (2004) who stated that there was a positive shift in behavior, as demonstrated by the adoption of the skills and innovations in training programmes. Desirable changes in trainees behavioral, according to Kirkaptrick (2006), can be defined as the degree to which a person's behavior has changed as a result of training. In this study we found major shift in perceived behavioural changes before and after the training.

Our findings are in line with Dijkxhoorn *et al.* (2016) who also found trainings are important for enhancing farmers' knowledge and practices. They used the Theory of change as base for assessing the behavioural changes among the farmers in the Cirebon area, Java, Indonesia. The success of an intervention depends on the logic and relevance of the theory of change articulated in the specific context and how that is carried out. They also recommended the importance of ease of understanding of course content as important point to be considered. Williams (2013) indicated that when instructional aids such as demonstrations and multimedia presentations were employed and technologies learnt in their farms improved, farmers understood better. They were therefore able to improve their cultivation methods. The study was conducted in hilly region its topography varies considerably encapsulating an array of challenges and environment that is different from the other farming area. While only 96 farmers were part of the study, they nevertheless captured the breadth of the farmers training system.

CONCLUSION

From the study it can be concluded that an effective training can impart desirable changes in farmer's behaviour by increasing knowledge, developing skills and changing attitude positively towards improved cultivation practices. To be effective, training should have convey the knowledge in such way seeming very easy to trainee farmers but not compromising with information adequacy. Easy understanding of contents, immediate usefulness of content, adequate information provided in training, timeliness of training, relevancy of course content, quality of practical field training are the important parameters which play an important role in changing farmers behaviour.

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Cost Effective Two Level Factorial Run Orders for Agricultural Experimentation

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ABSTRACT

Sustainable agriculture systems over the long term satisfies human food, enhances environmental quality, sustain the economic viability of farm operations and thus enhance the quality of life for farmers and society as a whole. Agricultural experimentations over the years are the backbone of sustainable developments and the importance of agricultural experiments are still increasing day by day as the observable phenomena is affected by a combination of several factors. Here factorial experiments plays a crucial role. In the present article, the concept of factorial run order where randomization of the experiment is difficult due to the presence of costly factors in the experiment has been discussed. These factorial run orders can be effective in reducing the cost of the experiments when the experiments involved costly factors.

Keywords: Hard-to-change factors, Minimal cost, Minimum level changes, Multifactor experiment, Run orders

INTRODUCTION

Sustainability in agricultural systems is a global problem today. Sustainable agriculture systems over the long term satisfies human food, enhances environmental quality, sustain the economic viability of farm operations and thus enhance the quality of life for farmers and society as a whole. One of the most important challenges facing humanity today is to conserve or sustain natural resources, including soil and water for increasing food production while protecting the environment. As the world population grows, stress on natural resources increases, making it difficult to maintain food security. Long term food security requires a balance between increasing crop production, maintaining soil health and environmental sustainability. It thus need continuous science based interventions in agricultural technology based on observation of natural phenomena. Science based experimentation in the area of agriculture can thus pave the way of achieving the goal of sustainable developments. Day by day the importance of agricultural experiments is increasing rapidly towards achieving the goal of sustainable development as the observable phenomena not only affected by a single factor or source of variation but also a combination of several factors. Here lies the role of factorial experiments. In statistical terminology, factorial experiment is a particular type of multifactor experiments which are having profound applications in many field of agricultural research. Research findings based on results obtained from the multifactor agricultural experiments are getting rapid momentum for achieving the goal of sustainable developments as factorial experiments not only allow us to study the effect of individual factors but also it helps us in getting a clear cut idea about how two or more factors interact with each other. It is always desirable to randomly execute the factorial run orders of any multifactor experiment to make the observation independent in order to get a valid estimate of the error by minimizing the bias which will ultimately increase the precision of the experiment. However, if proper randomization is carried out during the planning stage of multifactor experiment, the experimenter may witness a large number of factor level changes which ultimately make the experimentation expensive particularly if the experiment involves hard-to-change factors (where changing the levels of factors are difficult due to the cost structure of factors involved in such experiments or due to operational procedure). Consider the following is an experimental situation:

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Experimental situation [Bhowmik *et al.,* 2020]: "In an experiment of soil microbial diversity (community level physiological profiling) through BIOLOG ecoplates with the purpose of identifying the best treatment, three factors were tried *viz.* (i) CO_2 [Two levels: Elevated CO_2 and Ambient CO_2], (ii) Fertilizer (Two levels: Organic and Inorganic) and (iii) Variety [two wheat varieties]. It was known in advance that changing the levels of CO_2 was very expensive. Therefore, if randomization was done on the level combinations, it would have increase the cost of the experiment to a great extent since the experiment involved hard-to-change factors. In this situation, use of a factorial design where the number of factor level changes remains small, is advisable".

The number of factor level changes is a matter of great concern to experimenters in different agricultural, post-harvest and processing, engineering and industrial research as in such experiments it may be physically very difficult to change levels of some factors. In such situations one should try to have factorial run orders where total number of factor level changes vis-a-vis the cost of the experiment is minimum. A lot of work is available in literature in that aspects [see for reference Cox (1951), Draper and Stoneman (1968), Dickinson (1974), De León *et al.* (2005), Correa *et al.* (2009), Correa *et al.* (2012), Hilow (2013), Bhowmik *et al.* (2015) Varghese *et al.* (2017), Bhowmik et al. (2017), Oprime *et al.* (2017), Varghese *et al.* (2019), Bhowmik *et al.* (2020), Pureza *et al.* (2020) etc.]. Here, we have discussed the concept of factorial run order with minimum number of level changes viz cost of the experiment in the context of two level factorial experiments. These run orders will serve the purpose of minimizing the cost of the experiment and thus will be very effective for those experiments which involved costly factors.

MATERIALS AND METHODS

The number of changes in factor levels has significant impact on costs and effort for carrying out an experiment especially when a great amount of effort is required in changing the levels of a factor or when it is necessary to wait a certain amount of time or for some other reasons. The minimum number of factor wise level changes is attained when only one factor level is changed on two successive experimental trials. In other words, one can have a minimal cost factorial run order with minimum number of level changes when only one sign is changed by passing from one row to the next in the design matrix. If there are k factors with i^{th} factor is having s_i levels for $i = 1, 2, ..., k$, then the total number of level changes for the $\prod_{i=1}^{k} s_i$ factorial design will be $\left(\prod_{i=1}^{k} s_i\right) - 1$ i.e. one less than the total number of runs. Hence, for a 2^k factorial run order i.e. for *2*-level factorial with k number of factors, minimum number of changes will be 2^k-*1*.

RESULTS AND DISCUSSION

Base on the above principle, following are some two level factorial run orders with minimum number of level changes. All these run order will minimize the cost of the experimentations when the experiments involved costly or difficult to-change factors.

Table 1[(a) -(d)]: Four different minimal cost 2^2 factorial run order with minimal level changes [presence of letters indicate the higher levels of the factors with *(1)* indicate the lower levels of all the factors]

(a)	***A***	***B***	**Run Order**
	-1	*-1*	*(1)*
	-1	*1*	*b*
	1	*1*	*ab*
	1	*-1*	*a*
	Factorwise level changes		
	1	***2***	
(b)	***A***	***B***	**Run Order**
	-1	*-1*	*(1)*
	1	*-1*	*a*
	1	*1*	*ab*
	-1	*1*	*b*
	Factorwise level changes		
	2	***1***	
(c)	***A***	***B***	**Run Order**
	1	*-1*	*a*
	1	*1*	*ab*
	-1	*1*	*b*
	-1	*-1*	*(1)*
	Factorwise level changes		
	1	***2***	
(d)	***A***	***B***	**Run Order**
	1	*1*	*ab*
	-1	*1*	*b*
	-1	*-1*	*(1)*
	1	*-1*	*a*
	Factorwise level changes		
	2	***1***	

2^2 Factorial run order with minimum number of level changes: For a 2^2 factorial one can have a total of 4! = 24 number of run orders out of which there will be 8 run orders where total number of changes are minimum. All these 8 run orders will minimize the cost of the experiments particularly when the experiment involved hard-to-change factors. For a minimally changed 2^2 factorial run order i.e. for a minimally changed factorial run order with two factors each are having two number of levels, the total number of level change is *3*. Following are some 2^2 factorial run order with minimum number of level changes. In all the following run orders, the factor wise levels changes are 2 and 1 respectively in different permutation.

2^3 Factorial run order with minimum number of level changes: 2^3 factorial experiments where there are three factors each are having two number of levels are very commonly used in agricultural experiments. For a 2^3 factorial one can have a total of 8! = 40, 320 number of run orders out of which there will be 144 run orders where total

Table 2[(a)-(f)]: Six different minimal cost 2^3 factorial run order with minimal level changes [presence of letters indicate the higher levels of the factors with *(1)* indicate the lower levels of all the factors]

(a)	***A***	***B***	***C***	**Run Order**
	-1	*-1*	*-1*	*(1)*
	-1	*-1*	*1*	*c*
	-1	*1*	*1*	*bc*
	-1	*1*	*-1*	*b*
	1	*1*	*-1*	*ab*
	1	*1*	*1*	*abc*
	1	*-1*	*1*	*ac*
	1	*-1*	*-1*	*a*
	Factorwise level changes			
	1	***2***	***4***	

(b)	***A***	***B***	***C***	**Run Order**
	1	*1*	*-1*	*ab*
	1	*1*	*1*	*abc*
	1	*-1*	*1*	*ac*
	1	*-1*	*-1*	*a*
	-1	*-1*	*-1*	*(1)*
	-1	*-1*	*1*	*c*
	-1	*1*	*1*	*bc*
	-1	*1*	*-1*	*b*
	Factorwise level changes			
	1	***2***	***4***	

(c)	**A**	**B**	**C**	**Run Order**
	1	*-1*	*1*	*ac*
	1	*1*	*1*	*abc*
	1	*1*	*-1*	*ab*
	1	*-1*	*-1*	*a*
	-1	*-1*	*-1*	*(1)*
	-1	*-1*	*1*	*c*
	-1	*1*	*1*	*bc*
	-1	*1*	*-1*	*b*
	Factorwise level changes			
	1	***3***	***3***	

(d)	**A**	**B**	**C**	**Run Order**
	-1	*-1*	*-1*	*(1)*
	-1	*-1*	*1*	*c*
	-1	*1*	*1*	*bc*
	-1	*1*	*-1*	*b*
	1	*1*	*-1*	*ab*
	1	*-1*	*-1*	*a*
	1	*-1*	*1*	*ac*
	1	*1*	*1*	*abc*
	Factorwise level changes			
	1	***3***	***3***	

(e)	**A**	**B**	**C**	**Run Order**
	-1	*-1*	*-1*	*(1)*
	-1	*1*	*-1*	*b*
	-1	*1*	*1*	*bc*
	1	*1*	*1*	*abc*
	1	*1*	*-1*	*ab*
	1	*-1*	*-1*	*a*
	1	*-1*	*1*	*ac*
	-1	*-1*	*-1*	*c*
	Factorwise level changes			
	2	***2***	***3***	

(f)	**A**	**B**	**C**	**Run Order**
	1	*-1*	*-1*	*a*
	-1	*-1*	*-1*	*(1)*
	-1	*-1*	*1*	*c*
	-1	*1*	*1*	*bc*
	-1	*1*	*-1*	*b*
	1	*1*	*-1*	*ab*
	1	*1*	*1*	*abc*
	1	*-1*	*1*	*ac*
	Factorwise level changes			
	2	***2***	***3***	

Table 3[(a),(b)]: Two different minimal cost 2^4 factorial run order with minimal level changes [presence of letters indicate the higher levels of the factors with *(1)* indicate the lower levels of all the factors]

(a)	***A***	***B***	***C***	***D***	**Run Order**
	-1	*-1*	*-1*	*-1*	*(1)*
	-1	*-1*	*-1*	*1*	*d*
	-1	*-1*	*1*	*1*	*cd*
	-1	*-1*	*1*	*-1*	*c*
	-1	*1*	*1*	*-1*	*bc*
	-1	*1*	*1*	*1*	*bcd*
	-1	*1*	*-1*	*1*	*bd*
	-1	*1*	*-1*	*-1*	*b*
	1	*1*	*-1*	*-1*	*ab*
	1	*1*	*-1*	*1*	*abd*
	1	*1*	*1*	*1*	*abcd*
	1	*1*	*1*	*-1*	*abc*
	1	*-1*	*1*	*-1*	*ac*
	1	*-1*	*1*	*1*	*acd*
	1	*-1*	*-1*	*1*	*ad*
	1	*-1*	*-1*	*-1*	*a*
	Factorwise level changes				
	1	***2***	***4***	**8**	
(b)	***A***	***B***	***C***	***D***	**Run Order**
	-1	*-1*	*-1*	*-1*	*(1)*
	1	*-1*	*-1*	*-1*	*a*
	1	*-1*	*-1*	*1*	*ad*
	1	*-1*	*1*	*1*	*acd*
	1	*1*	*1*	*1*	*abcd*
	-1	*1*	*1*	*1*	*bcd*
	-1	*1*	*1*	*-1*	*bc*
	-1	*1*	*-1*	*-1*	*b*
	-1	*1*	*-1*	*1*	*bd*
	1	*1*	*-1*	*1*	*abd*
	1	*1*	*-1*	*-1*	*ab*
	1	*1*	*1*	*-1*	*abc*
	1	*-1*	*1*	*-1*	*ac*
	-1	*-1*	*1*	*-1*	*c*
	-1	*-1*	*1*	*1*	*cd*
	-1	*-1*	*-1*	*1*	*d*
	Factorwise level changes				
	4	***2***	***4***	**5**	

number of changes are minimum. All these 144 run orders will minimize the cost of the experiments particularly when the experiment involved hard-to-change factors. For a minimally changed 2^3 factorial run order the total number of level change is *7* which is one less than the total number of runs i.e. *8*. Out of the 144 run orders for a 2^3 factorial experiments with minimum number of level changes, there are 12 possible combinations where total number of change is 7 i.e. (1, 2, 4), (1, 4, 2), (2, 1, 4), (2, 4, 1), (4, 1, 2), (4, 2, 1), (1, 3, 3), (3, 1, 3), (3, 3, 1), (2, 2, 3), (2, 3, 2) and (3, 2, 2) respectively [Here numbers in brackets indicates factorwise number of level changes]. First 6 combinations are occurring 8 number of times each and remaining 6 combinations are occurring 16 number of times each. Each distinct combinations with factorwise level changes as (1, 2, 4), (2, 2, 3) and (1, 3, 3) in different permutations are coming 48 number of times. Following are some 2^3 factorial run order with minimum number of level changes. In all the following run orders, the factorwise levels changes are 2 and 1 respectively in different permutation.

2^4 Factorial run order with minimum number of level changes: For a 2^4 factorial one can have a total of 16! = 2.092279×10^{13} number of run orders. The number of minimally changed run orders are also large in number. For a minimally changed 2^4 factorial run order the total number of level change is *15* which is one less than the total number of runs i.e. *16*. Following are some minimally changed 2^4 factorial run order:

CONCLUSION

Agricultural experiments now a days are getting visibly importance due to continuous pressure of population growth, continuous depletion of natural resources, changing climatic scenario etc. Findings of agricultural experiments based on different factorial combinations can pave the way for sustainable developments. Multifactor experiments may witness great challenge when experiments involved costly factors for which levels are very difficult to change as randomization in such scenario although minimize the bias but may increase the cost of the experiments. In such situations, the minimally changed factorial designs (where the number of level changes are minimum) as discussed in the present article may be a valid alternative. However, the analysis remains a matter of concern due to lack of proper randomization of run orders. One approach in this direction is to use randomization tests to identify significant factor levels, but the total number of possible randomizations is likely to

be very small. Alternatively, an Analysis of Covariance (ANCOVA) type of models by considering the influence of time trend as a covariate may be a feasible solution. Beside, use of split plot type of model for analysis by taking the difficult-to-change factor as main plot factor may be another possible alternative although in such situations only sub plot factor and main plot-sub plot interaction effects will be estimated with more precision.

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Farmers' Perception towards Accessibility to Quality Seed: A Case of Wheat and Green Gram

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ABSTRACT

Quality seed contributes about 15-20 per cent of the total agricultural production, which can be raised when other management practices are put into good use. Accessibility to quality seed has remained a challenge in many developing and under-developed countries, due to production and distribution of scrupulous seed. The study was conducted in purposely selected states of Haryana and Uttar Pradesh to gauge the farmers' perception towards quality seed of wheat and green gram. The study found out that Haryana respondents recorded a *higher quality seed accessibility rate* as compared to those from U.P. Thus, efforts may be made to have good quality check if all available seed sources and subsidized seed may be provided to farmers of low-income group and small and marginal farmers. Understanding how farmers acquire their seed is a major step in the process of growing a seed sector this also aids marketers come up with progressive seed marketing strategies that will boost vast seed accessibility.

Keywords: Accessibility, Farmers' perception, Haryana, Quality seed, Uttar Pradesh

INTRODUCTION

The agrarian enterprise uses a number of inputs with seed being the prime. Seed contain the part of the plant that germinates and subsequently grows in to new plants. It is estimated that the direct contribution of quality seed alone is 15-20 per cent, which when coupled with efficient crop management practices can rise to 45 per cent (Agarwal *et al.,* 2016). Before the establishment of any formal seed industries and before the green revolution, farmers used their own farm-saved seed, exchanged among farming communities or bought from the local markets to meet their seed demands (Manjunatha *et al.,* 2015).

As the green revolution evolved, high yielding varieties of crops and hybrids were developed and distributed to farmers, hence the dependence on using their farm-saved seed greatly reduced. This great shift to commercially produced seed is what yielded the accessibility crisis. Seed accessibility can the studied in various aspects including: timeliness in availability, physical availability in desired quantities, proximity of seed source, seed source credibility, price of seeds, use of improved cultivar, physical and genetic purity of purchased seed, physical and genetic purity of farm saved seed, crop performance and records keeping and documentation (Manjunatha *et al.,* 2015). India's seed industry, though ranked fifth largest in the world and serving as the major seed hub for South East Asia, still faces a challenge of seed accessibility to its farmers (Nath and Biswas, 2011; Shashikant *et al*., 2011 and Singh *et al.* 2013).

MATERIALS AND METHODS

The *ex-post facto* research design was adopted for the study. Two states, Haryana and Uttar Pradesh (UP) were selected purposely for the study. Two districts from each state were selected namely: Palwal and Fatehpur of Haryana and Uttar Pradesh respectively. Further from each district, one block was selected Prithla and Telyani of Haryana and Uttar Pradesh respectively. A cluster of 3 villages were selected randomly from each block i.e. Dadhota, Kidhwari and Khajurka villages of Haryana and Bastapur, Kandhia and Panthua villages of Uttar Pradesh. From each cluster, 60 respondents were selected randomly. The total sample size for the study was 120 respondents. Primary data (both

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qualitative and quantitative) was collected using pre-tested interview schedules. In order to validate the primary data, focused group discussions were conducted with the respondents. Accessibility to quality seed is defined as the extent to which a farmer can easily get quality seed, of the desired cultivar, from a credible source, with a reasonable price in the right quantities and quality, and for which the farmer can use for crop production and get projected returns. To measure this, the Accessibility Index (AI) developed by Manjunatha (2015) was used with seven parameters including: availability in adequate quantities, timeliness in availability, proximity to source, seed purity, crop performance, credibility of source and price of seed.

Each parameter was measured using a five-point rating scale of appropriate levels, after which the mean, S.D, Range, mean difference were worked out separately for farmers in the two states to understand the variation in seed accessibility in the states. Composite scores were calculated for each respondent farmer, and based on their scores, they were categorized into 5 levels of accessibility i.e., very low, low, medium, high or very high. t-test was then applied for each of the 7 parameters and composite scores at 0.01 and 0.05 level of probability to check for any differences between farmers in Haryana and Uttar Pradesh.

RESULTS AND DISCUSSION

The results of farmers' perception to seed accessibility in the states of Haryana and Uttar Pradesh are as discussed below.

Availability in adequate quantities: This was operationalized as the ease with which farmers can access the seed they desire in the amounts they need. This was measured on a five-point rating scale of '*adequate quantity', 'adequate but must be procured early', 'moderate', 'scarce', 'very scarce'* and were scored as 5, 4, 3, 2, and 1 respectively. The results are as presented in Table 1.

The Farmers' perception towards seed availability in *adequate quantities* by Haryana and UP respondents is presented in Table 1, which shows the mean difference in availability in adequate quantities of seed between UP and Haryana being 0.26 and was statistically significant (at 0.05 level of probability). This indicated that the differences in availability of seed in adequate quantities were considerable. The data revealed that, most of the farmers enjoyed *availability of seed* in adequate quantities only if they procured the seed early. Notably, there was not much difference in the percentages of seed available in *adequate quantities* in both states. Only 8.3 per cent of Haryana farmers and 21.7 per cent of Uttar Pradesh farmers experienced moderate difficulty in accessing seed in adequate quantities.

Timeliness in availability: Was operationalized as the ease with which farmers can access seed, in desired amounts, whenever they need them. It was measured on a five-point rating scale of *'well in advance', 'available before 15 days of sowing', 'available within 3 days of sowing', 'late'* (when sowing season is in full swing), *'very late'* (available at the end of the sowing season) and were scored as 5, 4, 3, 2, and 1 respectively.

Table 1: Farmers' perception towards Seed Availability in Adequate Quantities

Availability in adequate quantities	Haryana (n=60)		Uttar Pradesh (n=60)	
Mean	4.26		4	
S.D.	0.6069		0.6638	
Range	3-5		3-5	
Mean difference	0.2667			
't'-test value	1.9804*			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Adequate quantity	21	35	13	21.7
Adequate but must be procured early	34	56.7	34	56.6
Moderate	5	8.3	13	21.7
Scarce	0	0	0	0
Very scarce	0	0	0	0
Total	60	100	60	100

*Significant at 0.05 level of probability

Table 2: The Farmers' perception towards Timeliness in Seed Availability

Timeliness in availability	Haryana (n=60)		Uttar Pradesh (n=60)	
Mean	4.13		3.65	
S.D.	0.65		0.70	
Range	3-5		2-5	
Mean difference	0.4833			
't'-test value	1.9804**			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Well in advance	17	28.3	4	6.7
Available before 15 days of sowing	34	56.7	35	58.3
Available within 3 days of sowing	9	15	17	28.3
Late (when sowing season is in full swing)	0	0	4	6.7
Very late (available at the end of the sowing season)	0	0	0	0
Total	60	100	60	100

**Significant at 0.01 level of probability

The Farmers' perception towards t*imeliness in seed availability* by Haryana and UP respondents are presented in Table 2, which revealed that a larger percentage of farmers in Haryana perceived that they got seed well in advance (28.3%) as compared to those in UP (6%). This maybe attributed to the fact that some of the villages that were studied in Haryana were adopted by IARI and hence the perceived *timeliness in availability of seed* was observed, and also diffusion of innovations could have led to the other villages accessing the seed well in advance before the planting season. The *timeliness in availability* in UP was not that bad as only 6.7 percent of farmers perceived that they have accessed seed late when the growing season was in full swing.

The mean difference in *timeliness in availability of seed* between UP and Haryana was 0.4833 and was statistically significant (at 0.01 level of probability). This indicates that the differences in *timeliness in availability* were considerable.

Proximity to source: Was operationalized as the distance to be covered before the respondent acquires seed or how far the seed shops are from where the respondent resides and was measured on a 5-piont rating scale of '*locality/ village', 'nearby block/town', 'district headquarters', 'select cities/ towns', 'cities far away'* scored as 5, 4, 3, 2, and 1 respectively.

From the results in Table 3, the mean perceived distance for farmer respondents in Haryana villages was 3.86 and it ranged from 3 to 5. A cursory look at the frequency distribution revealed that the distribution was highly skewed towards perceived close *proximity* of seed source with 60 per cent farmers could procure it from nearby areas. In case of UP farmers, the mean perceived distance was 3.68 and it ranged from 2 to 5. The frequency distribution revealed that the distribution was highly skewed towards perceived close *proximity* of seed source with only 46.7 per cent of farmers in UP could access the same from the neighbouring blocks and towns. A smaller percentage of UP farmers (5%) had to go to select cities and towns in order to access the required seed.

The mean difference in *proximity* of source of quality seed between the farmers in Haryana and UP was found to be statistically insignificant. This shows that there were no differences in farmers' perception to *proximity of seed source*.

Seed purity: Was operationalized as the standards that a farmer attaches to a particular seed and was measured on a 5-point rating scale of '*purest', 'pure', 'moderately pure', 'less pure',' not at all pure'* and scored as 5, 4, 3, 2, and 1 respectively

As presented in Table 4, the mean perception towards *seed purity* of farmer respondents in Haryana villages was 3.81 and its score ranged from ranged from 3 to 5. Standard deviation being at 0.65 also indicated that these farmers were widely dispersed on their perception about seed purity. A higher percentage of farmers from Haryana considered the seed they used as *purest* (13.3%) and *pure* (55%). This may be attributed to the fact that some of villages under study are IARI adopted villages and hence they perceived to have access to good quality seed. In case of UP farmers, their mean perception towards *seed purity*

Table 3: The Farmers' perception towards Proximity to seed source

Proximity to source	Haryana (n=60)		Uttar Pradesh (n=60)	
Mean	3.86		3.68	
S.D.	0.62		0.77	
Range	3-5		2-5	
Mean difference	0.1834			
't'-test value	1.9811^{NS}			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Locality/village	8	13.3	8	13.3
Nearby block/town	36	60	28	46.7
District headquarters	16	26.7	21	35
Select cities/towns	0	0	3	5
Cities far away	0	0	0	0
Total	60	100	60	100

^{NS} Not Statistically Significant

Table 4: The Farmers' perception towards Seed purity

Seed purity	Haryana (n=60)		Uttar Pradesh (n=60)	
Mean	3.81		3.41	
S.D.	0.65		0.59	
Range	3-5		2-4	
Mean difference	0.4			
't'-test value	1.9804**			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Purest	8	13.3	0	0
Pure	33	55	28	46.7
Moderately pure	19	31.7	29	48.3
Less pure	0	0	3	5
Not at all pure	0	0	0	0
Total	60	100	60	100

**Significant at 0.01 level of probability

was 3.41, while its score ranged from 2 to 5. The frequency distribution revealed that none of the farmer from UP perceived the seed they used as *purest* and while 46.7 per cent and 48.3 per cent considered them as *pure* and *moderately pure*. The mean difference in seed purity between UP and Haryana was 0.4 and was statistically significant (at 0.01 level of probability). This indicates that the differences in seed purity were considerable.

Crop performance: Was defined as the confidence in them for a bountiful harvest that a farmer places on the seed they grow. It was measured on a five-point rating scale of '*very good', 'good', 'moderate', 'poor', 'very poor',* and were scored as 5, 4, 3, 2, and 1 respectively.

It was apparent from the Table 5, the farmers from Haryana rated their *crop performance* due to perceived purity of seed as very good (10%) while majority of respondents i.e., 48.3 per cent respondents rated crop performance as *good* and 41.7 percent respondents rated crop performance as *moderate*. On the other hand, in UP villages majority of farmers rated their *crop performance* as *good* (51.7%) to *moderate crop performance* (45%) with only 3.3 per cent of them perceived *poor crop performance* that they attributed it to the quality of seed.

The mean difference in *crop performance* due to perceived purity of seed between the farmers in Haryana and UP was found to be statistically insignificant. This shows that

Table 5: The Farmers' perception towards crop performance

Crop performance	Haryana (n=60)		Uttar Pradesh (n=60)	
Mean	3.6833		3.4833	
S.D.	0.6507		0.5672	
Range	3-5		2-4	
Mean difference	0.2			
't'-test value	1.9806^{NS}			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Very good	6	10	0	0
Good	29	48.3	31	51.7
Moderate	25	41.7	27	45
Poor	0	0	2	3.3
Very poor	0	0	0	0
Total	60	100	60	100

^{NS} Not Statistically Significant

Table 6: The Farmers' perception towards Credibility of Seed Source

Credibility of source	Haryana (n=60)		Uttar Pradesh (n=60)	
Mean	3.68		3.45	
S. D	0.6507		0.5945	
Range	3-5		2-5	
Mean difference	0.2333			
't'-test value	1.98044*			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Highly credible	6	10	2	3.3
Credible	29	48.3	24	40
Somewhat credible	25	41.7	33	55
Less credible	0	0	1	1.7
Least credible	0	0	0	0
Total	60	100	60	100

*Significant at 0.05 level of probability

there were no differences in crop performance due to perceived purity of seed between the two states.

Credibility of source: Was operationalized as the trustworthiness a farmer accords to a seed provider and was measured on a 5-piont rating scale of '*highly credible', 'credible', 'somewhat credible', 'less credible', 'least credible'* and scored as 5, 4, 3, 2, and 1 respectively

The results in Table 6 indicate that the mean score value of respondents from Haryana in perceived *credibility of seed source* was 3.68 which was lesser compared to the mean score value 3.45 of respondents of UP. Majority of respondents of Haryana villages perceived as *credible* (48.3%) followed by 41.7 per cent perceived as *somewhat credible*. Only 10 per cent perceived seed source as *highly credible*. In case of respondents from UP villages, majority of farmers perceived seed sources as *somewhat credible* followed by 40 perceived the seed source as *credible* and *highly credible* (3.3%).

Thus, it may be concluded that most of the farmers in Haryana placed a higher trust in the seed providers/ source as compared to those in UP. This is because in UP most of the farmers get their seed from private seed shops which are at times may be unreliable or exploit them financially, as there are very less government shops selling seed there and also a smaller number of farmers/farmer

groups producing seed. Most of the farmers from Haryana get their seed from IARI or local seed producers who they really trust. The mean difference in *credibility of source* between UP and Haryana was 0.4 and was statistically significant (at 0.05 level of probability). This indicates that the differences in credibility of seed source were considerable.

Price of seed: Was operationalized as the monetary value attached to a particular seed and was measured on a 5-piont rating scale of '*affordable', 'moderately expensive', 'costly', 'very costly', 'beyond reach'* and scored as 5, 4, 3, 2, and 1 respectively

It can be seen from the results in Table 7 that in Haryana, only 3.3 per cent of the farmers felt the seed were *very costly* with 60 percent of them claiming that seed were *costly* and only 6.7 per cent of them perceived that the seed were *affordable*. On the other hand, 13.4 percent of farmers in UP perceived seed being *very costly*, majority (55%) of the felt that seed were *costly*, with only 8.3 percent of them being comfortable with the prices of seed as *affordable*.

The mean difference in *price of seed* between the farmers in Haryana and UP was found to be statistically insignificant. This shows that there were no major

Table 7: The Farmers' perception towards price of Seed

Price of seed	**Haryana(n=60)**		**Uttar Pradesh (n=60)**	
Mean	3.4		3.2667	
S. D	0.6689		0.7997	
Range	3-5		2-5	
Mean difference	-0.1333			
't'-test value	1.9809^{NS}			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Affordable	4	6.7	5	8.3
Moderately expensive	18	30	14	23.3
Costly	36	60	33	55
Very costly	2	3.3	8	13.4
Beyond reach	0	0	0	0
Total	60	100	60	100

^{NS} Not Statistically Significant

Table 8: Distribution of respondents on the overall scores of accessibility to quality seed

Accessibility to quality seed	**Haryana**		**Uttar Pradesh**	
Mean	26.85		24.95	
S. D	2.56		2.58	
Range	22-33		18-30	
Mean difference	1.9			
't' test value	1.9802**			
Categories	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Very low	0	0	0	0
Low	0	0	3	5
Medium	39	65	47	78.3
High	21	35	10	16.7
Very high	0	0	0	0
Total	60	100	60	100

** Significant at 0.01 level of probability

Table 9: Summary of the differences in mean values of scores of accessibility to quality seed by farmers in Haryana and Uttar Pradesh

Parameter	Mean value		Mean difference	't' value	Significance
	Haryana	Uttar Pradesh			
Availability in Adequate Quantities	4.26	4	0.2667	1.9804	*
Timeliness in Seed Availability	4.13	3.65	0.4833	1.9804	**
Proximity to seed source	3.86	3.68	0.1834	1.9811	NS
Seed purity	3.81	3.41	0.4	1.9804	**
Crop performance	3.6833	3.4833	0.2	1.9806	NS
Credibility of Seed Source	3.68	3.45	0.2333	1.98044	*
Price of Seed	3.4	3.2667	0.1333	1.9809	NS
Composite score	26.85	24.95	1.9	1.9802	**

Note: ** Significant at 1%, *Significant at 5%, NS=Not Significant

differences in price of seed. This parameter was highly influenced by the economic status of the respondents.

Composite Score of Accessibility to Quality Seed: Owing to the wide variations displayed by the respondents from both states i.e., Haryana and UP, a composite score was then calculated for each respondent so as to enable the categorization of respondents into five major groups of quality seed accessibility namely very low, low, medium, high and very high. The results are presented below in Table 8.

As presented in Table 8, the composite scores on accessibility of quality seed revealed that majority of the respondents from both states perceived 'medium accessibility' to quality seed. In Haryana, none of the respondent perceived seed accessibility as *very low* or *low* and this can be attributed to the fact that some of the villages under study were IARI adopted villages and hence a higher seed accessibility was recorded. The majority (65%) of the respondents from Haryana perceived a *medium level* of seed accessibility with 35 per cent of them perceived a *high seed accessibility*.

Among respondents of UP villages, majority (78.3%) of respondents perceived *medium* accessibility to quality seed, while 16.7 per cent of them perceived *high accessibility* to quality seed. Only 5 per cent of the respondents from UP had perceived *low seed accessibility*.

The mean scores of farmers from Haryana and UP on all parameters of accessibility to quality seed were tested for their statistical significance using t-test and are presented in Table 9. The difference in overall (composite) seed accessibility in both Haryana and UP was statistically significant at ($p<0.01$). There was no statistically significant difference between the farmers of Haryana and UP with respect to variables such as proximity to seed source, crop performance and price of seed. The difference was statistically significant with respect to variables such as timeliness in availability of seeds and seed purity ($p<0.01$); and Availability in Adequate Quantities and Credibility of Seed Source ($p<0.05$). The difference between expected yield and actual yield realized by farmers in Haryana was higher when compared to the farmers of UP.

CONCLUSION

The overall composite scores on accessibility of quality seed revealed that most of the respondents from both states experienced 'medium accessibility' to quality seed. In both Haryana and UP most of the farmers enjoyed availability of seed in adequate quantities only if they procured the seed early. Only 8.3 per cent of Haryana farmers and 21.7 per cent of Uttar Pradesh farmers experienced moderate difficulty in accessing seed in adequate quantities. The Farmers' perception towards timeliness in seed availability by Haryana and UP respondents reveal that a larger percentage of farmers in Haryana perceived that they got seed well in advance (28.3%) as compared to those in UP (6%). Though with a narrow difference, Haryana farmers were found to be closer to their seed sources as compared to those of UP. A higher percentage of farmers from Haryana considered the seed they used as pure and have better crop performance. This may be attributed to the fact that some of villages under study are IARI adopted villages and hence they could have access to good quality seed. Majority of respondents of Haryana villages perceived as credible while

respondents from UP villages perceived seed sources as somewhat credible. Farmers from UP complained of higher seed prices as they mostly sourced their seed from private companies, whose prices are not subsidized. The difference in overall (composite) seed accessibility in both Haryana and UP was statistically significant at ($p<0.01$). It can therefore be concluded that the respondents from Haryana had better seed accessibility than those from UP, evident from the high mean scores too.

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Effectiveness of Public and Private Extension Service Organization in Delivering Advisory Services in Meghalaya

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ABSTRACT

A study was conducted in Ri-Bhoi district of Meghalaya and two organizations KVK, Ri-Bhoi, Umsning block as public extension organization and RRTC, Umran block as private extension organization were selected randomly for the purpose of the study. The data were collected from randomly selected 120 farmers through structured interview schedule. The perceived effectiveness of extension advisory services was assessed in terms of extension delivery, yield and income, change in behaviours as a result of adoption of improved technology and found that majority of the farmers' perceived *change in awareness* was most important contributor towards perceived effectiveness of KVK, Ri-Bhoi. The perceived effectiveness in terms of change in awareness has showed the highest index value with 0.92, followed by effectiveness in term of change in yield and income with index value of 0.84. The least contributor for perceived effectiveness of the FAS of KVK, Ri-Bhoi was extent of delivery with 53.3 per cent of the farmers rated it in low category. The perceived change in terms of awareness of the technologies by the farmers has the highest index score of 0.86, followed by changes in terms of satisfaction of the farmers with index score of 0.85 in RRTC. Overall perceived effectiveness of delivering FAS for KVK, Ri- Bhoi was found more effective than RRTC.

Keywords: Effectiveness, Extension services, Farm advisory services, Factors affecting

INTRODUCTION

Agricultural extension and advisory services (AEAS) refers to any organization in the public or private sectors that facilitates farmers' and other rural actors' access to knowledge, information and technologies, and their interactions with other actors; and assists them to develop their own technical, organizational and management skills and practices, so as to improve their livelihoods and well-being.

Farm advisory services are important as it helps in educating farmers in innovation, crop yields, to protect environment and only 5 out of 43 per cent of women have access to extension services and an investment in extension yields on an average 40-60 per cent annual rate of return (GFRAS, 2012). It helps to obtain relevant information to solve their problem and provide skills and technologies to raise their standard of living. Agricultural advisory (extension) services are a vital element of the array of market and nonmarket entities and agents that provide critical flows of information that can improve farmers' and other rural peoples' welfare (Anderson, 2008).

There can be seen several extension service organisations from both public and private sector leading to pluralistic extension systems catering to the farmers' needs. An extension service includes all the activities involved in the exchange of information appropriate to agricultural, livestock production, processing and marketing. The key objectives of both the public and private sector extension organizations is more or less the same *i.e.,* enhancing the food production, ensuring the food and nutrition security and livelihood security of the rural people (Christoplos, 2003). Yet some differences can be noticed between them. While public sector extension organizations focused more on transfer of technology for achieving the food security of the nation, private sector extension organizations focused more on organizing the farm families and engaging themselves in socio-economic empowerment of famers mostly with mandate of donor agency. The

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public extension involves a professional body of agricultural experts to teach the improved method of farming, demonstration of the innovation, helps in organizing farmers meeting, training and organizing field days on a wide range of topic. Public extension, sometimes, acts as the channel to introduce and sometimes, acts as a mechanism to enforce policies in the agriculture.

Private sector provides services to farmers in accordance with their specialized incentives and in return farmers respond according to what they see as most beneficial to them. Private sector extension services focus is mainly on cash crops, or on sale of inputs (seeds, fertilizers, pesticides, machinery *etc.).* Private extension activities are vertically integrated enterprise. Some of the extension wings of non-government agencies use non-formal education techniques for teaching and training farmers. Yet, some other extension organizations adopt participatory extension and facilitation extension approaches in helping farmers to organise into farmers' groups (with similar resources and interest), such as farmer interest groups (FIGs) and/or self-help groups (SHGs) of poor rural women.

Public and private sector extension organizations differ in such aspects as nature, approach of the extension services, mode of operation, organizational structure, provision of various kinds of farm advisory services and their level of performance and impact on farmers' lives. So, it is imperative to assess how efficient are the two extension systems in terms of delivery of farm advisory services to the satisfaction of the farming community and functioning in catering to the needs of farmers. Thus an attempt was made to focus on the following research issues for empirical probing to analyze the effectiveness of extension service organization in delivering advisory services and factors affecting it.

MATERIALS AND METHODS

The study was conducted in Ri-Bhoi district of Meghalaya as very few studies have been conducted in North- East Hill region, Meghalaya's majority of population is tribal of which Khasis make the largest group and The Ri-Bhoi district was selected purposively as presence of many NGOs, ICAR Research Complex for NEH Region Post Graduate Institute (CAU), KVK are situated in this district. From the list available for FASs available in Ri-Bhoi district, two extension service organizations: KVK, Ri-Bhoi as Public sector extension service organization and RRTC a Non-Government organization as Private extension service organization were selected randomly to see their comparative performance. The data were collected from randomly selected 60 beneficiary and 60 non-beneficiary farmers through structured interview schedule.

The perceived effectiveness of extension advisory services was assessed in terms of extension delivery, yield and income, change in behaviors as a result of adoption of improved technology and process and their perceived usefulness and satisfaction for the farm advisory services received and used by them. A schedule was developed to measure the effectiveness of delivery of farm advisory services of extension service organization with regard to each of the effectiveness indicators to which numerical scores were assigned. It was measured with a three-point rating scale for each of the parameters. Adopter farmers of both extension service organizations were asked to state their rating on six components of effectiveness in delivery of farm advisory services and the data were analysed and the effectiveness component scores, and effectiveness index scores were computed.

$$EI = \frac{\text{Total obtained scores of all items} - \text{Minimum score}}{\text{Total maximum possible scores on all items} - \text{Minimum score}} \times 100$$

RESULT AND DISCUSSION

Effectiveness of Krishi Vigyan Kendra (KVK) in delivering farm advisory services: Adopted farmers of Public extension service organisation, i.e., KVK, Ri-Bhoi were asked to state their rating on six components of effectiveness in delivery of farm advisory services and the data were analysed and the effectiveness component scores and effectiveness index scores were computed. The frequency distribution of effectiveness scores is given in Table 1.

As can be seen from the data, majority of the farmers' perceived *change in awareness* was most important contributor towards effectiveness of KVK, Ri-Bhoi. As 63.3 per cent of farmers were in very high category and followed by high category (20%). Next two contributory factors towards perceived effectiveness were *change in yield and income* and *change in adoption* of technology. The least contributor for perceived effective of the FAS of KVK, Ri-Bhoi was *extent of delivery* with 53.3 per cent of the farmers rated it in low category. Patel and Patil (2020) concluded that farmers had a good perception towards

Table 1: Adopter Farmers' Perceived Effectiveness of delivery of FAS by KVK

Effectiveness of extension services organization indelivering FAS	Perceived Effectiveness of Adopter Farmers of KVK (n=30)					
	Extent of delivery	Change in awareness	Change in adoption	Change in yield and income	Change in behaviour	Level of satisfaction
Mean	0.58	0.92	0.80	0.84	0.79	0.80
Standard Deviation	0.19	0.119	0.159	0.13	0.1	0.12
Range (Min – Max)	0 - 1	0.62-1	0.43-1	0.55-1	0.55-0.95	0.64-1
V. Low (<0.5)	5(16.7)	0 (0)	1 (3.3)	0(0)	0(0)	0(0)
Low (0.5-0.65)	16(53.3)	2(6.7)	8 (26.7)	4(13.3)	5(16.7)	5(16.7)
Medium (0.65-0.78)	5(16.7)	3(10.0)	1 (3.3)	3(10.0)	4(13.3)	8(26.7)
High (0.78-0.92)	2(6.7)	6(20.0)	10 (33.3)	13(43.3)	19(63.3)	11(36.7)
V. high (>0.92)	2(6.7)	19 (63.3)	10 (33.3)	10(33.3)	2(6.7)	6(20.0)

KVK Training Centre as there were changes in their knowledge and skill.

The results from the Figure 1 showed the dimension-wise mean level of each effectiveness index score in the form of radar chart. From the diagram it appeared that the perceived effectiveness in terms of change in awareness has showed the highest index value with 0.92, followed by perceived effectiveness in term of change in yield and income with index value of 0.84. This showed that farmers' yield and income increase after the adoption of the technologies provided by KVK, Ri-Bhoi. The perceived effectiveness in term of change in extension delivery with the lowest index score of 0.58. Therefore, it may be inferred that there is need of improvement in terms of extension delivery in KVK, Ri-Bhoi, Meghalaya.

Effectiveness of Rural Resources Training Centre (RRTC) in delivering FAS: Adopter farmers of Private extension service organisation, *i.e.,* RRTC were asked to state their rating on six components of effectiveness in delivery of farm advisory services and the data were analysed and the effectiveness component scores and effectiveness index scores were computed. The frequency distribution of effectiveness scores is given in Table 2.

It is evident from the Table 2 the major contributors to perceived effectiveness of RRTC were *Level of satisfaction* and *Change in awareness* as 53.3 per cent of respondents were in very high category. *Change in behavior* was next contributor perceived for effectiveness of RRTC. Thus, it can be concluded that as farmers are highly aware of the technologies disseminated by RRTC that leads to change in behavior of the farmers and with high level of satisfaction as more than 53 per cent of the farmers are satisfied with the farm advisory services of RRTC. Likewise, in RRTC also has weakness in term of extent of delivery of the technologies as the index value was only 0.63, which also need lot of improvement in this

Figure 1: Radar chart showing overall effectiveness parameters of KVK

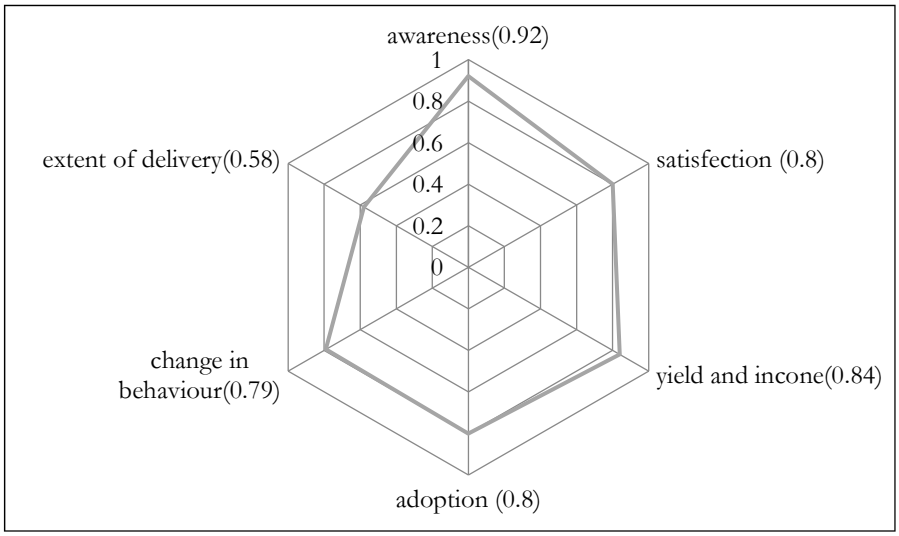

Table 2: Adopter Farmers' Perceived Effectiveness of delivery of FAS by RRTC

Effectiveness of extension services organization indelivering FAS	Perceived Effectiveness of Adopter Farmers of RRTC (n=30)					
	Extent of delivery	Change in awareness	Change in adoption	Change in yield and income	Change in behaviour	Level of satisfaction
Mean	0.63	0.86	0.72	0.67	0.82	0.85
Standard Deviation	0.22	0.182	0.121	0.19	0.15	0.198
Range (Min – Max)	0.18-1	0.36-1	0.35-9	0.33-1	0.36-1	0.29-1
V. Low (<0.4)	5(16.7)	1(3.3)	1(3.3)	5(16.7)	1(3.3)	1(3.3)
Low (0.4-0.58)	6(20.0)	1(3.3)	3(10)	2(6.7)	1(3.3)	2(6.7)
Medium (0.58-0.75)	7(23.3)	6(20.0)	14(46.7)	13(43.3)	9(30.0)	4(13.3)
High (0.75-0.93)	10(33.3)	6(20.0)	12(40.0)	8(26.7)	14(46.7)	7(23.3)
V. high (>0.93)	2(6.7)	16(53.3)	0(0)	2(6.7)	5(16.7)	16(53.3)

matter. Seepersad and Henderson (1984); Sulaiman and Sadamate (2000); Saravanan (2003) and Saravanan and Veerabhadraiah (2007) in their study stated that to identify the extension organization effectiveness indicators for delivering farm advisory services at different levels like level in input, level in extension activity, level in organizational and in practice change have been identified.

The results from the Figure 2 showed that change in terms of awareness of the technologies by the farmers has the highest index score of 0.86, followed by changes in terms of satisfaction of the farmers with index score of 0.85; this showed that farmers were satisfied with the FAS which were delivered by the RRTC. Likewise, in RRTC also has weakness in term of extent of delivery of the technologies as the index value was only 0.63, which also need lot of improvement in this matter.

Comparing the Means of Effectiveness of extension advisory services of KVK and RRTC: *T-test* is conducted to know whether there was any difference between the mean scores of six parameters in two organizations, KVK and RRTC. From the results in Table 3, it is evident that there was significant difference between the mean of KVK and RRTC on perceived changes in terms of *yield and income* of the farmers as the p-value was 0.00. There was also significant in perceived adoption of technologies by farmers at 0.5 level of significant and

Figure 2: Radar chart showing overall effectiveness parameters of RRTC

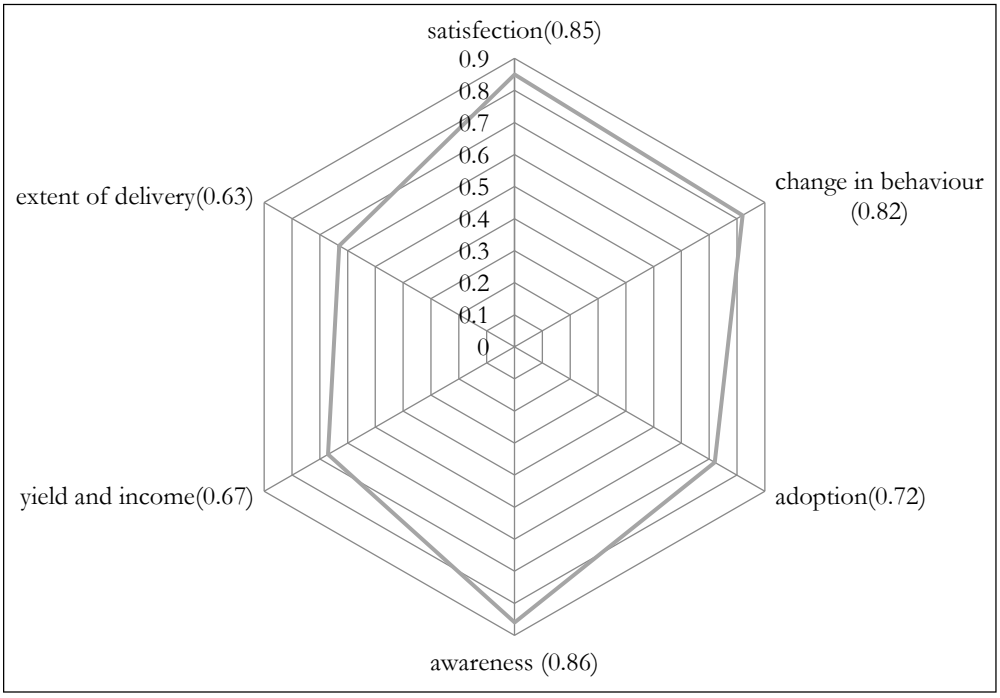

Table 3: Comparing KVK, Ri-Bhoi and RRTC in terms of effectiveness of extension advisory services

Variables	KVK mean	RRTC mean	Difference between means	t value	p-value
Extent of delivery	0.58	0.63	- 0.05	-1.082	0.284
Yield and income	0.84	0.67	0.17	4.00**	0.000
Awareness of technology	0.84	0.86	- 0.02	-0.503	0.617
Adoption of technologies	0.80	0.72	0.08	2.38*	0.020
Change in behaviour	0.79	0.82	- 0.03	-0.92	0.361
Usefulness and satisfaction	0.80	0.85	- 0.05	-1.011	0.316

positively correlated between the KVK and RRTC. We can conclude by saying that in KVK the mean value of perceived changes in terms of yield and income of the farmers is 0.84 which is considered more effective compared to RRTC with mean value of change in yield and income was 0.67.

Change in Adoption of technologies by farmers in KVK is also perceived better than RRTC as the mean value of change in terms of adoption of technologies was 0.80 in KVK and the mean value for RRTC was 0.72.

Table 4: Comparison of overall effectiveness index of KVK, Ri-Bhoi and RRTC

	KVK (n=30)		RRTC (n=30)	
Mean	0.794		0.764	
Standard deviation	0.79		0.76	
	Frequency	**%**	**Frequency**	**%**
V. low (<0.58)	0	0	4	13
Low (0.58-0.68)	1	3	1	3
Medium (0.68-0.77)	11	37	11	37
High (0.77-0.87)	15	50	12	40
V. high (>0.87)	3	10	2	7

From the Table 4 it is evident that the overall effectiveness index mean for KVK is 0.794 and the overall effectiveness index mean for RRTC is 0.764. In KVK, Ri-Bhoi, 50 per cent of the respondent fall under the effectiveness index score of high (0.77-0.87) and in RRTC, 40 per cent of the respondent fall under high (0.77-0.87) effectiveness index. From the overall results of the effectiveness index value, it can conclude by saying the perceived effectiveness of delivering FAS for KVK, Ri-Bhoi if found more effective than RRTC. Sahu *et al.* (2018) also opined that membership in organisation was positively related to the socio-economic upliftment of the people in the study area. The production, income and employment generated for the members were significantly higher in comparison to the non-members

Factors affecting the effectiveness of KVK, Ri-Bhoi and RRTC in delivering FAS: In order to find out the factors affecting effectiveness of KVK, Ri-Bhoi and RRTC, multiple regression analysis was done, and the results are given below:

Regression analysis for factors affecting the effectiveness of KVK, Ri-Bhoi: Multiple Regression analysis was done ascertain the predictors of effectiveness of KVK's delivery of farm advisory service. For this a regression equation was fitted keeping perceived effectiveness index scores as dependent variable with nine independent variables. The results showed that about 85 per cent of variance in dependent variable perceived effectiveness of KVK, Ri-Bhoi could be explained by the variables in the regression equation as can be seen from R^2 being 0.83, which is significantly different. Four variables were found to be significantly contributing to the effectiveness of KVK, Ri-Bhoi in delivery of farm advisory service. While age is positively contributing, thereby meaning that older people perceive that KVK's effectiveness is good. Education is found to be negatively affecting the effectiveness, thereby meaning that new entrants into farming with less farming experience look forward to services of KVK positively. Another interesting finding was observed to be that economic motivation of farmers was contributing positively to the effectiveness of KVKs' attempts at delivery of farm advisory services to its clients.

In analyzing the factors affecting the perceived effectiveness of ESO of RRTC sex is negatively affecting the effectiveness of the ESO at 0.05 level of significant. RRTC farmers' economic motivation was contributing positively to the effectiveness of RRTC in attempts at delivery of farm advisory services to its clients.

Table 5: Regression analysis of the perceived effectiveness of KVK, Ri-Bhoi

Model	Unstandardized coefficients		Standardized coefficients	t	P value
	B	Standard error	beta		
Constant	.538	.123		4.373	.000
sex	.023	.024	.112	.971	.344
Age	.004	.002	.332	2.332*	.031
Education	-.014	.007	-.228	-2.089*	.050
Occupation	.012	.014	.094	.875	.392
Land	-.002	.008	-.035	-.301	.766
Experience	-.004	.002	-.276	-2.336*	.031
Contact with ESO	.003	.004	.083	.767	.453
Level of aspiration	-.007	.010	-.092	-.715	.483
Achievement motivation	-.004	.011	-.037	-.352	.729
Economicmotivation	.042	.013	.448	3.342**	.003

R^2=0.83; F= 9.862; *significant at 0.05 level of probability; **significant at 0.01 level of probability

Table 6: Regression analysis of the effectiveness of RRTC

Model	Unstandardized coefficients		Standardized coefficients	t	P value
	B	Standard error	beta		
Constant	.695	.127		5.469	.000
sex	-.060	.027	-.250	-2.246*	.037
Age	-.001	.002	-.058	-.517	.611
education	.000	.005	-.010	-.095	.925
occupation	.000	.010	-.004	-.038	.970
Land	-.001	.019	-.007	-.064	.950
Experience	-.001	.002	-.074	-.605	.552
contact	-.008	.009	-.086	-.867	.397
Aspiration	-.003	.014	-.020	-.195	.847
Achievement	.003	.016	.019	.164	.871
Economic motivation	.075	0.014	.741	5.293**	0.000

R^2 = 0.847; F ratio = 10.5; df = 29; *significant at 0.05 level of probability; **significant at 0.01 level of probability

CONCLUSION

The farmers' perceived *change in awareness* was most important contributor towards perceived effectiveness of KVK, Ri-Bhoi as 63.3 per cent of farmers were in very high category followed by high category (20%). The perceived effectiveness in terms of change in awareness has showed the highest index value with 0.92, followed by effectiveness in term of change in yield and income with index value of 0.84. This showed that farmers' yield and income increase after the adoption of the technologies provided by KVK, Ri-Bhoi. The major contributors to perceived effectiveness of RRTC were Level of satisfaction, change in awareness and change in behavior Thus, it can be said that as farmers are highly aware of the technologies disseminated by RRTC that leads to change in behavior of the farmers and with high level of satisfaction as more than 53% of the farmers are satisfied with the farm advisory services of RRTC.

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The Impact, Governance Response and Adaptation Strategies: A Case Analysis of COVID-19 Lockdown in Marine Fisheries Sector of Kerala, India

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ABSTRACT

COVID-19 has profoundly impacted all areas of the global livelihoods and food system. The case is not different in marine fisheries sectors. Little is explored about the perceived impact it has created on earning, saving, spending patterns, and adaptation strategies among the fisherfolk. Therefore, this paper assesses the impact of COVID-19 lockdown on the livelihood supporting activities, adaptation strategies, and associated social security governance responses in the marine fisheries sector of Kerala. The study also highlights how a pandemic turned into an opportunity for a governance mechanism to have new interventions and how people perceived it.

Keywords: Adaptation, COVID-19, Fisheries, Governance, Response, Strategies

INTRODUCTION

The COVID-19 pandemic has steered to an existential threat for millions of people due to the loss of their livelihoods (WHO, 2020). It has created devastating disruptions in all walks of life, including the food system, education system, public health, and world of work. Though the post-COVID period is pronounced as a new normal, the normality is not relatively easy to attain. Following the cases of other nations, the India government ordered a nationwide lockdown for 21 days on 24th March 2020. Subsequently, it has been extended to 17th May 2020 in three different spells. The confinement measures and restrictions brought in the wake of lockdown have induced loss of access to livelihood assets and social protection among the people. Though central and state governments have announced different relief packages, many people who depend on agriculture and related fields underwent agonies in many ways (Nathan *et al.,* 2020; Avtar *et al.,* 2021). Kerala is one of India's maritime states, where the fisheries, especially the marine fisheries, are one of the most important livelihoods with a substantial economic contribution. According to GOK (2020), the marine fisheries sector in Kerala contributes livelihood for about 8 lakh people (nearly 2.5% of the state's total population) who work and reside in the 222 fishing villages situated in 9 districts along the coastline of the state. During the time of COVID-19 infestation, the state of Kerala also took strict governance measures to prevent the spread of the pandemic by restricting movement and activities. During the lockdown period in the marine fisheries sector, fishing harbours and fish landing centers in the Kerala state were not functional. Mechanized and motorized sectors were not allowed to operate; however, traditional fishing crafts were permitted.

Similarly, in marketing also many changes were implemented, which prohibited the traditional auctioning at the landing centers. An innovative supply chain governance mechanism was followed with a day-to-day price fixation for different types of fish (Rakshit *et al.,* 2020). The pandemic-induced restriction brought about 22,000 crafts that plied on various harbours of Kerala to a standstill and had a very adverse economic impact at the macro-level (Nigam, 2020). The cumulated economic loss (reduction in fish catch, landing center value, retail price, and export) over a period of 60 days starting from the first day of lockdown was estimated at Rs. 3481 crores

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with a per-day loss of Rs. 58 crores in the marine fisheries sector of Kerala (Ramachandran *et al.,* 2020). Though the macro-level assessment is useful, a detailed understanding of the micro-level changes in the livelihood pattern, socio-economic security networkings, and the attitude towards the governance response is more important in the marine fisheries sector, which exhibits a substantial degree of livelihood vulnerability (Islam *et al.,* 2014). Hence, the present study captured the micro-level impact of behavioural and structural changes (perceived impact and livelihood adoption strategies followed) among the marine fisher flok and communities as a governance response during the COVID-19 pandemic.

MATERIALS AND METHODS

We have conducted the study in the whole of coastal Kerala. An online data collection schedule was prepared in google forms both in English and Malayalam language. The sampling frame for the study was decided with the consultation of the contact fishermen and the field staff of CMFRI. The selection criteria were knowledge in using smartphones and their access, which facilitate the proper data collection. The shedule was sent to 300 fishermen through e-mail and Whatsapp. Out of 300 fishers contacted for the impact analysis of the COVID 19 scenario, we received 196 filled and 57 partially filled schedules with a 65.3 percentage of complete response rate. Forty-seven fishermen did not respond. The completely filled responses were considered for this research paper. A brief description about the respondents as follows; Among the 196 respondents (Gender: Male), 15.4 per cent fell in the 21-30 years of age group, 19.2 per cent in the 31-40 years of age group, 50 per cent in the 41-50 years of age group, and 15.4 per cent in 51-60 years of age group. The occupational profiling of the respondents showed that 80 per cent of them were associated with open sea fishing either as boat crew, boat driver, or boat owner. 15.4 per cent of the respondents represent harbor management and related occupation, and the remaining 7.7 per cent were retail fish sellers. The poverty status of the fishermen was assessed using the type of ration cards they possessed. In Kerala, the population is stratified into different economic groups, and each group is provided with varying codes of color (as a demarcation) under the public distribution system (PDS). Coloures yellow, pink, blue, and white represents the Antyodaya Anna Yojana, BPL, APL, and Non–Priority stratum of people, respectively. In the present study majority of the respondents had pink colour (51.9%) followed by blue colour ration card (40.7%). Though non of the respondents had the yellow colour ration card, more than 52 per cent of the respondents were coming under the BPL category. Descriptive statistical analysis was used for the presentation of the results.

RESULTANDDISCUSSION

Impact of COVID-19 lockdown on the livelihood supporting activities

Livelihood supporting resources comprises the capabilities, assets (including both tangible/material and intangible/ social resources), and activities essential for a means of living (Chambers and Conway, 1991). In the marine fishing sector, all the livelihood assets primarily depend on the active fishing days with fished sea resources and efficient marketing with a better price realization. The impact of the COVID-19 lockdown on livelihood was assessed by estimating the active fishing days before and during different phases of the lockdown, trends in resources availability and the input cost structure, changes in the marketing pattern, and earning level.

Impact on active fishing days: According to the fishermen (56%), on average, 20-25 active fishing days per month were recorded before the pandemic. Twelve percent of the respondents reported 28-30 active fishing days per month in normal situations. During the first phase of lockdown, (from 24th March 2020 to 14th April 2020) majority of the respondent (68%) recorded zero active working days. But a few proportions of the fishers (representing the traditional fisher group) reported 15 active working days. The first phase of lockdown was reported with an average of two active working days. Similarly, during the second lockdown phase (15th April 2020 to 3rd May 2020) and third lockdown phase (4th May 2020 to 20th May 2020), average active fishing days were reported as 3 and 4, respectively (Figure 1). Fishers in Kerala lost an average of 16 active fishing days (with respect to the minimum active working days per month (20) in the pre-COVID-19 period), in the 1st, 2nd, and 3rd (24th March 2020 to 20th May 2020) phases of nationwide lockdown. The results are in line with the report of the Kerala state planning board (2020).

Perception about the trends in landing pattern: The perceived changes in the landing pattern were also assessed. While 81.5 per cent of the respondents were of the view that

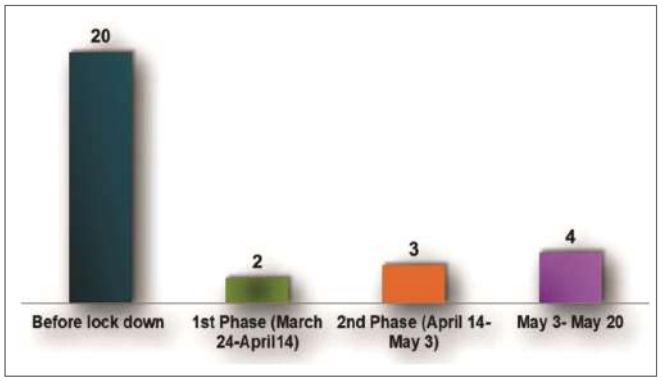


Figure 1: Active fishing days reported

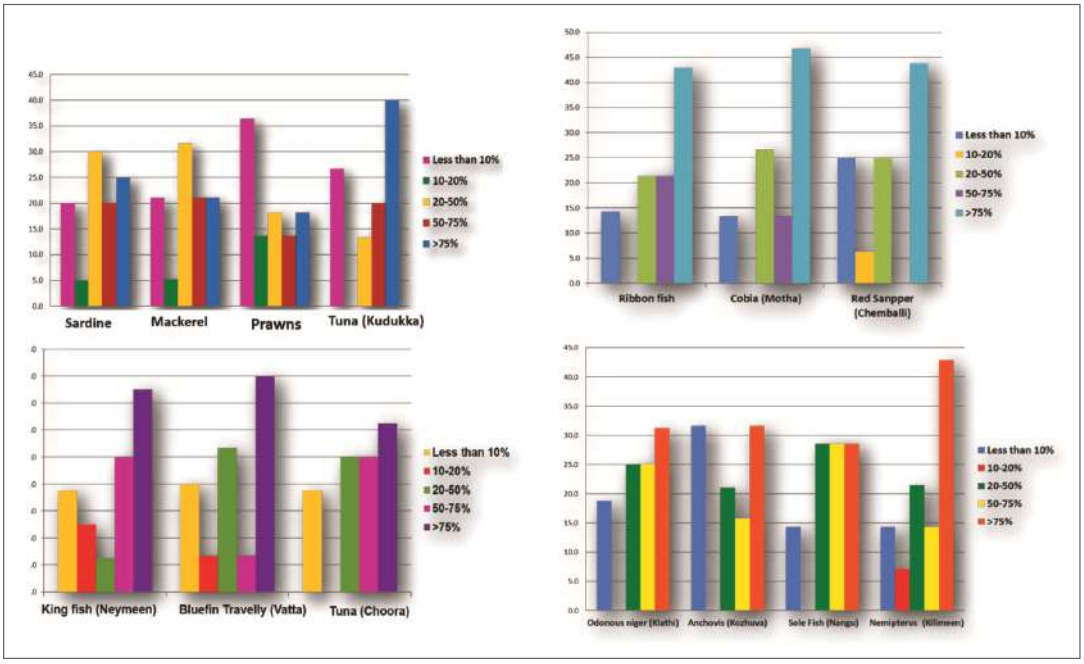
there could be a reduction in fish landing, 18.5 per cent responded (all are traditional fishers) thought that there would not be any change in the quantity of landing. Kerala's fish landing is dominated by Oil sardine, Mackerel, Anchovies, Odonusniger, Prawns, etc. (FRAD, 2020). A reduction in the availability of many of the common fishes in the Kerala coast, like Indian oil sardine (Mathi), Indian Mackerel (Ayala), and Tuna (Kudutha), is perceived by the majority of the fishermen. It was interesting to note that the commercial landings of Tuna (Kudutha), Nemipterus and Ribbonfish, Cobia, and Red snapper were perceived to exhibit heavy reduction (more than 75%). The perceived trend in the landing pattern is shown in Figure 2.

Impact of COVID-19 lockdown on fish harvesting input cost: Changes in the input cost structure for fishing were estimated with respect to the major inputs needed for a fishing trip. 74 per cent of the respondents have experienced an increase in the cost of harvesting inputs like labour, fuel, ice, and other groceries. More than 25 per cent of the respondents reacted that the price of ice and other groceries increased either high (20-50%) or severe range (>50%). The labour and fuel costs show a very low range of increase (as expressed by more than 70 per cent of the respondents) due to the COVID-19 lockdown (Figure 3a). Similarly, 81 per cent of the fishers experienced difficultly in the availability of resources. The difficulty of getting inputs like fuel and labour was marked as to lower than ice and other inputs (Figure 3b). It could be due that while the fuel supply was uninterrupted many of the ice factories did not function.

Impact of COVID- 19 lockdown on fish marketing: Marine fisheries marketing sector has a varied level of dynamism with respect to the fish species landed, auctioning and pricing of the landed resources at the harbour, number of people, and firms engaged in the marketing and value chain activities (Purkait *et al.,* 2020). In the present study, 166 fishers (85% of fishers) reported that they experienced difficulty in marketing the fish. Nearly 58 per cent of them experienced high to severe difficulty in marketing.

Impact of COVID-19 lockdown on income and earning: The loss in active fishing days due to the pandemic-induced lockdown had a very severe impact on the earning level of the marine fisherfolk, who are generally known for the high saving volatility (Salim *et al.,* 2017). It is well evident

Figure 2: Species-wise anticipated reduction in fish availability during post- lockdown*
(*Correlational studies with the post lockdown fish landing data is needed for the validation).



from the study result, as 96 per cent of fishers responded that they had experienced a reduction in daily earnings. Nearly 65 per cent of them rated a high to severe level of decline in daily earnings compared to average normal per day earning (Figure 4 a &b).

Adaptation Strategies followed by the marine fisherfolk during the Covid 19 pandemic

Adapting to a new normal during and post-pandemic is not easy, particularly in an unorganised sector like marine fisheries, which act as sole livelihood support for millions of people. In addition to the health crisis it created, the seriously disrupted supply chain in the COVID-19 pandemic has led to a looming food crisis and increased poverty in many areas (Balasubramanian, 2020; Global Panel, 2020). As indicated in the study, a high to severe level of reduction in daily earnings compared to average normal per day earning was observed along the coastal belt.

Livelihood strategies adopted: The state of Kerala has suggested and provided many adaptation strategies (free ration with diversified food basket to prevent poverty and hidden hunger, financial assistance, community kitchen, etc.) amid lockdown to prevent the livelihood uncertainties created by the pandemic. Livelihood adaptation strategies followed by the marine fisherfolk during the pandemic were assessed with five different criteria like savings due to the changes in the spending pattern, free ration system, adoption of diversified livelihood options, COVID related financial assistance by government, and pension. An overlapping pattern was found in the adoption of different livelihood supporting strategies. The majority (74%) of the respondents said that the government free kits (Kerala government provided free food and essential household inputs through the public distribution system (Table 1) for all, in different time spells) was the primary source of household inputs during the COVID-19 period.

Though the volatility of the saving is a significant characteristic of the marine fisherfolk, 48 per cent of the respondents also met the financial requirement for the household inputs from the savings they had made by changing their family expenditure pattern. It was reported that reducing the quantity of food per meal, consuming low price food items, and reducing the expenditure for

Figure 3a &b: Perceived changes in cost structure and availability of harvesting inputs during the COVID-19 lockdown

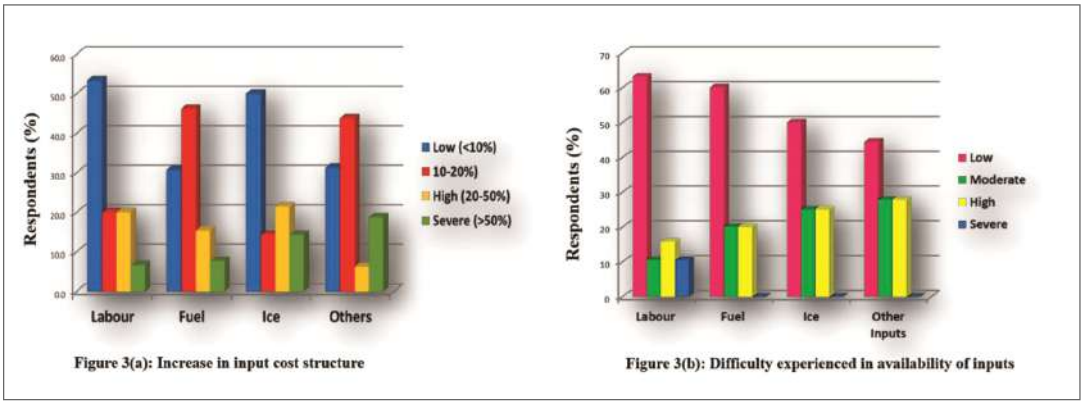


Figure 4a &b: Earning pattern during the COVID-19 lockdown

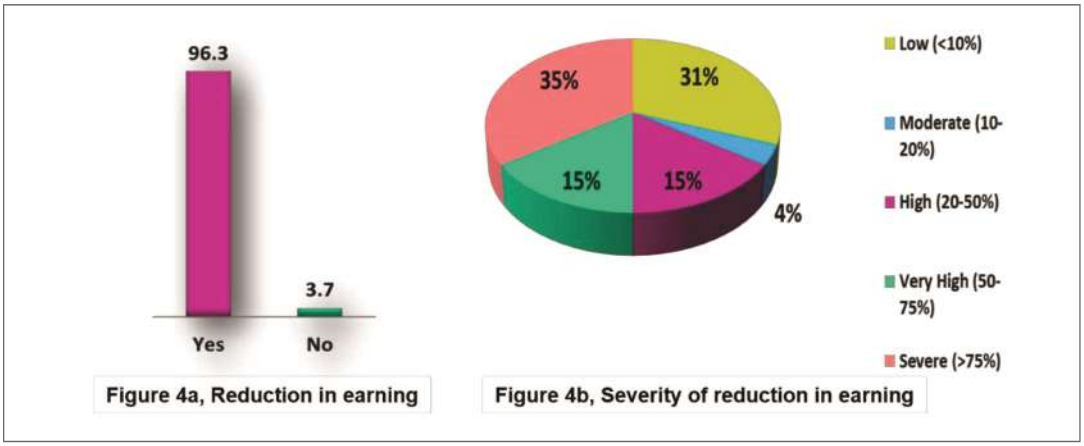


Table 1: Composition of food kit provided by the Kerala government during COVID-19 lockdown

No.	Items	Quantity
1.	Sugar	1 kg
2.	Tea powder	250 g
3.	Salt	1 kg
4.	Green gram	1 kg
5.	Bengal Gram	1 kg
6.	Dal	250 g
7.	Coconut oil	0.5 litre
8.	Sunflower oil	1 litre
9.	Whole-wheat flour	2 kg
10.	Rava	1 kg
11.	Black gram	1 kg
12.	Chilly powder	100 g
13.	Coriander powder	100 g
14.	Turmeric powder	100 g
15.	Fenugreek	100 g
16.	Mustard	100 g
17.	Soap	2 Nos

attending the marriage, festivals, and other social functions helped them save. They saved by virtue of stopping the social functions for which they usually spend a substantial amount. Other than those, the decline in spending on liquor due to unavailability also contributed largely to the livelihood supportive savings during the lockdown. At the same time, 3.7 per cent of the respondents stated that they met their household demands by the financial help provided by the government (Figure 5). The requirement of liquid money to meet the day-to-day expenses and additional medical expenses incurred was partially supported by the government's financial support and pension, as reported by about 11 per cent of the respondents. Diversification of livelihood was seen in 7.4 per cent of the respondents, and small-scale agriculture practices in the vicinity of the homesteads helped them meet some household and dietary inputs during the lockdown period.

Changes in spending pattern: Since the saving due to the changes in the spending pattern is also reported as an adaptation strategy, we conducted an assessment of its trends. A general reduction was observed in the spending pattern of fisherfolk in all major heads like food items, medical treatment, religious contribution, and general items (other than the food items). But the reduction was more for spending on religious donations and other grocery items than food as 88 per cent and 84 per cent of the respondents indicated the same (Figure 6). Twelve percent of the respondents reported no change in the spending on medical treatment, but 8 per cent of the respondents reported an increase in the expenditure on medical during the COVID-19 period. The prohibition of religious gatherings (festivals) and leisure shopping etc., resulted in reduced spending on those heads. Similarly, fear of getting infected with the

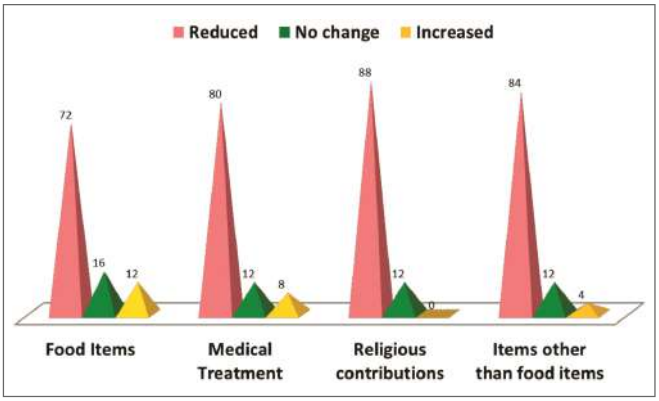
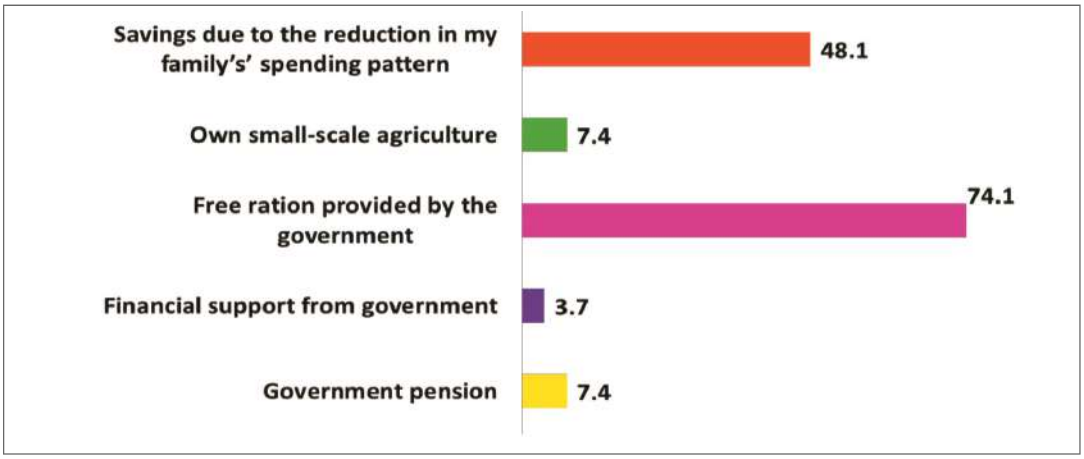


Figure 6: Trends in Spending Pattern during COVID-19 lockdown period

Figure 5: Livelihood adaptation strategies followed during COVID-19 lockdown



Noval coronavirus and general discouragement from the medical department prevented frequent visits to hospitals. People reduced the medical consultation for many of the lifestyle diseases other than life-threatening diseases. Though a reduction in the spending on food items was observed (might be due to the free ration and working of the community kitchens), the decline was less than the reduction observed in other expenditures. Though few respondents reported an increase in spending on food items, medical treatment, and non-food items, none reported an increase in spending on religious contributions.

Changes in socio-personal behavioural factors: The social structural changes and adaptation of the marine fisherfolk due to the pandemic were analysed based on different aspects of personal and social engagements (Table 2). The activities were measured with three levels: lower than usual, no change from usual level, and higher than usual level. Involvement of activities at the house and family level showed an increased level. Nearly 90 per cent of the respondents expressed that they spent more time with their family members and were actively involved in the children's activities. Similarly, most of the respondents (94.4%) revealed that social media usage was higher than the usual level. A general reduction trend was observed in the social linkage and activities like direct interaction with fellow fishermen (90.8%) and line departments (49.5%). Similarly, nearly 80 per cent of the respondents perceived that there was lower dependence on liquor consumption. Mental depression, a mood disorder reported as a major negative externality associated with the lockdown (Rehman *et al.,* 2020). It is identified as one of the major reasons for reducing work efficiency and productivity in many skilled and unskilled sectors (Jong-Min *et al.,* 2011). In the present study, 47.4 per cent of the respondents perceived that during the COVID-19 lockdown, the level of depression was higher than the usual level. It probably stemmed from restricted social interactions, precarious livelihood, and fear of illness. However, 39.8 per cent of the respondents felt otherwise. The level of depression expressed by these respondents was less compared with the pre-COVID regular active fishing days. Assured government support as the livelihood options (like free kits, government pensions, and financial support) and more engagement with their family members during the lockdown period were perceived as reasons for the same. Similarly, 88.3 per cent of the respondents perceived that they gained a higher knowledge about the COVID-19 and related things.

Governance responses during the COVID-19 pandemic lockdown period

The government of Kerala had undertaken many governance interventions and implemented many among those (like community kitchens, free ration kits, etc.) in a decentralized manner. Respondents were asked to rate those interventions in a 5-point continuum, from highly unsatisfied to highly satisfied. Seventy-seven percent of the respondents were satisfied with the government interventions during the lockdown period. Among them,37 per cent of the fisherfolk expressed a very high level of satisfaction with the government interventions. Nearly 7 per cent of the respondents said they were not satisfied with the government interventions because they did not reach the intended beneficiary. In the marine fisheries sector, two major interventions were implemented during the lockdown period, i.e., elimination of the auctioning in the landing centers with the price fixation of the fish species

Table 2: Changes in socio-personal behavioural factors during the COVID-19 lockdown period

Socio-personal behavioural changes	Lower than usual		No change*		Higher than Usual	
	f	*%*	*f*	*%*	*f*	*%*
Interaction with fellow fishermen	178	90.8	18	9.2	0	0.0
Time spent with family members	8	4.1	11	5.6	177	90.3
Involvement in children's activity	8	4.1	20	10.2	168	85.7
Feeling of depression	78	39.8	25	12.8	93	47.4
Alcoholism	163	83.2	33	16.8	0	0.0
Interaction with the line department	97	49.5	62	31.6	37	18.9
Use of social media	11	5.6	0	0.0	185	94.4
Knowledge and understanding about COVID-19	0	0.0	23	11.7	173	88.3

**No Change category indicates either their involvement or non-participation is on the same level as before*

landed and prevention of the fishing activities (other than the traditional fishing). Respondents were asked explicitly about the perceived effect of those interventions in the marine fisheries in general (Figure 7a &b). Sixty-three percent of the respondents perceived that the elimination of auctioning in the landing center might positively impact the fisheries sector. In contrast, nearly 15 per cent of them expressed that this regulation might be creating a destructive impact due to changes it may cause in traditional social relations like patronage (Figure 7a).

Similarly, 69 per cent of fishers experienced an increase in landing center price than the usual pattern (might be due to the new pricing mechanism followed by the government). While asked about the expectation of the future retail price for the fish, 63 per cent of them expressed that the retail price for the fish might be higher than the usual during the post lockdown period. The majority of the respondents expect that the pricing mechanism changes at the landing center might also continue during the post lockdown period, giving a better price realization. Similarly, concerning the fishing activity regulation, also respondents had a mixed response. Nearly 45 per cent of them expressed (Figure 7b) that the regulation of fishing activities would not improve the present situation; instead, it reduces the livelihood options for the fisherfolk.

Directive governance insight from the study

The COVID-19 induced crisis, as evidenced by its impact on the economy and people's livelihood, catastrophic as it is, also opened enormous opportunities for devising, implementing, and refining governance policies in many sectors. The measures like complete closure and social distancing created a multifaceted impact in different areas. Feeling of depression due to isolation, reduced socialization and information sharing, etc., are counted as negative

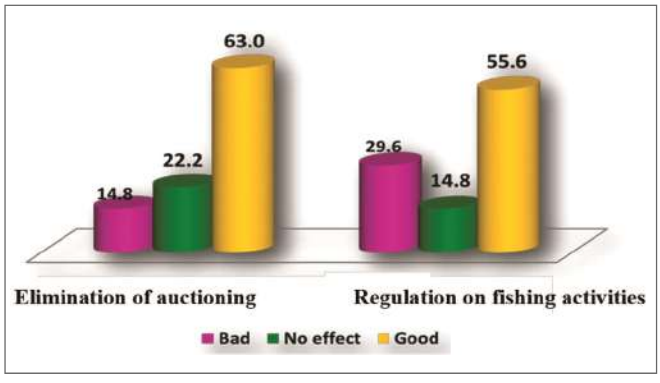


Figure 7 a&b: Perception about the impact of Govt. interventions in fisheries during the COVID-19 lockdown

externalities of the pandemic in addition to the threats of disease infestation. At the same time, the crisis is also considered an opportunity to make structural changes in the governance policies, which otherwise in the normal situation is regarded as a difficult task. Though a worldwide and country-level policy direction is needed to flatten the pandemic curve and boost the economy, state government and local governing bodies are the frontline agents to combat pandemic-induced social and livelihood insecurities. Interventions done by the government of Kerala, especially in the marine fisheries sector, were noteworthy (Rakshit *et al.,* 2020). While dealing with the adaptation and mitigation governance strategies for a livelihood sector in a crisis, it should be balanced both on the felt needs and availability of livelihood options. Lockdown and restriction in fishing activities have resulted in a drastic decline in marine fish and seafood supply. The market reforms like elimination of the auctioning at the landing centers and implementation of price fixation through the novel marketing model (Ramachandran *et al.,* 2020) tried to make a better price realization for the fishers. Rightly speaking, the pandemic provided an opportunity to develop and test the governance option for eliminating the middlemen in the supply chain. It also opened the way for refinement and reconsideration of the policy to address the apprehension of different players in the supply chain through consensus by virtue of the several stakeholder's meets organised by the state.

While providing social security supports (social supports and financial assistance) and containment regulation, publicizing and communicating the same with clarity would reduce rent-seeking, thereby reducing the trust deficit of beneficiaries' in the governance system. The pandemic has shown its impact not only on socio-economic dimensions but also on behavioural dimensions. It is well evident from the change in frequency of liquor consumption (reduced than usual for the majority of the respondents), which otherwise used to take a significant toll on family expenditure and nutritional security of the fisherfolk (Salagrama, 2006). It can be considered as a governance-led positive behavioural change that could also take shape as a livelihood adaption strategy in the lockdown period. Though the impact of such changes would not be everlasting, this is considered an opportunity to make use of these sub liner changes to kindle an Ecos of temperance among the community. The pandemic also points to the need for governance support in institutionalizing interventions in the fisheries supply chain, promoting coastal

agriculture, diversification, etc., apart from the social security supports like financial assistance, free rationing, etc., which are not sustainable public policy choices in the long run.

CONCLUSION

Fish, especially marine fishery resources, are the most traded commodity globally, contributing remarkably to the world economy. Being a maritime state, the marine fisheries' contribution to Kerala's economy is significant, especially providing livelihood security for more than 2.5 per cent of its total population. Like in any other primary sector, the economic effect of reduced availability and nearly collapsed price structure during the COVID-19 pandemic also created a distressing situation in the marine fisheries at the macro level. This study attempted to examine the micro-level impact of the COVID-19 lockdown and the governance response pattern in Kerala's marine fisheries by considering a multi-dimensional approach. The study revealed that, on average, fishers in Kerala lost 68 per cent of the active fishing days during the different phases of nationwide lockdown. About 81.5 per cent of the respondents perceived a reduction of fish resources available at the landing centers during the post lockdown period. Though 96 per cent of fishers had experienced a decline in daily earnings during the lockdown period, the majority could meet the household expenses and needs mainly because of the social security-oriented governance response. A positive attitude was also showed by the majority of the respondents towards the intervention done in the fisheries value chain. The study also highlighted how a pandemic turned into an opportunity for a governance mechanism for new interventions and how people reacted to it.

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Understanding the Constraints of Fisheries Extension Personnel in Shrimp Aquaculture Sector, Maharashtra

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ABSTRACT

Study of constraints faced by those who are involved in the extension services in the Department of Fisheries (DoF) can be a powerful paradigm for solving combinatorial problems. Combining a range of techniques like socio-economic analyses and weighted average techniques this paper draws on to capture the full breadth and depth of the constraints faced by the extension personnel in the DoF, Maharashtra with a specific focus on shrimp aquaculture. This paper provides a reasonably complete coverage of constraints faced and reveals that less training on scientific shrimp farming practices, inadequate staff strength and insufficient infrastructural facilities as major constraints faced by fisheries extension personnel. It is suggested to create exclusive unit of extension services in DoF which could focus on technology transfer. Regular training programmes are recommended for extension personnel for updating of know-how and recent advancement in the field. With very good focus by the Government towards fisheries and aquaculture sector, this will further enhance sustainable development of sector

Keywords: Constraints, Fisheries extension personnel, DoF, Shrimp sector, Maharashtra

INTRODUCTION

Any farming system requires effective extension services to succeed. Farm extension services play vital role in agrarian development (Birner *et al.*, 2006; Anderson, 2007). Extension personnel ought to possess sound technical knowledge and extension skill in order to be efficient and effective in publicizing relevant technologies for ultimate adoption by the aquafarmers. The success in agricultural extension services largely depends on extension skills of extension workers (Kashem *et al.*, 2001; Ahamad, 2002). India's agri-extension services has been evolving but the real question lies in building capacities of the personnel involved in extension so that technologies are transferred to the bottom of the pyramid in equitable and efficient manner. It is reported by Gulati *et al.* (2018) that 92 per cent of total extension expenditure was allocated only for crop husbandry and only 0.9 percent was allocated to animal husbandry and dairy segment. They have also reported that despite the growing importance of the livestock sector, India's agriculture research and extension system has not absorbed the velocity of its growth yet. It is necessary to know what the scenario in fisheries extension is. In this context, fisheries and aquaculture is still in nascent stage. But with Pradhan Mantri Matsya Sampada Yojana (PMSSY) there has been growing recognition on the importance of the sector.

It is known that fisheries and aquaculture sector is a sunshine sector as it contributes immensely not only to the foreign exchange earnings and GDP, but also to the employment, food and nutritional security. In this, aquaculture is an important farming component and recognized as an important means for livelihood, rural development, food and nutritional security (Ayyappan and Diwan, 2007). Coastal aquaculture is an important farming system which contributes immensely for the socio-economic change of small-scale aquafarmers in the maritime states. In Indian aquaculture, shrimp farming is said to be the fastest growing food sector where most shrimp is exported. India's sustained income growth and a fast-growing urban population are causing changes in food-consumption patterns away from low-value staples towards high-value food commodities so shrimps have potential in the domestic market also.

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Shrimp aquaculture has been successful in Andhra Pradesh and Gujarat. But Maharashtra state still ranks 6th among the coastal states in shrimp production. Suitable potential brackish water area in Maharashtra state is 10,400 ha but out of this, only 1,291 (12%) ha area is under shrimp farming. There is huge potential in Maharashtra to increase the production and productivity of shrimp aquaculture and technology will play pivotal role in improving the production and productivity. In this view it is essential to transfer the scientific shrimp farming practices and technologies to the aquafarmers for profitability in shrimp farming. The gap between the technologies developed and adopted is widening due to the various factors influencing transfer of technology. Technology transfer is a stream-lined flow of technical know-how from the researchers though extension personnel to the farmers, who develop, disseminate and adopt technologies respectively. The development of aquaculture productivity is mostly depending on effectiveness of extension functionaries and the constraints faced by them are necessary to be documented and addressed. Special extension efforts are needed to reach the rural farmers and communicate with them effectively. Extension plays a key role in raising the shrimp productivity by offering technical advice, help aquafarmers to identify their problems, opportunities and sharing of information. Hence this investigation was undertaken with objective to study constraints perceived by extension personnel with reference to shrimp aquaculture in coastal districts of Maharashtra.

MATERIALS AND METHODS

The study was conducted in coastal districts of Maharashtra state. A total of 55 fisheries extension personnel were randomly selected out of a total of 72 from Department of Fisheries (DoF), Maharashtra. Profile of the extension personnel with reference to age, gender, educational status, experience, training on shrimp farming and extension, source of information for fisheries related knowledge, frequency of meeting with shrimp farmers and preferred mode of contact with shrimp farmers was collected.

The classical and quite generic definition of constraint i.e., "something that limits or restricts something else" was taken as a context for the study. In order to enlist the constraints faced by fisheries extension personnel, a thorough review of literature and discussion with expert group was done and all possible constraints faced by extension personnel with reference to shrimp aquaculture were listed. The expert group comprised of 05 academicians, 05 extension officers and 05 DoF officials. Further discussions were held with 15 extension personnel (other than expert group) where they were requested to suggest if they faced any other constraints in addition to those already listed and the same were included. A total of 19 constraints which were listed were then categorized under four heads i.e. 'extension', 'administrative', 'financial' and 'infrastructure' related constraints.

To test the agreement of the extension personnel towards a specific constraint a five-point scale with weight 4 for strongly agree, 3 for agree, 2 for neither agree nor disagree, 1 for disagree and 0 for strongly disagree was used. Test-retest method was used to test the reliability of this scale and for this list of constraints was given to 10 extension personnel and their agreement level for each constraint was recorded. This was again repeated after 15 days. Correlation coefficient was calculated based on the two sets of agreement scores which was 0.79 indicating that scale was reliable. After this, fisheries extension personnel (N=55) were asked to provide their agreement towards the constraints. In order to rank various constraints Weighted Average (WA) technique was used and a constraint could attain a maximum score of 20 and minimum score of 0. Weighted average was calculated by as given below:

Weighted average = Sum ($X_1.W_1 + X_2.W_2 + X_3.W_3 + X_4.W_4 + X_5.W_5$) / Sum ($W_1+W_2+W_3+W_4+W_5$)

Where,

X_1, X_2, X_3, X_4, X_5 = Frequency of the respective constraints

W_1, W_2, W_3, W_4, W_5 = Weighted values i.e., 0, 1, 2, 3 and 4

Kruskal-Wallis test was applied to test if there was a significant difference in the WA scores of different constraints.

The formula for test is; $H = \frac{12}{n(n+1)} \Sigma \frac{R_i^2}{n_i} - 3(n+1)$

Where,

n is the number of observations

n_i is the number of observations in i^{th} group

R_i is the rank total of each group

$$\Sigma R_i = \frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \frac{R_3^2}{n_3}$$

RESULTS AND DISCUSSION

***Profile of fisheries extension personnel*:** Majority (58.18%) of the extension personnel were male and were in age group of 46 and above with post graduates in Fisheries Science or Zoology (83.64%). Around, 47.27 per cent of extension personnel had service experience up to ten years. Majority of extension personnel (58.18%) had not attended any formal training in scientific shrimp farming and extension management. Internet was the main information source (74.55%) followed by fisheries institutions (16.36%). It was reported that 49.09 per cent of extension personnel had occasionally contacted shrimp farmers. Most (58.18%) were using mobile phones as a preferred mode for contacting farmers while, 32.73 per cent extension personnel were following group contact method such as group meeting for contacting farmers.

Constraints faced by fisheries extension personnel: Constraints faced by extension personnel with reference to shrimp aquaculture were divided into four heads i.e., extension constraints, administrative constraints, financial constraints and infrastructure constraints. Table 1 presents the WA and rank for each of these constraints.

From Table 1, it is observed that, extension related constraints were ranked first with WA of 15.38, while administrative constraints ranked second (WA=13.62). This was followed by financial constraints and infrastructure constraints. Kruskal-Wallis test was applied to test if there was a significant difference with reference to WA scores of different constraints and the results revealed no significant difference (P> 0.05) as the P value was 0.068.

Table 1: Constraints faced by extension personnel with reference to shrimp aquaculture in coastal districts of Maharashtra

S.No.	Constraints	Weighted average (Max score = 20)	Rank
1.	Extension constraints	15.38	I
2.	Administrative constraints	13.62	II
3.	Financial constraints	13. 20	III
4.	Infrastructure constraints	11.54	IV

Extension constraints: Detailed enquiries were done with reference to the extension constraints faced by the extension personnel. Theses constraints with the WA and ranks are presented in Table 2.

It is clear from Table 2 that less training on scientific farming practices and conducting demonstrations was ranked first with WA of 16.70 followed by less availability of training material/equipment (WA=16.50) and less skill to handle equipment with a WA of 16.20. Poor response from farmers was also reported a constraint with a WA of 14.90. Few trainings on communication skills had a relatively less WA.

Studies done in Maharashtra and other states have also reported similar results. Like Misha *et al.* (2016) in their study in Kolhapur district of Maharashtra reported lack of training and non-availability of training literature as major constraints faced by extension personnel. Whereas. Pathak *et al.* (2014) studied constraints of fishery extension officers in Assam and West Bengal and lack of training material and lack of equipments was a major constraint reported in their study. Even in other countries like Ethiopia, Gebresilasie (2014) reported lack of training being a major constraint for extension agents which is same what Thanh and Singh (2006) also found for agriculture farmers of India.

The extension constraints faced by extension personnel in the present study seem to be similar with the results of other studies. However, it has to be noted that shrimp farming is different from other kinds of farming. It is more knowledge intensive so the constraints related to

Table 2: Extension constraints faced by extension personnel with reference to shrimp aquaculture in coastal districts of Maharashtra

S.No.	Extension constraints	Weighted average (Max score = 20)	Rank
1.	Less training on scientific farming practices, conducting demonstrations	16.70	I
2.	Less availability of training material / equipment	16.50	II
3.	Less skills to handle equipment	16.20	III
4.	Poor response from farmers	14.90	IV
5.	Few trainings on communication skills	12.60	V

extension and training can reduce the rate of effectiveness of extension services.

If we have a look at the extension service providers in shrimp aquaculture in India it is found that it is dominated by private players specially input supplier companies. Patil *et al.* (2019) reported that aqua-company technicians are the major source of information for shrimp farmers (85.45%) of Palghar district, Maharashtra. Kumaran *et al.* (2012) in Tamil Nadu and Andhra Pradesh also reported that 90 per cent of aqua farmers depend on private extension sources (inputs companies and aqua consultants). As shrimp farming is knowledge intensive it is required that extension personnel are updated with recent advances and best management practices (BMPs). Patil and Sharma (2018) have studied in details about the training needs of shrimp farmers of Maharashtra.

But in order to train farmers' extension personnel should be having knowledge on important areas like BMPs, shrimp disease management, nursery management, feeding management, use of biosecurity measures, farming with biofloc technology etc. However, DoF has been focusing more on regulation activities related to shrimp farming and not in providing extension services. Taking advantage of this, input supplier companies have been actively providing extension services to the farmers along with input sale. Therefore, it is necessary that DoF takes measures to reduce these constraints so that shrimp farming related information and innovations are disseminated to all farmers.

Administrative constraints: After discussion on extension related constraints the second ranked constraints i.e., administrative constraints are discussed and the same are presented in Table 3.

It is clear from Table 3 that inadequate staff strength was first ranked constraint (WA=15.30) followed by frequent transfers (WA=14.90) which ranked second and issues in assessment system (WA=13.40) which ranked third. Centralised decision making was also reported as a constraint (WA=12.70) and delayed promotions had a WA of 11.80. The issue of inadequate staff strength has been highlighted by other researchers also like Misha *et al.* (2016) reported this in their study on agricultural extension personnel in Kolhapur, Maharashtra. They found that large number (53.13%) of vacant posts as a major constraint. Similarly, Patel *et al.* (2016) reported inadequate staff strength in agriculture department as first and foremost administrative constraint faced by extension personnel of Karnataka. However, in case of Maharashtra realizing the constraint of inadequate staff strength Government has inducted 30 more fisheries officers which is encouraging because inadequate staff strength can lead to more work load per person and wide spread area of jurisdictions. At the time of study when the additional officers were not inducted, it was reported that Assistant Fisheries Development Officer or Fisheries Development Officer does extension work in addition to their regular duties of implementation of policies and regulation. The officers had reported that they were often overburdened which can have an adverse effect on fisheries extension service delivery systems. With reference to the constraint of frequent transfer, Pathak *et al.* (2014) found this a major constraint for fishery extension officers in West Bengal while Patel *et al.* (2016) in their study on agriculture extension personnel of Karnataka reported lack of a proper transfer policy as a major constraint. Further enquiries with the extension personnel in this study revealed that frequent transfers from one place to other every 2 to 3 years lead to lack of security of their tenure at same place.

Table 3: Administrative constraints faced by extension personnel with reference to shrimp aquaculture in coastal districts of Maharashtra

S.No.	Administrative constraints	Weighted average (Max score = 20)	Rank
1.	Inadequate staff strength	15.30	I
2.	Frequent transfers	14.90	II
3.	Issues in assessment system	13.40	III
4.	Centralized decision making	12.70	IV
5.	Delayed promotion	11.80	V

***Financial constraints*:** After discussion on extension and administrative related constraints the third ranked constraint i.e., administrative financial constraints are discussed and the same are presented in Table 4.

The first ranked financial constraint was insufficient salary as compared to work load with WA of 13.70, while inadequate TA & DA was the second ranked financial constraint (WA=13.30). Inadequate incremental plan ranked third financial constraint with WA of 13 and no specific funds for training had a WA of 12.80.

With reference to other studies, Majhi (2001) in his study reported that, non-disbursement of salary in time was constraint faced by fishery extension officers in Odisha.

Table 4: Financial constraints faced by extension personnel with reference to shrimp aquaculture in coastal districts of Maharashtra

S.No.	Financial constraints	Weighted average (Max score = 20)	Rank
1.	Insufficient salary as compared to workload	13.70	I
2.	Inadequate TA and DA	13.30	II
3.	Inadequate incremental pattern	13.00	III
4.	No specific funds for conducting trainings	12.80	IV

Study on agricultural extension personnel by Patel *et al.* (2016) in Karnataka and study by Misha *et al.* (2016) in Maharashtra have also a reported insufficient salary as compared to work load as second major financial constraint. In the present study, the second major financial constraint faced by extension personnel was reported to be inadequate TA & DA. Extension personnel go on tour to organize mass contact programmes for providing extension services to farmers. Thy felt that existing TA and DA was inadequate to meet their requirements during field visits. Studies by Patel *et al.* (2016) in Karnataka and Pathak *et al.* (2014) also stated that irregular payments of TA & DA as one of the constraints faced by fisheries extension personnel of West Bengal and Assam. Inadequate incremental pattern was third major ranked financial constraint faced in this study. Majhi (2001) also found that majority of fishery extension officers were not satisfied with promotional avenues offered by state department of Fisheries, Odisha. It is known that everybody desires to go up in his/her service career. If one does not get promotion after serving the department for quite long time they may lose may interest in job.

Infrastructure constraints: After discussion on extension, administrative and financial constraints the fourth ranked constraint i.e., infrastructure constraints are discussed and the same are presented in Table 5.

Extension personnel reported poor infrastructural facilities like old building, few accommodation facilities, less support for schooling for kids, medical treatment etc. as first ranked constraint. Lack of input supply for programme implementation was ranked second with WA of 11.70. In addition, non-availability of office transportation facility was ranked third followed by lack of testing equipments as fourth ranked constraint. Poor information and communication facilities were least ranked infrastructure constraint. It was reported that for conducting any training programmes in shrimp aquaculture inputs like seed, feed, fertilizers, medicines, equipments might be needed timely.

If there is a delay in getting various inputs from Department, it has high possibility of becoming an obstacle in effective technology transfer. Other researchers like Majhi (2001); Kumaran *et al.* (2007); Kumaran *et al.* (2012) have reported that poor infrastructure, non availability of office transport facility and equipments as major constraints faced by fisheries extension personnel.

CONCLUSION

Fisheries extension personnel are the key persons in the process of transfer of technology as they have far reach in dissemination of technologies and BMPs. If extension personnel work under constraints, then technologies will take time to reach the famers or someone else will use this an opportunity to reach the farmers. This study has revealed that less training on scientific shrimp farming practices, and insufficient infrastructural facilities are major constraints faced by fisheries extension personnel. Inadequate staff strength has been addressed by the Government by new recruitments which is very

Table 5: Infrastructure constraints faced by extension personnel with reference to shrimp aquaculture in coastal districts of Maharashtra

S.No.	Infrastructure constraints	Weighted average (Max score = 20)	Rank
1.	Insufficient infrastructure facilities	15.00	I
2.	Lack of input supply for programme implementation	11.70	II
3.	Non availability of office transport facility	10.90	III
4.	Lack of testing equipments	10.40	IV
5.	Poor information and communication facilities	9.70	V

encouraging. Efforts are needed to reduce the constraints faced by extension personnel, so that are able to work efficiently and transfer the technologies and gain trust of shrimp farmers. For this one suggestion is that exclusive unit of extension services can be created in DoF which can focus on technology transfer. In addition, DoFs are to be energized with positive attitude and funds to function as an effective extension organization. It is suggested to use the internet and social media as information tool for extension advisories and trainings. Regular training programmes and refresher courses are recommended for extension personnel for updating of know-how and recent advancement in their field. Fisheries personnel in DoF, Maharashtra are working hard for fisheries development. With very good focus by the Government towards fisheries and aquaculture sector, this will further enhance sustainable development of sector.

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Impact of (CFLDs) on *Kharif Groundnut* Productivity and Income of Farmers in Sitapur District of Uttar Pradesh

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ABSTRACT

The cluster frontline demonstrations (CFLDs) on groundnut were conducted by Krishi Vigyan Kendra-II, Sitapur during *kharif* season from 2016-17 to 2018-19 on more than 150 farmer's field of different villages of Sitapur district. The results found that the average higher pod (21.1 q/ha) and haulm (40.21 q/ha) yield of groundnut were recorded in CFLDs as compared to farmer's practices (FP) average pod (17.5 q/ha) and haulm (37.85 q/ha) yield. The increase in the demonstrations pod yield over FP was 20.35 per cent. The extension gap, technology gap and technology index were 3.6 q/ha, 6.16 q/ha and 22.60 per cent, respectively. The average gross return (Rs. 110879/ha) and net return (Rs. 66207/ha) in CFLDs were found higher than the FP gross return (Rs. 93844/ha) and net return (Rs. 43334/ha). The average net returns 52.21 per cent higher than that of FP. The B: C ratio exhibited the same trend as in gross and net return which was found 2.49 in CFLDs and 1.86 in FP. By conducting cluster frontline demonstrations of improved variety with intervention practices of proven technologies in farmer's field, groundnut productivity enhanced to a great extent which increased in the income level of farmers and improved livelihood of farming community.

Keywords: Groundnut, CFLDs, Extension gap, Technology gap, Technology index, Yield and Net return

INTRODUCTION

Groundnut, or peanut, is commonly called the poor man's nut. Today it is an important oilseed and food crop. This plant is native to South America and has never been found uncultivated. The botanical name for groundnut, Arachis *hypogaea* Linn. is derived from two Greek words, *Arachis* meaning a legume and *hypogaea* meaning below ground, referring to the formation of pods in the soil. Groundnut is an upright or prostrate annual plant. It is generally distributed in the tropical, sub-tropical and warm temperate zones. Ethnological studies of the major Indian tribes of South America document the widespread culture of groundnut and provide indirect evidence for its domestication long before the Spanish Conquest. When the Spaniards returned to Europe they took groundnuts with them. Later traders were responsible for spreading the groundnut to Asia and Africa where it is now is grown between the latitudes 40°N and 40°S (Pattee and Young, 1982*). (Source- FAO groundnut Post-harvest operations)* Groundnut is not only an important oilseed crop of India but also an important agricultural export commodity. With annual all-season coverage of about 70 lakh hectares, globally India ranks first in groundnut acreage and with an output of approx. 80-85 lakh MT (in shell groundnuts), second in production. Although in various states of India groundnut is cultivated in one or more (*kharif, rabi* and *summer*) seasons, nearly 80 per cent of acreage and production comes from *kharif* crop (June-October). The Sitapur district has been considered as productively potential region of groundnut due to assured irrigation facilities, and favorable soil and climate conditions. Although this identity of Sitapur district has faded in the last few years but from the year 2016-17, there has been a lot of progress in the field of groundnut sowing through cluster front line demonstration and some specific projects run by Krishi Vigyan Kendra in collaboration with DGR-Directorate of Groundnut Research, Junagadh, Gujarat.

Lack of awareness about scientific production techniques like new varieties, seed treatment with fungicide, insecticides and biofertilizers, soil testing based nutrient

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management was a major reason for low productivity of groundnut. The productivity of the crop can be increased by adopting recommended scientific and sustainable management production practices with improved high yielding varieties and other important inputs through Cluster Frontline Demonstrations (CFLDs).

MATERIALS AND METHODS

The present study was carried out in operational area by Krishi Vigyan Kendra-II, during *kharif* season from 2016-17 to 2018-19 (3 years) in farmer's field of different villages of Sitapur district of U.P under National Mission on Oilseeds and Oil palm (NMOOP) scheme. In total 150 clusters frontline demonstrations (CFLDs) conducted in 60 ha area covering different villages. Each farmers plot size was 0.4 ha (1.0 acre) under CFLDs for demonstration of recommended improve production practices of groundnut. The rainfall recorded in the demonstration area during 20016-17 was 437 mm, in 2017-18 was 397 mm and in 2018-19 was 487 mm.

In the demonstration plots, many scientific inputs of CFLDs were given to farmer per acre basis on one month before a season in group meeting programme and trained each farmers for their appropriate application in field. The technological inputs were improved variety TG-37A seed, Bio fertilizers (*Rhizobium* and Phosphate solubilizing micro-organisms), *Metarhizium anisopliae* and *Tricoderma harzianum*, *Beauveria bassiana* provided to farmers. Soil samples were taken and analyzed before sowing of CFLD. Other technical information like sowing time, seed treatment, soil test based nutrient management, weed and water management, IPM practices, harvesting and threshing are also given from time to time. KVK scientists also regularly visited the demonstration areas and continuously guided the farmers. Field days and group meetings were also organized at the demonstration sites to provide opportunities for other farmers to see the benefits of the demonstrated technologies.

The necessary steps for the selection of site, farmers and lay out of demonstration were followed as suggested by ATARI, Kanpur, Zone-III.

In the demonstration, one control plot was also kept where farmer's practices was carried out. Data were collected with the help primary and secondary data collection methods as well as personal contact and observations on yield data was also recorded at the time of separate threshing. The yield of each demonstration was recorded in a systematic manner and the yield of farmer's practices was also recorded at the same time. The data obtained from demonstration plot and famers plot were analyzed for extension gap, technological gap and technological index study (Samui *et al.,* 2000) as given below.

Extension gap = Demonstration yield- Farmer's yield

Technology gap = Potential yield- Demonstration yield

$$\text{Technology index} = \frac{\text{Potential yield- Demonstration yield}}{\text{Potential yield}} \times 100$$

The collected data were tabulated and statistical analysis was performed to interpret the results. The economic parameters (gross return, net return and B:C ratio) were calculated on the basis of prevailing market prices of inputs and minimum support prices of outputs.

RESULTS AND DISCUSSION

Groundnut yield: Results of 150 cluster frontline demonstrations conducted during 2016-17 to 2018-19 in 60 ha area on farmer's field revealed that the average higher pod (21.1 q/ha) and haulm (40.21 q/ha) yield of groundnut were recorded in CFLDs as compared to farmer's practices average pod (17.5 q/ha) and haulm (37.85 q/ha) yield. The results clearly indicated that the pod yield of groundnut could be increased by 20.35 per cent over the pod yield obtained under farmer's practices of groundnut cultivation due to adoption of improved variety TG-37A with appropriate production technology.

Extension gap and technology gap: The data presented in Table 1 indicated that the extension gap ranged from 2.3 q/ha to 5 q/ha and overall average extension gap was 3.6 q/ha during the period of demonstration emphasized the need to educate the farmers through various means for the adoption of improved groundnut production technologies to reverse this trend of wide extension gap. More and more use of latest production technologies with high yielding varieties will subsequently change this alarming trends galloping extension gap. The new technologies will eventually lead to the farmers to discontinuance of old varieties with new technology.

However, the technology gap observed ranged from 4.26 q/ha to 9.46 q/ha. The average 6.16 q/ha technology gap observed during the experimental period. The technology gap observed may be attributed to the

Table 1: Productivity, extension gaps, technology gaps and technology index of kharif groundnut as grown under cluster frontline demonstrations (CFLDs) and existing farmer's practices (FP)

Year	Area (ha)	No of Demo	Potential pod yield (q/ha)	Average pod yield (q/ha)		Average haulm yield (q/ha)		% pod yield increase over FP	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
				Demo.	FP	Demo.	FP				
2016-17	20	50	27.26	22.5	19	41.40	39.55	18.42	3.5	4.76	17.46
2017-18	20	50	27.26	23	18	44.32	42.50	27.78	5	4.26	15.63
2018-19	20	50	27.26	17.8	15.5	34.90	31.50	14.84	2.3	9.46	34.70
Mean			27.26	21.1	17.5	40.21	37.85	20.35	3.6	6.16	22.60

Table 2: Economic analysis of cluster frontline demonstrations and farmer's practices

Year	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio		Net return increase over
	Demo.	FP	Demo.	FP	Demo.	FP	Demo.	FP	FP (%)
2016-17	45000	53500	111510	96000	66510	42500	2.48	1.79	56.49
2017-18	43736	50400	120124	97136	76388	46736	2.75	1.93	63.45
2018-19	45280	47630	101002	88395	55722	40765	2.23	1.86	36.69
Mean	44672	50510	110879	93844	66207	43334	2.49	1.86	52.21

dissimilarity in the soil fertility status and weather conditions i.e. rainfall and temperature. Hence variety wise location specific recommendation appears to be necessary to minimize the technology gap for yield level of different situations.

Technology index: In case of technology index, lower the value of technology index indicate more is the feasibility of technology. The data (Table 1) showed that minimum technology index value 15.63 per cent was noticed in 2017-18 followed by 17.46 per cent in 2016-17 whereas, maximum value of technology index 34.70 per cent in 2018-19, The average 22.60 per cent technology index found during the experimental period it exhibited the feasibility of technology demonstrated.

Economics: The economics of groundnut production under cluster frontline demonstrations and farmer's practices have been presented in Table 2. The average gross return (Rs. 110879/ha) and net return (Rs. 66207/ha) in CFLDs were found higher than the farmer's practices gross return (Rs. 93844/ha) and net return (Rs. 43334/ha). The average net returns 52.21 per cent higher than that of farmer's practice. The B:C ratio exhibited the same trend as in gross and net return which was found 2.49 in CFLDs and 1.86 in farmer's practice. It showed that the adoption of demonstration technology by farmers would be higher economically and gainful proposition.

CONCLUSION

From the above findings, it can be concluded that by conducting cluster frontline demonstrations of improved variety with intervention practices of proven technologies in farmer's field, groundnut productivity enhanced to a great extent which increased in the income level of farmers and improved livelihood of farming community. Farmers were motivated by cluster frontline demonstrations in groundnut crop and they would adopt these technologies in the coming years.

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A Case Study on Gender Differentiated Role Analysis in Rice Farming in a Rice Intensive Ecology

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ABSTRACT

A study was conducted in Sankilo village from Cuttack district of Odisha to understand the gender issues and gender role analysis in rice farming. The village was selected after making due consultations with the households and finding the social climate relatively better in gender sensitiveness and a PRA study was undertaken by involving both male and female, key informants separately to identify major gender issues in rice farming. Daily activity clock analysis revealed that farm women got only 6 hours rest as compared to male counterparts with $7^1/_2$ hours and 8 hours during wet and dry season, respectively. Farm women were found overloaded with works round the year as compared to males for 6 months during July- December. Major benefits acquired by farm women out of the involvement in rice farming were financial benefit through direct cash inflow (90%) and social recognition (86%). The results also revealed that major decision regarding the plant protection measures (100%), buying farm equipments/ machinery (93.33%), and quantity and type of fertilizers (90.00%) tends to be higher in case of men as compared to women. Almost all the farmwomen showed their interest in accessing productive resources for rice production like labour, capital, inputs, technologies etc. On the basis of this case study a 3E's concept was developed for bringing gender equity, promoting entrepreneurship and realization of empowerment with planning for training, research and extension activities for farm women development and federating farm women into business group.

Keywords: Access to resources, Decision making, Gender issues, Role analysis, Women participation in rice farming

INTRODUCTION

Agriculture plays a significant role in economic growth and reduction of poverty in developing countries. Historically, women in rural areas have played major roles and have made a noteworthy contribution in rice farming because women provide a source of low-priced labour for rice cultivation. In actual fact, their role in farming is influenced by several interrelated socio economic (including ethnicity, class, religion, and age), environmental, and political factors which are recognized as "gender roles" (Quisumbing *et al.*, 2014; Alesina *et al.*, 2013). Women have a decisive role in ensuring food security and preserving local agro-biodiversity. Women comprise, on an average, 43 per cent of the agricultural labour force in developing countries. Women work in multi-dimensional sectors may it be as farmers, workers or as an entrepreneur but still they face more severe constraints than men almost everywhere in accessing markets and services. The 17 Sustainable Development Goals (SDGs) intended to achieve a better and more sustainable future have prioritized the significance of reducing the gender gaps and empowering women as 5th SDG, in farming sector by minimizing poverty as the 1st SDG, and end hunger by boosting productivity as 2nd SDG (UNDP, 2015). If we want the agricultural sector to thrive in the country, acknowledging the contribution of women farmers becomes an absolute necessity. So, it is clear that we need to provide women farmer with opportunities and upgrade their skills through collective training and capacity building programs (Martolia *et al.,* 2020).

Rice is considered as the major crop and is the staple food of almost all the people of eastern and southern parts of the country but the role played by women in paddy fields remain invisible or not highlighted. Globally,

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women represent 49.6 per cent of the total population, but only 40.8 per cent of the total workforce is in the formal sector (World Bank, 2011). The female labour in paddy cultivation is comparatively higher than male labour in poor households and mostly female labour fulfills the major demand of labour required in the whole process of paddy planting to marketing. Migration of male counterparts to urban areas for better income has also led to backdrop of agriculture sector. Women in rural production women in India played a major role in the national economy and also at household level. In regions with intensive farming, women's share in rice and tea production was remarkably more. Women invest as much as 10 times more of their earnings than men do in their family's well-being in areas including child health, education and nutrition (Duflo, 2012; Maertens and Verhofstadt, 2013; Quisumbing and Maluccio, 2000).

Traditionally, women have played roles in activities such as sowing, transplanting, weeding, and crop processing while males have been responsible for land preparation, ploughing, irrigation, and field leveling (McGuire, 2015). The participation or involvement of women farmers in weed management (87.50%), nursery raising/sowing (65%), transplanting (60%) and threshing (57.50%) in paddy cultivation was significantly more as compared to men (Das *et al.,* 2020). Women produce over 50% of the world's food and their role is increasing in the rural areas precisely where men are increasingly moving to cities (Banque Mondiale, 2017). The household economic status and gender differences for instance in education, may affect the scope of individual labour allocation or off-farm opportunities available to women compared to men. For instance, as rural wage labourer, women receive lower wage than men and their opportunity for education, skill formation and shifting to better paid work are also narrow (Vepa, 2005). If women were given similar opportunities and access to the productive resources as men, they would be equally productive as male farmers, as expressed by Agarwal (2015). Despite the dominance contribution and multiple roles of the female labour force, women in India still face extreme disadvantage in terms of pay, land rights and representation in local farmers' organizations. They are not adequately recognized in the male-dominated society (Kumari *et al.,* 2020). The consequence of gender discrimination in access to resources resulting in a lower output than it would be if women had greater access to these resources, the wider implication being slower economic development (Khachaturyan and Peterson, 2018).

MATERIALS AND METHODS

The case study was undertaken in Sankilo village under Nischintakoili block of Cuttack district. The village was selected after making due consultations with the households and finding the social climate relatively better in gender sensitiveness. Gender sensitization programmes and PRA study were undertaken by involving both male and female key informants separately, the major focus or objective was to identify the gender issues and role analysis in rice farming. For the study, a representative sample of 30 farm families were selected from the cluster and a bench mark survey of participating farm women on their profile, involvement (both physical and management activities), access to productive resources, benefit from rice farming, gender relation etc. through a well developed interview schedule was carried to understand the women and gender issues.

RESULTS AND DISCUSSION

Through various gender sensitization programmes and using different tools of Participatory Rural Appraisal, major gender issues were identified in rice farming. From daily activity clock analysis during the wet season it was found that farm women worked for about 18 hours in the household and farm activities with only 6 hours rest period as compared to 7½ hours rest by their male counterparts. Similarly, during dry season too, farm women took only 6 hours rest as compared to 8 hours rest by male farmers. Pair-wise matrix ranking on preference for rice variety revealed that men preferred a variety for its 'disease-pest resistance' followed by 'yield' and 'cooking quality' out of ten identified parameters while women preferred 'high yield' followed by 'early duration' and 'cooking quality' of eight identified parameters of preference.

Regarding workload in different calendar months, farmers perceived that they were heavily loaded with works during July-December when the field activities were more. In contrast, farm women were comparatively heavily burdened with household works and farm activities round the year except some leisure time. As regards to major problems being encountered by farm women in rice farming activities, the women enlisted health hazards (waist pain), storage problem of grains & seeds, threshing & winnowing, water scarcity, capital shortage for procurement of inputs, and lack of technical knowledge & skills in rice cultivation. They wanted institutional credit facility, farm machineries on custom hiring basis and training on rice farming.

Household profile: Thirty households of the participating farmwomen of village Sankilo were selected for bench mark survey. Most of the house owners were middle aged (46.67%, 45-60 years) followed by young (43.33%, up to 45 years). Half of them were from general castes followed by SC (33.33%). Majority were living in nuclear family (70%) with family size of up to 5 members (60%). Above 83 per cent of the respondents were literates, but all of them were dependant on farming for their livelihood. Rice is grown by all during *kharif* followed by green gram, black gram and vegetable cultivation. Most of them were small farmers (70%) with land holding of up to1ha. Land ownership lies with the male members (96.67%) except one widow (3.33%). About half of them were below poverty line (53.33%) and half (46.67%) were above poverty line families.

Profile of participating farmwomen: The profile of the farm women indicated that about two thirds of the participating farm women were young (63.33%) and rest (36.67%) were middle aged; one third were illiterates (33.33%), one third were educated up to primary school (33.33%) and only 10 per cent were matriculates, all were having experiences in rice farming. But more importantly, 80 per cent of the farm women were either members (66.67%) or office bearers (13.33%) of some social organizations.

The results relating to gender-based role performance in rice farming in Table 1 showed that the involvement of women farmers was more in the case of storage (93%), preparation of value added products (90%), weed management (83%), nursery raising/sowing (67%), transplanting (60%) and threshing (60%) where their involvement was remarkably more than men. Whereas, in procurement of inputs (67%) pesticide application (60%), fertilizer application (53%) and marketing (50%) the involvement of men was found to be more. The study conducted by Das *et al.* (2014) revealed that the farm women perceived the traditional technologies *viz.*, manual transplanting, manual weeding, harvesting by traditional sickles and parboiling in traditional way were not efficient indicating development of women friendly implements. According to the study undertaken by Martolia *et al.* (2020), the value addition done by farm women were basically performed for household consumption and this shows the reason that being women they were not supported by the family to self empowered them and curb the loss of farm produce in post harvest segment.

The physical involvement of farm women in production related activities was more in 0.01-0.5 acres of land followed by 0.51-1.0 acres (Table 2a). As the area increase their participation was tend to be lower. In case of post-harvest activities (Table 2b) their involvement was

Table 1: Gender-based participation in Rice Farming (N=30)

S.No.	Activities	Women	Men	Both
1.	Field preparation	6(20.00)	8 (27.00)	16 (53.00)
2.	Procurement of Inputs	4(13.00)	20 (67.00)	6 (20.00)
3.	Nursery raising/sowing	20 (67.00)	3 (10.00)	7 (23.00)
4.	Transplanting	18 (60.00)	5 (17.00)	7 (23.00)
5.	Fertilizer Application	3 (10.00)	16 (53.00)	11 (37.00)
6.	Pesticide Application	3 (10.00)	18 (60.00)	9 (30.00)
7.	Weed management	25 (83.00)	3 (10.00)	2 (7.00)
8.	Irrigation	11 (37.00)	7 (23.00)	12 (40.00)
9.	Harvesting	11 (37.00)	7 (23.00)	12 (40.00)
10.	Threshing	18 (60.00)	5 (17.00)	7 (23.00)
11.	Cleaning and Winnowing	3 (10.00)	7 (23.00)	20 (67.00)
12.	Storage	28 (93.00)	0 (0.00)	2 (7.00)
13.	Marketing	7 (23.00)	15 (50.00)	8 (27.00)
14.	Sale decision	12 (40.00)	8 (27.00)	10 (33.00)
15.	Preparation of value addition products	27 (90.00)	2 (7.00)	1 (3.00)

(The number in the parenthesis indicates percentage)

Table 2(a): Physical involvement in major crop production activities of rice farming (N=30)

S.No.	Physical Activities	Quantum of Work Undertaken by the farm women (Area in acre)				
		Nil	0.01-0.5	0.51-1.0	1.01-1.5	Above 1.5
1.	Assisting in Land preparation	16(53.33)	14 (46.67)	0 (0.00)	0 (0.00)	0 (0.00)
2.	Seed selection and treatments	8 (26.67)	3 (10.00)	9 (30.00)	4 (13.33)	6 (20.00)
3.	Sowing seeds	9 (30.00)	21 (70.00)	0 (0.00)	0 (0.00)	0 (0.00)
4.	Uprooting seedlings	2 (6.67)	28 (93.33)	0 (0.00)	0 (0.00)	0 (0.00)
5.	Transplanting	0 (0.00)	20 (66.67)	9 (30.00)	1 (3.33)	0 (0.00)
6.	Weeding	0 (0.00)	20 (66.67)	9 (30.00)	1 (3.33)	0 (0.00)
7.	Assisting in Irrigation	9 (30.00)	14 (46.67)	5 (16.67)	2 (6.67)	0 (0.00)
8.	Chemical Fertilizer application	28(93.33)	2 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)
9.	Pesticide application	30(100.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
10.	Harvesting	0 (0.00)	11(36.67)	16(53.33)	2 (6.67)	1(3.33)

Table 2(b): Physical involvement in major post-harvest activities of rice farming (N=30)

S.No.	Physical Activities	Quantum of Work Undertaken by the farm women (Quantity in qtls.)				
		Nil	Upto 10	11-20	21-30	Above 30
1.	Threshing	0 (0.00)	9 (30.00)	14(46.67)	4 (13.33)	3 (10.00)
2.	Winnowing	0 (0.00)	7 (23.33)	13(43.33)	7 (23.33)	3 (10.00)
3.	Drying and cleaning	0 (0.00)	9 (30.00)	14(46.67)	7 (23.33)	0 (0.00)
4.	Storage	0 (0.00)	4 (13.33)	14(46.67)	8 (26.67)	4 (13.33)
5.	Value addition	0 (0.00)	19(63.33)	10(33.33)	1(3.33)	0 (0.00)

higher in 11-20 qtls category especially in threshing, drying and cleaning and storage closely followed by winnowing which indicates the post-harvest activities are the domain of farm women. In the case of value addition the farm women are actively involved in 10qts category. Hence, skill up-gradation training should be imparted to them for commercialization and setting up small enterprise in rice-based value added products.

With regard to the extent of participation in major decision-making process in farm management activities (Table 3), majority of women were consulted in activities like varietal selection (93.33%), irrigation (90%), sale of produce (83.33%) and financial management (80%), but rarely consulted in plant protection measures, fertilizer application and buying of farm equipments. But unfortunately, their suggestions were hardly accepted by their male counterparts.

The findings presented in Table 4, depicts that almost all the farmwomen showed their interest in accessing productive resources for rice production like labour, capital, inputs, technologies etc. It was seen that about 47 per cent succeeded in accessing the land and 40 per cent of farm women accessed up to 100 per cent of the family capital. These were some positive indications of gender friendly social climate.

Regarding benefits accrued in rice farming to individual women, the results in Table 5 were highly encouraging. The women growers perceived following major benefits by involvement in rice farming *viz.*, financial benefit through direct cash inflow by selling of straw, grain, chaff and through value added products (90%), social recognition in family, community and at the organizational level and indirect financial benefits through utilization of by-products and exchange process, respectively.

The critical examination of existing gender relations in household chores as in Table 6 indicates that majority of respondents (86.67%) were fully engaged in livestock care, closely followed by child care (80%). With regards to sharing with male members only 20 per cent farm women shared fully relating to moving out for treatments etc and partially (60%) with their male counterparts relating to livestock care. The findings also reflects that majority

Table 3: Participation of farm women in decision-making related to rice farming

Area of Decision- making	Extent of your participation (N=30)												
	Have you been consulted		Have you suggested		Extent of suggestion accepted (Rating on 5 point scale)						Who takes major decision		
	Yes	No	Yes	No	0	1	2	3	4	5	Men	Women	Both
Rice variety selection	28 (93.33)	2 (6.67)	28 (93.33)	0 (0.00)	0 (0.00)	3 (10.00)	11 (36.67)	9 (30.00)	5 (16.67)	0 (0.00)	14 (46.67)	11 (36.67)	5 (16.67)
Financial management	24 (80.00)	6 (20.00)	24 (80.00)	0 (0.00)	0 (0.00)	4 (13.33)	9 (30.00)	5 (16.67)	5 (16.67)	1 (3.33)	14 (46.67)	10 (33.33)	6 (20.00)
Buying farm equipments/machinery	8 (26.67)	22 (73.33)	8 (26.67)	0 (0.00)	1 (3.33)	1 (3.33)	1 (3.33)	5 (16.67)	0 (0.00)	0 (0.00)	28 (93.33)	2 (6.67)	0 (0.00)
Quantity and type of fertilizers applied	4 (13.33)	26 (86.67)	2 (6.67)	2 (6.67)	0 (0.00)	2 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	27 (90.00)	2 (6.67)	1 (3.33)
New farm practices	23 (76.67)	7 (23.33)	19 (63.33)	4 (13.33)	2 (6.67)	10 (33.33)	4 (13.33)	3 (10.00)	0 (0.00)	0 (0.00)	21 (70.00)	3 (10.00)	6 (20.00)
Irrigation management	27 (90.00)	3 (10.00)	24 (80.00)	3 (10.00)	0 (0.00)	9 (30.00)	11 (36.67)	2 (6.67)	2 (6.67)	0 (0.00)	17 (56.67)	3 (10.00)	10 (33.33)
Plant protection measures	2 (6.67)	28 (93.33)	0 (0.00)	2 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	30 (100.00)	0 (0.00)	0 (0.00)
Selling surplus farm produce	25 (83.33)	5 (16.67)	25 (83.33)	0 (0.00)	0 (0.00)	5 (16.67)	12 (40.00)	5 (16.67)	1 (3.33)	2 (6.67)	14 (46.67)	8 (26.67)	8 (26.67)

Table 4: Access of farm women to productive resources for rice production (N=30)

Resources		Have you shown interest in accessing the resources		If yes, what is the % of success					
		Yes	No	0(Nil)	1(1-20%)	2(21-40%)	3(41-60%)	4(61-80%)	5(81-100%)
Land		30 (100.00)	0 (0.00)	0 (0.00)	1 (3.33)	1 (3.33)	4 (13.33)	10 (33.33)	14 (46.67)
Labour	Family	30 (100.00)	0 (0.00)	0 (0.00)	0 (0.00)	4 (13.33)	6 (20.00)	11 (36.67)	9 (30.00)
	Hired	22 (73.33)	8 (26.67)	0 (0.00)	8 (26.67)	6 (20.00)	4 (13.33)	4 (13.33)	0 (0.00)
Capital	Family	30 (100.00)	0 (0.00)	0 (0.00)	5 (16.67)	0 (0.00)	4 (13.33)	9 (30.00)	12 (40.00)
	Institute	14 (46.67)	16 (53.33)	5 (16.67)	6 (20.00)	3 (10.00)	0 (0.00)	0 (0.00)	0 (0.00)
Input	Fertilizer	22 (73.33)	8 (26.67)	20 (66.67)	2 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	Plant protection chemicals	4 (13.33)	26 (86.67)	4 (13.33)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
	FYM	30 (100.00)	0 (0.00)	1 (3.33)	0 (0.00)	4 (13.33)	8 (26.67)	11 (36.67)	6 (20.00)
Improved technology		25 (83.33)	5 (16.67)	13 (43.33)	8 (26.67)	1 (3.33)	2 (6.67)	1 (3.33)	0 (0.00)
Market accessibility		24 (80.00)	6 (20.00)	3 (10.00)	7 (23.33)	6 (20.00)	6 (20.00)	2 (6.67)	0 (0.00)

Table 5: Benefits out of engagement in rice farming (N=30)

S.No.	Benefits	Frequency	Percentage
1.	Social Recognition (Family, Community, Organization)	26	86.66
2.	Financial benefit through direct cash inflow (Rs.) (Selling of straw, grain, chaff, value added products)	27	90.00
3.	Indirect financial benefits (By utilization of products/ by-products and exchange process in Rs.)	20	66.66
4.	Any lump sum towards your contribution (Rs.)	13	43.33

(80%) of the respondents have never shared with their male members relating to food preparation indicating the gender stereotype role. Hence, this requires knowledge enhancement, skill upgradation, exposure and provision of logistic support for various entrepreneurial activities to recognize and make the farm women an active part of national development programme.

CONCLUSION

For a long time, in the whole world women have been the torch bearers in rice production. In India, participation of women has been low because of social barriers and cultural constraints. The role of female farmers in field is same as men except transport and procurement process. Regarding workload in different calendar months, men farmers perceived that they were heavily loaded with works during July-December when the field activities were more. In contrast, farm women were comparatively heavily burdened with household works and farm activities round the year except some leisure time. The major problems being encountered by farm women in rice farming activities, the women enlisted health hazards (waist pain), storage problem of grains & seeds, threshing & winnowing, water scarcity, capital shortage for

Table 6: Existing gender relations in household chores (N=30)

Dimensions of roles & responsibilities	Extent of engagement			Can you share with male members			Can you share with female members		
	Fully	Partially	Never	Fully	Partially	Never	Fully	Partially	Never
Food preparation	21(70.00)	9(30.00)	0(0.00)	0(0.00)	6(20.00)	24(80.00)	9(30.00)	9(30.00)	12(40.00)
Livestock care	26(86.67)	4(13.33)	0(0.00)	4(13.33)	18(60.00)	8(26.67)	3(10.00)	6(20.00)	21(70.00)
Fire wood arrangement	23(76.67)	7(23.33)	0(0.00)	3(10.00)	10(33.33)	17(56.67)	3(10.00)	7(23.33)	20(66.67)
Excess workload in field in the peak season	20(66.67)	7(23.33)	3(10.00)	4(13.33)	17(56.67)	9(30.00)	6(20.00)	7(23.33)	17(56.67)
Child care	24(80.00)	6(20.00)	0(0.00)	4(13.33)	16(53.33)	10(33.33)	3(10.00)	10(33.33)	17(56.67)
Collection of water	22(73.33)	8(26.67)	0(0.00)	0(0.00)	7(23.33)	23(76.67)	7(23.33)	11(36.67)	12(40.00)
Washing and cleaning of utensils	23(76.67)	7(23.33)	0(0.00)	0(0.00)	7(23.33)	23(76.67)	6(20.00)	14(46.67)	10(33.33)
Washing of clothes	23(76.67)	7(23.33)	0(0.00)	0(0.00)	9(30.00)	21(70.00)	5(16.67)	11(36.67)	14(46.67)
Cleaning of houses & yards	20(66.67)	8(26.67)	2(6.67)	0(0.00)	10(33.33)	20(66.67)	7(23.33)	8(26.67)	15(50.00)
Moving out for trainings, treatments etc.	7(23.33)	16(53.33)	7(23.33)	6(20.00)	13(43.33)	11(36.67)	9(30.00)	6(20.00)	15(50.00)

procurement of inputs, and lack of technical knowledge & skills in rice cultivation.

With regard to the extent of participation in major decision-making process in farm management activities, majority of women were consulted in activities like varietal selection, irrigation, sale of produce and financial management, but rarely consulted in plant protection measures, fertilizer application and buying of farm equipments. Unfortunately, their suggestions were hardly accepted by their male counterparts.

Hence, there is a need to generate educated, trained, self-reliant, self-motivated, innovative and visionary women farmers to lead our agricultural production systems out of their multiple responsibilities. For '*Atmanirbhar Bharat*' it's important to take women along. The focus should be on the role of women in reviving the economy and making India self-reliant. Hence, a gender transformative approach is required to transforms gender inequalities addressing their root causes. On the basis of this study a 3E's concept was developed for bringing gender equity, promoting entrepreneurship and realization of empowerment with planning for training, research and extension activities for farm women development and federating farm women into business group. Concentrate on skill development, articulation of Tradition, Technology, Talent and Trade and developing farm women based clear road map for agricultural development in the country are required for bringing women to mainstream in agriculture and allied sectors.

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Adoption of Silver Nanoparticles Diagnosis and Therapeutic Management

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ABSTRACT

This review presented as uses of silver nanoparticles in different fields including medicines food health care, consumers, cosmetics and industrial purposes due to their unique physical and chemical properties. These includes optical thermal, high electrical conductivity and biological properties. The adoption of silver nanoparticles in medicines for antimicrobial and anti cancer therapy and also applied in the promotion of wound repair and bone healing or as the vaccine adjuvant antidiabetic agent and cosmetics products as antiseptics as well as preservatives to treat dermal problem. Thus silver nanoparticles have been developed as a superior product in the field of nanotechnology.

Keywords: Anticancer, Antimicrobial, Nanoparticles, Silver

INTRODUCTION

Nanotechnology has been rapidly growing field with numerous uses in science field. Silver nanoparticles are increasingly used in various field cancer therapy drug delivery diagnosis regenerative medicines cosmetics molecular imaging (Figure 1). AgNps are various shapes and size differing in optical properties and chemical sensors. Silver nanoparticles are being used in numerous technologies. AgNPs are various shape and size. The size can vary according to field of application in drug delivery are generally greater than 100 Nano meters to accommodate good amount of drug to be delivered similarly, the ideal size of the NPs for treatment of cancer is 70-200 nanometer (De Jong *et al*., 2008) the fenestrations in the endothelium is a developing tumors is about 200-780 Nano meter (Gaumet *et al.,* 2008). The anti cancer property has been analysed *in vitro* against various type of cancer cells human hepatoma cells (Kawata *et al*., 2011) lung cancer (Foldbjerg *et al*., 2011) breast cancer (Gurunathan *et al*., 2013) and cervical Cancer carcinoma (Vasanth *et al*., 2014). They impart toxicity to cancer cells by decreasing mitochondrial function, reactive oxygen species production (ROS). The medical use of silver nanoparticles wound dressing creams and an antibiotics coating on medical devices. Wound dressings containing silver (Lu *et al.,* 2008). sulfadiazine or silver Nano materials may be used to treat external infection. Silver nanoparticle have been studied for their antimicrobial potential and have proven to be antibacterial agents against both Gram negative and Gram positive bacteria (Kim *et al.,* 2007; Sondi *et al.,* 2004) and antiviral agents against the HIV-1 (Sun *et al.,* 2005) hepatitis B virus (Lu *et al*., 2008) respiratory syncytial virus (Sun, 2008) herpes simplex virus type 1 (Baram *et al*., 2009) and monkey pox virus(Rogers *et al.,* 2008). The development of silver nanoparticle products is expanding. They are now used as part of clothing, food containers, wound dressings oinments, implant coating and other items (Arora *et al.,* 2008; Kamari *et al.,* 2008). Some silver nanoparticle applications have received approval from the US food and Drug Administration (Dunn *et al.,* 2004).

AgNPs enter the mammalian cells as aggregates mostly through endocytosis and can also Cross the blood brain due to their small size upon entering the cells in the endocytic vesicles they are distributed to cytoplasm and nucleus through intracellular trafficking (Greulich *et al*., 2011). Due to difference in their physics chemical properties, they may affect different cellular processes. Silver nanoparticles are widely used in a variety of commercial products, there has only recently been major effort to study their effect on

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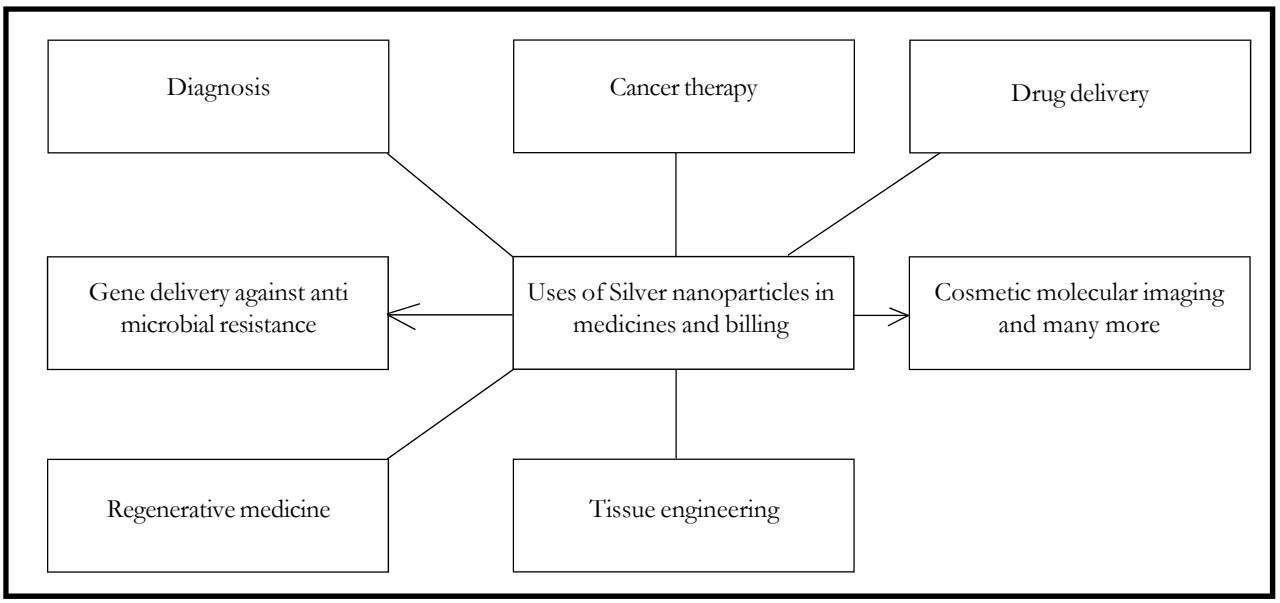

Figure 1: Uses of Silver nanoparticles in different fields of medicine and biology

human health. Several studies that describe the in vitro toxicity of silver nanoparticles to a variety of different organs, including lungs liver skin brain and reproductive organs. Many studies have shown that silver nanoparticles have made their way into therapeutic use in cancer as anti cancer agents and incorporated in a wide array of consumers products that take advantage of their describe optical conductivity and antibacterial properties in optical properties (Raghunandan *et al*., 2011). The drug currently used for anti cancer treatments are toxic to the body producing side effects and unintended or untargeted effects. On body physiology development of drug resistance quick drug metabolism and clearance from the patient body decreasing effective treatment time. AgNPs can also be used in conjugation and combination with drugs or coated with a polymer to be used against cancer cells.

ANTICANCER ACTIVITY

Silver nanoparticles are a promising treatment option for cancers that are resistant to common therapies. In a new study magnetic Silver nanoparticles to damage tumor cells in animal models. Silver nanoparticles have a magnetic dipole, a property that allows them to rotate alone the axis When we apply a magnetic field externally, these nanoparticles spin. Nano particles attach to the surfaces of cancer cells and then induced the spinning to mechanically destroy the cell membrane. Most therapies chemotherapy radiation focus on DNA damage, which cancer cells often find a way to overcome. The magnetic particles were designed to work against cancer cell using mechanical force is a very different way for cancer treatment, not impair normal cell in the process of cancer treatment. The Silver nanoparticles can be equipped with an antibody that recognizes a receptor expressed only on cancer cells. Silver nanoparticles injected into brain and applied a low frequency rotating nanoparticles created enough force to damage cancer cells membrane s and jump start cell death in brain tumors and as reduced tumor size and prolonged the survival rate of organism without adverse effects. This can be apply many types of cancer from brain tumors to breast cancer. Several in vitro studies have indicates that silver nanoparticles can enter cells by endocytosis and their localization inside the cell can be determined as perinuclear space of cytoplasm and endolysosomal compartment (Baram Pinto *et al*., 2009; Greulich *et al*., 2011; Kalishwaralal *et al*., 2009). AgNPs affect the junction of the vascular growth factor (VEGF). It is also known as vascular permeability within tumors (Kalishwaralal *et al*., 2009). These result s supports AgNPs have anti cancer properties that can be used as an alternation for cancer therapy and angeognesis inhibitor therapy (Sriram *et al.,* 2001).

ANTIBACTERIAL ACTIVITY

Antibacterial are agents used to disinfect surfaces and eliminate potentially harmful bacteria. That interfere with the growth of reproduction of bacteria. They are added to some soaps detergents skincare products and household cleaners.

Use of quantum dots in the treatment of cancer is a great advancements in this area. Use of quantum dots in the metal is a potent antibacterial agent. Silver nanoparticles particles have the ability to penetrate bacterial cell wall, changing the structure of cell membrane and even resulting of cell death. Silver ions perform their rarely work by punching holes in bacterial membranes and wreaking havoc once inside silver ions bind to the bacterial cell wall blocking transport of substances in and out of the cell. Silver ions are transported in to the bacterial cell wall they block the respiratory system destroying energy production (Lansdown, 2006). Silver ions interact with DNA and inhibit bacterial cell division stopping replication Due to antibacterial properties of silver nanoparticles it can be used as preservatives in cosmetics and in the anti acne preparation and are also incorporated into toothpaste and shampoos as preservatives. Now silver containing cleanser soap was claimed to have bactericidal and fungicidal properties and was found useful in treating sun damaged skin treatment of cancer is a great advancements in this area. Quantum dots glow when exposed to UV light. When inducted they see into cancer tumour (Xiu *et al.,* 2012; Tang *et al.,* 2018; Martinez *et al*., 2008).

ANTIDIABETIC ACTIVITY

Diabetes mellitus (DM) is a group of metabolic disease characterized by hyperglycemia DM is due to insufficient insulin secretion commonly used hypoglycemic agent can lower blood sugar by promoting secreting of insulin or increasing cell sensivity (Yugal *et al.,* 2017).

In recent studies it shows that AgNPs synthesized by plant extracts exhibit antidiabetic potential (Yugal *et al.,* 2017). The antidiabetic ability of AgNPs gives effective inhibition against carbohydrate digestive enzymes such alfa amylase and alfa glucosidase. Functions of alpha amylase inhibit by AgNPs. Alpha amylase also hydrolyzes the alpha liked polysaccharides like glycogen and starch to yield monks a charades such as glucose and maltose. This shows that AgNPs synthesized by neem and aleovera (Sathvika *et al*., 2019). The aqueous leaf extract of *P. sapota* and AgNPs exhibited efficient antidiabetic activity in the rat model of diabetes and therefore could have potential for development for medical applications in future (Satya Prabhu *et al.,* 2018).

ANTIOXIDANT ACTIVITY

Antioxidant are compounds that inhibit oxidation a chemical reaction that can produce free radicles and chain reactions that may damage the cells of organisms. Antioxidant such as thiols or ascorbic acid may act to inhibit these reaction.

Silver nanoparticles have more antioxidant activity as compared to vitamin C. Silver nanoparticles have been synthesized by extract of *Rhododendron dacuricum*. Anti oxidant constituents present in *R. dauricum* flowers part and their possible interaction with metallic surface like Ag. The antioxidant potential of silver nanoparticles capped by dilution of *R. dauricum* flowers part (Mitta*l et al.,* 2012). Silver nanoparticles have strong antioxidant active due to the presence of bioactive molecules on the surface of silver nanoparticles.

ANTI HIV ACTIVITY

Acquired immune deficiency syndrome AIDS has killed more than 25 million people science it was first recognized in 1981(Wikipedia) Globally there are approximately 33.3 million people currently living with the human immunodeficiency virus as of 2009 (Zussman *et al.,* 2003). Silver hydrosol nanoparticle are presently used to treat HIV /AIDS patients who legally request alternative treatment of nano-silver from the Immune Recovery Foundation Data. Data will be collected from AIDS/HIV patients until approximately 70 per cent are assessed (Ricardo, 2012).

According to joint united nation programme on HIV/ AIDS, an estimated 33 million people living with HIV IN 2007, 2.7 million fever than 2001. Although the rate of new HIV infections has fallen in several countries, the HIV/ AIDS pandemic still stands as a serious public health problem worldwide. The antiviral properties of silver nanoparticle against HIV-1 strain at non cytotoxic concentrations. The silver nanoparticle was similar to the spacing of gp120 spikes over the viral membrane receptor. The mode of antiviral action of silver nanoparticle against HIV. Silver has antimicrobial properties that selective targeted and kill rapidly proliferation single celled organism such as viral and other pathogens, while normal tissue remained unaffected (Ricardo, 2012; Gordon, 2007).

VACCINE ACTIVITY

Vaccination has had a major impact on the control of infectious diseases. Traditional vaccinations include live a attenuated microbes, killed microbes or components of microbes. Althoud, some do not afford good protection against disease. many of these vaccine have been central to

the control of infectious disease (Anthony *et al*., 2013). AgNPs recently have Included in vaccine formation to improve their efficacy and effectiveness (Okamoto *et al*., 2009). Most of the current influenza vaccine s fail to develop a strong immunity at lung mucosae. Vaccination presence of AgNPs protected mice from lethal flue compared with others chemicals. AgNPs enhance specific IgA secreting plasma cells and antibodies titers shows successful mucosal immunity (Daniel *et al*., 2019).

PARASITIC ACTIVITY

Silver nanoparticle also used as antimalarial efficiency in parasitized human red blood cells and to detect against malaria *P. falciparum* as a new nanotool against malaria. *A. abrotanum* AgNPs prepared and antiplamodial effect has been assesses using increase doses of *A. abrotanum* AgNPs on the perasitized red blood cells. With the treatment of arborescens AgNPs the parasite growth was locked in the ring stage (Elisabetta *et al*., 2020). Silver nanoparticle are considered potent therapies in the treatment of toxoplasmosis. AgNPs decrease the cell viability of some parasitic species. Toxoplasama gondii parasite can survive and contaminated the water, vegetable's and produced toxoplasmosis and chorioretinitis in human when it treated with different ratio of and exposure time the morphological alteration of the cell structure of oocyte was observed and inhibition of the viability of these microorganism (Diego *et al.,* 2020).

CONCLUSION

The silver nanoparticles proved unique anticancer activity against significantly affect the cytotoxic activity of the achieved silver nanoparticles. In this review we have focused on their use as anticancer agents. AgNPs have been extensively as a part of various therapies in in vitro and in vivo for their anticancer properties against different types of cancer. With the data collected from this study we concluded that silver nanoparticles are safe to use in cosmetics depending upon the size of particles as it seems that the smaller size particles present higher toxicity compared with bigger nanoparticles. AgNPs makes promising anti cancer agents because first they are affective against drug resistant tumour cells and its hard to developed resistance against them. Second they help in targeted delivery and due to their nanometer size range are able to cross the fenestration in the blood capalliaries and even the blood brain barrier. Third they can be formulated and targeted in a number of ways conjugated coatings drug encapsulation bimetallic application etc. (Heerak *et al.,* 2020).

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Discerning Extrinsic Motivational Factors of Performance in Extension Service Delivery to Disadvantageous Locations: A Dimension Reduction Approach

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ABSTRACT

Grassroots extension functionaries in disadvantageous settings often face formidable challenges and difficulties in reaching set performance standards. To harness optimum performance, it is necessary to delve into their perceived performance prerequisites – the extrinsic motivational factors. The present study conducted during 2015-16 aimed at extracting extrinsic motivational factors of performance of Subject Matter Specialists (SMSs) working in Farm Science Centers popularly known as *Krishi Vigyan Kendras* (KVKs) located across the disadvantageous Northeastern region (NER) of India. Sample of the study comprised two hundred and thirty one SMSs from fifty nine KVKs across eight NER states (n=231). A factor analysis following principal component extraction approach and orthogonal rotation helped in isolating ten major extrinsic motivational factors from thirty eight variables governing performance of the SMSs of NER KVKs: organizational climate and work culture (F1), technology application and capacity building aids (F2), road infrastructure and transport facilities (F3), physical facilities within KVK (F4), safety of KVK staff, resources, and produce (F5), host institute's support (F6), experimentation and demonstration facilities (F7), ease of external contact (F8), task-remuneration balance (F9), and basic amenities within reach (F10). Findings of the study will be useful for the Indian Council of Agricultural Research and the concerned development departments of the state governments in formulation and implementation of suitable development policies and welfare measures. The factors identified may be used as useful indicators for scaling, index development, and for other related measurement purposes by the policy makers and future researchers.

Keywords: Extension, Factor analysis, KVK, Motivation, Northeast, Performance

INTRODUCTION

Extension services although have enormous potential to increase agricultural productivity, a review of the recent empirical evidences across regions and countries reveals mixed results in performance and impact (Ragasa *et al.,* 2016). Extension service delivery in the disadvantageous locations generally suffers from compliance issues due to various contextual difficulties and inherent limitations (Kokate *et al.,* 2016; Paul *et al.,* 2016a). The Northeastern region (NER) of India is such a disadvantageous region where the extension functionaries face formidable challenges in reaching to the farmers with improved agricultural technologies. Extension and advisory services in the region is primarily pivoted by the network of farm science centres popularly known as *Krishi Vigyan Kendras* (KVKs). The overall agricultural development and sustainable livelihood of the marginalized farmers in the entire NER to a great extent depends on effective functioning of these grass roots extension organizations

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(Ray *et al.,* 2020; Paul *et al.,* 2020). Improved effectiveness of the KVKs off course result from enhanced performances of the Subject Matter Specialists (SMSs) of KVKs, and therefore, they are required to be necessarily facilitated with extrinsic motivational factors to carry out their jobs to perfection. Past studies show that operational and financial problems to maintain motivation of functionaries may lead to inefficiency of public run extension systems indicating to the critical government role in a pluralistic extension system to provide appropriate regulatory framework in sustaining performance standards and ensuring fair competition (Vyas *et al.,* 2020; Alex *et al.,* 2002; Rivera *et al.,* 2001). It is evident that human resource development and organizational development interventions for harnessing optimum performance of the KVK SMSs require larger attention (Paul *et al.,* 2016b). In this backdrop, the present study aims at understanding the perception of KVK SMSs regarding various extrinsic motivational factors controlling their performance in the disadvantageous NER. The study employs a dimension reduction approach in extracting common factors of perception.

MATERIALS AND METHODS

Locale of the study: The present study was carried out during 2015-16 in one of the most disadvantageous and remote pockets of the country – the NER which covers eight states- Sikkim and the 'seven sister' states namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura (Figure 1). At present there is a network of seven hundred and sixteen KVKs in the entire country out of which eighty nine KVKs spread across the eight NER states - Arunachal Pradesh (16), Assam (26), Manipur (10), Meghalaya (7), Mizoram (8), Nagaland (11), Sikkim (4) and Tripura (7) (ICAR, 2020).

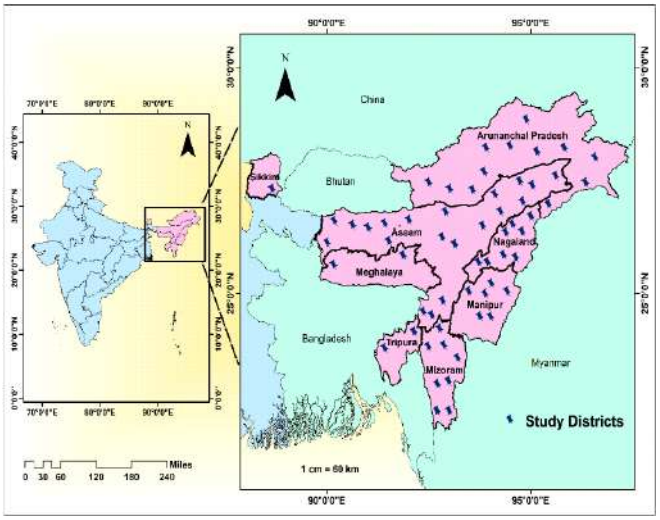

Figure 1: Locale of the study
Source: Authors

Sampling and data: A complete enumeration was attempted at the start of the study with all the four hundred and nineteen SMSs from seventy four district KVKs existing during the study period. A comprehensive list of thirty eight variables which are related to performance of the KVK SMSs in their mandated activities was prepared in consultation with different levels of stakeholders from the KVKs, their host institutes, and ATARIs (Table 1). A structured pretested questionnaire containing the thirty eight variables each with a six-point rating scale (0-5) was administered to all the SMSs who were asked to rate the variables (representing performance prerequisites) as observed and experienced by them in carrying out day-to-day mandated activities of their respective KVKs. Upon return of the filled up questionnaires, they were screened for completeness of responses. Completely filled up questionnaires were received from two hundred and thirty one SMSs who represented fifty nine district KVKs – twelve from Arunachal Pradesh, twenty from Assam, six from Manipur, two from Meghalaya, eight from Mizoram, eight from Nagaland, one from Sikkim, and two from Tripura. Therefore, sample of the study comprised two hundred and thirty one respondents (n=231).

Dimension reduction and factor extraction: A factor analysis (FA) following principal component extraction method with orthogonal (varimax) rotation helped in extracting the underlying dimensions and common factors explained by the different groups of variables (Kumar *et al.,* 2015). Observed variables which have similar patterns of responses because of their association with a latent variable, not directly measurable, are suitable for factor analysis. Before proceeding for the analysis, the Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) test of factor adequacy was applied to the data. Both the tests produced statistically significant results indicating to suitability of the data for factor analysis. In order to understand the extent of agreement among the respondent SMSs regarding the perception, Kendall's coefficient of concordance (W) was worked out (Paul *et al.,* 2017a). All the analyses were carried out using the statistical language programming software R (ver. 4.0.1).

RESULTS AND DISCUSSION

The correlation matrix of the thirty eight variables in our dataset significantly diverged from the identity matrix as indicated by a Bartlett's test ($\chi^2 = 5497.205$, $p < 0.001$). The dataset therefore was subjected to a factor analysis for extracting a comprehensive summary of the studied variables. Although the factor analysis grouped the thirty eight variables into same numbers of factors, only ten factors with eigen values equaling or exceeding 1.00 ($\lambda \geq 1.00$) were finally retained for interpretation (Kaiser, 1958). Factor loadings of 0.3 or more have been considered significant to report as far as possible (Harman, 1967; Gorsuch, 1973; Comrey, 1973). Ten extrinsic motivational factors exert significant influence on performance of the respondent extension functionaries. The cumulative variance contributed by the ten factors was 73.29 per cent (Table 2).

Factor I: Organizational climate and work culture

The most number of variables (13) significantly loaded under the first factor which is named as 'organizational climate and work culture' in view of the nature of its explanatory variables (Table 1). A conducive organizational climate is crucial to ensure organizational communication, job motivation, reduced job stress, and scientific productivity (Selamat *et al.,* 2013; Muda *et al.,* 2014; Paul *et al.,* 2015). Organizational justice, work engagement, public service motivation and transformational leadership are also important dimensions of organizational climate, as they govern job performance (Jankingthong and Rurkkhum, 2012). Organizational effectiveness being largely determined by task performance and contextual performance of employees (Borman and Motowidlo, 1993) and KVKs being such organizations requiring skill in team playing on part of their SMSs, a congenial organizational climate is the foremost prerequisite for fostering work culture in the KVKs and thereby enhancing individual job performance. The factor explained the highest variance (33.05%) in total variability of data indicating to the fact that the constituent variables reported under this factor varied the highest across the KVKs.

Factor II: Technology application and capacity building aids

Adequacy and timeliness of availability and access to equipment and instruments for technology application in the farmers' fields and training programmes for farmers, farm women and rural youth as depicted by the second factor are important prerequisites for effective job performance. Five variables namely, modern technological tools (X_6), farm equipment (X_{11}), research laboratory in KVK (X_5), audio visual aids (X_8), and public address system (X_9) contributed to constitute the second factor which had a total variance of 9.61 per cent in total variability of data. The entire mandate of the KVK is fulfilled through successful application of improved agricultural technologies to the farmers' fields through on-farm testing, frontline demonstration, and capacity building interventions. Therefore, it is quite obvious that the SMSs require strong support of the necessary aids to fulfil the KVK mandate.

Factor III: Road infrastructure and transport facilities

Development of road infrastructure and transportation facilities in the NER is quite challenging primarily due to its topographical disadvantages amidst various other factors. The same is supposed to provide an enabling environment for overall rural development and is included in the World Bank's rural development indicators also (Bhattacharyya *et al.,* 2018). The third factor consisted of four variables- geographical location of the KVK (X_{33}), road connectivity (X_{13}), fund for carrying out mandated activities (X_{10}), and means of transportation (X_{12}) as depicted by their communality values and high loading on the said factor. The variance explained by the factor was 6.42 per cent.

Factor IV: Physical facilities within KVK

The fourth factor consisted of three variables- training hall (X_7), office building (X_1) and working space in the office (X_2). Variance explained by the factor was 4.57 per cent. Office facilities and workplace milieu to have enormous impact on employee performance has been reported in other studies also (Parveen *et al.,* 2012; Leblebici, 2012).

Factor V: Safety of KVK staff, resources, and produce

A large majority of the KVKs in the NER being located in hilly, forested tracts are vulnerable to fragile ecological conditions, frequent extreme climatic events, wild animals, and ethnic groups (Paul *et al.,* 2017b). Freedom from damage caused by wild animals (X_{31}), harsh climate (X_{32}), external influence exerted by ethnic groups in day to day activities (X_{23}) were the three variables which had high loadings on the fifth factor. The factor accounted for 4.15 per cent of total variance.

Table 1: Factor loadings and communality values of variables contributing to extrinsic motivational factors of performance (n=231)

Factor	Constituent variables	Highest loading on the factor	Uniqueness (1-communality)
F-I	Transparency and impartiality maintained in the KVK (X_{26})	0.769	0.289
	Mutual trust in the KVK (X_{37})	0.717	0.333
	Efficiency of resource management in the KVK (X_{38})	0.715	0.334
	Job related support from the peers (X_{17})	0.695	0.395
	Job related support from the superiors (X_{15})	0.689	0.237
	Job related support from the subordinates (X_{16})	0.682	0.186
	Work culture in the KVK (X_{25})	0.672	0.451
	Leadership in the organization (X_{20})	0.660	0.424
	Recognition to honesty, efficiency and hard work (X_{28})	0.626	0.497
	Job structure (X_{18})	0.586	0.513
	Job autonomy (X_{14})	0.574	0.366
	Freedom from involvement in other than mandated activities (X_{21})	0.556	0.469
	Competitive atmosphere in the KVK (X_{36})	0.533	0.523
F-II	Modern technological tools (X_{6})	0.713	0.380
	Research laboratory in KVK (X_{5})	0.703	0.398
	Public Address System (X_{9})	0.633	0.449
	Farm equipment (X_{11})	0.581	0.440
	Audio Visual Aids (X_{8})	0.558	0.487
F-III	Means of transportation (X_{12})	0.749	0.291
	Road connectivity (X_{13})	0.575	0.482
	Fund for carrying out mandated activities (X_{10})	0.527	0.456
	Geographical location of the KVK (X_{33})	0.259	0.651
F-IV	Office Building (X_{1})	0.814	0.194
	Working space in the office (X_{2})	0.797	0.154
	Training hall (X_{7})	0.616	0.216
F-V	Freedom from damage caused by wild animals (X_{31})	0.983	0.005
	Freedom from damage caused by harsh climate (X_{32})	0.638	0.499
	Freedom from external influence exerted by ethnic groups in day to day activities (X_{23})	0.323	0.716
F-VI	Administrative support received from the host institute (X_{35})	0.806	0.113
	Professional mentoring received from the host institute (X_{34})	0.755	0.196
F-VII	KVK farm/ experimental field (X_{3})	0.764	0.191
	KVK demonstration unit/ experimental unit (X_{4})	0.763	0.192
F-VIII	Mobile connectivity (X_{29})	0.876	0.045
	Internet connectivity (X_{30})	0.495	0.467
F-IX	Salary (X_{19})	0.623	0.400
	Freedom from task overload (X_{27})	0.421	0.415
	Housing/ accommodation (X_{22})	0.394	0.578
F-X	Basic amenities for living in the locality (X_{24})	0.367	0.670

Source: Authors' calculation

Table 2: Eigen values and percent variances explained by factors determining job performance of SMSs (n=231)

S.No.	Name of the factor	Eigen value (λ)	Variance explained (%)
1.	Organizational climate and work culture (F-I)	13.69	33.05
2.	Technology application and capacity building aids (F-II)	3.98	9.61
3.	Road infrastructure and transport facilities (F-III)	2.66	6.42
4.	Physical facilities within KVK (F-IV)	1.89	4.57
5.	Safety of KVK staff, resources, and produce (F-V)	1.72	4.15
6.	Host institute's support (F-VI)	1.49	3.59
7.	Experimentation and demonstration facilities (F-VII)	1.39	3.35
8.	Ease of external contact (F-VIII)	1.29	3.10
9.	Task-remuneration balance (F-IX)	1.25	3.02
10.	Basic amenities within reach (F-X)	1.01	2.43
	Total	73.29	

Source: Authors' calculation

Factor VI: Host institute's support

Support and professional mentorship received from the host institute and opportunities for active participation in different knowledge sharing forums significantly influence performance of the KVK SMSs (Paul *et al.,* 2016a). As found in the present study, two variables- professional mentoring received from the host institute (X_{34}) and administrative support received from the host institute (X_{35}) loaded high on factor VI. The factor accounted for 3.59 per cent of the total variance.

Factor VII: Experimentation and demonstration facilities

It is important to have proper experimentation and demonstration facilities within the KVKs to promote performance of the SMSs (Paul *et al.,* 2021). The seventh factor consisted of two variables- KVK farm/ experimental field (X_3) and KVK demonstration unit/ experimental unit (X_4) which encourage the SMSs to be productive through active experimentation and planning impactful demonstration for their clientele groups. The factor explained 3.35 per cent of the total variance.

Factor VIII: Ease of external contact

The NER is far-flung and geographically dispersed often suffering from connectivity issues for day-to-day communication with the other parts of the country. Two variables- mobile connectivity (X_{29}) and internet connectivity (X_{30}) had high loadings on the factor. It had a variance contribution of 3.10 per cent to overall variability of data.

Factor IX: Task-remuneration balance

Three variables- freedom from task overload (X_{27}), accommodation/ housing (X_{22}), and salary (X_{19}) loaded high on the ninth factor. It was named as 'task-remuneration balance' which contributed 3.02 per cent to overall variability of data.

Factor X: Basic amenities within reach

The last factor comprised only a single variable–basic amenities within reach (X_{24}). It contributed only 2.43 per cent to total variance. It is in fact the least amount of variance explained by a factor which indicates that basic amenities available in the region is perceived almost same by the extension functionaries.

Extent of agreement about overall perception of SMSs

In order to find out whether there was considerable agreement among the respondent SMSs regarding their

Table 3: Kendall's coefficient of concordance (W) and its significance depicting agreement among respondent SMSs regarding their perception (n=231)

Statistic	Value
Sample size (n)	231
Kendall's coefficient of concordance (W)	0.209
Chi-Square (χ^2)	1788
Degrees of freedom (df)	37
Asymptotic significance (p)	0.000

Source: Authors' calculation

perception, the Kendall's coefficient of concordance (W) was worked out and its significance was tested. The coefficient value (W= 0.209) and significant test statistic (χ^2=1788 with 37 df, p <0.001) suggests that the overall perception among the respondent SMSs regarding the variables which significantly influenced their performance, was in accord (Table 3).

CONCLUSION

The present study focused on extrinsic motivational factors of performance of KVK SMSs in the NER which is considered as a difficulty prone and disadvantageous area. Keeping in view the harsh climatic conditions, topographical disadvantages and other related extremities which act as hurdles to effective extension service delivery, there is a need to provide requisite supports to the KVKs and their functionaries in a timely manner in order to sustain their motivation and improve upon their performance. The present findings imply that the KVKs, their host institutes and the supervising ATARIs should ensure prevalence of a conducive organizational climate and work culture in all the KVKs. The ICAR should attach special emphasis on the NER KVKs in strengthening their infrastructure by providing adequate physical facilities and other necessary supports in a timely manner for harnessing optimum performance of the KVK SMSs. The factors identified may further be included as useful indicators for scaling, index development, and other related measurement purposes by the future researchers. Intrinsic motivational factors, like achievement motivation, value orientation, self-esteem etc. which are also crucial in determining job performance of individual SMSs, were beyond the scope of the present study. Variability produced by intrinsic factors in conjugation with the extrinsic factors, may necessitate a future study for a complete understanding and modeling the factors of performance.

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Stability Analysis for Yield and Maturity Traits in Coloured Sweet Pepper (*Capsicum annuum* L. var. *grossum* Sendt.)

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ABSTRACT

The present investigation was carried out with fifteen coloured capsicum genotypes grown at three locations during *kharif* 2018. Pooled analysis of variance over three environments revealed highly significant differences among genotypes for all the characters. The environment E_1 was the most favourable environment for the expression of all traits. The pooled analysis of variance for stability revealed significant variation among genotypes for all traits. Environments (linear) component of variance was significant for all traits. The linear component of genotype × environment was also significant for all traits. The estimates of regression coefficients for fifteen genotypes ranged from 0.46 to 2.16 for days to first flowering, 0.56 to 1.43 for days to first fruit set, 0.18 to 1.76 for days to first harvest, -0.26 to 3.05 for number of fruits plant^{-1}, 0.24 to 1.91 for average fruit weight, 0.24 to 2.15 for average fruit yield plant^{-1} and 0.23 to 2.13 for fruit yield plot^{-1}.

Keywords: Sweet pepper, Stability, Yield, Maturity

INTRODUCTION

Sweet pepper is a versatile crop; it is mainly used in preparation of various products such as soups, stews, sausage, cheese, snacks, salad dressing, sauces, pizza, confectionaries, beverages etc. and to a limited extent canned, pickled or consumed as a fermented product which make it a major commodity in culinary industry. The consumption of sweet pepper is on the increase all over the world. It has become a multibillion dollar industry, as well as a part time hobby for home gardeners. Moreover the coloured bells command a higher market price and provide an alternate channel for this crop.

The genotype × environmental (G × E) interactions are major concern to plant breeders for developing improved cultivars. For a cultivar to be commercially successful, it must perform well across a range of environments in which the cultivar has to be grown. Among the different models proposed for estimating stability of genotypes by various workers Eberhart and Russel (1966) has been most extensively used to identify stable genotypes for important quantitative traits over environments in various crop species. Eberhart and Russel (1966) defined a stable genotype as one having high mean with a regression close to zero. Accordingly, genotypes could be classified as, below average stable performing well only in favourable environments ($b_i > 1$). Above average stable adapted specifically to poor environments ($b_i < 1$) and average stable performing well in most of the environments ($b_i = 1$).

MATERIALS AND METHODS

The present investigation was carried out to determine adaptive potential and phenotypic stability of fifteen coloured capsicum genotypes grown at three locations during *kharif* 2018. The experiment was laid out in a completely randomized block design with three replications at each location. The observations recorded on various maturity and yield attributing traits were subjected to statistical and biometrical analysis and the results thus obtained are described as under.

RESULTS AND DISCUSSION

Pooled analysis of variance over three environments (Table 1) revealed highly significant differences among genotypes for all the characters. Mean sum of squares due to

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Table 1: Mean squares of pooled environments for maturity and yield attributing traits in coloured Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.)

Source of variation	d.f	Days to first flowering	Days to first fruit set	Days to first harvest	Number of fruits plant^{-1}	Average fruit weight (g)	Average fruit yield plant^{-1} (kg)	Average fruit yield plot^{-1} (kg)
Genotypes	14	27.832**	22.506**	21.077**	20.758**	908.508*	0.214**	21.755**
Environments	2	3.968*	36.192**	32.742**	171.540**	3712.613**	1.176**	119.460**
Genotype × Env.	28	2.855*	2.178*	3.610*	2.275*	373.908*	0.093*	7.390*
Error	112	1.235	1.260	1.277	1.779	206.528	0.058	5.952

environments were significant for all the characters. Mean sum of squares due to genotype × environments were also significant for all characters.

The effect of environment in a stability analysis study is quantified through environmental index. The environmental indices for different traits are presented in Table 2. The present investigation revealed that the environment E_1 i.e. (Experimental Farm of Division of Vegetable Science, SKUAST-Kashmir, Shalimar) was the most favourable environment for the expression of all traits as indicated by the highest environmental index for number of fruits plant^{-1} (0.731), average fruit weight (3.325), fruit yield plant^{-1} (0.090) and fruit yield plot^{-1} (0.913) and lowest environmental index for days to first flowering (-0.895) and days to first harvest (-0.908). E_1 was also found to be favourable for expression of days to first fruit set (-0.339). The environment E_2 i.e., Vegetable Farm of Krishi Vigyan Kendra, Haran, Budgam was most favourable for expression of traits viz., days to first fruit set (-0.859). E_2 was also favourable for expression of various other traits like days to first flowering (-0.544), days to first harvest (-0.362), number of fruits plant^{-1} (0.018), average fruit weight (0.030), average fruit yield plant^{-1} (0.009) and average fruit yield plot^{-1} (0.002). The environment E_3 i.e., Regional Research Station and Faculty of Agriculture, Wadura was found to be unfavourable for expression of all traits. The influence of various environments as depicted by estimates of environmental indices was also reported by Tembhurne and Rao (2013).

Table 2: Environmental indices for various maturity and yield attributing traits in coloured Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.)

Character	Environmental index		
	E_1	E_2	E_3
Days to first flowering	-0.895	-0.544	1.439
Days to first fruit set	-0.339	-0.859	1.196
Days to first harvest	-0.908	-0.362	1.269
Number of fruits plant^{-1}	0.731	0.018	-0.749
Average fruit weight (g)	3.325	0.030	-3.355
Average fruit yield plant^{-1} (kg)	0.090	0.009	-0.099
Average fruit yield plot^{-1} (kg)	0.913	0.092	-1.005

Mean squares of stability analysis in respect of various maturity and yield attributing traits under study are summarized in the Tables 3a and 3b. The pooled analysis of variance for stability of fifteen genotypes over three environments revealed significant variation among genotypes for all traits indicating the presence of large amount of variability in the material chosen for study. The mean sum of squares due to environments were significant for all traits indicating that environments selected to conduct the study were variable and influenced the expression of traits. Similar results have been reported by Tembhurne and Rao (2013); Ummayiah *et al.* (2015) and Spaldon *et al.* (2017), etc.

Environments (linear) component of variance was significant for all traits indicating that environmental effects were predictable. These results agree with the findings of Jyothi *et al.* (2012); Tembhurne and Rao (2013); Ummiayah *et al* (2015) and Spaldon *et al.* (2017). The linear component of genotype × environment was also significant for all traits indicating the significant linear response of genotype to environmental changes for these traits. Non-significant effect of genotype × environment (linear) for rest of the traits indicated that the different genotypes did not differ genetically in their response to different environments. The linear component was found to be greater in magnitude than the corresponding non-linear component for almost all the traits suggesting that the performance of genotypes across environments could be predicted with greater precision for these traits. The pooled deviation was significant for days to first fruit harvest and average fruit weight indicating the important contribution of non-

Table 3a: Mean squares of stability analysis for maturity and yield attributing traits in coloured Capsicum (*Capsicun annuum* L. var. *grossum* Sendt.)

Source of variation	d.f	Days to first flowering	Days to first fruit set	Days to first fruit harvest
Rep within Env.	6	0.814**	0.206	0.234
Genotypes	14	10.056**	9.988**	12.902**
Environment+ (genotype× Env.)	30	1.933**	1.270**	1.618**
Environments	2	23.742**	17.123**	19.243**
Genotype× Env.	28	0.375*	0.138*	0.359*
Environments (L)	1	47.485**	34.246**	38.486**
Genotype × Env. (L)	14	0.571*	0.143*	0.411*
Pooled Deviation	15	0.167	0.124	0.287*
Pooled Error	84	0.278	0.184	0.158
Total	**44**	**4.518**	**4.044**	**5.208**

* and ** significant at 5% and 1% respectively

Table 3b: Mean squares of stability analysis for maturity and yield attributing traits in coloured Capsicum (*Capsicum annuum* L. var. *grossum* Sendt.)

Source of variation	d.f	Number of fruits plant^{-1}	Average fruit weight (g)	Average fruit yield plant^{-1} (kg)	Average fruit yield plot^{-1} (kg)
Rep within Env.	6	0.454*	0.854	0.002	0.219
Genotypes	14	24.949**	1759.933**	0.304**	30.748**
Environment+ (genotype× Env.)	30	0.895**	17.096**	0.012**	1.221**
Environments	2	8.218**	167.355**	0.135**	13.893**
Genotype× Env.	28	0.372**	6.364*	0.003**	0.316**
Environments (L)	1	16.435**	334.710**	0.271**	27.785**
Genotype × Env. (L)	14	0.608**	7.117*	0.005**	0.487**
Pooled Deviation	15	0.128	5.236**	0.001	0.135
Pooled Error	84	0.243	1.157	0.001	0.128
Total	**44**	**8.549**	**571.637**	**0.105**	**10.616**

*and ** significant at 5% and 1% respectively

predictable component in respect of these traits. Similar results have been reported by Srividhya and Ponnuswami (2010); Tembhurne and Rao (2013); Ummyiah *et al.* (2015); Spaldon *et al.* (2017).

The genotypes exhibiting stability for different traits are given in Table 4a and 4b. In the present study, the estimates of regression coefficients for fifteen genotypes ranged from 0.46 to 2.16 for days to first flowering, 0.56 to 1.43 for days to first fruit set, 0.18 to 1.76 for days to first harvest, -0.26 to 3.05 for number of fruits plant^{-1}, 0.24 to 1.91 for average fruit weight, 0.24 to 2.15 for average fruit yield plant^{-1} and 0.23 to 2.13 for fruit yield plot^{-1}indicating that the genotypes possess different set of alleles for adaptation across environments.

Since early flowering is a desirable character in sweet pepper, the genotypes requiring less number of days to flowering as compared to the population mean would be desirable. Early flowering together with non-significant regression coefficient and non-significant deviation from regression indicating average stability were identified as SH-SP-2, SH-SP-4, SH-SP-5, SH-SP-14, SH-SP-15, SH-SP-16 and Nishat-1. The genotypes requiring less number of days for first flowering as compared with general mean together with significant but less than one regression coefficient together with non-significant deviation from regression would indicate above average stability. None of the genotypes exhibited above average stability. SH-SP-11 with regression coefficient value significantly greater

Table 4a: Stability parameters for various maturity and yield attributing traits in coloured Capsicum (*Capsicum annuum* L.var. *grossum* Sendt.)

S.No.	Genotype	Days to first flowering			Days to first fruit set			Days to first fruit harvest		
		μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di
1.	SH-SP-1	31.933	0.50	0.172	37.111	0.99	0.02	52.578	0.18	0.33
2.	SH-SP-2	31.044	1.17	-0.303	39.422	0.65**	-0.19	54.378	1.42	-0.10
3.	SH-SP-3	31.756	0.83	-0.070	37.378	0.56	-0.18	52.089	0.53	0.14
4.	SH-SP-4	27.378	1.08	-0.317	33.900	1.43	-0.11	48.604	1.76	0.14
5.	SH-SP-5	30.000	1.15	-0.310	36.600	1.01	-0.07	51.044	1.04	0.10
6.	SH-SP-7	32.489	0.90	-0.119	37.422	1.07	0.08	53.311	0.56	-0.15
7.	SH-SP-8	33.756	0.52	0.323	37.978	0.92	-0.18	54.733	1.36	-0.16
8.	SH-SP-9	33.800	1.10	-0.121	37.978	0.73	-0.01	55.533	0.73	0.88*
9.	SH-SP-10	32.822	1.24	0.159	38.044	0.85	0.32	52.244	0.83	0.58*
10.	SH-SP-11	32.022	2.16**	-0.312	37.444	1.22	0.03	52.711	1.20	-0.13
11.	SH-SP-12	33.133	0.46*	-0.313	38.333	0.81	-0.15	54.022	1.08	0.25
12.	SH-SP-14	30.089	0.96	-0.311	34.422	1.16	-0.18	51.267	0.88	-0.15
13.	SH-SP-15	30.267	0.59	-0.303	34.978	1.31	-0.12	51.267	1.00	0.25
14.	SH-SP-16	28.956	1.07	-0.222	36.222	1.04	-0.07	52.356	1.14	-0.06
15.	Nishat-1	30.178	1.25	-0.153	33.022	1.25	-0.12	49.089	1.29	-0.07
	Population mean	31.30	1.000		36.684	1.000		52.482	1.000	
	S.E	± 0.22	± 0.289		± 0.23	± 0.248		± 0.33	± 0.378	

Table 4b: Stability parameters for various maturity and yield attributing traits in coloured Capsicum (*Capsicum annuum* L.var. *grossum* Sendt.)

S.No	Genotype	Number of fruits per plant			Average fruit weight (g)			Average fruit yield per plant (kg)			Fruit yield per plot (kg)		
		μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di
1.	SH-SP-1	12.644	0.86*	-0.26	80.698	0.24	-0.45	1.019	0.62	-0.07	10.220	0.64	-0.12
2.	SH-SP-2	7.844	0.58	-0.24	105.222	1.70	0.71	0.844	0.97	-0.05	8.438	0.96	-0.06
3.	SH-SP-3	10.200	0.58	-0.25	90.504	0.50*	-1.13	0.923	0.59	-0.08	9.240	0.60	-0.11
4.	SH-SP-4	11.533	0.99	-0.22	85.538	0.64	-1.08	0.985	0.88	-0.07	9.872	0.90	-0.08
5.	SH-SP-5	8.71	0.54	-0.25	79.997	1.84	21.77 **	0.709	0.90	-0.03	7.093	0.89	-0.04
6.	SH-SP-7	12.644	1.63	-0.20	141.272	0.81	11.37**	1.783	2.15	0.11	17.882	2.13	0.19
7.	SH-SP-8	11.733	0.82	-0.16	104.958	0.69	4.56*	1.249	0.60	-0.01	12.498	0.67	-0.03
8.	SH-SP-9	5.933	1.61	0.02	139.378	0.95	6.97**	0.827	1.89	0.34	8.286	1.88	0.45*
9.	SH-SP-10	12.411	3.05	0.02	54.431	1.90	-0.10	0.662	1.48	-0.06	6.624	1.47	-0.11
10.	SH-SP-11	11.156	1.26	-0.17	60.097	0.63	-0.49	0.671	0.83	-0.05	6.710	0.81	-0.10
11.	SH-SP-12	6.267	1.03	-0.19	92.457	1.17	-0.24	0.581	0.99	0.02	5.812	0.98	0.04
12.	SH-SP-14	13.444	1.05	0.18	89.871	0.83	-1.10	1.208	1.07	0.06	12.136	1.07	0.08
13.	SH-SP-15	9.978	0.99	-0.25	76.129	1.91	21.47**	0.798	1.30	-0.03	7.990	1.28	-0.09
14.	SH-SP-16	15.667	-0.26	0.18	80.948	0.69*	-1.13	1.262	0.24	0.10	12.669	0.23	0.13
15.	Nishat-1	14.933	0.28	-0.15	82.448	0.50	0.34	1.230	0.51*	-0.10	12.343	0.49*	-0.13
	Population mean	11.007	1.000		90.930	1.000		0.983	1.000		9.854	1.000	
	S.E	± 0.25	± 0.341		± 0.48	± 0.180		± 0.02	± 0.267		± 0.26	± 0.26	

than unity along with non-significant deviation from regression showed below average stability and was significantly adapted to favourable environments. The mean performance of both genotypes being greater than population mean were undesirable. Early fruit set is again a desirable trait. The genotypes exhibiting average stability were identified as SH-SP-4, SH-SP-14, SH-SP-15, SH-SP-16 and Nishat-1. Above average stability was exhibited by the genotypes SH-SP-2 though taking more number of days to first fruit set. Similarly, early fruit harvest is a desirable character. The genotypes showing average stability were identified as SH-SP-3, SH-SP-4, SH-SP-5, SH-SP-14, SH-SP-15 and Nishat-1. The genotypes SH-SP-9 and SH-SP-10 depicted unpredictable behaviour with respect to days to first harvest. None of the genotypes exhibited above average stability.

The genotypes SH-SP-4, SH-SP-7, SH-SP-8, SH-SP-10, SH-SP-14, SH-SP-16 and Nishat-1 showed average stability for number of fruits plant^{-1}. The genotype SH-SP-1 showed above average stability. For average fruit weight only two genotypes SH-SP-2 and SP-12 exhibited average stability. The genotypes SH-SP-5, SH-SP-7, SH-SP-8, SH-SP-9 and SH-SP-15 showed unpredictable behaviour as indicated by significant values of S^2 di and prediction of stability was not reliable. For average fruit yield plant^{-1}, SH-SP-1, SH-SP-7, SH-SP-14 and SH-SP-16 showed average stability. Nishat-1 showed above average stability. SH-SP-8 showed significant deviation from regression indicating that prediction on stability of this genotype is not reliable. For average fruit yield plot^{-1}, SH-SP-1, SH-SP-7, SH-SP-8, SH-SP-14 and SH-SP-16 average stability. Nishat-1 showed above average stability. The stability of SH-SP-9 was not predictable.

As indicated by the stability parameters, the genotypes that were well adapted to all the environments (Table 5) were SH-SP-2, SH-SP-4, SH-SP-5, SH-SP-14, SH-SP-15, SH-SP-16 and Nishat-1 for early flowering; SH-SP-4, SH-SP-14, SH-SP-15, SH-SP-16 and Nishat-1 for early fruit set; SH-SP-3, SH-SP-4, SH-SP-5, SH-SP-14, SH-SP-15 and Nishat-1 for early fruit harvest; SH-SP-4, SH-SP-7, SH-SP-8, SH-SP-10, SH-SP-14, SH-SP-16 and Nishat-1 for number of fruits plant^{-1}; SH-SP-2 and SH-SP-12 for average fruit weight; SH-SP-1, SH-SP-7, SH-SP-14 and SH-SP-16 for average fruit yield plant^{-1} and SH-SP-1, SH-P-7, SH-SP-8, SH-SP-14 and SH-SP-16 for fruit yield plot^{-1}. Similar results with respect to various traits have been reported by Srividhya and Ponnuswami (2010); Ummyiah *et al.* (2015); Spaldon *et al.* (2017).

The genotypes which show unpredictable behaviour as depicted by significant deviation from regression irrespective of regression coefficient whether it is significant or not were SH-SP-9 and SH-SP-10 for days to first fruit harvest; SH-SP-5, SH-SP-7, SH-SP-8, SH-SP-9 and SH-SP-15 for average fruit weight; SH-SP-8 for fruit yield plant^{-1} and fruit yield plot^{-1}.

Table 6 depicts the total number of traits for which each genotype is stable. SH-SP-1 was found to be stable for average fruit yield plant^{-1} and average fruit yield plot^{-1}; SH-SP-2 was found to be stable for days to first flowering and average fruit weight; SH-SP-3 was found to be stable for days to first fruit harvest; SH-SP-4 was found to be stable for days to first flowering, days to first fruit set, days to first fruit harvest and number of fruits per plant; SH-SP-5 was found to be stable for days to first flowering and days to first fruit harvest; SH-SP-7 was found to be stable for number of fruits plant^{-1}, average fruit yield plant^{-1} and average fruit yield per plot; SH-SP-8 was found to be stable for number of fruits plant^{-1}; SH-SP-9 was not found to be stable for any trait under study; SH-SP-10 was found to be stable for number of fruits plant^{-1}; SH-SP-11 was not found to be stable for any trait under study; SH-SP-12 was found to be stable for average fruit weight;

Table 5: Stable genotypes of coloured Capsicum (*Capsicum annuum* var. *grossum* Sendt.) with respect to different traits

S.No	Traits	Genotypes showing average stability
1.	Days to first flowering	SH-SP-2, SH-SP-4, SH-SP-5, SH-SP-14, SH-SP-15, SH-SP-16, Nishat-1 (check)
2.	Days to first fruit set	SH-SP-4, SH-SP-14, SH-SP-15, SH-SP-16, Nishat-1 (check)
3.	Days to first harvest	SH-SP-3, SH-SP-4, SH-SP-5, SH-SP-14, SH-SP-15, Nishat-1 (check)
4.	Number of fruits plant^{-1}	SH-SP-4, SH-SP-7, SH-SP-8, SH-SP-10, SH-SP-14, SH-SP-16, Nishat-1(check)
5.	Average fruit weight (g)	SH-SP-2, SH-SP-12
6.	Average fruit yield plant^{-1} (kg)	SH-SP-1, SH-SP-7, SH-SP-14, SH-SP-16
7.	Average fruit yield plot^{-1} (kg)	SH-SP-1, SH-SP-7, SH-SP-8, SH-SP-14, SH-SP-16

Table 6: Stability of coloured Capsicum (*Capsicum annuum* var. *grossum* Sendt.) with respect to different traits

S.No	Genotypes	Traits for which genotypes show average stability
1.	SH-SP-1	Average fruit yield plant^{-1}, average fruit yield plot^{-1}
2.	SH-SP-2	Days to first flowering, average fruit weight
3.	SH-SP-3	Days to first harvest
4.	SH-SP-4	Days to first flowering, days to first fruit set, days to first harvest, number of fruits plant^{-1}
5.	SH-SP-5	Days to first flowering, days to first harvest
6.	SH-SP-7	Number of fruits plant^{-1}, average fruit yield plant^{-1} and average fruit yield plot^{-1}
7.	SH-SP-8	Number of fruits plant^{-1}, average fruit yield plot^{-1}
8.	SH-SP-9	-
9.	SH-SP-10	Number of fruits plant^{-1}
10.	SH-SP-11	-
11.	SH-SP-12	Average fruit weight
12.	SH-SP-14	Days to first flowering, days to first fruit set, days to first harvest, number of fruits plant^{-1}, average fruit yield plant^{-1}, average fruit yield plot^{-1}
13.	SH-SP-15	Days to first flowering, days to first fruit set, days to first harvest
14.	SH-SP-16	Days to first flowering, days to first fruit set, number of fruits plant^{-1}, average fruit yield plant^{-1}, average fruit yield plot^{-1}
15.	Nishat-1 (Check)	Days to first flowering, days to first fruit set, days to first harvest, number of fruits plant^{-1}

SH-SP-14 was found to be stable for days to first flowering, days to first fruit set, days to first fruit harvest, number of fruits plant^{-1}, average fruit yield plant^{-1} and average fruit yield plot^{-1}; SH-SP-15 was found to be stable for days to first flowering, days to first fruit set, days to first fruit harvest; SH-SP-16 was found to be stable for days to first flowering, days to first fruit set, days to first fruit harvest, number of fruits plant^{-1}, average fruit yield plant^{-1} and average fruit yield plot^{-1} and Check (Nishat-1) was found to be stable for days to first flowering, days to first fruit set, days to first fruit harvest and number of fruits plant^{-1}.

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Perceived Constraints in Adoption of Paddy Straw Management Techniques Among Farmers of Punjab State

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ABSTRACT

Punjab state considers as a major rice growing region of India. Due to monoculture large number of about 16-17 MT rice residue is produced and most of it is burnt in the fields each year prior to wheat sowing. Government programmes, research institutions have been promoting alternate methods of paddy straw management and framing several policies and disseminating them with the help of extension personnel for the wider adoption of these technologies but there are problems which are faced by the farmers. The constraints regarding adoption of innovative PSM technology was divided into management, economic and financial, regarding domestic use and policy framework. The results had shown that the major management constraint was interference of straw with tillage and seedling operations in adopted villages and non-adopted villages. The major economic and financial constraints were higher labour wages and high cost involved in straw removing from the field in adopted and non-adopted villages. The problem of poor fuel at higher temperature was major problem with domestic use and uneven distribution of CRM implements was major policy framework problem faced by farmers of both adopted and non-adopted villages. The study also focussed on the problems faced by the farmers in using particular paddy straw management technology under which, hindrance on sowing operations of wheat due to use of Happy seeder, effect of wind on wheat crop when sown by using rotavatar, low efficiency of mulcher on moist soil, and lack of efficiency of MB plough on the mulched soil were major constraints as perceived by the farmers.

Keywords: Adoption, Farmers, Happy seeder, Paddy straw management, Perceived constraints

INTRODUCTION

India is an agrarian country which has a significant share in gross domestic product of the country. India has a huge population of 1.21 million according to 2011 census and still increasing at fast rate, to feed such a large population large quantity of food crop production which imparts an extra force on Punjab and Haryana states which were pioneers of green revolution in India. This leads to change in cropping pattern of the states and rice-wheat cropping system became non cohesive part of the states. Due to monoculture and intensive cultivation, along with crops, large amount of crop residue which is estimated around 600 million tons is produced out of which 70 per cent accounts from cereals (Jain *et al.,* 2014). It brings many opportunities in the region but also brings some drastic problems related to management of such a large amount of paddy straw. Farmers of the region found a cheap way of burning paddy straw which causes environmental pollution and degradation of land and water resources. By realising sensitivity of the problems government frames policies and direct research institutes to develop alternate methods to manage straw at huge level. These efforts lead to innovation of alternative paddy straw management techniques i.e. Baler, Happy seeder, Super SMS, Super seeder etc., which were capable to manage a large amount of straw in-situ or ex-situ. Extension personnels act as channel to disseminate the innovations and technologies which are developed by research stations to the farmers. Though the adoption of these technologies have been seen, there are some problems faced by the farmers of the state. Hence the study was conducted to understand the perceived constraints in adoption of these technologies and problems faced by the farmers for adoption of individual paddy straw management technology in adopted

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and non-adopted villages by different agencies in Punjab state.

MATERIALS AND METHOD

The study comprised of two types of respondents i.e. adopted villages and non-adopted villages. One district of Punjab having majority of its area under *kharif* rice was selected purposively. Further from one district 6 villages were selected from which three villages was selected randomly which was not adopted by any institution and three villages was selected intentionally which was adopted by any institution. From each village 20 farmers were selected randomly, thus comprising sample of 60 farmers from adopted and 60 farmers from non-adopted villages, making the total sample size of 120. The data was collected by the researcher by come upon the study area and personally interviewing the respondents in the study area. The data was analysed by using statistical tools such as frequency, percentage and weighted mean score.

RESULTS AND DISCUSSION

Perceived Constraints by the respondents of adopted and non-adopted villages: The possible management, economical, domestic and policy related problems as perceived by farmers regarding paddy straw management technology are presented in Table 1. The various constraints studied were management, Economical and financial, related to domestic use and policy framework.

In the management related constraints, interference of paddy straw with tillage and seedling operations was found as the major problem in adoption of paddy straw management techniques by the farmers from both adopted and non-adopted. The second major problem identified by majority of the farmers of adopted and non-adopted villages was incompetence to purchase heavy and costly machines. Lack of cost effective technologies was found to be the third major constraint by farmers of adopted villages and non- adopted villages. The fourth major constraint as perceived by the farmers from adopted and non-adopted villages was non-availability of labour required for managing the paddy. Lack of proper training was considered as fifth major problem by adopted and non-adopted village farmers. Effect of the paddy straw management techniques other than burning on sowing of wheat was the sixth problem identified by the farmers from adopted and non-adopted villages.

In the economic and financial related constraints, high labour wages was ranked first by the farmers of adopted and non-adopted villages. The second major constraint faced by the farmer of adopted and non-adopted villages was high cost involved in removing paddy straw from the field. Lack of credit facilities available for the farmers was the third major constraint. Further, transportation cost of paddy straw also found as the fourth major constraint related to paddy straw management techniques by the farmers of both adopted and non-adopted villages.

The constraints related to domestic use in adopted villages, the major problem was that the paddy straw is a poor fuel in high temperature as identified by the farmers. The second major constraint was high silica content present in the paddy straw as perceived by the farmers. The coarse nature of paddy straw constituted as the third major problem. Lack of local economic use and reduction in milk yield by feeding paddy straw were identified as fourth and fifth major constraints respectively by the farmers. In case of farmers from non-adopted villages, paddy straw as poor fuel in high temperature, the coarse nature of paddy straw, no local economic use, the presence of high silica content in paddy straw, and reduction in milk yield by using rice residue as cattle feed were identified as first, second, third, fourth and fifth major constraints. The constraints related to policy framework by the farmers of adopted villages, uneven distribution of CRM implements was ranked first. Further, lack of trainings, lack of timely subsidies, unavailability of CRM techniques and lack of policies related to crop residue management were identified by the farmers as second, third, fourth and fifth major constraints respectively. However, in case of non-adopted village farmers, lack of trainings, uneven distribution of CRM implements, unavailability of residue management implements, lack of timely subsidies and lack of policies related to crop residue management were ranked as first, second, third, fourth, and fifth major constraints. The findings are in line with the study conducted by Lohana (2018); Lyngdoh (2018); Roy and Kaur (2015).

Problems as perceived by the farmers regarding paddy straw management technology: Regarding problems faced by farmers in using specific paddy straw management technologies major problems were identified individually. For Happy Seeder technology, majority of the farmers from both adopted and non-adopted villages (91.6% and 88.3% respectively) said that large quantities of straw hinder

Table 1: Distribution of respondents according to constraints faced by farmers in adoption of Paddy straw management techniques in adopted and non-adopted villages

S.No.	Constraints	Adopted villages (n=60)		Non-adopted villages (n=60)	
		Weighted mean score	Rank	Weighted mean score	Rank
A.	**Management constraints**				
1.	Non availability of labour to manage paddy straw	2.38	IV	2.42	IV
2.	Except burning, other alternatives of paddy straw management delays wheat sowing.	2.23	VI	2.32	VI
3.	Lack of training	2.35	V	2.36	V
4	Lack of cost effective technologies	2.48	III	2.50	III
5.	Incompetence to purchase costly and heavy machines for straw management	2.52	II	2.58	II
6.	Straw interferes with tillage and seedling operations	2.60	I	2.68	I
B.	**Economic and Financial constraints**				
1.	High cost involved in straw removing from the field	2.23	II	2.36	II
2.	High labour wages	2.28	I	2.40	I
3.	Transportation cost is high	1.96	IV	2.10	IV
4.	Lack of credit facilities for paddy straw management	2.10	III	2.23	III
C.	**Problems in Domestic use**				
1.	Generally, residues from rice varieties are not palatable with milch animals	2.33		2.41	
2.	Feeding of rice residue reduces milk yield	1.36	V	1.45	V
3.	Paddy residues are high in silica content	2.13	II	2.18	IV
4.	Paddy residues are coarse in nature	2.08	III	2.28	II
5.	Poor fuel at higher temperature	2.43	I	2.63	I
6.	Paddy residue has no local economic use	2.0	IV	2.23	III
D	**Policy Framework**				
1.	Lack of training	2.53	II	3.0	I
2.	Timely subsidies	2.4	III	2.3	IV
3.	Unavailability of CRM implements	2.30	IV	2.46	III
4.	Uneven distribution of CRM implements	2.66	I	2.71	II
5.	Lack of implementation of deterrent policy	2.01	V	2.23	V

sowing operation which leads to non-germination of following crop the major problem followed by the technical problems such as technical training for proper calibration of machinery (88.3% and 83.3) and the issue of seed depth (76.6% and 70%). The issues like happy seeder cannot be used on unlevelled fields and that it requires higher horse power tractor to work properly were ranked fourth and fifth by the respondents.

The major problem faced by farmers regarding rotavator was the effect of wind due to less depth of sowing of wheat plants as perceived by 81.66 per cent and 76.66 per cent of the farmers from adopted and non-adopted villages respectively. The second major problem was that the rotavator makes the soil harder with each operation so the farmers finding this as problematic for long term, as said by 78.3 per cent and 71.6 per cent of the respondents from adopted and non-adopted villages. The third major problem was that there was no significant reduction in the weed growth after straw incorporation as perceived by 71.6 per cent and 65 per cent of the respondents. The other major problems were regarding

Table 2: Distribution of respondents according to problems faced by farmers in using particular paddy straw management technology (n=60)

Problems	Adopted villages		Non adopted villages	
	f (%)	Rank	f (%)	Rank
1. Happy seeder				
Happy seeder cannot be used on unleveled fields.	41 (68.33)	IV	39 (65)	IV
Large quantities of straw hinder sowing operation and leads non-germination of wheat.	55 (91.66)	I	53 (88.33)	I
Happy seeder requires higher horse power tractor to work properly.	30 (50)	V	29 (48.33)	V
It requires technical training to operate the machinery.	53 (88.33)	II	50 (83.33)	II
Seed depth requires more consideration	46 (76.66)	III	42 (70)	III
2. Rotavatar				
Rotavator usually requires 2-3 runs resulting into higher maintenance cost due to breakdown of its blades.	37 (61.66)	V	33 (55)	V
It makes the soil harder with each operation which may turn problematic in long term.	47 (78.33)	II	43 (71.66)	II
No significant reduction in the weed growth in case of straw incorporation.	39 (65)	IV	36 (60)	IV
Irrigation requirement of rotavator sown (incorporation of straw) fields is more.	43 (71.66)	III	39 (65)	III
Wheat plants are more likely to be affected by the wind due to lower depth of sowing	49 (81.66)	I	46 (76.66)	I
3. Mulcher				
It can't be used in moist soil as the blades slip and can't cut the straw effectively.	47 (78.33)	I	41 (68.33)	I
There are cases where curved disk harrow is preferred over mulcher, for rotavator application.	37 (61.66)	II	32 (53.33)	II
4. MB plough				
It requires high horse power tractor and associated diesel consumption is higher.	36 (60)	III	33 (55)	III
MB Plough can't be used in cases where the sub-soil is infertile or sandy.	42(70)	II	38 (63.33)	II
MB Plough is works best in case of sowing of potato as potato can't be sown onto mulched soil.	45 (75)	I	41 (68.33)	I

the irrigation requirement and work efficiency and maintenance cost of rotavator.

Regarding mulcher, majority of the farmers from adopted and non-adopted villages (78.3% and 68.3%) said that the mulcher could not be used when the straw is moist as the blades of mulcher would slip and not cut the standing straw effectively. The other major problem was high cost of cultivation which was perceived by 61.66 per cent and 53.3 per cent of the farmers respectively for the adopted and non-adopted villages.

The MB plough technology had the issues such as it works best in case of potato as the next crop as potato can't be sown onto the mulched soil as said by the majority i.e. 75 per cent and 68.3 per cent of the farmers from adopted and non-adopted villages. Further, the problem that the MB plough can't be used in cases where the sub-soil is infertile or sandy was ranked second by the (70% and 63.3%) farmers. Another major problem perceived by farmers was that it requires high horse power tractor and associated diesel consumption is higher. Regarding problems faced by farmers in using specific paddy straw management technologies, the possible problems regarding specific technologies were identified through review of literature. A list has been made and the respondents were asked whether the respondents faced the problem of not in yes/no response. According to the responses received the by the farmers, major problems were identifies and ranked. These findings are in line with the study conducted by (Gupta, 2019).

CONCLUSION

As the mechanical paddy straw management techniques provide better alternatives for management of paddy straw but the problems related to use of different paddy straw management techniques i.e. It requires technical

training to operate the machinery, seed depth requires more consideration, Happy seeder cannot be used on unleveled field were ranked second, third, fourth, respectively. In case of rotavator the major problem founded was related to wheat plants were affected by wind due to lower depth of sowing.

The major problem in regards of mulcher was that it cannot be used in moist soil as the blades slip and cannot cut straw effectively in both adopted and non- adopted villages. The major problem faced by adopted and non-adopted villages was it cannot be used in mulched soil. The constraints faced by farmers in adoption of paddy straw management techniques in adopted and non-adopted villages related to management, economic and financial and domestic use and policy framework. The major management constraints founded was straw interferes with tillage and seedling operations with weighted mean score of 2.60 in adopted villages and 2.68 in non- adopted villages. The major economic and financial constraints were higher labor wages and high cost involved in straw removing from the field in adopted and non- adopted villages. The problem of poor fuel at higher temperature was major problem with domestic use and uneven distribution of CRM implements was major policy framework problem faced by farmers of both adopted and non-adopted villages.

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Constraints Perceived by Farmers in Adoption of Sustainable Residue Management Practices in Haryana State of India

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ABSTRACT

This present study was undertaken in Haryana state to identify the prevailing constraints in adopting sustainable residue management practices. The severity of constraints was analyzed using the Garret ranking technique. The data were solicited from 180 farmers from three major crop residue burning districts of Haryana state. These constraints were categorized as technological, straw use constraints, communication constraints, economic, and management. The study reveals that availability of less time between two crops was found the major constraints with a highest mean score of 81.67 per cent. Secondly, high production cost through hiring of the machinery was ranked as second constraint (73.01%), followed by less availability of practical techniques (69.12%). Therefore, for increasing the adoption rate of management alternatives, there is a need to resolve these problems with research, extension, and policy measures in the state.

Keywords: Burning, Constraints, Garratt ranking, Residue, Sustainable alternative

INTRODUCTION

India accounts for 17 per cent of the world's population in just 2 per cent of the world area. For feeding such a large population from limited land and resources, intensive cultivation is required. During the green revolution era, a significant shift of cropping system seemed from traditional crops like maize, pearl millet, pulses, and oilseeds to rice-wheat cropping system in Punjab, Haryana, and western Uttar Pradesh (UP). High grain production produces huge volume of crop residue in monoculture and intensive cultivation. The residues are estimated around 500 million tons (IARI, 2012). National Policy for Management of Crop Residue (2017) analyzed in the context of Haryana state, total amount of crop residues is estimated as 27.83 million ton (MT). Wheat straw is mostly used for livestock feeding while surplus residues (i.e., 9.08 MT) are burnt every year. The crop residue burning is negatively impacted the air, soil, human, and animal health (Tripathi *et al.*, 2012). The Government of India has taken many initiatives to mitigating crop residue burning. Under Section 144 of the Civil Procedure Code (CPC), crop residue burning is prohibited. The penalty is being imposed on many offending farmers. The National Green Tribunal (NGT) has imposed fines ranging between Rs. 2,500 to Rs. 15,000 based on the area under burning. Along with the strict actions, the Government is also trying to convince the farmers by providing incentives and subsidy on purchasing of machinery for crop residue management, and adoption of crops diversification. There are many alternative or residues management options are available using machinery such as happy seeder, zero tiller, baler, etc. Crop residues can be used as raw material and fuels for industries like paper/cardboard, brick kilns, production of bio-energy, packaging, etc. Despite the many alternatives, farmers are still facing problems in the adoption of crop residue management practices. Hence, a study was conducted to analyze various constraints, and their amelioration through government policies, research and extension activities.

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MATERIAL AND METHOD

Study area and sampling plan: The study was carried out in Haryana state of north India, which was purposively selected as it is one of the major crop residues burning states. The rice-wheat based cropping system is prevalent in Haryana, which generates 27.83 MT crop residues (NPMCR, 2017). Stratified random sampling techniques was employed in selection of the farmers. Based on strata as given by Haryana Space Applications Centre (2018) report, three top districts where burning is highest, namely Karnal, Kurukshetra, and Fatehabad districts were selected purposively. In the second strata, from each selected district, two blocks were selected randomly. In which, Nissing and Indri from Karnal district, Sahabad, and Thanesar from Kurukshetra district, and Fatehabad and Ratiya from Fatehabad district were selected. In the last strata, from each block, three villages were randomly selected. Farmers who had at least one acre of landholding and cultivating rice and wheat crops from previous five years were chosen for study. Hence, 10 farmers from each village were randomly selected using a stratified random sampling technique. Thus, 180 farmers constituted the sample for the study.

Analytical framework: Initially, information on farmers' perception about constraints obtained to prepare the interview schedule through conducting focused group discussions, farmers-scientist interactions, and first-hand information from the field visits. The constraints were conscripted in the consultation with expert/extension agents. The interview schedule was prepared with the finalized list of constraints and then translated into Hindi for better readability to farmers. After that, the farmers were asked to rank the problems being faced by them. Garrett's ranking technique provides the change of orders of constraints and advantages into numerical scores. This technique's prime advantage over simple frequency distribution is that the constraints are arranged based on their severity from respondents' point of view. Outcomes of such ranking have been converted into score value with the help of the following formula.

$$\text{Percent position} = \frac{100*(Rij-0.5)}{Nj}$$

Where; Rij = Rank given for the i^{th} variable by j^{th} respondents

Nj = Number of variables ranked by j^{th} respondents

Each rank's percent position was converted into scores, referring to the table given by Garrett and Woodworth (1969). Similar method was used by Jyothi *et al.* (2020). The scores of individual respondents were multiplied by garret value, and then it was added together and divided by the total number of the respondents for whom scores were added. Based on these mean scores for all the constraints, ranks were assigned.

RESULTS AND DISCUSSION

Constraints as perceived by farmers in adoption of sustainable crop residue management alternatives were studied in the study. Constraints were categorized under different heads such as technological, uses of straw, communicational, economic, and management (Table 1). The overall ranking to these constraints is presented as.

Technical constraints: Table 2 shows that less time availability between harvesting of paddy and sowing of wheat was observed one of the major constraints with highest mean scone (81.67%). Due to this narrow gap farmers are unable to adopt any management practices. Hence, they perceived burning as a less time consuming and cost-effective practices. Glithero *et al.* (2013) stated that, the major reasons given by farmers for not baling or selling cereal straw are the short period of operations for the next crop. With 69.12 per cent mean score, low

Table 1: Percentage position and their corresponding Garett's table value

Rank	Percentage position		Garrett table
1	100 (1-0.5)/15	3.33	86
2	100 (2-0.5)/15	10	75
3	100 (3-0.5)/15	16.66	69
4	100 (4-0.5)/15	23.33	64
5	100 (5-0.5)/15	30	60
6	100 (6-0.5)/15	36.66	57
7	100 (7-0.5)/15	43.33	53
8	100 (8-0.5)/15	50	50
9	100 (9-0.5)/15	56.66	47
10	100 (10-0.5)/15	63.33	43
11	100 (11-0.5)/15	70	40
12	100 (12-0.5)/15	76.66	36
13	100 (13-0.5)/15	83.33	31
14	100 (14-0.5)/15	90	24
15	100 (15-0.5)/15	96.66	15

Table 2: Coding of constraint statements

S.No.	Constraints	Coding
A.	**Technological constraints**	
1.	Lack of cost-effective technologies	AC1
2.	Lack of technical expertise in handling of machinery	AC2
3.	Less time gap between harvesting of paddy and sowing of wheat	AC3
4.	Crop residue interferes with seeding operations	AC4
5.	High power tractor requirement to use CRM machineries	AC5
B	**Constraints in the use of straw**	
6.	Less market demand of paddy straw	BC1
7.	Rice straw contains low protein and high silica, make it less palatable	BC2
8.	Crop residue require moisture for decomposition in soil	BC3
C	**Communication constraints**	
9.	Less linkage with ICAR /Govt. institute regarding crop residue management solutions	CC1
10.	Less training facilities available	CC2
D.	Economic constraints	
11.	High transportation cost	DC1
12	Hiring machineries for crop residue management increases cost of production	DC2
13	Adoption of management alternative prevents farmers to grow vegetable crop in intermediate time	DC3
E	**Management constraints**	
14	Non-availability of labour to manage paddy straw.	EC1
15	Crop residue is bulky in nature	EC2

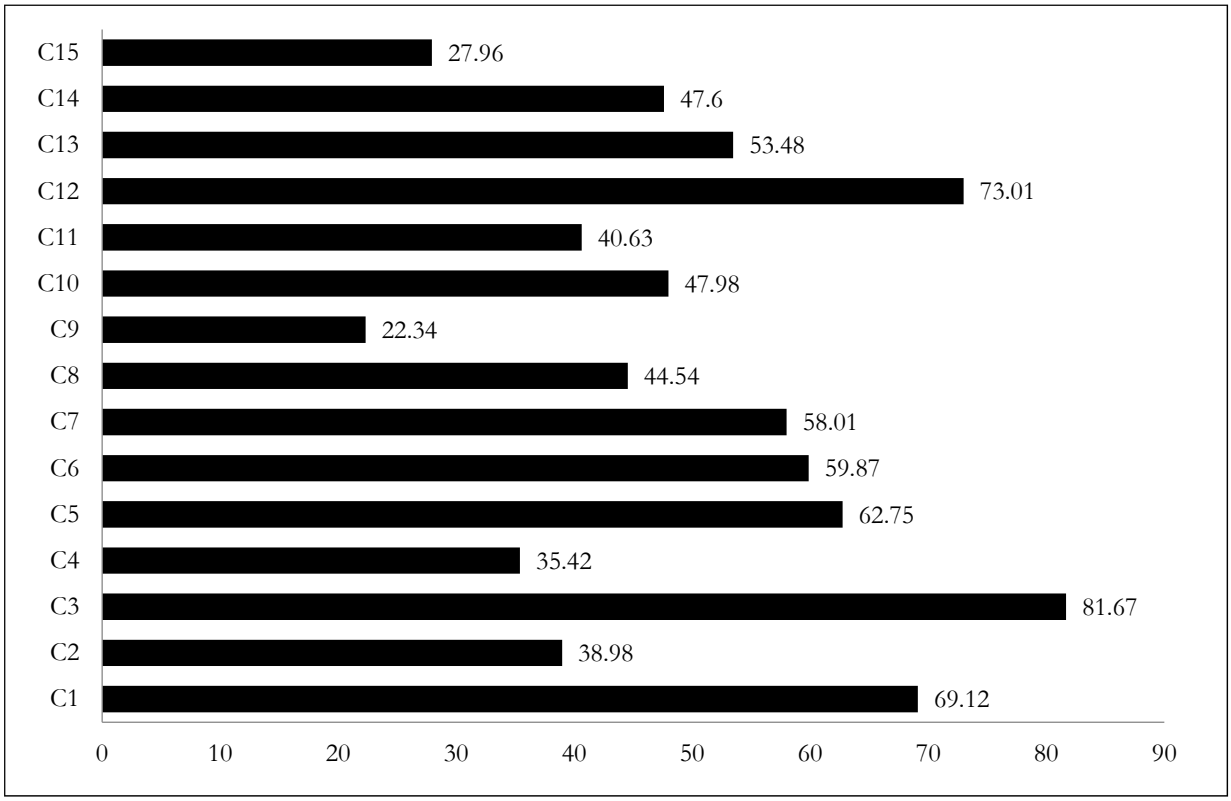

Figure 1: Mean distribution of constraints (n=180)

availability of cost-effective technologies was considered as 3rd important technical constraint. Since the available techniques are not suitable to the agro-economic conditions of the farmers to address their management problems. The heavy machineries like happy seeder, etc., which requires high power tractors, which is not available in every households mainly for small and marginal farmers. It was found 4th important constraints with 62.75 per cent mean score. The lack of technical expertise in handling of machineries on the part of farmers was considered as 12th constraints (38.98%). Farmers are not capable to hire or buy the experts. The crop residue interferes with tillage/ seedling operation is less severe constraint which is also supported by Sofoluwe *et al.* (2011). Hence, it ranked as 13th constraints.

Constraints in use of paddy straw: The study reveals that farmers were not collecting crop residues due to less market demand at local level. Hence, this was ranked as 5th important constraints (59.88% mean score). Study reveals, that high silica contents and low protein makes it less palatable for milch animals. This was identified as 6th constraints with mean score of 58.02 per cent. The rice straw contains low protein and energy so it creates nutrients deficiency, if it is given to livestock alone and may reduce the milk yield in milch animals. The finding is also supported by Lyngdoh *et al.* (2018). Crop residue requires high moisture for decomposition was considered as 10th constraint with 44.54 per cent mean score. Hence, maintaining high moisture was also difficult on part farmers, even extra ploughing was also required.

Communicational constraints: Less training facilities was available for farmers for management of crop residues in the field. Hence it was considered as 8th important constraints (47.99%). Patel *et al.* (2016) reported that major constraints affecting the transfer of technology were inadequate staff strength in department, lack of proper transfer policy, poor infrastructural facility, lack of input supply. Less farmer-extension linkage was also found as 15th communicational constraint. That's why farmers have less information source regarding selling of straw in paper industries and bio energy plants.

Economic constraints: High cost of production due to adoption of management practices was 2nd major economic constraint with 73.01 per cent mean score. Stevens (2014) reported that farmers' personal preferences focused mainly on costs and benefits. In the study area,

Table 3: Ranking of the constraints in adoption of sustainable crop residue management (n=180)

S.No.	Constraints	Frequency distribution of ranking of constraints															Total score	Mean % score	Ranking
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
1	AC1	1290	750	9315	320	240	114	53	100	94	86	80	0	0	0	0	12442	69.12	3
2	AC2	0	75	276	128	240	228	106	150	235	344	800	4032	310	48	45	7017	38.98	12
3	AC3	12298	900	552	448	60	114	106	50	94	43	0	36	0	0	0	14701	81.67	1
4	AC4	172	75	138	256	180	228	106	200	141	215	400	540	3410	240	75	6376	35.42	13
5	AC5	172	225	1035	8448	600	171	106	200	47	129	40	36	62	24	0	11295	62.75	4
6	BC1	172	300	690	512	7740	570	371	150	94	43	40	72	0	24	0	10778	59.88	5
7	BC2	344	150	345	320	1260	7296	265	200	141	86	0	36	0	0	0	10443	58.02	6
8	BC3	0	0	138	192	300	342	265	400	470	5160	320	252	155	24	0	8018	44.54	10
9	CC1	86	0	138	64	120	114	0	50	282	86	160	360	372	360	1830	4022	22.34	15
10	CC2	0	75	69	0	0	171	530	6200	470	387	320	252	62	72	30	8638	47.99	8
11.	DC1	0	75	138	192	60	171	212	350	376	516	4520	180	248	216	60	7314	40.63	11
12.	DC2	1290	10200	552	384	240	57	106	50	94	129	40	0	0	0	0	13142	73.01	2
13.	DC3	172	150	276	192	300	570	6625	600	470	86	120	36	31	0	0	9628	53.49	7
14.	EC1	86	225	138	64	240	171	265	500	5734	559	320	180	62	24	0	8568	47.6	9
15.	EC2	0	0	0	0	60	114	53	100	235	258	400	504	558	2496	255	5033	27.96	14

mainly in Karnal and Kurukshetra, many farmers grow vegetables so, they follow burning to take advantage of the time interval. If they invest in management of residues, they perceived that it as an economic loss. Hence, farmers ranked it as 7th constraint. The high cost of transportation was also observed as 11th constraints, which was also observed by Qian *et al.* (2014) and Roy (2015).

Management constraints: Less labour availability for managing the crop residue was ranked as 9th constraints with 47.60 per cent mean score. Respondents said that except burning, other alternatives of paddy straw management delay the wheat sowing. Straw is challenging to store and, due to its bulky nature it is a challenge to transport. Contradictory result was reported by Subbaiah *et al.* (2020) that with use of baler storage and transportation becomes easy. This constraint obtained 27.96 per cent mean score, and ranked as 14th constraints by the respondents.

CONCLUSION

A sustainable option for opting a suitable alternative of residue management instead of burning in the open field is the need of hour. Although these alternatives are not economically viable and practically feasible as perceived by farmers. The major problems are less time availability between the harvesting of rice and showing of wheat crop, followed by cost of cultivation increases, if machinery is used, and lack of cost-effective & viable technologies. Hence, the result can be used to intervene technically to mitigate constraints in residue management. Thorough understanding of these constraints is necessary for practical solutions. Rice varieties producing minimum biomass & mature in short period can widen the time gap between harvesting of rice and sowing of wheat. Machineries which can be driven with low horse power tractors must be encouraged. The custom hiring centers must be promoted in cluster mode of villages in the state. Awareness campaign and training program should be organized to promote this approach.

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Farm Women Knowledge Groups (FWKGs) for Enhanced Use of ICT in Agriculture and Allied Sectors

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ABSTRACT

The use of ICT application can enhance opportunities of the remote farmers to live in close proximity of the scientific input. The fusion of computing and communications, especially through the internet has reduced the world into global village creating new actors and new environments. Extension is now becoming more diversified, technology intensive, knowledge oriented and more demand driven. Keeping in view the study was carried out through multistage random sampling along with purposive sampling technique. The result reveals that the situational analysis on knowledge and use of ICT in agriculture and allied sectors from each block, 1-10 villages were selected, FWKGs were organised for enhancing use of selected ICT application,6 to 10 groups were formed from 1 to 10 villages as per the contacts of individual centres. The numbers of group members at initial stage of formation were 60-157 in the states. Data reveals that 36-92 per cent of the members belonged to 18-35 years of age group, 7-22 per cent were illiterate, Majorities (78-100%) were married and belonged to medium and small family size and were from nuclear families. Majority had farming as their occupation and had small and marginal land holding. More than 50 per cent members had general membership of organisations. The result reveals to enhance the use of ICT tool for agriculture and allied activities interventions programmes for the group members was organised, pre and post scores of knowledge, it was found that there was significant increase in knowledge of respondents of all centres, The knowledge and use of selected ICT tool was also increased significantly in all the centres after intervention, correlation coefficient analysis reveals that there was significant and positive correlation between knowledge and use in 6 centres.

Keywords: Communication, Extension, Farm women knowledge groups, ICT, Knowledge

INTRODUCTION

In India Farm women contributes majority of the farm activities from land to harvesting, thus far, their access to resources is not as much as their male counterparts. Farmers need information to make essential decision to improve their production in agriculture for which a strong network of extension systems functioning is needed. In spite of authenticity that mobile phone technology for farmers has started in developing countries, most of the farmers still pertain to traditional agriculture systems. Farm women are still unenthusiastic to use the mobile phone for agriculture information communication and others. This may be due to technical illiteracy (Computer and mobiles). Despite the fact that there are many challenges to use mobile phone and ICT technologies in agricultural sector of developing countries, however depends on the ability to gather, access, analyse and utilize information and knowledge (Jakhar, 2015). Information and communication technology (ICT) should be the medium for empowering farm women. It can be an effective tool to bridge the gap for farm women's participation in training, information and knowledge regarding improved agricultural production, marketing facilities and selling of agricultural produce in markets where they can double their income (Das *et al.*, 2021). Strong linkages need to be established between direct ICT interventions and it should be part of the national level program on agricultural development. The farmer friendly technology dissemination process needs to be handled with careful planning and incorporation of information communication technology. The justification for farmers

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to foster more trust in mobile based communication is mobile based advisory system which was moreover similar to individual communication though various programmes (Shamna *et al.,* 2019).

The innovative extension approach should focus on capacity building, people's participation along with government initiative to provide strong infrastructure to be worked with the modern age technologies. The farmer friendly technology dissemination process needs to be handled with careful planning and incorporation of information communication technology. The ICT led extension systems are going to act as a key agent for changing agrarian situation and farmers' lives by improving access to information and sharing knowledge. Consequently, there is a renewed enthusiasm to use new ICTs like mobile apps and web-based media for agricultural advisory services (Das *et al.,* 2020). The use of ICT application can enhance opportunities of the remote farmers to live in close proximity of the scientific input. Hence, Promoting Farm Women Knowledge Groups (FWKGs) for Enhanced Use of ICT in Agriculture and Allied Sectors has been undertaken with the following objectives:

- To conduct situational analysis on knowledge and use of ICT in agriculture and allied sectors.
- To organize and promote Farm Women Knowledge Groups (FWKGs) for enhanced use of selected ICT application.
- To study the impact of FWKGs in enhanced use of selected ICT application

MATERIALS AND METHODS

Multistage random sampling along with purposive sampling technique was used for the study. The study was confined to the states where AICRP on Home Science Centre is going on. One district per centre was selected. One block from selected district through simple random sampling method was used. Five villages were selected from the block/mandal. Thus altogether 55 villages has been selected for the study. Six farm women knowledge groups (FWKGs) were formed with ten women members in each group in each Centre, totalling to 66 Farm Women Knowledge groups with 660 farm women. Farm Women Knowledge Groups (FWKGs) members were given intervention i.e., training on hardware and usage of mobile phone. A schedule was developed for the study. Pre and Post knowledge on use of mobile phones and functions were tested.

RESULTS AND DISCUSSION

Table 1 shows the location of the study conducted in various states for situational analysis on knowledge and use of ICT in agriculture and allied sectors. Each state selected one block for the study. From each block, 1-10 villages were selected.

Table 2 shows that, FWKGs were organised for enhancing use of selected ICT application. For the purpose 6 to 10 groups were formed from 1 to 10 villages as per the contacts of individual centres. The number of group members at initial stage of formation was 60-157 in the states. But at the time of the study increase in number of members was there in two states i.e., Rajasthan and

Table 1: Location for situational analysis

State	District	Block	Number of villages
Assam	Jorhat	Chipahikhola Block	5
Haryana	Hisar	Hisar –I and Hisar-II	5
Himachal Pradesh	Kangra	Baijnath	7
Karnataka	Dharwad	Hubballi	1
Maharashtra	Parbhani	Parbhani	5
Meghalaya	Wets Garo Hills	Gambegre	3
Punjab	Ludhiana	Doraha	10
Rajasthan	Udaipur	Mavli	3
Tamil Nadu	Madurai	Alanganallur	3
Telangana	Ranga Reddy	Maheswaram and Moinabad	6
Uttarakhand	Udham Singh Nagar, Nainital	Rudarpur, Bhimtal	7

Table 2: Farm women knowledge groups formed for enhancing the use of ICT

State	Number of groups	Number of villages	Number of members at initial stage	Number of members during the study period
Assam	10	5	100	100
Haryana	6	5	60	60
Himachal Pradesh	6	6	60	56
Karnataka	7	1	70	60
Maharashtra	10	05	100	60
Meghalaya	6	3	60	60
Punjab	10	10	157	110
Rajasthan	6	1	60	102
Tamil Nadu	6	1	60	60
Telangana	6	6	100	60
Uttarakhand	6	4	60	95

Uttarakhand, decrease in four states these were Himachal Pradesh, Karnataka, Maharashtra and Punjab, and no change in rest of the States/Centres. Increase in number might be due to farm women felt that the ICTs help in acquiring needed knowledge regarding farming/ agriculture. Decrease in number may be due to non availability of mobile phone with them and also may be due to technical illiteracy of handling mobile phone. Farmwomen were formed into groups of 10 members collective from each village and named them as Farm Women Knowledge Groups. They not only share the knowledge through mobile information but also focus on increasing access to resources, learning skills and promoting collective action.

The study reveals that 36-92 per cent of the members belonged to 18-35 years of age group while 23-57 per cent members were from 36-50 years age group. Very few (3-20%) were above 50 years. At all the centres, nearly 8.3 to 48.3 per cent members were educated from primary to class X. Few respondents (7-22%) were illiterate in Haryana, Rajasthan and Telangana States whereas 2-32 per cent members were found as post graduate also in Meghalaya, Haryana, Punjab and Uttarakhand. Majorities (78-100%) were married and belonged to medium and small family size and were from nuclear families. Only in Meghalaya 100 per cent members were from joint family. Majority had farming as their occupation and had small and marginal land holding. More than 50 per cent members had general membership of organisations. Whereas the respondents from Haryana (93.3%), Punjab (70%), Uttarakhand (66%), Karnataka and Maharashtra (61.67%), Meghalaya (26.7%) and Himachal Pradesh (16.67%) had no membership of any organisation.The results were in consonance with the findings of Bansal and Joshi (2018) and Paliwal and Maheshwari (2015) who reported that one- thirds of the respondents (37.50%) had middle level of education.In contrast with this result Dayya and Bansal (2016), Paliwa and Maheshwari (2015) also reported the identical outcomes that the family occupation of all the respondents (100%), also reported 89 per cent of the farm women had no organizational membership whereas 11 per cent farm women were members of formal organization (SHGs).

Knowledge is operationalised as awareness or familiarity gained by experience of a fact or situation for use and functions of mobile phone. Knowledge on use of mobile phone were categorized into use and functions of mobile phones, different parts of mobile, source of learning about the mobile phone, frequency of receiving SMS from mobile phone and use of internet and social media.

The result reveals from the Figure 1 that, to enhance the use of ICT tool for agriculture and allied activities, intervention programmes were organised for the group members. Hence all the centres exposed their groups to different aspects about use and operation of mobile phones. For this 5-42 trainings were organised by the centres in which various aspects were covered i.e. sending and receiving SMS and saving contact list, use of YouTube and agricultural apps, Installing and uninstalling apps, use of WhatsApp and Facebook. Total beneficiaries covered

Table 3: Percentage distribution of respondents according to their personal and socio-economic status of members of FWKGs (N=660)

Attributes	Assam	Haryana	Himachal Pradesh	Karnataka	Maharashtra	Meghalaya	Punjab	Rajasthan	Tamil Nadu	Telangana	Uttarakhand
Age											
18-35 years	36.60	71.70	56.67	91.66	78.33	65.00	53.30	40.00	38.00	41.67	45.00
36-50 Years	43.30	23.30	31.67	6.66	15.00	30.00	43.30	53.33	57.00	40.00	45.00
Above 50 Years	20.00	5.00	11.67	01.66	6.67	5.00	3.30	6.66	5.00	18.33	10.00
Education qualification											
Illiterate	0.00	6.70	0.00	0.00	0.00	-	0.00	16.66	0.00	21.67	-
Can read & write	0.00	5.00	0.00	0.00	0.00	15.00	0.00	8.33	0.00	20.00	3.33
Primary	13.30	8.30	8.33	28.33	28.33	10.00	0.00	35.00	8.00	3.33	31.67
Middle	6.60	16.70	16.67	20.00	20.00	20.00	3.30	20.00	18.00	20.00	11.67
Up to Class-X	16.60	21.70	48.33	20.00	20.00	41.67	38.30	15.00	23.00	13.33	15.00
HSLC Passed	35.00	28.30	0.00	6.67	6.67	-	21.70	0.00	15.00	16.67	3.33
HS passed	20.00	8.30	20.00	23.33	23.33	5.00	0.00	0.00	18.00	—	11.67
Graduate	8.30	0.00	6.67	1.67	1.67	6.66	15.00	5.00	15.00	5.00	3.33
Post Graduate	0.00	6.70	0.00	0.00	0.00	1.67	21.60	0.00	7.00	—	31.67
Marital status											
Married	100.00	86.70	96.67	80.00	80.00	78.33	86.70	90.00	85.00	98.33	95.00
Unmarried	0.00	13.30	1.67	16.67	16.67	21.67	10.00	10.00	5.00	—	5.00
Widow	0.00	-	1.67	1.67	1.67	-	3.30	0.00	7.00	1.67	-
Divorce				1.67	1.67				3.00		
Family size											
Small	51.60	45.00	55.00	40.00	40.00	78.33	48.30	53.33	70.00	86.67	50.00
Medium	31.60	45.00	40.00	41.67	41.67	21.67	38.30	40.00	15.00	8.33	40.00
Large	16.60	10.00	5.00	18.33	18.33	-	13.30	6.66	15.00	5.00	10.00
Family type											
Nuclear	73.30	70.00	56.67	48.33	48.33		60.00	43.33	68.00	85.00	68.33
Joint	26.60	30.00	43.33	50.00	50.00	100.00	40.00	56.66	32.00	15.00	31.67
Extended				1.67	1.67						
Family occupation											
Farming	53.30	61.70	23.33	91.67	91.67	5.00	86.67	53.33	12.00	80.33	68.33
Service	20.00	28.30	46.67	3.33	3.33	10.00	8.33	13.33	10.00	1.67	18.33
Farm Allied	8.30	1.70	6.67	3.33	0.00	-	0.00	0.00	48.00	16.00	-
Business	18.30	1.70	10.00	0.00	1.66	3.33	5.00	33.33	17.00	—	11.67
Daily Wage Earner	0.00	6.70	13.33	3.34	3.34	81.67	0.00	0.00	33.00	2.00	1.67

Table 3 contd....

Attributes	Assam	Haryana	Himachal Pradesh	Karnataka	Maharashtra	Meghalaya	Punjab	Rajasthan	Tamil	Telangana Nadu	Uttarakhand
Occupation of respondents											
Farming	53.30	33.30	71.67	70.00	70.00	98.33	0.00	90.00	38.00	78.67	95.00
Service	20.00	3.30	6.67	3.33	3.33	1.67	25.00	3.33	5.00	1.67	3.33
Farm Allied	26.60	15.00	6.67	3.33	3.33	-	0.00	0.00	3.00	18.33	-
Business	0.00	0.00	5.00	0.00	0.00	-	8.30	6.66	8.00	-	1.67
House wife	0.00	48.30	0.00	0.00	0.00	-	66.70	0.00	0.00	-	-
Daily Wage Earner		33.30	10.00	23.33	23.33	-	0.00	0.00	45.00	1.33	-
Land holding											
Landless	0.00	0.00	0.00	0.00	0.00	-	6.60	0.00	11.00	5.00	3.33
Marginal	45.00	36.70	41.67	16.67	16.67	40.00	61.70	70.00	57.00	25.00	81.67
Small	31.60	45.00	55.00	35.00	35.00	40.00	6.60	26.66	24.00	68.33	15.00
Medium	23.30	13.30	3.33	31.66	31.66	20.00	18.30	3.33	8.00	1.67	-
Large	0.00	5.00	0.00	16.67	16.67	-	6.60	0.00		-	-
Membership status											
General Membership	66.60	5.00	63.33	23.33	23.33	58.33	15.00	73.33	80.00	85.00	28.33
Office Bearer	33.30	1.70	20.00	15.00	15.00	15.00	15.00	26.66	20.00	15.00	5.00
No membership	0.00	93.3	16.67	61.67	61.67	26.70	70.00	0.00	0.00	0.00	66.67

Figure 1: Intervention programme for enhancing the knowledge and use of selected ICT tool for agriculture and allied activities

at each centre ranged from 60-504, covering 1715 beneficiaries in total. The training provided to them in the intervention increased their ability to understand messages they were receiving from different sources. The findings were in coincidence with Paliwal and Maheswari (2015) in their study on access and utilization of Information and Communication Technologies who explored that all the respondents (100%) had accessed and utilized TV and Mobile Phone daily for their agriculture related information. While the findings were in disparity with Syiem and Raj (2015) from their study who found that level of access and usage of ICTs among farmers of Meghalaya that (100%), all the farmers owned mobile phones as well as television and radio and the most frequently used ICT was mobile phone.

The Table 4 shows comparison of pre and post scores of knowledge, it was found that there was significant increase in knowledge of respondents of all centres i.e. in Assam, Haryana, Karnataka, Maharashtra, Meghalaya, Punjab, Rajasthan, Tamil Nadu, Telangana and Uttarakhand. The mean increase in knowledge in these States were 0.60, 0.52, 0.28, 1.30, 0.89, 1.81, 0.50, 0.36, 0.91, 1.56 and 1.13, respectively. In majority centes there was a clear differentiation between pre and post test, farm women are receptive and gained knowledge on mobile usage after the intervention. Jakhar (2015) also reported that Information Technology has changed our daily lives radically over the recent years, for example, the user of mobile phones to make calls and send text messages, use of internet for searching information, use of email for communication over the internet etc. The results were in consonance with the findings of Sarah Kamala *et al.* 2019 that the level of availability and accessibility of ICTs was

Table 4: Comparison of knowledge of members of FWKG's regarding selected ICT tool before and after intervention (n=660)

Intervention	Pre intervention score (Range 0-2)	Post intervention score (Range 0-2)	Mean difference/Gain (Range 0-2)	't' value
Assam	0.8033	1.4033	0.60	9.60**
Haryana	0.76	1.29	0.53	4.15**
Himachal Pradesh	1.21	1.49	0.28	0.32
Karnataka	0.48	1.79	1.31	43.97**
Maharashtra	0.33	1.23	0.90	13.67**
Meghalaya	0.11	1.99	1.82	2.20*
Punjab	0.69	1.19	0.50	17.99 **
Rajasthan	0.54	0.90	0.36	7.11**
Tamil Nadu	0.56	1.47	0.92	13.78**
Telangana	0.33	1.89	1.56	36.55**
Uttarakhand	0.14	1.27	1.13	20.76**

*, **Significant at 5 and 1 per cent level of significance respectively

Table 5: Comparison of use of selected ICT tool before and after intervention by members of FWKG's (n=660)

Intervention	Pre intervention score (Range 0-2)	Post intervention score (Range 0-2)	Mean difference/Gain (Range 0-2)	't' Value
Assam	0.74	1.25	0.50	12.44**
Haryana	0.44	1.36	0.93	1.70
Himachal Pradesh	1.43	1.89	0.44	1.35
Karnataka	0.42	1.20	0.78	23.15**
Maharashtra	0.21	0.54	0.33	3.94**
Meghalaya	0.11	1.84	1.73	7.36**
Punjab	0.51	1.22	0.67	33.56**
Rajasthan	0.41	0.68	0.27	6.49**
Tamil Nadu	0.53	1.62	1.09	23.98**
Telangana	0.16	1.84	1.68	60.76**
Uttarakhand	0.13	0.73	0.60	11.42**

*, **Significant at 5 and 1 per cent level of significance respectively

the highest for television followed by mobile phones and radio respectively.

The results stated in Table 5 clearly indicates that like knowledge and use of selected ICT tool was also increased significantly in all the centres after intervention i.e. Assam, Haryana, Karnataka, Himachal Pradesh, Maharashtra, Meghalaya, Punjab, Rajasthan, Tamil Nadu, Telengana and Uttarakhand. The significant 't' values given in the table also reveals that the findings indicating the effect of intervention in improving the use of ICT tool. The findings of Jain *et al.* Reaffirmed the vital role being played by ICTs in improving the status of farm women and increasing their economic welfare. The correlation coefficient analysis reveals that there was significant and positive correlation between knowledge and use in 6 centres i.e. Karnataka, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Telangana. While positive but non-significant result was there in rest of the States. The results were significant showing the positive influence of the mobile trainings which has generated curiosity among the farm women to acquire the knowledge and use of mobile operations from different available source.

CONCLUSION

Agriculture is the backbone of the Indian economy, out of which 56.6 per cent of the Indian populations are dependents on agriculture (GoI, 2011b). Agriculture in India

Table 6: Relationship of knowledge and use regarding selected ICT tool (n=660)

States	Mean knowledge score (Range 0-2)	Mean use score (Range 0-2)	'r' value
Assam	0.59	0.91	0.31*
Haryana	0.53	0.93	0.85**
Himachal Pradesh	1.74	1.45	0.99**
Karnataka	1.31	0.78	0.64**
Maharashtra	1.23	0.54	0.90**
Meghalaya	1.02	0.97	0.84**
Punjab	1.19*	1.22*	0.38*
Rajasthan	0.72	0.54	0.82**
Tamil Nadu	0.55	1.55	0.21*
Telangana	0.33	1.52	0.43**
Uttarakhand	1.28	0.73	0.92**

**Significant at 5 and 1 per cent level of significance respectively

defines familial tradition, social relations and gender roles. Female in the agricultural sector, whether through traditional means or industrial, for subsistence or as an agricultural laborer, represents a momentous demographic group. It is easy to approach women farmers with improved knowledge and practice on sustainable agriculture practices when they are in groups. For the women farmers, it is also easy to come out of their household as the member of a Farm Women Knowledge Groups (FWKGs), who are also part of self-help group in which they share their group identity.

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Quality Assessment of Multigrain Porridges

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ABSTRACT

Multigrain porridges can act as a vehicle in rural areas for incorporation of different nutritionally rich ingredients. Hence, the present study was carried out with the objective to utilize selected grains, pulse and green leaves to develop nutrient dense multigrain porridge for nutrition improvement of vulnerable group in nutri smart village of Morena district of Madhya Pradesh. For preparation of porridge, wheat, pearlmillet, green gram and drumstick leaves were used with different levels by taking five different treatments as T1, T2, T3, T4 and T5. Prepared porridges were then packed in a suitable packaging material and stored at room temperature for further use. Chemical compositions of products were assessed using standard procedure. The different prepared porridges were subjected to organoleptic evaluation using 9-point hedonic rating scale. The calcium content ranged from 27.35±2.16 to 61.84±11.58 mg/100g in the different combinations of multigrain porridges. Maximum iron content was found in T5 (6.42±1.04) and whereas control sample obtained minimum value. All combinations of porridges had no ascorbic acid content except T4 sample (10.8±1.67). All the porridges were acceptable and T4 sample was superior to others with the highest acceptability value at 8.60±0.4, followed by T3 (7.63±0.50), T2 (7.50±0.37), T1 (7.25±0.43), T5 (7.14±0.14), respectively. On the basis of findings it was concluded that greengram, pearlmillet and drumstick leaves blended multigrain porridge could be consider the best from both nutritional and sensory point of view.

Keywords: Multigrain, Nutrients, Pearlmillet, Porridge, Wheat

INTRODUCTION

Malnutrition is the outcome of inadequate food intake among children, the elderly as well as expectant and lactating mothers (Mohajan, 2014). Multigrain porridges are used as a vehicle in rural areas for incorporation of different nutritionally rich ingredients. Fortification of wheat porridge with different grains, pulse, and green leaves increases nutritional and sensory qualities of prepared product. Multigrain approach is a most common and convenient way of formulating the desired quality of formulations because of the supplementary effect of different nutrients from the combination of different grains making the end product more nutritious at the same time rich in other healthy constituents. Multi-grain foods often have three to five different grains but can have up to twelve different grains (Mridula *et al.,* 2015).

Porridge is made by milling or grinding the grains coarsely so that the refining process doesn't occur making the food more nutritious. Wheat porridge (dalia) is a major breakfast cereal in north India and it is prepared by cooking cracked wheat in milk or water, with sugar or salt. It is also consumed as a savory dish after cooking with water, vegetables and spices (Rehal *et al.,* 2015).

Pearlmillet is the most widely grown type of millet in Morena district of Madhya Pradesh. Pearlmillet proteins are good sources of essential amino acids except lysine and thrieonine but are relatively high in methionine. Pearl millet is also rich sources of phytochemicals and micronutrients (Singh *et al.,* 2012).

Green gram adds to the goodness of fiber and iron along with vitamins. It helps to recover from iron deficiency and reduce the risk of anemia. Drumstick leaves (*Moringa oleifira*) is available at no cost and is very rich in all the micronutrients. The leaves possess remarkable nutritional and medicinal qualities (Singh *et al.,* 2012 and Mishra *et al.,* 2011). Drumstick leaves can be used successfully in its dried state or powdered form for the purpose of making different types of meals and porridge diets mostly aiming

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pregnant expectant mothers, nursing mothers, infants and young children, as well as adults of all age groups (Alakali *et al.,* 2015) mostly due to their nutritional and medicinal properties. Usually the dried leaves can be stored for a long time and can be used regularly without refrigeration, and reportedly without loss of nutritional value (Fahey, 2005).

There is urgent need for finding out the solution for alleviating malnutrition related problems at a cheaper and most affordable way for the benefits of vulnerable group in rural areas. The addition of cereal, millets, pulses, and green leaves makes the porridge wholesome and rich in protein-calorie as well as other nutrients required for the vulnerable group. Hence, the present study was carried out with the objective to utilize selected grains, pulse and green leaves to develop quick cooking nutrient dense multigrain porridge for nutrition improvement of vulnerable group in nutri smart village of Morena district of Madhya Pradesh, India.

MATERIALS AND METHODS

Procurement of raw materials: Basic ingredients like wheat, pearlmillet, green gram and drumstick leaves were procured from demonstration units of RVSKVV-Krishi Vigyan Kendra, Morena, Madhya Pradesh for preparation of porridges.

Preparation of grains and pulse: Ingredients like wheat, pearlmillet and green gram were cleaned to remove the dirt, dust and foreign matter by winnowing. For the preparation of porridge, multi-nutrient grains and pulse was first roasted at 120°C for 2-3 min, then grinded and sieved through 600 micron sieve.

Preparation of dried drumstick leaves: Drumstick leaves can easily lose moisture after harvesting, therefore, these leaves were harvested early in the morning. The stalk of the leaves was cut from the main branches. Diseased and damaged leaves are discarded manually just after the collections of fresh leaves. Fresh green undamaged drumstick leaves were selected for drying to produce the best quality product. The leaves were then washed three to four times with plenty of water to remove all the adhering dust and dirt particles. The petioles of the leaves were kept intact for the easy handling of the leaves. After washing, the petiole of the leaves were tied together in small bunches and were hung in airy spaces to drain away extra water and to air dry the leaves. The residual moisture was evaporated at room temperature before the actual drying process, on a clean muslin cloth with constant turning to avoid fungal growth. After that the petioles were removed and only the leaves were taken for drying. The air dried leaves were spread on cotton cloth and were kept in a well ventilated room for shadow drying. The leaves were dried till they turned crisp, brittle and their moisture level reduced to 6-7 per cent.

Preparation of porridge: For further preparation of porridge, grinded grains, pulse and dried drumstick leaves were weighed and mixed with different levels by taking five different treatments T1, T2, T3, T4 and T5. Porridge sample T1 is control sample of wheat porridge. All the measured porridges were mixed together with hand uniformly as the improper mixing results in uneven quality of final product. Prepared porridges were then packed in a suitable packaging material and stored at room temperature for further use (Figure 1).

Organoleptic evaluation: The different prepared porridges were subjected to organoleptic evaluation for appearance, aroma, taste, texture and overall acceptability using 9-point hedonic rating scale (Srilakshmi, 2007).

Proximate and statistical analysis of porridges: Chemical compositions of products were assessed using standard procedure for proximate (moisture, protein, fat, ash, carbohydrate, fiber and energy), mineral and vitamin composition. The data obtained were tabulated and analysed statistically with the help of approved statistical techniques.

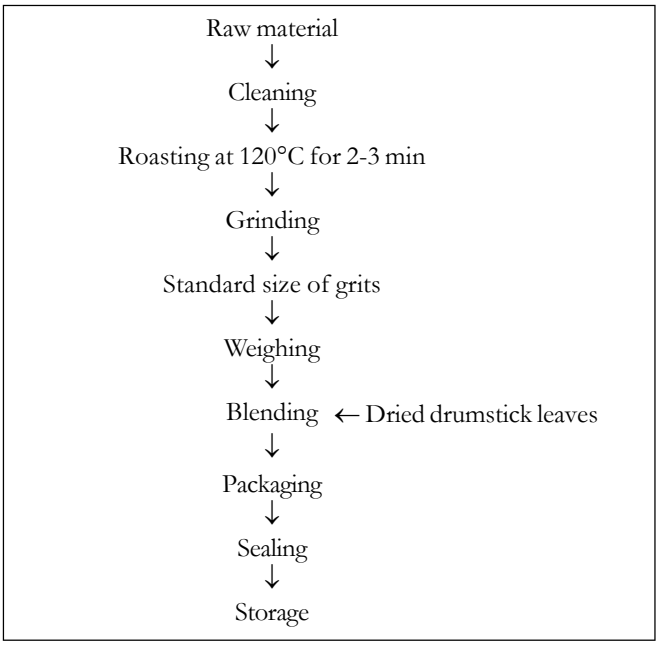

Figure 1: Preparation of multigrain porridge

RESULTS AND DISCUSSION

Proximate composition of porridges

Moisture content: There was significant difference in moisture content of different treatment combinations. The maximum moisture content was recorded in the sample of T4 (16.76±097 g) followed by T2 (13.17±0.95 g), T3 (13.12±1.0 g), T1 (10.58±1.11g) and T5 (8.97±0.60 g) (Table 1). The difference in moisture was due to the composition difference of wheat, pearl millet, green gram and drumstick leaves which were used in different propositions in different treatments.

Crude protein: Protein content increased with incorporation of legumes grits. Results showed that maximum protein content was found in T3 formulated multigrain porridge, whereas minimum was found in T1 multigrain porridge. Different combination of multigrain porridge supplemented with 20 percent green gram grits was significantly superior than other formulated multigrain porridges. This could be due to the supplementation with the pulses grits. Similar findings have been observed by Vardis *et al.* (2009).

Crude Fat: The fat content of control wheat porridge is increased gradually among different combinations of multigrain porridge. There was significant difference in moisture content of different treatment combinations. This might be due to supplementation of fat rich grit of pearlmillet. These results are close agreement with Curley (2008) in oat porridge.

Ash content: The results also showed an increase in ash content of porridges with the supplementation of green gram and drumstick leaves, though the difference was significant. The recorded values for ash content were 1.42±0.19, 1.76±0.16, 1.76±0.15, 1.79±0.17 and 1.37±0.17 g within the combinations T1 to T5, respectively. Maximum ash content was found in T4 and whereas T5 obtained minimum value amongst all combinations.

Carbohydrate: The carbohydrate content was found to be highest in control sample followed by T5 (61.78±0.85 g), T3 (61.00±1.52 g), T2 (60.12±1.26 g), T4 (55.58±2.68 g) respectively. Multigrain porridge T4 got the lowest value for carbohydrate content. It can be seen from the results supplementation of green gram and drumstick leaves decreased the carbohydrate content in multigrain porridges. Control wheat porridge was significantly superior than other formulated porridges.

Fiber: The recorded values for fiber were 11.23±0.77, 12.48±1.36, 12.45±1.36, 11.84±0.63 and 11.49±0.62 g/ 100 g for T1 to T5, respectively. Incorporation of pulses gradually increased the fiber content in all multigrain porridges. The highest value for fiber content was obtained from T2 sample, while the control sample exhibited lowest fiber content.

Energy: It is cleared from the results that the energy values did not follow a consistent pattern. It increased with pearlmillet supplementation but decreased with 20 percent green gram. The highest energy value (1456±18 Kcal) was obtained from T5 followed by T2 (1356.1±21.9 Kcal), T1 (1347±23 Kcal), T3 (1345.2±22.4 Kcal) and T4 (1213.77±20.7 Kcal). T5 formulated multigrain porridge was significantly superior to other formulated porridges.

Mineral and vitamin contents of porridges

Calcium: The values presented in Table 2 showed that calcium content ranged from 27.35±2.16 to 61.84±11.58 mg/100g in the different combinations of multigrain porridges. The highest calcium content was recorded in T4 (61.84±11.58 mg/100g) and lowest in T4 (27.35±2.16 mg/100g). The supplementation of drumstick leaves significantly increased the calcium content in multigrain porridge.

Phosphorus: The phosphorous content in multigrain porridges varied from 289±25.3 mg/100g to 317.4±36.86 mg/100g. The highest phosphorus content was observed

Table 1: Nutritional composition of porridges (g/100g, on dry matter basis)

Treatment	Moisture (g)	Crude Protein (g)	Crude Fat (g)	Ash (g)	Carbohydrate (g)	Crude Fiber (g)	Energy (Kcal)
T1	10.58±1.11	10.59±0.60	1.47±0.05	1.42±0.19	64.72±1.74	11.23±0.77	1347.00±23.0
T2	13.17±0.95	13.10±0.47	2.67±0.25	1.76±0.16	60.12±1.26	12.48±1.36	1356.10±21.9
T3	13.12±1.00	13.05±0.50	2.20±0.19	1.76±0.15	61.00±1.52	12.45±1.36	1345.20±22.4
T4	16.76±097	12.01±0.51	2.03±0.17	1.79±0.17	55.58±2.68	11.84±0.63	1213.77±20.7
T5	8.97±0.60	10.96±0.26	5.43±0.64	1.37±0.17	61.78±0.85	11.49±0.62	1456.00±18.0

Table 2: Mineral and vitamin contents of porridges

Treatment	Minerals (mg/100g of porridge)				Vitamin (Per 100 g of porridge)	
	Calcium (mg)	Phosphorus (mg)	Iron (mg)	Zinc (mg)	Vitamin C (mg)	β carotene (μg)
T1	39.36±5.65	315.00±41.80	3.97±0.78	2.85±0.65	0	3.03±2.13
T2	36.52±4.51	314.80±35.11	4.71±0.76	4.76±0.45	0	32.18±10.6
T3	37.72±4.85	317.40±36.86	4.45±0.76	4.76±0.47	0	34.87±9.86
T4	61.84±11.58	296.20±35.99	4.39±0.81	4.06±0.47	10.8±1.67	1780.81±150.22
T5	27.35±2.16	289.00±25.30	6.42±1.04	2.76±0.36	0	28.23±9.42

in T3 and lowest in T5 sample. The addition of pulses grits showed a remarkable increase in phosphorus content.

Iron: The results also showed an increase in iron content of porridges with the supplementation of pearlmillet, though the difference was significant. The recorded values for iron were 3.97±0.78, 4.71±0.76, 4.45±0.76, 4.39±0.81 and 6.42±1.04 mg/100g within the combinations T1 to T5, respectively. Maximum iron content was found in T5 and whereas control sample obtained minimum value amongst all combinations. The supplementation of pearlmillet in different ratio increased the iron content of the multigrain porridges.

Zinc: The recorded values for zinc were 2.85±0.65, 4.76±0.45, 4.76±0.47, 4.06±0.47and 2.76±0.36 mg/100g for T1 to T5 samples, respectively. Incorporation of green gram gradually increased the zinc content in T2, T3 and T4 samples. The highest value for zinc content was obtained from T2 sample, while T5 exhibited lowest zinc content.

Vitamin C: As per Table 2, results showed that all combinations of porridges had no ascorbic acid content except T4 sample (10.8±1.67 mg/100g). The supplementation of drumstick leaves in T4 sample increased vitamin C content of the multigrain porridge.

β carotene: There was significant difference in β carotene content of different combinations of porridges. The vitamin A content was found to be highest in T4 sample (1780.81±150.22 μg) followed by T3 (34.87±9.86 μg), T2 (32.18±10.6 μg), T5 (28.23±9.42 μg), T1 (3.03±2.13 μg), respectively. Multigrain porridge T4 got the highest value for β carotene content. It can be seen from the results that the incorporation of drumstick increased the β carotene content in T4 sample while in other combinations, increased β carotene content was due to green gram and pearlmillet.

Sensory evaluation of porridges

The average sensory scores of various sensory attributes like appearance, aroma, taste, texture and overall acceptability of porridges are shown in Table 3.

Appearance: Average sensory score of porridges in relation to appearance had the highest in control sample (8.80±0.26), followed by T4 (8.46±0.44), T5 (7.55±0.55), T3 (7.41±0.46), T1 (7.07±0.16), respectively. There was a significant difference between different treatments indicating that the addition of different proportions of green gram, pearlmillet and drumstick leaves affect the appearance of the prepared porridge. The colour and appearance of the porridge becomes darker and acceptability level decreases as the amount of pearlmillet grains increases.

Aroma: The difference in aroma was due to the composition difference of different porridges which were used in different propositions in different treatments. It was highest in T4 sample (7.94±0.6) while pearlmillet porridge showed lowest score (6.80±0.26) for aroma.

Table 3: Organoleptic properties of porridges

Treatment	Appearance	Aroma	Taste	Texture	Overallacceptability
T1	8.80±0.26	7.30±0.42	7.21±0.36	7.46±0.37	7.25±0.43
T2	7.07±0.16	7.73±0.42	7.61±0.57	6.64±0.48	7.50±0.37
T3	7.41±0.46	7.76±0.56	7.55±0.50	7.84±0.44	7.63±0.50
T4	8.46±0.44	7.94±0.60	8.01±0.45	8.74±0.31	8.60±0.41
T5	7.55±0.55	6.80±0.26	7.41±0.46	6.94±0.48	7.14±0.14

Taste: Taste is the primary factor which determines the acceptability of any product. The mean score for taste of multigrain porridges was lowest in control sample (7.21±0.36) against the highest score (8.01±0.45) in T4 sample. Addition of green gram, pearlmillet and drumstick leaves increased the taste of the prepared multigrain porridges.

Texture: The textural properties showed significant difference among all the treatments. Maximum textural score was secured by control T4 (8.74±0.31) while minimum score was observed in T2 (6.64±0.48).

Overall acceptability: All the porridges were acceptable and T4 sample was superior than others with the highest value at 8.60±0.40, followed by T3 (7.63±0.50), T2 (7.50±0.37), T1 (7.25±0.43), T5 (7.14±0.14), respectively. Addition of different proportions of green gram and pearlmillet increased the overall acceptability of the prepared multigrain porridge upto a certain limits.

CONCLUSION

Millets contain many major and minor nutrients like carbohydrate, protein, fat, dietary fibre, vitamins and minerals as well as antioxidant and phytochemicals. Pearlmillets are easily available and cheap in cost in Morena district of Madhya Pradesh. Drumstick leaves serves as natural biofortified food, potentially healthy and can be used as food medicine for malnutrition among children, adolescent girls and women. On the basis of findings, it can be concluded that the multigrain porridges were acceptable as compared to control sample. The results revealed that wheat, greengram, pearlmillet and drumstick leaves blended multigrain porridge had best acceptance from both nutritional and sensory point of view. Thus multigrain porridge can be used to improve nutritional status of preschool children, adolescent girls, pregnant and lactating women in rural areas.

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A Review: Integrated Farming Systems for Sustainable Livelihood Security of Small and Marginal Farmers

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ABSTRACT

The current farming situation in India, calls for an integrated effort to deal with the emerging issues. The integrated farming systems are considered to be the most influential tools for enhancing productivity and profitability of farming systems, particularly for small and marginal farmers to make them self reliant .In fact, our past experience has clearly depicted that the income from cropping alone is hardly sufficient for small and marginal farmer's needs. With improved consumerism in rural areas, requirements cash for the farmer's have also increased to improve the standard of living which is specially true in case of small and marginal farmers. Therefore, farmer's profitability and food security would have to be increased by adoption of different efficient allied enterprises like horticulture (fruits/ vegetables/ flowers/ medicinal and aromatic plants), dairy, apiary, fisheries, apiculture, mushroom cultivation, etc. These integrated farming systems required to be designed, planned, implemented and critically analyzed for productivity and cost economics of the farmers. The sustainability of livelihoods of the farmers becomes a function of how farm men and farm women utilize asset portfolios on a short and long-term basis. Sustainable livelihoods of the farmers are those that are able to cope up with and recover from stresses and shocks such as drought, flood, civil war and policy failure by the adaptive and coping strategies (Jirli *et al.,* 2008). Sustainability, capability and equity combine in the concept of sustainable livelihood. In this regard, Indian Council of Agricultural Research has launched National Agricultural Innovation Project (NAIP) on 26th July, 2006 with endeavor to establish system and action research for livelihood enhancement of vulnerable groups in different disadvantaged regions of India.

Keywords: Agriculture, Economy, Farmer, Integration, Livelihood security, Sustainable

INTRODUCTION

Integrated farming system is a generally used word to explain a more integrated farming approach as compared to monoculture approach. It refers to agricultural systems that integrate different enterprises like crop production and livestock or integrate livestock and fish. In this system inter- dependent and inter-related set of enterprises practiced so that the "waste" from one component of farm becomes an input for another part of the farming system, which improves production and reduces cost / income. Integrated farming system is a system of systems. IFS ensure that wastes from one component of agriculture become a resource for another component. Since this system not only utilizes wastes as resources, but also ensure increase in productivity for the whole agriculture systems. Overall integrated farming systems fulfill the multiple objective of making farmers self-reliant by ensuring the family members a balance diet, provide more employment, minimizing the risk and uncertainties, improving the standard of living through maximizing the net returns and keeping harmony with the environment (Mali *et al.,* 2014).

Integrated Farming System is a multidisciplinary entire farm approach and very helpful in solving the problems of small and marginal farmers. The whole farm approach aims at increasing profitability, income and employment generation from small land-holding by integrating variety of farm enterprises and recycling the crop residue and by products within the farm. The small and marginal farmers need to be assured of regular income for livelihood security and living at least above poverty line. The steady growth in output is necessary to face the different challenges posed by the present technological environment, economic and

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political. In this context, integrated farming system approach is one of the most important solutions to face the challenges as in the IFS approach the different enterprises can be vigilantly undertaken and the location specific IFS models are developed based on available local resources which will result in the development of sustainable livelihood security of the farmers. The emergence of IFS has enabled us to build up a framework for an improved alternative model to enhance the feasibility of small and marginal farmers in relation to larger ones.

The concept Sustainable Livelihood security is an attempt to go beyond the typical definitions and strategies of poverty eradication. These had been found to be narrow because they focused only on certain aspects of poverty, such as low income, or did not reflect on other aspects of poverty such as social inclusion and vulnerability. Now it is recognized that more attention should be given to the various processes and factors which either hinder or enhance poor farmer's ability to make a living in an socially, economically, ecologically sustainable manner. The concept of sustainable livelihood security offers a more consistent and integrated approach for poverty alleviation. To achieve sustainable livelihood security, different livelihood capitals such as natural capital, human capital, physical capital, financial capital and social capital would play a major role to cope with stresses and shocks and maintain or improve the individuals capabilities and resources in present and in the future without degrading the natural resource.

Gautam *et al.* (2007) revealed that the increase in farmers income resulted improvement of their livelihood security. Elevated biological productivity translates into higher income for small farmers. Oilseed and pulses gave more income from the farm, if included in cropping system. The raised income resulted into higher purchasing capacity of the small and marginal farmers. Farmers can spend their earnings to purchase the essentials of their living. They can afford good education and health to their family members. This increase in pecuniary returns increases their living standards. Use of modern crop production technologies not only beneficial to the farmers practicing farming but also the small and marginal farmers and land less workers depend upon farm labour.

Mangala (2008) observed that the highest farming practices adopted by respondents after execution of IFS programme in Dharwad were agriculture–horticulture–forestry–dairy–vermin compost-forage crops (21.43%) and agriculture–horticulture–forestry–dairy–Vermin compost (62.14%).

Nageswaran (2009) concluded that the five treatments of crop+poultry (6 layers), crop + dairy (3 milch cows), dairy cum poultry (3 milch cows + 6 layers), improved cropping alone and farmers' cropping alone were taken, of all the treatments, in Paiyur, dairy based farming gave the highest income (Rs 12,180/ha/yr.) and employment (518 man days) in a year. In Yercaud, dairy cum poultry farming gave the utmost income (Rs. 13,822/ha/yr.) and employment (556 man-days) in a year.

Mohanty *et al.* (2010) found a successful tribal integrated farmer in Orissa who was enhanced his productivity as well as the profitability after adopting the IFS as compared to the conventional farming system. The farmer earned seven times higher Net Monetary Return (NMR) as compared to traditional methods of farming.

Ugwumba *et al.* (2010) observed the impact of IFS on farm cash income. Found that majority of the farmers in the study area practiced partial integration farming practices and results showed that all types of IFS were on the average profitable. Net farm income responded by farmers who maintained crop-livestock-fish integration was the highest. Implying that farmers who want to achieve full integration and thus earn more income and getaway from poverty will target the combination of more enterprises including crops, fisheries, processing, livestock, and even biogas. Farm cash income was positively inclined by farmer's age, level of education, years of experience and type of integration. It was, however, negatively influenced by cost of farm inputs, household size and gender of farmer. Such measures may take account of subsidization of inputs and enlightenment campaigns in form of trainings, workshops and seminars.

Jagadeeshwara *et al.* (2011) concluded that the productivity of IFS farmers was 26.3 per cent higher than the conventional farmers. Among the variety of components, maximum productivity was observed in crop yield (46.32 %), followed by dairy (42.26 %) horticulture (16.77 %) and piggery (8.07 %) in the southern Karnataka state.

Goswami (2012) concluded that physical capital (Before-88 and After-119) and human capital (Before-77 and After-156) has considerably improved in Sonahara because of Joint Forest Management intervention whereas, for Safarambera, significant progress was found in financial capital (Before-105 and After-164). Overall, financial and human capital was notably improved over time as noticed

by the perception analysis tool. As capitals increased, vulnerabilities also went down and better opportunities helped people coping up with several vulnerabilities like different seasonal health hazards, food insecurity, distress sale and problem of water unavailability etc.

Makdoh *et al.* (2014) reported from Umiam, Meghalaya that due to adoption of multiple cropping pattern in a farming system approach, high maize equivalent yield of 6.78 t (18.79 t/ha) was recorded from an area of 0.36 ha in sloping land. The same land area if kept under maize mono cropping would have noticed a maximum productivity of 3.85 t/ha under most favorable management practices. Thus, a farmer can understand almost five times enhancement in productivity.

Manjunatha *et al.* (2014) investigated economic viability of integrated farming system research models developed for different states of the India and findings stated that IFS enabled the agricultural production system profitable and productive. Near about 95 per cent of nutritional requirement of the agricultural system is self-sustained by resource recycling and the number of enterprises were increased, the profit margin increased but there was simultaneously coupled with increase in production cost. Employment generation though the profit increase was found marginal. Further, it is marked that profit margin varied with the management skill, socio-economic conditions and ecosystem (rain fed/irrigated). On an average profit margin of IFS varied from Rs 15,000 to Rs 1,50,000/ha/annum. Simultaneously it takes care of the nutritional security and food of the farming family. The study further concluded the improvement in the net profit margin was varied from 30-50 per cent. The resource characterization study marked that/ha significant improvement in profitability varied from Rs 20,000 to 25,000 under irrigated condition, generate 50-75 man-days/ family/ year and decrease the cost of production by Rs.500-1,000/ha. Therefore from the above study it can be concluded that there is an urgent need to promote the IFS concept under all agro-climatic conditions of the country.

Sheeba *et al.* (2015) studied integrated farming system in Southern Kerala and concluded form their study that IFS approach is far better than traditional system in its contribution to profitability, productivity, economics and employment generation for the farmers. It was also noted that IFS helps to create confidence among small and marginal farmers through higher profitability.

Walia *et al.* (2016) conducted a study on integrated farming system in Punjab and it was found that net returns of Rs 380308/ha with B:C ratio of 1.08 can be obtained by the farmers from integrated farming system (IFS) which were near about three times more than the existing rice-wheat cropping system. The study stated that IFS is possible with respect to socio-economic variables but actual adoption of integrated farming system is limited and it is unevenly spread among the farmers. Thus, in order to develop a nation, farmers should be made aware about the use and effective management of IFS and the Government should emphasize on prevailing alternative to rice-wheat cropping system to spread the ray of hope in the farmers who are the actual victims of agrarian crisis in Punjab.

Tanwar *et al.* (2018) recommended IFS model for 5–7 ha farm holding for 250–400 mm rainfall zone. This includes arable cropping (20%), agroforestry (30%), agri-horticulture (20%), horti-pasture (10%), silvi-pasture (10%) and boundary plantation (10%). The estimated net returns from this IFS model was found 70,000/ha with a payback period of 5 years at an (IRR) of 33%. This IFS model was expected to generate employment of 130 man-days/ ha.

Debnath (2019) noted that the productivity was 3-7 times higher and profit was 8-15 times higher in IFS models when compared to the traditional Rice-based farming system. Agri Horti Duckery-Fishery based farming system was the most profitable system with benefit-cost ratio of 4:6.

Choudhary (2019) stated that Integrated farming system is the only possible way to increase the farmer's income and to fulfill the need of food for increasing population in the country. In IFS systems all agricultural enterprises including fishery, bee keeping, cropping systems, animal husbandry, fruits, vegetable goat rearing, and others are setup into a single piece of land hence, better recycling of resource occurs which ultimately increase farmer's income.

Paramesh *et al.* (2019) studied the impact of crop–livestock-aquaculture integration in west coast of India on profitability, sustainability, energy efficiency and environmental. Rice grown in rice-baby corn sequence noted higher yield than rice-cowpea system. About 4 ton of fodder and 0.7 ton of azolla were produced and recycled to feed the dairy animals. The household requirements of fruits and vegetables were produced

mainly in the kitchen garden (80 m). The greenhouse gas emission was found to be 10.7 t CO_2 eq. and the major contributor to the total emission were enteric methane emissions (24%) which was from livestock component and diesel consumptions (16%). The emissions of N_2O was mainly found from the chemical fertilizers (13%). The percent share of different components to the net return was noticed higher in cropping systems (40.5%) followed by dairy (37.8%).

Role of IFS in the Empowerment of Women

Women play various roles in household management and in agricultural operations. This is especially true for small and marginal farm families. There is enormous scope to improve the household productivity and profitability by integration different farm enterprises and thoughtfully utilizing family labour using different innovative practices and through multiple uses of various household resources. This is only possible through women's empowerment, through location specific trainings and need based support. With the improvement in the educational status of the women in the years to come, the role of women in agriculture and household resource management will be increasingly important. Since, feminization of agriculture in the long run is expected and development of women-centric farming system models will be a real challenge.

CONCLUSION

The above studies indicated that Integrated Farming Systems (IFS) provides higher income compared to the conventional farming systems or sole cropping systems and it also helps in generating better employment opportunities to the farmers. The Integration of dairy enterprise with the crop is suggested by various researches as it helps in improving socio-economic conditions and nutritional standards of the farmers. IFS models itself serves as an insurance to the farmers compare to non IFS models, still it is desirable for the farmers to link weather based crop insurance on a wide scale covering main crops which contributes to the income security of the farmers. The IFS concept needed to be expanded and strengthened across different land holding sizes to enable farmers capture synergies. This needs effective Farm Management and extension effort.

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Model for the Success of Self-help Groups

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ABSTRACT

Self-help group approach is the group based approach, to enable members to gain economic benefits out of mutual help, solidarity and social responsibility. Self-help groups (SHG) are instrumental in empowerment of women by enabling women to work together in collective agency. But all SHGs are not successful in taking up group enterprise. The main objective of this study was to analyse the working of SHG's and develop a model for the success of SHGs. The study was conducted in Karnataka state during 2014-17 under All India Coordinated Research Project (Home Science Extension). From the entire state eight districts were randomly selected for the study. At the first stage from each district 50 SHGs were randomly selected and thus totally 400 SHGs (N = 400) were the sample for the study. Finally to develop the model information was collected from selected 32 SHGs which have taken up group enterprises. The model consists of eight stages starting from initiation and formation, growth and stability of the group, selection of an enterprise, project planning, mobilization of funds, project implementation and empowerment of women. The SHGs can be successful in taking up group enterprise when they go in a systematic way as given in the model. There is significant difference between the empowerment status of women before and after joining SHGs in case of all types of empowerment.

Keywords: Empowerment, Group enterprise, Model, Self-help group, Success

INTRODUCTION

A self-help group (SHG) is a small, economically homogeneous group of 10-20 poor people who come together to save small amounts regularly. The SHG generally perform various types of economic activities with the help of their small savings. Women self-help groups are informal association of women. The main purpose of such an association is to enable members to gain economic benefits out of mutual help, solidarity and social responsibility. Generally, the economic benefit includes mobilization of savings and credit facilities and to pursue group based economic activities. Self Help Group approach is a group based approach, which help the poor women members of each SHG to accumulate capital by way of small savings and helping them to get credit facilities from their funds. Presently, the poor women of the society are facing financial problem to start business or to undertake different economic activities to become self-employed and self-reliant. The SHGs can empower poor women by providing facilities like savings and credit in the economic development process of the society.

Self-help groups are based on principles of empowerment, inclusion, nonhierarchical decision making, shared responsibility and a holistic approach to people's cultural, economic and social needs. The SHG model was introduced as a core strategy for empowerment of women in the Ninth Five year plan and was continued in the tenth, eleventh and twelfth plans. Both central and state Governments have given special emphasis for organizing women into SHGs and connecting them into the mainstream of the society during all these plans. As a result of this, today we see greater movement in this sector and it is proved that the SHG's are the right platform for financial inclusion of the people. A growing number of

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poor people in various parts of India are members of SHGs. Once the members are organized into SHG's and start their activities, the group savings and lending starts. Such micro financing has helped the rural poor to improve their life standards and fulfill their credit needs. This has helped the rural women to overcome the exploitation by the local money lenders. Vijayanthi (2000) attempts to explain the process of women's empowerment and find out the levels of awareness creation, decision making, self and group empowerment among women from self help groups formed under Comprehensive Community Development Programme implemented in five slum areas of Chennai. Ritu *et al.* (2003); Kamble *et al.* (2006) reported that there is positive relationship between self help groups and the socio-economic status of women.

Alka Srivastava (2005) in her study on women self help groups from Indian States found that through micro-finance based entrepreneurship, women have been able to contribute to household finances, which led to some decision making role for them in the household. Koul *et al.* (2009) said that the self help groups helped the rural women folk in improving their socio-economic status as well as their self dependency. Panda and Debadutta (2009) and Kondal (2014) reported that participation of women in self help group based microenterprises has a positive impact on women empowerment. Rani and Dhiman (2012) revealed that 87 per cent of the SHG members family members income had increase due to SHG activities.

The studies conducted by Lopamudra and Singh (2012); Ramakrishna *et al.* (2013) as well as Yadav (2013) have shown that there is a positive impact of self help groups on women empowerment in various parts of India. Jerinabi *et al.* (2014) studied the performance of SHG linkages models adopted by bankers in Coimbatore District of Tamil Nadu. They analysed two direct linkage models as well as one indirect linkage model and indicated that SHG's were performing better not only as providers of financial services in terms of augmenting savings, lending and ensuring loan recovery, but also in terms of awareness creation and empowerment. Chandran and Sreedaya (2016), in their study on SHG's in Kerala found that participating in SHG's had helped women to increase their social capital as majority (82%) had medium level of social capital formation and 10 per cent had high level of social capital formation.

All the studies reviewed have reported that the self help group has helped women empowerment in various ways. But in order to increase the income of the households, the women members are encouraged to adopt livelihood activities in farm and off-farm sectors. Members are also encouraged to take up group enterprises/micro enterprises. The findings of the review paper on self help groups (Jyothi and Sindhe, 2014) reveals that none of the studies highlighted on women entrepreneurship or women members of self help groups who are engaged in income generating activities. Keeping this in view a study was conducted in Karnataka during 2014-17 with the following objectives,

1. To find out the extent of groups involved in income generating activities and group enterprises.
2. To develop a model for the success of SHGs indicating the process of empowerment.
3. To study the various types of empowerment of the women due to successful SHGs.

MATERIALS AND METHODS

The study was conducted in Karnataka state during 2014-17 under All India Coordinated Research Project (Home Science Extension). From the entire state eight districts were randomly selected for the study. At the first stage from each district 50 SHGs were randomly selected and thus totally 400 SHGs (N = 400) were the sample for the study. Information was collected from these 400 SHGs about their activities with the help of a schedule. Among these 400 SHGs five had discontinued and they were excluded for the further study. Information was collected from 395 SHG's by personally interviewing the office bearers as well as members with the help of a structured schedule to know the various activities of the SHG's (n_1= 395). At the second stage, to measure the empowerment status of members of SHG's the scale developed for the study to measure various types of empowerment was administered to all the 6338 members from the 395 self help groups (n_2 = 6338). In order to compare the empowerment status with nonmembers, the same scale was administered to 500 women from rural area who were not members of any self help groups (n_3 = 500). After the analysis of the collected information it was noted that only 32 SHGs had taken up group enterprises. As the objective of the study was to develop a model of SHG for taking up group enterprise, further during the third stage focused group discussions were conducted with these 32 groups to identify the stages through which they have gone through to reach the success (n_4 = 32). The economic, socio-

psychological, political and legal empowerment of all the 480 members from 32 groups was assessed with the help of the scale developed for the study (n_5 = 480). To assess empowerment status before joining SHG's recall method was used.

RESULTS AND DISCUSSION

The result in Table 1 shows the distribution of SHGs according to their activities. Among the total SHGs only 32 (8.0%) had taken up group enterprises. In the remaining 288 (72%) had taken up individual income generating activities, 75 (18.75%) were doing only micro financing and 5 (1.25%) groups had discontinued. Majority of the groups had taken up income generating activities because either one or the other member would be ready to do it individually. But to take up group enterprises the members require support, additional skill and should proceed in a systematic way, hence it is difficult for all the groups.

In case of money collection and deposit pattern of SHGs, Table 2 reveals that 45.83 per cent of the groups collected Rs. 100 per month from each member, 38.48 per cent of the groups collected Rs. 50 per month per member towards their micro finance deposit. Thus average amount collected per group was Rs. 1951.12 which amounted to an annual collection of Rs. 7,80,450 from all the 395 groups. This shows that a significant contribution is made towards saving which would not have been occurred without group formation.

The results in Table 3 shows that 32.65 per cent of the groups saved their money in commercial banks, equal per cent that is 20.25 per cent of the groups saved in co-operative banks and post office, 13.41 per cent in organized sector, 11.39 per cent in unorganized sector and 2.02 per cent in insurance companies. This was mainly because of the availability and accessibility of the organization for the group as all the villages do not have branches of commercial banks.

The findings in Table 4 reveal that among 6338 members, 1483 (23.40%) of the members had taken up individual income generating activities and were earning an annual income of Rs. 7809/- per member. Group entrepreneurial activity was taken up by 480 (7.57%) members and were earning an annual income of Rs. 11,807/- per member. But majority of them (69.03%) had not taken up any income generating activity but were involved in micro financing. The groups involved in micro financing used the income earned to increase their capital for micro financing and never distributed it among the members, hence the members were not able to get direct income from the group. Even though the income earned is very less, it was taken up only to utilize their free time. But it shows that women have potential to take up income

Table 1: Distribution of SHGs according to their activities (N=400)

Activities	Frequency	Percentage
Group enterprise	32	8.0
Individual income generating activity	288	72.0
Microfinance	75	18.75
Discontinued	05	1.25
Total	400	100

Table 2: Money collection and deposit pattern of SHG groups (n_1 = 395)

Status	F (%)
Rs/ Monthly	
50	152(38.48
100	132(45.83)
200	04(1.01)
Deposit monthly	395 (100)
Total collection (Annual)	7,80,450
Average collection of group/month	1951.12

Table 3: Mode of savings of SHG members (n_1= 395)

Institution	F (%)
Co-operative Banks	80(20.25)
Commercial Banks	129(32.65)
Insurance companies	08(2.02)
Post office	80(20.25)
Un organized sector	53(13.41)
Other organized sector	45(11.39)

Table 4: Annual income of members from self help groups (n_2 = 6338)

Particulars	F	%	Average annual income (Rs.)
Individual income generating activity	1483	23.40	7809
Group income generating activity	480	07.57	11807
No income generating activity	4375	69.03	-

generating activities for which they require to move in a proper direction. Lopamudra and Singh (2012); Ramakrishna *et al.* (2013); Yadav (2013) have opined that SHG's have an impact on women empowerment and Chandran and Sreedaya (2016) found that SHG's have helped women to increase their social capital. In order to increase their economic empowerment there is a need to help them to take up enterprises

The results in Table 5 shows that there is significant difference between the members of self help groups and non members with regard to psycho-social, economic, legal as well as overall empowerment. It shows that the empowerment status of members is higher than nonmembers in all the cases. This clearly indicates that self help group has helped the members to get empowered in all aspects that is psycho-social, economic and legal. Psycho-social empowerment is gained as the members should compulsorily attend all the meetings and participate in all the activities of SHG's, women who were attached to their homes have a chance to mingle with other women and outside world. Due to microfinancing and taking up income generating activities they are economically empowered. Compared to other two types of empowerment legal empowerment is little low but still they have gained a lot of knowledge about their legal rights due to exposure they have received after becoming members of self help groups.

With reference to the entrepreneurial activities taken up by the groups, Table 6 shows that 34.38 per cent of the groups had taken up savouries production, 21.88 per cent of the groups were producing convenience consumer products followed by equal percentage (12.50%) of the groups had taken up coconut tree byproducts production as well as animal husbandry and agro based enterprises and miscellaneous enterprises were taken up by equal percentage of groups (9.37%). The enterprises selected by the groups were based on the skills of the members as well as the availability of raw materials and marketing facilities in the near vicinity. They were not very organized in their activities and worked for these activities only during their free time, hence the income earned was very less.

Table 5: Comparison of empowerment status of members and non-members

	Members of group (n_2 = 6338)	Non members (n_3 = 500)	t value (Test significance)
Psycho-social	4.14	2.24	66.32*
Economic	3.14	2.24	22.18*
Legal	2.72	1.76	27.76*
Overall	3.65	2.41	72.22*

*Significant at 5% level

Table 6: Group income generating activities (n_4 = 32)

Group income generating activity	Frequency	Percentage
Savories	11	34.38
Convenience consumer products	7	21.88
Coconut tree byproducts	4	12.50
Animal husbandry	4	12.50
Agriculture based activity	3	9.37
Miscellaneous	3	9.37

Table 7: Empowerment status of group members (n_5=480)

Empowerment status	Before	After	't'
Economic empowerment	23.76	37.49	18.05*
Socio-psychological empowerment	14.7	93	45.67*
Legal & political empowerment	26.67	41.16	16.82*
Overall empowerment	55.67	82.22	72.22*

* Significant at 1 % level

The results in Table 7 clearly shows that there was significant difference between the empowerment status of the members of the successful self help groups before and after joining SHGs, in case of all types of empowerment viz., economic, socio-psychological, legal & political as well as overall empowerment. Before joining SHGs economic empowerment status of group members was 23.76, socio-psychological (14.7), legal and political (26.67) and overall empowerment (55.67) but after joining SHGs it was increased to economic (37.49), socio-psychological (93), legal and political (41.16) and overall empowerment (82.22). This clearly shows that the empowerment of members in all types had increased due to joining SHGs. The members have involved in various types of activities after joining SHGs like saving money, generating income through enterprise, visiting exhibition for sale etc. and thereby it has provided them a platform to be empowered in all walks of life.

Model for the success of self help groups

The model for the success of SHG given in Figure 1 shows the different stages through which the groups should pass through in order to take up a group enterprise and succeed. The stages are explained below:-

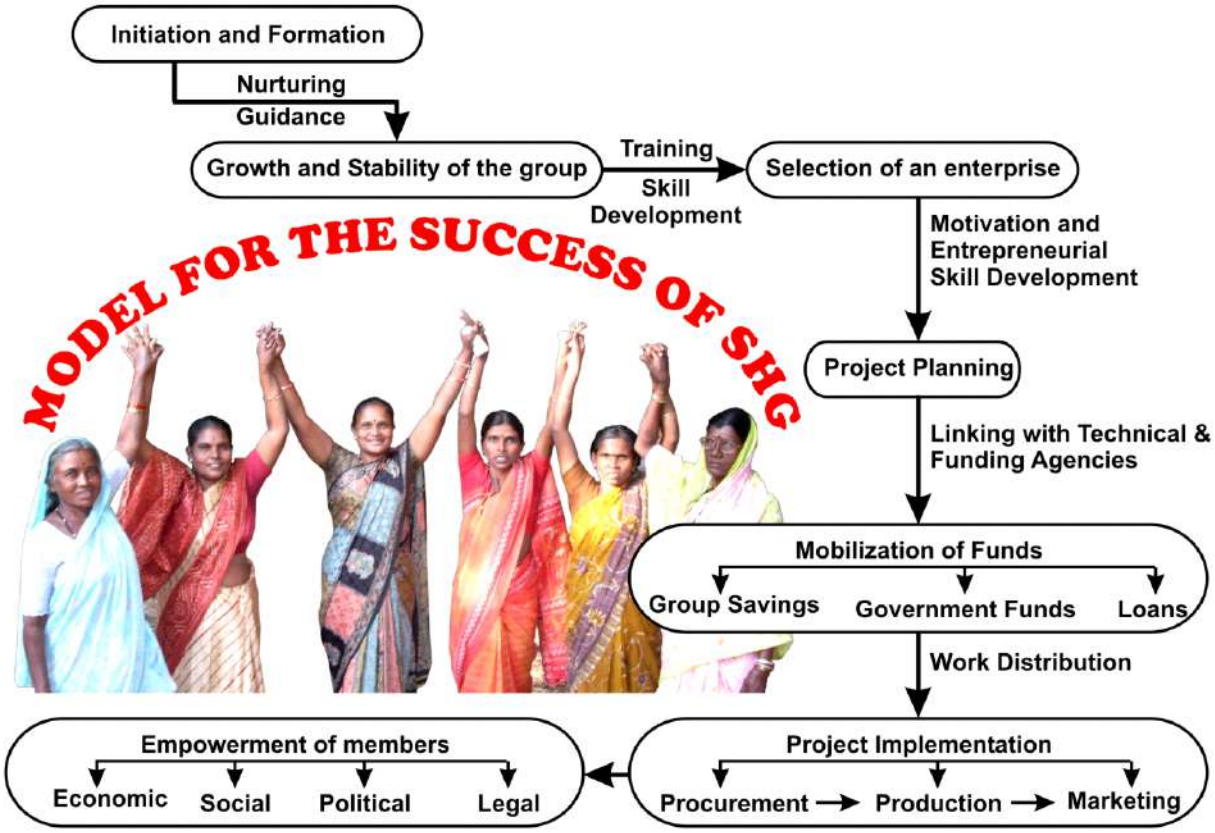

Figure 1: Model for the success of self help groups

Initiation and formation: This is the first stage in the formation of SHG. Any organization that has an intention of forming self help group should go to the village conduct group meetings and motivate women to join SHGs. Among the women who come forward groups of 10-20 like minded people are formed into groups. In each group one president and one or two secretaries are appointed based on the rules of the organization. Once the groups are formed, the group members should be given guidance about conducting meetings, starting savings in the group, opening bank account to deposit their savings and internal lending in the group. The group should be nurtured unless they understand the objectives of formation and start meeting regularly. Any one literate member in the group should be taught about maintaining records. If the members are not capable of maintaining records then the organization should provide some help in maintaining records.

Growth and stability of the group: In order to validate whether the group has grown sufficiently and reached the stage of stability, it is necessary to ensure the group is conducting the following activities:

1. Conduct meetings regularly
2. Collecting savings and depositing it in the bank regularly
3. Internal lending of the saved money

The group can reach the stage of stability due to the nurturing and guidance by the initiated organization and co-operation among the group members.

Selection of an enterprise: As the group reaches the stability stage, the group members should attend trainings organized by various line departments for the SHGs or any trainings organized by the sponsored agencies. By attending such trainings members develop skills in producing many things. Based on the skill developed and analyzing their abilities and resources available, the group members become capable of selecting an enterprise as their group activity.

Project planning: After selection of an enterprise, before implementation, project planning should be done. In order to plan the project, the group members should be motivated and should be trained in developing entrepreneurial skills. By this, they will be provided with necessary capabilities and sufficient support should be

provided by the sponsoring organizations. The organization should also help the group in getting linked with necessary technical as well as funding agencies based on the requirement of the enterprise.

Mobilization of funds: The self help groups based on the planning should estimate the amount required for starting the enterprise. The groups can get finance from three different sources viz., group savings, Government funds and loans. The groups should first take into consideration the amount saved by them. Next it should see if any facilities/subsidies are available from the government. At last after calculating the savings and funds from the government for the remaining amount it should approach to the bank or any other funding agency to which they are linked. Finally it should make sure that the group has sufficient budget to start the enterprise.

Project implementation: Project implementation should be divided into three parts viz., procurement of resources, production and marketing. Only when all the three are implemented effectively, the enterprise can succeed. As it is a group activity, work distribution among the members for all these three activities is very important for the enterprise to run smoothly. The work distribution can be done in two ways based on the capabilities of the group members.

1. If all the members are capable of doing all the three activities then based on the requirement of the activity, the work can be distributed among members. Also as all the members are capable of doing all the activities the members can do different activities on rotation basis so that they do not have any misunderstanding.
2. If all the members are not capable of doing all the three types of activities, then members should be allotted different activities based on their capabilities.

The work distribution is an important activity in order to have co-operation and reducing misunderstandings among themselves. When work is distributed and carried on properly then the enterprise will be very successful.

Empowerment of members: The result of effective implementation of the project is empowerment of the group members. Due to the profit earned from the enterprise the members get economically empowered and due to the increased contacts with different types of people as a part of their activity in the enterprise, they get socially empowered. Economic & social empowerment in turn leads to political and legal empowerment. Thus we can say that establishing group enterprises lead to the all round empowerment of women. Thus any group which follows these steps in an effective way will be successful in its enterprise.

CONCLUSION

The self help groups have gone a long way in empowering rural women in various ways. But till now it is unable to support family income by continuous contribution. This is possible when majority of the groups take up group enterprises. Groups can be successful in taking up group enterprises when they go in a systematic way starting from formation, to project implementation with the support of the sponsoring organization and developing linkage with technical and funding agencies. The organizations which start SHGs can follow this model step by step so that the SHGs become successful and the SHGs which are practicing only micro financing, can be taught how to go about to start group enterprise and become a successful SHG with the help of the model.

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Impact Assessment on Frontline Demonstration of Garden pea under Longleng District of Nagaland

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ABSTRACT

The present study was carried out in three different villages under Longleng district of Nagaland where frontline demonstration of garden pea (Azad pea 1) was conducted during 2015-16 and 2016-17 by KVK, Longleng. A total 44 nos. of demonstrations were evaluated to find out the yield gaps between garden pea variety Azad pea 1 and variety grown by farmers. Yield data of both demonstration and farmers practice were recorded and their yield gap, technology gap, extension gap and technology index were analyzed. Results revealed that the garden pea yield (cv. Azad pea 1) was recorded 40.6 to 40.7 per cent higher over farmer's variety. On an average technology gap was recorded 4.10 q/ha, while average extension gap was recorded 2.40 q/ha. Average technology index was recorded 34.10 per cent. Average net return was found Rs. 15375.50/ha and Rs. 8637.50/ha with demonstration and farmers practice respectively. Higher benefit cost ratio, production efficiency and economic efficiency were recorded in demonstration plot than the farmers practice.

Keywords: Economics, FLD, Gaeden pea, Technology index, Yield

INTRODUCTION

Pea (*Pisum sativum* L.) having a chromosome number 2n = 14, a leguminous crop, belongs to family Leguminoseae and contain higher amount of protein having essential amino acids particularly lysine. Each 100 g edible portion of the green pea contains moisture 72.9 g, protein 7.2 g, fiber 4.0 g, carbohydrates 15.9 g, energy 93 K cal, calcium 20 mg, phosphorus 139 mg, iron 1.5 mg, carotene 83 µg and dry pea contains moisture 16.0 g, protein 19.7 g, fiber 4.5 g, carbohydrates 56.5 g, energy 315 K cal, calcium 75 mg, phosphorus 298 mg, iron 7.05 mg and carotene 39 µg (Choudhary *et al.,* 2009). Large proportion of vegetable pea is processes (canned, frozen, or dehydrated) for consumption in the off season. Peas are very common nutritious vegetable and are mainly cultivated as winter crop throughout the world. The potential of vegetables in contributing to the national economy has been well recognized in recent year. India is the second largest producer of vegetables, next only to China, in the world with a production of 40 million hectares of land area. In spite of that, this seemingly high level of production can provide only 208 grams of vegetables (Sharma, 2003). In India, the area of pea was (545.89 ha) in 2016-2017 with production of (5451.62 MT). The main constituent of cost of cultivation of peas is organic manures followed by cost on human labour for cultivation. As the same time, the income per hectare from vegetable crops has been almost four times, as compared to food crops (Thakur *et al*., 1996).

The cropping intensity of the state is very low (115%) due to mono cropping of rice. Rice is the second most important cereal after maize grown in the state. Most of the farmers of the District following monocropping and kept their rice field fallow after harvesting of rice and residual soil moisture was remained in the soil. Therefore, garden pea cultivation may be an option, not only to utilized the soil moisture but also improve the soil fertility status, which ultimately increased the yield of succeeding rice crop. As growing of vegetable crops provided almost four times higher income compared to food grain crops. Huge gap is being observed in demand and supply of vegetables due to low production in the state. Thus there

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is potential for growing of vegetable pea in rice-fallow areas for increasing the cropping intensity, productivity and income of the farmers. Therefore, the Krishi Vigyan Kendra (KVK), Longleng, Nagaland took the initiative and conducted frontline demonstration (FLD) on vegetable pea in the rabi season during the year of 2015-16 to 2016-17 in lowland rice-fallow for additional income of the farmers.

MATERIALS AND METHODS

Krishi Vigyan Kendra, Longleng is situated at 26° 26' 0" N Latitude, 94° 52' 0" E Longitude with altitude of 1366 m MSL. The soil is generally high in soil organic carbon (1.2-1.7%), low to medium in available N (281-339 kg/ha) and K (178-203 kg/ha) and low to medium in available P (10.8-14.7 kg/ha). Total annual rainfall varied between 2192 mm to 1793 mm during 2015-16 and 2016-2017 respectively and average annual rainfall was recorded 217.1 mm during (October-January) cropping period (Figure 1). The monthly mean maximum temperature was recorded 19.71 to 27.4°C and 23.9 to 29.45°C during 2015-16 and 2016-17 respectively (Table 1). Whereas, minimum temperatures during the study period ranged 4.1 to 14.7°C and 7.74 to 20.51°C 2015-16 and 2016-17 respectively. Frontline demonstrations on garden pea (Cv. Azad pea 1) was conducted under Lowland rice-fallow by Krishi Vigyan Kendra, Longleng in different villages under the District in an area of 1.3 ha and 2.5 ha during the year 2015-16 and 2016-17, respectively. Garden pea was sown as second crop in residual soil moisture just after harvesting of Lowland rice during the last week of October - 1st week of November. The recommended doses of fertilizers (RDF) was applied @ 20:60:40 kg NPK/ha with sources of DAP and MOP. If necessary, weeding was done to field free from weed up to 35 days. Neem oil was sprayed @ 3-4 ml per litre of water to manage the insect pest and disease problem at interval of 7-10 days. The garden pea (green pod) crop was harvested in 85-110 days. The yield data from the demonstration and farmers practice were recorded and their technology gap, extension gap and the technology index were worked out using methods developed by Kumar *et al.* (2020) as stated below:

Technology gap = Potential yield – Demonstration yield

Extension gap = Demonstration yield – Farmer's practice yield

Technology Index : Potential yield- Demonstration yield/ Potential yield

In economics, cost of cultivation was taken into account for calculating economics of treatments as work out net return per ha and benefit-cost ratio. The gross returns were taken as total income from the produce of grain and straw yield based on prevailing price. Net return and benefit-cost ratio was calculated with the help of following formula:

Net Return (Rs/ha) = Gross return (Rs/ha) - cost of cultivation (Rs/ha)

$$\text{Benefit cost ratio} = \frac{\text{Gross return (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Production efficiency and economic efficiency were calculated with the help of the formula (Kumar *et al.,* 2017).

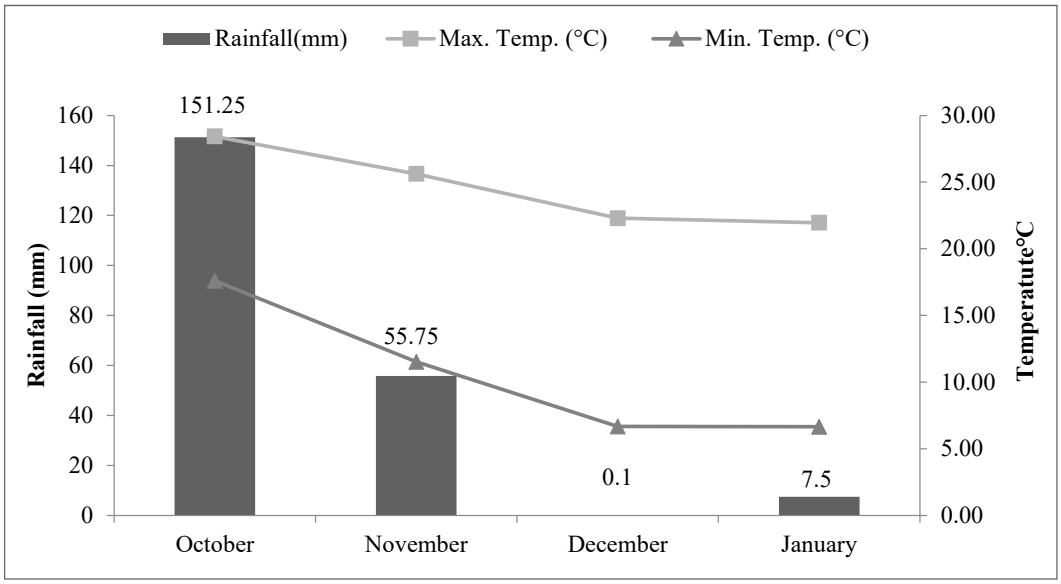

Figure 1: Weather parameter during the cropping period (two year mean)

Table 1: Difference between demonstration package and farmers practices of garden pea

S.No.	Particulars	Demonstration package	Farmers' practices
1.	Variety	Azad pea 1	Local
2.	Seed rate	70-80 kg	90-100 kg
3.	Sowing method	Line/Broadcasting	Broadcasting
4.	Sowing time	Last week of October – 1st week of November	Middle of November
5.	Fertilizers' doses	20:60:40 kg NPK/ha	Without NPK
6.	Weeding	One weeding	No weeding
7.	Plant protectionmeasures	Need based spray of neem oil	No spray

$$\text{Production efficiency (kg/ha/day)} = \frac{\text{Grain yield (kg/ha)}}{\text{Total duration of the crop (days)}} \times 100$$

$$\text{Economic efficiency (Rs/ha/day)} = \frac{\text{Net return (Rs/ha)}}{\text{Total duration of the crop (days)}} \times 100$$

RESULTS AND DISCUSSION

FLDs was conducted during 2015-16 and 2016-17 in 3.8 ha area with 44 nos. of demonstration at farmer's field covering four different villages of Longleng district of Nagaland. Results indicated that the yield of garden pea variety azad pea 1 was substantially higher than the variety grown by the farmers during both the years (Table 2). The yield of garden pea in different demonstration plots was recorded 47.60 q/ha and 51.20 q/ha in the year 2015-16 and 2016-17, respectively, which was 30.55 and 46.50 per cent higher over farmer's practice. On an average 38.41 per cent increase in yield was obtained in the demonstration plots whereas average yield in farmer's field was recorded only 35.40 q/ha. Mukherjee (2003) reported that the innovative innovation may have superior implication in enhancing productivity. Similar results also reported by Mishra *et al.* (2009) and Lepcha *et al.* (2015). The poor productivity in farmers practice might be mainly due to factors like use of non descript local variety and low level of agronomic management in addition to non availability of resources in time. The result clearly depicts the positive effects of FLDs over the existing practices towards enhancing the production and productivity of garden pea in the District. The extension gap was obtained 14.2 q/ha and 12.8 q/ha during the year 2015-16 and 2016-17 respectively, emphasizes the need to educate the farmer through various means for adoption of improved agricultural production to reverse the trend of wide extension gap. To increase the productivity and production of garden pea, seed replacement of non-descriptive varieties by improved is very much essential. In this context, front line demonstrations are playing an important role in popularizing the improved garden pea variety among the farming community.

The technology gap was recorded 13.8 and 17.4 q/ha during 2015-16 and 2016-17 respectively. The average technology gap was recorded 15.50 q/ha during the period of demonstration. The variation in technology gap observed might be due to dissimilarity in soil fertility, management factors and weather condition.

The technology index showed the feasibility of evolved technology at the farmer's fields. The lower value of technology index the more is the feasibility of technology (Kumar *et al*, 2014). As such reduction of technology index varying from location to location which exhibited the

Table 2: Productivity, technology gap, extension gap and technology index in garden pea

Year	Area	No. of Demo.	Potential yield (q/ha)	Average yield (q/ha)		% increase over farmer practice	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
				Demo	Local				
2015-16	1.3	13	65.0	47.6	37.00	30.55	10.00	18.00	27.70
2016-17	2.5	31	65,0	51.2	34.80	46.50	16.20	14.00	21.54
Total	3.8	44	-	98.8	70.80	-	26.20	32.00	49.24
Average	-	-	-	49.4	35.40	38.41	13.10	16.00	24.62

Table 3: Economics and efficiency of demonstrated plot and farmers practices

Year	Net return (Rs/ha)		B:C ratio		Production efficiency (kg/ha/day)		Economic efficiency (Rs/ha/day)	
	Demonstrated plot	Farmers practice	Demonstrated plot	Farmers practice	Demonstrated plot	Farmers practice	Demonstrated plot	Farmers practice
2015-16	89940	62520	2.70	2.28	45.33	33.63	856.57	568.36
2016-17	100740	55920	2.90	2.15	48.76	31.63	959.42	508.36
Average	95340	59220	2.80	2.22	47.04	32.63	908.00	538.36

feasibility of technology demonstrated. Similar yield enhancement in different crops in front line demonstration has amply been documented by Mishra *et al.* (2009) and Kumar *et al.* (2020). The technology index was recorded 21.23 per cent and 26.77 per cent during the year 2015-16 and 2016-17, respectively with average technology index of 24.00 per cent. As such fluctuation in technology index (ranging during the study period in certain villages, might be attributed to the dissimilarity in soil fertility status, weather conditions, non-availability of irrigation water, insect pest attack and disease infestation in the crop. Similar finding were reported by Dutta (2014) in rapeseed and mustard and findings of Mitra and Samajdar (2010) who opined that lower the value of technology index, more is the feasibility of the technology demonstrated.

Net return and benefit cost ratio were recorded Rs. 100740/ha, Rs. 89940/ha in demonstration plots and Rs. 62520/ha, Rs. 55920/ha in farmer's practices during the year 2015-16 and 2016-17, respectively (Table 3). Hence, higher B:C ratios proved economic viability of the interventions made under FLD programme. Higher production efficiency (kg/ha/day) and economic efficiency (Rs/ha/day) were recorded 48.76, 45.33 and 959.42, 856.57 in demonstration plot than the farmers practice (4.66 kg/ha/day,73.2 Rs/ha/day, respectively) during the year 2015-16 and 216-17, respectively. Therefore, to exploit the potential of improved production and protection technologies efforts through FLDs ought to be increased awareness among the farmers. The results confirm the findings of frontline demonstrations on oilseed and pulses crops reported by Chaudhary *et al.* (2012) and Kumar *et al.* (2020).

CONCLUSION

It may be concluded that adoption of improved production technology can reduce the technology gap to a considerable extent which leads to increased productivity of garden pea in the district. Moreover, Krishi Vigyan Kendra need to provide proper technical support to the farmers through different extension methods to reduce the extension gap for better production in the district. More efforts should be made to motivate the farmers for adoption of improved agricultural technologies including HYV to revert the trend of wide extension gap and also increase their family income for livelihood improvement.

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Development and Application of a Psychometric Scale to Measure Awareness of the Dairy Farmers on Animal Waste Management in Urban and Peri-urban Areas of National Capital Region (NCR), India

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ABSTRACT

This study has been undertaken to measure the awareness of urban and peri-urban dairy farmers regarding the dairy animal waste management. A scale has been developed by summated rating method suggested by Edward (1969) with little modifications. It was then administered to 252 dairy farmers from four different sub-regions of National Capital Region, India equally covering urban and peri-urban dairies. The data was analyzed using Mann-Whitney U Statistic and Duncun Multiple Range Test. The dairy farmers were grouped into low, medium and high categories of awareness level and highest number of the farmers belonged to low awareness category (35.71%) followed by medium (35.32%) and high (28.97%) awareness category. Overall, in NCR, there exist a significant difference at 1 per cent level (P value=0.001; <0.01) between the awareness of respondents in urban and peri-urban areas. The dairy farmers in Delhi were found to be more aware regarding the dairy animal waste management with mean value of 33.76±1.20 followed by Rajasthan (25.06±1.84), Haryana (23.70±1.17) and Uttar Pradesh (23.17±1.84). This study will provide a significant tool for the researchers to measure the awareness of dairy farmers on animal waste management. It will gain attention of policy makers to adopt strategies for improving the awareness of dairy farmers and thus minimize the risk caused by dairy farming in urban areas.

Keywords: Dairy animal waste management, Awareness scale, Scale construction, Dairy farms, Urban and Peri-urban dairies

INTRODUCTION

Awareness is the key for adopting good management practices. As our country is facing lot of enviromental threats in the present scenario, proper waste management is one of the most significant area which need more attention. When dairy farmers gain awareness regarding the importance of waste management, they will perform better to maintain a hygienic environment in their dairy farms and will also try for converting waste to wealth. This will obviously helps in the clean milk production in dairies and also in enhancing their income. So, before trying to improve their awareness, the present status of awareness level should be known. In many cases most of the people are aware about the health and environmental effects due to the exposure to different wastes (Lutui, 2001; Abul, 2010; Chengula *et al*., 2015). People also know that improper waste management attracts the multiplication of microorganisms, fungi, bacteria viruses which affects human (Jatau, 2013) and improper waste disposal causes diseases in human like cholera (Chengula *et al*., 2015). Increased awareness of zoonoses (pathogenic microbes of animal origin) in animal wastes is now recognized as a public health concern, especially because of the occurrence of waterborne disease outbreaks apparently caused by fecal contamination of manure origin (Sobsey *et al.,* 2006). The awareness of people regarding the waste effects vary with their age, education and other personal and socio economic characteristics (Lutui, 2001; Jatau, 2013; Baksh *et al.,* 2015). Hasan (2004) reported that citizens must be made aware of the problems associated with mismanagement of waste; because if left unmanaged, it may become a matter of life and death. An environmentally aware citizen along with a determined

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leadership in the government would ensure that wastes that will continue to be generated in the future will be properly managed, thereby eliminating risk to their lives and assuring a clean and healthy environmnet for future generations. Kusiluka *et al.* (2012) in Tanzania found that majority of the respondents were aware about the usefulness of animal wastes while few of them did not consider animal wastes to be useful. In this scenario this research study has undertaken to measure the awareness of urban and peri urban dairy farmers regarding dairy animal waste management.

MATERIALS AND METHODS

This study was purposively carried out at the National Capital Region (NCR) of India, considering the extent of urbanization and locale of large number of urban and peri-urban dairies. The NCR Region consists of the parts of 4 different states Haryana, Delhi, Uttar Pradesh and Rajasthan. Through proportionate random sampling method, seven districts were selected from these sub regions. The selected districts were, Sonepat, Panipat and Palwal from Haryana, North and North West Delhi, Bhagpat from Uttar Pradesh and Alwar from Rajasthan. From each district one city was selected purposively and from each city, 36 dairy farmers (18 from urban and 18 from peri-urban area) were selected randomly. Thus a total sample of 252 dairy farmers was selected as respondents. The constructed awareness scale was administered to these 252 dairy farmers and analysis was done to measure their awareness level and also categorized them according to their awareness level.

Construction of Dairy Animal Waste Management Awareness Scale

A scale has been developed by summated rating method suggested by Edwards (1969) with little modifications. The following steps were considered for developing the awareness scale.

i) Collection of Statements: Through literature review and discussions with experts, 37 statements were formulated for the development of dairy animal waste management awareness scale. Statements were grouped in to two different dimensions like Harmful effects of Dairy Animal Waste and Scope of Utilization of dairy animal waste.

ii) Relevancy test of the selected statements: The selected statements were then administered to a group of 120 judges through personnel contact, email and Google forms. The judges were requested to check each and every statement *w.r.t.* its relevancy on a three point continuum *viz.* Most relevant, Relevant and Least relevant with scoring 3, 2 and 1 to measure the awareness of the dairy farmers to various aspects of dairy animal waste management. Based on the response obtained from 33 judges, relevancy weightage (RW) and mean relevancy score (MRS) were worked out for all the selected statements individually by following Maiti *et al.* (2016). The minimum cut off was set at 0.75 for the relevancy weightage and 2.25 in case of MRS. Hence after the relevancy test the number of statements was reduced to 24 as those falling below the cut off were eliminated.

iii) Item Analysis: Items which scored above the pre decided cut off, in the relevancy test were restructured and modified following the suggestion of experts of relevant domain. Then the modified instrument was administrated to 40 randomly selected dairy farmers from the non-sample city(s) in NCR. Respondents were requested to give their response on a four point continuum from 'fully aware' to 'not aware at all' with a score of 3,2,1 and 0 respectively in a personal interview by the researcher. The total individual score of subjects was calculated by summing up the response score of each statement given by individual subjects

iv) Calculation of 't' values: The 't' values were worked out for the individual statements (Edwards, 1969) and those statements with 't' value equal to or greater than 1.75 were retained. Thus 20 statements on dairy farmers' awareness about dairy animal waste management were retained in the final scale as shown in Table 1.

v) Reliability and validity of the scale: Cronbach alpha (internal consistency reliability) coefficient was used to determine the reliability of the measuring instrument. The alpha coefficient value was found to be 0.83 for the scale constructed. The ideal value for alpha in exploratory research is 0.60 (Sivakumar *et al.*, 2017). Hence the whole scale was found to be reliable. Validity is the extent to which a scale accurately represents the concept or construct of interest. The content of the final scale was finalized through exhaustive literature survey, followed by interaction with experts of the relevant field, farmers and other researchers. In addition the judgement survey conducted prior to its finalization and selection of indicators according to the relevancy weightages, ensured the content validity of the instrument.

Table 1: The selected statements for dairy animal waste management awareness scale

S.No.	Statements	t value
I. Harmful effects of Dairy Animal Waste		
1	Flies and mosquitoes may spread diseases if the dairy animal waste remains unattended in the cattle shed.	4.87
2	Persisting odour from the uncleaned cattle shed may cause suffocation	5.09
3	The dust with dairy animal waste particles leads to respiratory problems in humans.	3.35
4	Flushing of dung into the drainage channels results in blockage	3.89
5	Milk may get contaminated due to the unattended waste in the cattle shed	3.88
6	Bovines may feel discomfort as they are subjected to sit and stand on their dung and urine	4.43
7	Improper management of dairy animal waste may results in poor air and water quality of surrounding environment	3.05
8	Methane and nitrous oxide gases are emitted from the unattended dung which causes global warming	3.20
9	Residential area and locality are deteriorated due to dumping of dairy animal waste and uncleaned cattle shed	6.70
II. Scope of Utilization		
10	Dairy Animal Waste is only a misplaced resource that can be a valuable input for another component	6.70
11	Integrated farming is a perfect choice for the appropriate use of dairy animal waste	1.76
12	Composting or vermi-composting with dung can results in good manure	4.67
13	Anaerobic composting of dung prevents the emission of methane as well as reduce the smell and fly problems	4.81
14	Biogas plants can be run with dung as a major input for producing cooking gas at household level	6.09
15	Cow urine has insect repellent activity that can be used as bio-pesticide to protect the crops	4.58
16	Proper management of dung and urine helps the farmer to fetch more income	2.33
17	Proper waste management practices can result in the sustainability of dairy farm	1.84
18	Shift to organic farming nowadays has increased the demand for dung and urine to use for crop cultivation	2.24
19	Group approach in collection of dung and construction of biogas plants can result in more benefit	2.32
20	Processed products of dung and urine are marketed through online as well as other marketing channels	2.44

vi) Administration of the scale: The final scale consisting of 20 statements was administered to the dairy farmers on a 4 point continuum viz., fully aware, somewhat aware, aware and not aware at all with a score of 3,2,1 and 0 respectively. Scores were summed up to get the total score for awareness of each respondent. The overall possible minimum and maximum score ranges between 0 to 60.

Statistical Analysis

The dairy farmers were categorized in to three different levels by cumulative square root frequency method to show the differential level of awareness among them. Duncan's Multiple Range test (DMRT) was used to compare the means. The SPSS 20 software was used for performing this post hoc test. The means of different sub regions (Delhi, Haryana, Uttar Pradesh and Rajasthan) of NCR were compared by this. Mann Whitney U Statistic was used (in SPSS 20) to compare the means of two independent samples viz. urban and peri-urban areas.

RESULTS AND DISCUSSION

Based on the response of dairy farmers, to the developed psychometric tool, their awareness scores were found out. Range of Awareness score was found as 6.00 to 56 among the respondents. The dairy farmers were then categorized into three different categories of awareness based on the cumulative square root frequency method. It was found that majority of the farmers belonged to low awareness category (35.71%) followed by medium (35.32%) and high (28.97%) awareness category (Table 2).

Table 2: Level of awareness regarding dairy animal waste management among the respondents (n=252)

Category	Frequency	Percentage
Low (6-20.37)	90	35.71
Medium (20.38-34.76)	89	35.32
High (34.77-56)	73	28.97
Total	252	100.00

Table 3: Differential level of awareness across the sub-regions of NCR

Study Area	Low (6-20.37)#	Medium (20.38-34.76)#	High (34.77-56)#
Delhi (n=72)	4(5.56)	35(48.61)	33(45.83)
Haryana (n=108)	51(47.22)	34(31.48)	23(21.30)
Uttar Pradesh (n=36)	18(50.00)	8(22.22)	10(27.78)
Rajasthan (n=36)	17(47.22)	12(33.33)	7(19.45)
Overall (n=252)	90(35.71)	89(35.32)	73(28.97)

score for level of classification. Values in parenthesis indicate percentage.

The distribution of respondents according to their awareness scores across the study locales was summarized as follows to have a comparative over view (Table 3).

Table 3 depicts that the respondents with low level of awareness was highest in Uttar Pradesh (50.00%) followed by Haryana and Rajasthan (47.22%). The highest proportion of high level of awareness was found in Delhi (45.83) followed by Uttar Pradesh (27.78%), Haryana (21.30%) and Rajasthan (19.45%). It was revealed that the highest percentage of respondents (48.61%) from Delhi sub-region was belonged to medium level of awareness followed by 45.83 per cent of respondents with high level of awareness. In Delhi the people with low level of awareness is quite low (5.56%) compared to the other sub regions. This can be attributed to the life in metropolitan cities where people have more access to education.

To delineate the differentiation of awareness, if any, among the respondents in urban and peri-urban area, Mann-Whitney U statistics was also used (Table 4). It was found that there exist a significant difference between the awareness of respondents in urban and peri-urban areas of Haryana (P value=0.018; < 0.05) and Uttar Pradesh (P value=0.014; <0.05) at 5 per cent level of significance. It was also found that there exist no significant difference between the awareness of respondents in urban and peri-urban areas of Delhi (P value=0.417; >0.05) and Rajasthan (P value =0.134; >0.05). Due to the high urbanization, in Delhi the peri-urban areas are not much different from urban areas. In Rajasthan, the influence of an Non Governmental Organization named 'Humana' was quite visible in the awareness level of farmers in both urban and peri-urban areas. Overall, in NCR, there exist a significant difference at 1 per cent level (P value=0.001; <0.01) between the awareness of respondents in urban and peri-urban areas

The different dimensions of Awareness regarding dairy animal waste management i.e., harmful effects of dairy animal waste and scope of utilization were also studied to understand the dairy farmer's awareness regarding these different aspects of animal waste management (Table 5).

Duncun's Multiple Range Test (DMRT) was applied for comparative evaluation of awareness of dairy farmers in different sub regions. Results of DMRT shows that there was a significant differentiation at 5 per cent level between the dairy farmers of Delhi (denoted by superscript [a]) and the other three sub-regions (denoted by superscript [b]) with respect to their awareness regarding dairy animal waste management. The dairy farmers in Delhi was found to be more aware regarding the dairy animal waste management with mean value of 33.76±1.20 followed by Rajasthan (25.06±1.84), Haryana (23.70±1.17) and Uttar Pradesh (23.17±1.84).

Table 4: comparative evaluation of awareness of respondents in urban and peri-urban areas of different states in NCR

States	N	Mean ± SD	Urban		Peri-urban		Mann whitney	P value
			N	Mean ± SE	N	Mean ± SE	U statistic	
Delhi	72	33.76±1.20[a]	36	34.81±1.77	36	32.72 ±1.62	720	0.417
Haryana	108	23.70±1.17[b]	54	26.43±1.67	54	20.98±1.58	1842*	0.018
Uttar Pradesh	36	23.17±1.84[b]	18	27.39±2.54	18	18.94 ± 2.34	39*	0.014
Rajasthan	36	25.06±1.84[b]	18	28.39±2.54	18	21.72±2.48	209.5	0.134
Total (NCR)	252	26.69±0.76	126	29.24±1.05	126	24.15±1.06	6007**	0.001

**significant at 1 % level of significance, in a two tail test. *significant at 5 % level of significance, in a 2 tail test. Multiple comparisons are based on the DMART post hoc test. Values with different superscripts column wise differs significantly at 5% level of significance

Table 5: Average value and comparative evaluation of awareness regarding dairy animal waste management and its different dimensions in NCR (Mean±SE)

S.No.	Study Area		Harmful effects of Dairy Animal Waste	Scope of Utilization
1	Delhi	Urban (n=36)	18.33 ± 0.64	16.47±1.17
		Peri-urban (n=36)	16.89±0.60	15.83±1.06
		Total (n=72)	17.61 ± 0.44	16.15±0.78
2	Haryana	Urban (n=54)	12.70±0.82	13.72±0.88
		Peri-urban (n=54)	10.15±0.79	10.83±0.82
		Total (n=108)	11.43±0.58	12.28±0.62
3	Uttar Pradesh	Urban (n=18)	12±1.15	15.39±1.43
		Peri-urban (n=18)	8.61±1.02	10.33±1.37
		Total (n=36)	10.31±0.81	12.86±1.07
4	Rajasthan	Urban (n=18)	12±1.12	16.39±1.47
		Peri-urban (n=18)	9.78±1.18	11.94±1.32
		Total (n=36)	10.89±0.82	14.17±1.04
	Overall		12.96±0.37	13.74±0.42

The maximum awareness regarding the harmful effects of waste was found in Delhi (17.61 ± 0.44) followed by Haryana (11.43±0.58), Rajasthan (10.89±0.82) and Uttar Pradesh (10.31±0.81). In case of the awareness regarding the scope of utilization of animal waste the dairy farmers in Delhi again stood in first place with mean value of 16.15±0.78 followed by Rajasthan (14.17±1.04), Uttar Pradesh (12.86±1.07) and Haryana (12.28±0.62). These results can be used in designing the awareness campaigns appropriately as it indicates what information is lacking among the dairy farmers.

CONCLUSION

The awareness of dairy farmers on dairy animal waste management varies in different regions of NCR. Larger number of dairy farmers possesses low level of awareness regarding waste management. These findings regarding awareness of dairy farmers in urban and peri urban areas shows the requirement of awareness programs for enabling the dairy farmers to create safe environment and to earn profits out of waste management. The awareness programs should be area specific and target oriented as the present awareness levels vary among urban and peri urban areas and also among different sub regions of National Capital Region.

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Low-Cost Farm Implements for Enhanced Work Efficiency Amongst Farm Workers

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ABSTRACT

The rural populations consisting of marginal and poor farmers are dependent on labourers for all farm related activities like sowing / planting of paddy, harvesting of agricultural and horticultural produce and application of pesticides which can be very costly. These labourers also face a lot of problems in sowing / planting of paddy as it has to be done by bending down continuously or during application of pesticides to cotton fields drift can be major health concern and harvesting different produce like bhendi due to its thorny spikes and capsaicin content of chilies. In view of this, KVK, Wyra has assessed cost effective farm implements and is relentlessly trying to popularize them. These included use of protective clothing during application of pesticides, rolling stem applicator for controlling sucking pest in cotton, knitted gloves for bhendi plucking and chilli finger guard for its plucking. These simple and cost-effective farm implements helped farm women in drudgery reduction, ergonomic stress on various body parts, improved work efficiency, decreased labour cost and body allergies. Protective clothing reduced itching, irritation, skin allergies, burning, vomiting, headache and faintness over a month's time, rolling stem applicator was ecofriendly and decreased the amount of chemicals, knitted gloves for bhendi plucking reduced the bruising and repeated damage to fingers during harvesting and chilli finger guard improved the work efficiency.

Keywords: Farm implements, Improved work efficiency, Drudgery reduction, Work related disorders, Ecofriendly

INTRODUCTION

Rural population living in India constitutes around 72.0 per cent of the total population, constituting that include labourers, poor and marginal farmers (ICAR-DPR, 2012). India ranks second worldwide in farm outputs and as per 2018, agriculture employs 50.0 per cent of work force contributing to 17-18 per cent to India's GDP (The Financial Express, 2018). The women work force in agriculture and allied sectors is estimated to be around 91.0 million accounting to 37.0% of the total farm workers in India (Banthia, 2004; GOI, 2006; Anonymous, 2014).

Women have traditionally been involved in labour intensive, time consuming and tedious jobs like sowing, transplantation, weeding, harvesting, threshing and post-harvest operations from times immemorial working 14 to 18 hours in a day (Srivastava, 1985). The traditional methods used by farm labourers causes drudgery leading to serious health issue such as back pain, knee pain and other work-related health hazards (Khadatkar *et al*., 2017). The minimal independent participation of women was observed in seed treatment and fertiliser application as technical aspects were involved. Less participation by women in irrigation activities may be due to restrictions in movement outside the house during odd hours (Sidhu and Pannu, 2005). Scientific along with technological inputs and interventions in agriculture help to relieve farm women from the physical and mental strain (Patel *et al*., 2015).

Drudgery involves physical agony, mental strain, fatigue, monotony in work and extreme hardships experienced by humans. Improved simple implements and tools developed, refined and evaluated based on feedback of the farm women can be helpful to them. The number of machines developed so far to increase efficiency and reduce drudgery at lower cost are usually popular among male farmers (Mukherjee, 2014).

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The use of simple farm implements can reduce the ergonomic stress on the body, help in improving work efficiency and decrease man hours in case of few of the implements. These implements can be used by females also very effective as they are simple to use. Some of the implements introduced to the farming community by Krishi Vigyan Kendra, Wyra, Khammam district are discussed below:

Protective clothing: Protective clothing should consist of polyester and cotton blended fabric for a new one whereas a blended old shirt can be starched to close the pores in the fabric to prevent any chemicals coming in contact with skin. These were worn during spraying of pesticides to reduce the occupational hazards that include itching, irritation, skin allergies, burning, vomiting, headache and faintness. With the use of protective clothing the occupational health hazards decreased in a period of one month. As old full hands shirts were starched and used, the durability can be improved and was cost effective also (Jyoshna *et al*., 2017).

The cost of protective clothing is around Rs. 600–650/-. It can be used repeated after washing and as it is cotton, it can with stand the wear and tear of repeated washing (Plate 1).

Rolling stem applicator: The rolling stem applicator consisted of a 2.5 feet length pipe with 2.5 cm diameter, a foam holder with reusable sponge and weighing 250g. The applicator was operated by dipping the sponge into prepared spray chemical fluid and can be applied to the base of the stem for about 15 to 20 plants. This implement reduced the drudgery to negligible levels, the time required for applying chemical spray decreased by 40 to 50 per cent, with no environmental pollution, zero levels of inhalation of pesticide during application by farm workers, no drift loss and no toxicity to natural enemies. The ease of application of this implement is very easy and comfortable (Kumar *et al*., 2019). It can around Rs. 250/- and each sponge change can be used for one season of crop (Plate 2).

Knitted gloves for bhendi plucking: Women encounter lot of hazards during harvesting of bhendi crop with bare hands as they have thorny spikes that hurt hands due to cutting, bruising and repeated damage to fingers. The knitted gloves were designed in a manner that they can be easily worn at the time of harvesting bhendi and was absorbed the sweat from hands also. At a cost of Rs. 25 per pair, these gloves lasted the entire season of harvest. Farm women harvesting bhendi felt that these gloves

Plate 1: Use of protective clothing during spraying

Plate 2: Use of rolling stem applicator in cotton field

Plate 3: Use of knitted gloves for bhendi plucking

Plate 4: Use of finger guard for chilli plucking

protected their hands from dust, cuts, sores, allergies and other skin rashes (Jyoshna *et al*., 2017) (Plate 3).

Chilli finger guard: Chilli is one the largest grown crops in Khammam district with 3 to 4 pickings during harvest period. The reduction in labour availability necessitated the use of simple finger guard to hasten the harvest time increasing the harvest output. The work output and field acceptability of this guard were 37.5 and 86.0 per cent higher than regular plucking with bare hands as per the demonstrations carried out by at Krishi Vigyan Kendra, Wyra (Plate 4).

CONCLUSION

Farming can be stressful during harvesting especially to women as many of them are involved in this activity. The use of these simple implements not only improved the working conditions for the farm labourers but also increased the harvest rate there by helping the farmers to reduce the cost of harvesting. Similarly, the use of protective clothing occupational health hazards like itching, irritation, skin allergies, burning, vomiting, headache and faintness in a month's time, rolling stem applicator for cotton was ecofriendly and decreased the cost on chemicals, knitted gloves for bhendi plucking reduced the bruising and repeated damage to fingers during harvesting, drum seeder for sowing of germinated paddy was effective in reducing the labour costs and easy to use, chilli finger guard improved the work out when plucking chilli as there are usually 3 to 4 pickings and cotton harvest bag improved the work efficiency of the pluckers as they were able to harvest more cotton with bearable pain of body parts.

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Need of Mechanized Interventions in Selected Farm Operations in Finger Millet Cultivation in Tribal Hill Areas of Odisha

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ABSTRACT

Millet is one of the oldest human foods and is important food for sustaining tribal population in Koraput region of Odisha. The declining trends indicate the reduction in millet production in these regions as well. One of the main reasons for less popularity of finger millet is that they are labour intensive and require difficult post-harvest operations. In comparison to other major cereals, it requires high labour input mainly during transplanting, weeding, harvesting, threshing and grinding. For present study, two ragi producing tribal villages from hill tracts of Koraput district were selected randomly. Out of the selected villages, thirty women involved in ragi production were selected and interviewed for ascertaining the gender differentials in ragi cultivation and drudgery experiences. Experimental data was collected for 12 farm women in the age group of 30-45 years involved in ragi cultivation for five years. Need for technological and educational interventions is emphasised.

Keywords: Discomfort, Drudgery, Energy expenditure, Ergonomics, Manual threshing

INTRODUCTION

Small millets have consistently been an important and nutritious part of the diets of small-scale farmers and indigenous groups. Millet is one of the oldest human foods and is important food for sustaining tribal population in Koraput region of Odisha. Koraput district is a hilly region of 8807 square kilometres located in the southwest part of Odisha State at the northern end of the Eastern Ghats range. Ragi, a staple food grain for the rural population of Koraput District, has been cultivated here for thousands of years. Ragi is cultivated on 74,300 hectare, another 24.7 per cent after Paddy. But slowly the trend shows decrease in ragi production in this area. The declining trends indicate the reduction in millet production in these regions as well. One of the main reasons for less popularity of finger millet is that they are labour intensive and require difficult post-harvest operations. In comparison to other major cereals, it requires high labour input mainly during transplanting, weeding, harvesting, threshing and grinding. This increases the workload of farmers, especially women, throughout the whole process of cultivation and preparation of finger millet food items. Even many farmers are either declining or leaving the production of finger millet because of the drudgery experienced in the whole process. The other reason is technological negligence these millets face. Nutritious millets are neglected in all respects including technology development for grain processing. There is no efficient technology for processing these grains at village level, despite India producing about two million tons of these grains. Such lack of technology has been forcing the dependence on traditional methods of grain processing, which are tedious, time consuming and cause of drudgery for women. The small seed size also makes processing of the crop difficult and time consuming. The drudgery faced by the farmers and the returns on investment are among the major constraints for declined interest towards finger millet farming.

Against this backdrop, the study on assessment of drudgery in finger millet post-harvest operations is taken up. The study intended to study: i) the role of women in finger millet cultivation activities, ii) to assess the drudgery involved in finger millet production, and iii) to carry out physiological and biomechanical evaluation of finger millet production activities. In the present study, field visits were

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made and information was collected in participatory mode, to assess the drudgery involved in finger millet production, which is a major cause for disenchantment of farmers from this pro-poor, pro-nutrition crop.

MATERIALS AND METHODS

Selection of subjects: For present study, two ragi producing tribal villages from hill tracts of Koraput district namely *Gheuria Guda* and *Kandul Guda* were selected randomly. Out of the selected villages, thirty women involved in ragi production were selected and interviewed for ascertaining the gender differentials in ragi cultivation and drudgery experiences. A total of 12 farm women in the age group of 30-45 years selected randomly for experimental data. Various tools and techniques were used for taking measurements and recording responses.

Recording of physiological parameters: Finger millet threshing, which was perceived as most drudgery prone activity by tribal women, was further evaluated on the basis of physiological parameters *viz.* Heart rate and energy expenditure. Before the start of each part of the selected activity, the resting heart rate of the respondent per minute for five minute was recorded. Then the heart rate at the interval of 30 minute while carrying out the activity was also recorded. Immediately after the completion of the activity, respondents were made to sit in relaxed position and recovery heart rate was recorded for 5 minutes at an interval of 1 minute each (or till the value reached resting value). Heart rate was measured by using Polar heart rate monitor (RS 800). The energy expenditure per minute was estimated from heart rate and the classification of work load was done as per Varghese *et al.* (1994).

Energy Expenditure (kj/min) = 0.159 x Average Heart rate (beats/min.) – 8.72

Recording of psycho-physical parameters: Rated perceived exertion is subjective expression of feeling of respondents towards light/heavy work being undertaken by them. It is based on physical sensations a person experiences during physical activity. Although it is a subjective measure, a person's exertion rating may provide a fairly good estimate of the actual heart rate during physical activity. In this study, a modified 5-point scale of perceived exertion was developed by Varghese *et al.* (1996) was used to calculate mean scores of physical fatigue.

Recording of biomechanical parameters: A pen and paper technique termed as Rapid Entire Body Assessment (REBA) was used to assess biomechanical stress involved in ragi threshing activity. This tool uses a systematic process to evaluate whole body postural musculo-skeletal disorder (MSD) and ergonomic design risks associated with job tasks. A single page form is used to evaluate required body posture, forceful exertions, type of movement or action, repetition, and coupling. A score is assigned for each of the following body regions: wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk.

RESULTS AND DISCUSSION

Gender roles in finger millet production: Focused group discussions were held with women farmers on their participation in finger millet cultivation and post production activities (Plate 1). In Odisha, major activities performed by tribal farmwomen in finger millet cultivation were seed management (83.33%), cleaning the field (63.33%), weeding (86.67%), harvesting (80%), bringing crop to home (93.33%), threshing (63.33%), winnowing (83.33%), cleaning the grain (100%), storage (60%) and pounding/ taking to mill (100%). A benchmark study conducted in selected villages of Odisha by IDRC (2013) revealed that women participate in over 60 per cent of the activity related to production and postharvest crop handling in small millets. About sixty per cent farm women were involved in selling the produce either from farm gate or to middlemen. The post-production activities were done manually like harvesting done manually with traditional sickle and threshing being done in open fields on earthen ground with wooden log.

Plate 1: Focused group discussions with a section of farmwomen of Koraput

Finger millet post-production activities performed in traditional cultivation: Harvesting includes harvesting, transporting, staking and drying as sub-activities. The harvesting of finger millet crop takes place mainly during October to November in Odisha. After crop maturity, the matured panicles (ear heads) alongwith stalk are collected by cutting with the help of traditional sickle. The harvested panicles are gathered in a container, such as bamboo baskets (*tokri)* or polyethene bags, before heaping them in a convenient place. *Bhadi,* a special type of wooden structure, is used for staking stalk bundles near threshing yard. The threshing ground is prepared by applying cow dung slurry on the ground. When dried, the panicles are kept on ground and beaten with wooden logs in continuous fashion. The threshed grain is collected and sieved and then stored. Storage is done by keeping the produce over fireplace. Threshing is done in open fields on earthen ground leading to high levels of contamination with foreign matter composed of stones, soil and plant matter (Plate 2).

Hardship involved in traditional finger millet post production activities: The respondents were asked to rate the difficulty experienced in carrying out post production activities in finger millet cultivation as extremely difficult (3), moderately difficult (2) and easy (1). The weighted mean sores were calculated for each activity and ranks were assigned as per the difficulty perceived. Of all the post production activities, threshing was perceived as the most difficult task followed by winnowing, harvesting and pounding. Sreenatha (2010) also estimated that harvesting and threshing of crops consume about one-third of the total effort requirement of the production system. A study by Budihal (2007) opined that among the post-harvest activities, majority of the female labourers reported bundling and threshing activities as most difficult (51.52%, and 63.33% respectively), whereas, winnowing was expressed as difficult by 66.07 per cent, and most difficult by 33.93 per cent.

Plate 2: Sieving and winnowing of finger millet

Being ranked as the most difficult to perform activity (Table 1), ragi threshing was analysed further for drudgery assessment. A job is considered highly repetitive if the cycle time is 30 seconds or less. In threshing, it was recorded that women have to beat the finger millet panicles about 25 times in each minute with heavy wooden log.

Musculo-skeletal discomfort while threshing finger millet: Work related muscular stresses perceived by respondents while carrying out threshing activity were recorded by body map technique (Corlette and Bishop, 1976). The mean score of the pain felt by the respondents in threshing of ragi by traditional method was highest in the upper arm (7.26) followed by lower back (7.2), mid back (6.13) and shoulder (5.73). The pain and discomfort in legs was highest, whereas discomfort in buttock, thighs and upper back was comparatively low (Plate 3). This revealed that the workers suffered from pain and discomfort more in upper arm due to manual beating for a long duration, which also caused musculo-skeletal discomfort. The discomfort in lower back and shoulders were due to blending postures adopted by them at work place. In line with the fact documented by Miranda et al. (2012) women are reporting high perceived pain in various body alignments including low muscle mass and low bone mineral density. Further West Gaurd and Aaras (1985);

Table 1: Difficulty perceived in post-production activities of Finger millet cultivation (N=30)

S.No.	Activity	Extremely difficult (3)	Moderately difficult (2)	Easy (1)	Difficulty score	Rank
1.	Harvesting	23(77)	4(23)	3(10)	2.6	III
2.	Threshing	30 (100)	0(0)	0(0)	3.0	I
3.	Sieving/winnowing	26 (87)	3(13)	1(0)	2.8	II
4.	Pounding/Grinding	10(33)	1(20)	5(17)	1.1	IV

*Figure in parenthesis shows percentage

Plate 3: Traditional threshing of finger millet with wooden logs

Keyserling *et al.* (1988); Ryan (1989) and Burdorf *et al.* (1992) supported the above said facts by stating that poor body posture was the major cause of musculoskeletal disorders.

To study the psycho-physical aspect of drudgery in form of the subject's perception of exertion, they were asked to give ratings on a 10 point scale after completion of task. It was found that the mean rating of perceived exertion found to be 8.67 which further depicts that the task of threshing is perceived as heavy and very hard to carry activity by the respondents (Borg 1982).

Physiological response of subjects performing threshing activity: Heart rate of the subjects while carrying out threshing activity was used to assess drudgery involved as heart rate is a major parameter in quantification of drudgery (Astrand and Rodahl, 1977). Cardio vascular responses such as heart rate and energy expenditure with respect to working on existing working condition have been depicted in Table 2.

Table 2: Heart rate and energy expenditure while threshing finger millet

Subject	HR Beats/min (Working)	HR Beats/min (Rest)	HR Beats/min (Recovery)	EER KJ/min
1.	141.00	101	103	13.70
2.	153.90	98	101	15.75
3.	141.80	94	98	13.83
4.	137.82	97.16	96.3	13.19
5.	141.43	101	102	13.77
6.	134.41	77	81	12.65
7.	126.90	98	92.6	11.46
8.	122.12	86.3	85.37	10.70
9.	120.00	89	95.16	10.36
10.	114.23	99	110.2	9.44
Mean	133.36	95.046	96.46	12.48

The drudgery involved in finger millet threshing was quantified by taking heart rate measurements by polar heart rate monitor and calculating energy expenditure. A job is considered highly repetitive if the cycle time is 30 seconds or less (Siegfried, 2002). High task repetition, when combined with other risk factors such as high force and/or awkward postures, can contribute to the formation of MSD. In threshing, it was recorded that women have to beat the finger millet panicles 25 times in each minute with heavy wooden plank. During this, she adopts bending and squatting posture repetitively. The women did not use any tarpaulin or sheet on the ground while threshing which increases the contaminants and foreign substances in the grain, thus adding to drudgery in winnowing and cleaning grains. The drudgery is further accentuated with small husk particles released while beating which may cause respiratory problems.

The average working heart rate for finger millet threshing activity was found to be 133 beats per minute, with peak heart rate while working was observed to be 154 beats per minute. Total cardiac cost of work and physiological cost of work for finger millet threshing activity was found to be 1673 and 56 beats per minute, respectively. The average energy expenditure was found to be 12.48 kj/min thus classifying the activity as heavy one (Varghese *et al.,* 1994). The results are in concordance with the data on drudgery in ragi threshing in hills of Uttarakhand which also classifies the activity as heavy (Joshi *et al.,* 2014).

Analysis of working posture while performing ragi threshing activity: Ragi threshing activity performed by the hill tribe farming women were analysed with Rapid Entire Body Assessment (REBA) to determine the postural load and to categorize the potential harm involved due to the postures adopted while carrying out the activity. As evident from Table 3, most of the work postures adopted during ragi threshing involve sustained bending in association with repetitive movements. Therefore, biomechanically such work is highly detrimental with possible lead towards spinal cord and other MSD related injuries. In Phase I, while beating the panicles, the knees were found bent with bent back and abducted wrist. The risk level for this subtask was found to be very high indicating that there is urgent and immediate need to find

Table 3: Analysis of working posture with REBA method during finger millet threshing

Activity Threshing	Photograph	Posture adopted	REBA score	Risk level	Action Category
Phase I: Beating panicles with wooden log		Bent back, both knees bent, both arms below shoulder level, repetitive motions, wrist abducted.	11	Very High	Necessary urgent-Work must cease until a safer solution can be found.
Phase II: Collecting ragi grains with broom		Bent back, arms below shoulder level.	4	Low	Investigate further.
Phase III: Sieving of grains		Squatting, repetitive movements of hands.	6	Medium	Further consideration should be given as to how risk can be lowered.

out a safer solution to replace this activity. Further, the ragi grains are sieved for separating chaff and grains. This activity also requires sitting in squatting posture and repetitive movements of hand. This activity fell under medium risk and requiresfurther consideration to lower the MSD risk involved. The third sub-activity of sieving grains fell under Medium risk category as the worker needs to squat for a longer period accompanied with repetitive movements of hand.

As evident from Table 3, most of the work postures adopted during ragi threshing involve sustained bending in association with repetitive movements. Therefore, biomechanically such work is highly detrimental with possible lead towards spinal cord and other MSD related injuries. Impact of these MSD related injuries were confirmed by the workers.Many work tasks and cycles are repetitive in nature, and are frequently controlled by hourly or daily production targets and work processes. High task repetition, when combined with other risks factors such as high force and/or awkward postures, can contribute to the formation of MSD. REBA analysis was carried out for 15 subjects performing the threshing activity. The mean scores for overall final REBA mean score was found as 11.06 for existing working condition (Figure 1).

On comparing the score in the REBA score sheet (Table 4), it was found that there was very high risk in the working postures of the worker. Immediately change shall be brought to discontinue the in posture. Thus, change in posture soon is recommended. Majority of the women (93.33%) were observed to be in REBA action level four (AL4) which indicates high postural risk for women performing the activity in the conventionally (Figure 1). Khan and Siddique (2005) also concluded that the workers, who have to work for long hours in a particular posture should be advised to take couple of minutes rest after working for some time to reduce pressure on the spinal column.

Table 4: REBA score and associated risk level

REBA score	Action level
1	Negligible risk
2-3	Low risk change may be needed
4-7	Medium risk, further investigation, change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implements change

Source: McAtamney and Higett (1995)

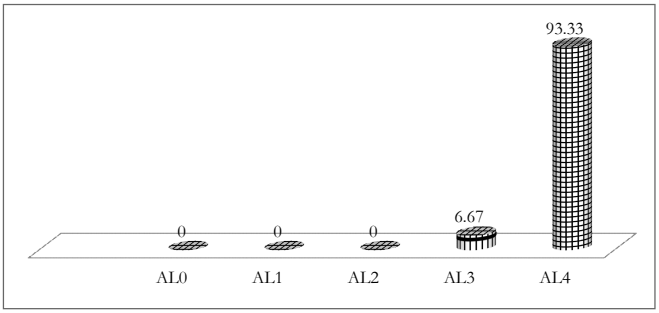

Figure 1: Risk level involved

CONCLUSION

Women manually beat the dried spikelet in scorching sun on earthen ground with big wooden logs. The repetitive nature of work with bent postures makes the activity more tedious and drudgery prone. Moreover, the work environment during threshing and winnowing is full of husk and dust particles which again is hazardous and may make women prone to respiratory problems. No usage of personal protective equipment was found. The production of small millet is higher in tribal upland areas of Koraput district therefore the post-harvest processing of these millets need to be advent with mechanization so that the time consumption, excessive physiological demand of energy and fatigue level can be minimized with reference to drudgery reduction. During various finger millet post production operations, women are suffered with high physical strain and fatigue. The repetitive nature of work with bent postures makes the activity more tedious and drudgery prone. The cardiac strain experienced in finger millet threshing labels the activity as heavy one to perform and drudgery prone. Need for technological and educational interventions like introducing low cost, labour saving drudgery reducing technology for post-harvest operations of finger millet *viz*. Ragi thresher and personal protective equipment (PPE) is emphasized.

1. The need of introducing labour saving drudgery reducing technology for post-harvest operations of finger millet *viz*. Ragi thresher and personal protective equipment (PPE) is emphasized to make these operations easier.
2. Add a short rest break to their work schedule during threshing to avoid excessive physical stress.
3. Repetition of work which causes musculoskeletal disorders should be avoided. Brief intra-work pauses to decrease fatigue in repetitive work in which the muscles can rest after expe-riencing a static load and a break after a period of continuous work.
3. Proper knowledge and education should be provided to the farmwomen for their better health and in-turn increased efficiency in the agricultural operations.

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Differential Effect of Gender and Locality on Big five Factors of Personality and Life Satisfaction among Elderly

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ABSTRACT

The present study was carried out to understand the differential effect of locality and gender on big five factors of personality and life satisfaction among elderly during 2016-17 in Dharwad taluk of Karnataka. The sample comprised of 70 elderly; 35 elderly from rural area and 35 elderly from urban area (31 were male and 39 were female) in the age of 60 or above years. The background information of the elderly was collected with the help of self-structured questionnaire. Big Five Inventory was used to identify the big five factors of personality among elderly. Life satisfaction tool was used to measure life satisfaction among elderly. The results revealed that male and female were similar in their big five factors of personality and also in their life satisfaction. Subsequently, elderly from rural area were distinctively better in big five factors of personality than urban area but elderly from urban area were distinctively better in life satisfaction than elderly from rural area.

Keywords: Agreeableness, Conscientiousness, Emotional stability, Extraversion, Life satisfaction, Openness to experience

INTRODUCTION

Personality is a dynamic and organized set of characteristics developed by an individual that uniquely influences their psychological processes and behavior in various situations. According to social scientists, personality is the sum total of behavior, attitudes, beliefs, and values that are characteristic of an individual. No two individuals have the same personalities. Each individual has his or her own way of interacting with other people and with his or her social environment. In earlier days personality was believed to be the product of heredity and that the individual was a 'chip off the old block'. Today there is ample evidence that personality pattern is the product of both heredity and environment. Our personality traits determine how we adjust to our environment and how we react in specific situations. There are several factors that significantly impact personality such as age, gender, education, socio-economic status of family, quality of interrelationships, rural and urban background. Assessment of personality is most complex and a precise assessment is essential because of its multi-factors and multidimensional nature. The big five factors of personality has predictably gained popularity in 21st century. It comprises of extraversion, agreeableness, openness to experience, conscientiousness and emotional stability. Studies have shown that these factors of personality significantly vary between male and female. Recent studies shown the positive trend of maturation and saturation of big five factors in their developmental process, such differences have been shown in various cross-cultural populations (Lehmann *et al*., 2013; Costa *et al*., 1986 and Steunenberg *et al.,* 2005). Subsequently on Indian population, there are studies that have evaluated big five factors by multiple group factor analysis in evaluating the Five-Factor Model (Lodhi *et al*., 2002). Some studies identified the differential effect of locality on personality of adolescent (Rajkumari and Hunshal, 2015). Allik *et al.* (2004) reported that personality trait structure matures and become sufficiently differentiated around age 14-15 and grows to be practically distinguishable adult personality by age of 16. Personality of elderly becomes more saturated and differentiated completely.

Life satisfaction is the sum total of perceptions of an individual towards his various aspects of life. Life satisfaction among elderly is an important concept as it

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gives us an overall view of the adjustment as well as adaptive coping ability of the individual. Life satisfaction influenced by various factors like demographic factors, socio-economic status, physical status, social support. In terms of demographic factors, gender and locality have a significant effect on individual's life satisfaction. Studies have supported the effect of gender and locality on life satisfaction of elderly. In most societies, there was gender difference found in the day to day activities, in access and control of resources and also in participation in decision making which ultimately influence the life satisfaction. In most societies women as a group have less access than men to resources, opportunities and decision- making (Kumari and Kumari, 2019). Studies also showed that gender role conflict is related to strain and well-being in a reciprocal manner (Das *et al.,* 2021). Balachandran *et al.* (2007) concluded that elderly men experience less alienation in comparison to the elderly women however, both elderly male and females do not exhibit significant differences in their life satisfaction. Women life satisfaction increases with higher number of social activities and friend circle which is not that significant predictor of life satisfaction among the males (Vera-Sanso, 2005). With regard to locality, studies has shown that the urban elderly reported better health and financial satisfaction because of good health facilities due to advanced hospitals and other urbanized sectors for reemployment and some source of earning money but semi-urban elderly neither had proper health nor re-employment facilities were available neither the familial and social bonding of traditional times due to urbanization nor they have traditional occupation as farming and children have fled to nearby city for earning leaving them alone and isolated (Priyanka and Mishra, 2013).There are few studies on personality and life satisfaction in relation to gender and locality, hence, the present study was undertaken with the objectives to identify the role of gender and rural and urban background in the development of big five factors of personality and life satisfaction among elderly.

MATERIALS AND METHODS

The study was conducted in Dharwad taluk of Dharwad district in Karnataka. The sample comprised of 70 elderly aged of 60 or above, among which 35 elderly selected from rural and 35 elderly selected from urban areas of Dharwad randomly. The schedule consisted of back ground information, Big five factors personality inventory (John *et al*., 1991) and Life satisfaction tool (Ram Murthy, 1978). The data were subjected to frequency, percentages, chi- square analysis was used to measure association between levels of five factors of personality and life satisfaction of elderly from rural and urban areas and t-test was applied to make comparison between groups.

RESULTS AND DISCUSSION

Role of gender in big five factors of personality among elderly: The results of (Table 1) revealed that, around 52 per cent and 48 per cent of male elderly were average and high on their extraversion, respectively, but around 49 per cent and 51 per cent of the female elderly were average and high in their extraversion, respectively. The male and female elderly of Dharwad were almost similar in their extraversion.

In case of agreeableness, around 26 per cent and 74 per cent of male elderly were average and high on their agreeableness, respectively, but around 16 per cent and 84 per cent of the elderly from female of Dharwad were average and high in their agreeableness, respectively. The male and female elderly of Dharwad were almost similar in their agreeableness. In case of openness to experience, around 58 per cent and 42 per cent of male elderly were average and high level in openness to experience, respectively, whereas 61 per cent and 38 per cent of female elderly were average and high in openness to experience, respectively. The male and female elderly of Dharwad were almost similar in their openness to experience. In case of conscientiousness, about 13 per cent of the male elderly were average and 87 per cent were high in conscientiousness, whereas nearly 23 per cent and 77 per cent of female elderly were average and high level in conscientiousness, respectively. The male and female elderly were almost similar in their conscientiousness.

With respect to emotional stability, around 52 per cent and 48 per cent of male elderly were in average and high in emotional stability, respectively; whereas 54 per cent and 46 per cent of female elderly were average and high in emotional stability, respectively. The male and female elderly were almost similar in their emotional stability.

This reason may be due to that male and female elderly were more or less equal in their all personality factors and there was no gender difference regarding in their personality as both male and female were getting equal exposure to society and carried same responsibility for their family life.

This result of this study is in line with Marsh *et al.* (2009), they found that men were higher than women on

Table 1: Role of gender in big five factors of personality among elderly (N=70)

Gender	Big five factors of personality				
	Average	High	χ^2	Mean ±SD	t-value
Extraversion					
Male	16(51.60)	15(48.40)	0.06^{NS}	32.58 ± 4.62	0.24^{NS}
Female	19(48.70)	20(51.30)		32.33 ± 3.94	
Agreeableness					
Male	10(25.60)	29(74.40)	0.93^{NS}	36.16 ± 3.47	0.48^{NS}
Female	5(16.10)	26(83.90)		35.66 ± 4.85	
Openness to experience					
Male	18(58.10)	13(41.90)	0.08^{NS}	66.35 ± 6.41	0.58^{NS}
Female	24(61.50)	15(38.50)		65.51 ± 5.63	
Conscientiousness					
Male	4(12.90)	27(87.10)	1.18^{NS}	36.12 ± 4.18	0.79^{NS}
Female	9(23.10)	30(76.90)		35.35 ± 3.91	
Emotional stability					
Male	16(51.60)	15(48.40)	0.03^{NS}	32.67 ± 4.56	0.45^{NS}
Female	21(53.80)	18(46.20)		32.23 ± 3.72	

Figures in parenthesis indicate percentages, NS- Not significant

Table 2: Role of locality in big five factors of personality among rural and urban elderly (N=70)

Locality	Big five factors of personality					
	Low	Average	High	χ^2	Mean±SD	t-value
Extraversion						
Rural	-	9(25.70)	26(74.30)	16.51***	34.14±3.67	3.65**
Urban	-	26(74.30)	9(25.70)		30.74±4.09	
Agreeableness						
Rural	-	4(11.40)	31(88.60)	4.16*	36.82±3.77	1.87^{NS}
Urban	-	11(31.40)	24(68.60)		34.94±4.58	
Openness to experience						
Rural	19(45.20)	23(54.80)	-	0.95^{NS}	66.77±5.96	1.25^{NS}
Urban	16(57.10)	12(42.90)	-		65.00±5.91	
Conscientiousness						
Rural	-	-	35(100.00)	15.96***	37.05±2.57	2.98**
Urban	-	13(37.10)	22(62.90)		34.34±4.73	
Emotional stability						
Rural	-	10(28.60)	25(71.40)	16.57***	33.74±3.75	2.82**
Urban	-	27(77.10)	8(22.90)		31.11±4.04	

Figures in parenthesis indicate percentages, *significant at 0.05 level of significance, **significance at 0.01 level of significant, ***significance at 0.001 level of significant, NS- Not significant

openness to experience but in other personality traits there was no significant difference between gender.

Role of locality in big five factors of personality among rural and urban elderly: The results of (Table 2) revealed that; about 26 per cent and 74 per cent of elderly were high and average in extraversion respectively. There was a difference in elderly from rural and urban area in their extraversion. Urban elderly were better than rural elderly in extraversion. The reason may be due to urban

elderly people were more exposed to outer society than rural elderly and feel confident to deal with others.

In case of agreeableness, around 11 per cent and 89 per cent of elderly were from rural area of Dharwad were average and high on their agreeableness respectively but around 31 per cent and 69 per cent of the elderly from urban area were average and high in their agreeableness respectively. The elderly from rural and urban area were more or less similar in their agreeableness. This may be due to that both group elderly were equal friendly and compassionate and cooperative with others.

In case of openness to experience, around 45 per cent and 55 per cent of rural elderly were low and average in openness to experience respectively, whereas around 57 per cent and 43 per cent of urban elderly were low and average in openness to experience, respectively. The elderly from rural and urban area are more or less similar in their openness to experience. The reason behind this may be due to that both rural and urban elderly were curious to know new things and interested to being with people and talking with them.

In case of conscientiousness, all of the rural elderly were high in conscientiousness, whereas around 37 per cent and 63 per cent of urban elderly were average and high in conscientiousness, respectively. There was difference between rural and urban elderly on their conscientiousness but rural elderly were better than urban elderly. This may be due to that the rural elderly were highly organized in their work and more dutiful in their life process because of their restricted life pattern and their regularity.

In case of emotional stability, around 29 per cent and 71 per cent of rural elderly were low and average in emotional stability respectively; whereas about 77 per cent and 23 per cent of urban elderly were average and high in emotional stability respectively. There was difference between rural and urban elderly on their emotional stability and rural elderly were better than urban elderly. This reason may be due that the rural elderly were getting more emotional peace to being with friends and family where in urban area elderly were lonelier on personal relations between the people living around.

This result of this study is in line with Lockenhoff *et al.* (2009), he reported that there was a significant difference in big five personality traits like extraversion, conscientiousness, openness to experience and emotional stability between rural and urban elderly.

Role of gender in life satisfaction among elderly: The result (Table 3) revealed that, around 42 per cent and 58 per cent of male elderly were average and high in their life satisfaction respectively, but around 5 per cent, 46 per cent and 49 per cent of the female elderly were low, average and high in their life satisfaction respectively. This result signified that male and female elderly were almost similar in their life satisfaction. The reason may be due to that male and female elderly were more or less equal in their life and had equal expectations and feelings and same problems. So, there was not much differences in life satisfaction between them.

Role of locality in life satisfaction among rural and urban elderly: The result in (Table 4) revealed that, around

Table 3: Role of gender in life satisfaction among elderly (N=70)

Gender	Levels of life satisfaction					
	Low	Medium	High	χ^2	Mean ±SD	t-value
Male	-	13(41.90)	18(58.10)	1.94^{NS}	30.19 ± 3.22	0.41^{NS}
Female	2(5.10)	18(46.20)	19(48.70)		29.82 ± 4.10	

Figures in parenthesis indicate percentages, NS- Not significant

Table 4: Role of locality in life satisfaction among rural and urban elderly (N=70)

Locality	Levels of Life Satisfaction					
	Low	Medium	High	χ^2	Mean ± SD	t-value
Rural	1(2.85)	8(22.86)	26(74.29)	13.34**	28.14 ± 3.27	4.74***
Urban	1(2.85)	23(65.71)	11(31.44)		31.82 ± 3.22	

Figures in parenthesis indicate percentage, **significance at 0.01 level of significant, ***significance at 0.001 level of significant, NS- Not significant

3 per cent, 23 per cent and 74 per cent of elderly were from rural area were low, medium and high in their life satisfaction, respectively but around 3 per cent, 66 per cent and 31 per cent of the elderly from urban area were low, medium and high in their life satisfaction, respectively. The results signified that elderly from rural and urban areas were differ in their life satisfaction and urban elderly were high in their life satisfaction than rural elderly.

The reason may be due to that the urban elderly can more avail for basic health facilities and entertainment source than rural elderly of Dharwad. This result of this study is in line with Martin (2015) found that the elderly who were living in urban area was found higher levels of life satisfaction than rural elders because of greater access to basic social and medical service.

CONCLUSION

The present study indicated that male and female were similar in their big five factors of personality and also in their life satisfaction. Subsequently, elderly from rural area were distinctively better in big five factors of personality than urban area but elderly from urban area were distinctively better in life satisfaction than elderly from rural area. Developing all personality traits from early stage of life and providing basic facilities and developing proper designing of the welfare programs, policies and regulations for elderly are very important since it is considered as a critical psychological factors for enhancing life satisfaction among elderly and enhance them equally both in urban and rural areas.

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Zone wise Knowledge Disparities about Water Pollution and its Mitigation Strategies Among Farming Families of Punjab, India

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ABSTRACT

Water is one of our most important natural resources. More than 2.2 million people died every year primarily in developing countries due to water borne diseases. Polluted water can cause many diseases like cholera, typhoid, diarrhoea etc. The present study entitled 'Zone wise Knowledge Disparities about Water Pollution and its Mitigation Strategies among Farming Families of Punjab, India' was conducted with the objectives to assess the knowledge level of farming families about causes, effects and mitigation practices for water pollution and to study the application of mitigation strategies by them. Data was collected from five agro-climatic zones i.e. central plain zone, sub-mountain undulating zone, undulating plain zone, western plain zone and western zone of Punjab state. From each of the selected agro climatic zone, fifteen farm families were selected randomly, the male and female heads of the family were chosen for responses, thus, in total 150 respondents were randomly selected. Data was collected using pre-tested structured interview schedule and a knowledge test. The data was analyzed using frequencies and percentages. The findings of the study revealed that most of the respondents had medium level of knowledge about causes and effects of water pollution as well majority of the respondents across all agro-climatic zones had medium level of knowledge for mitigation of water pollution. It is further found that zone wise, most of the respondents of agro-climatic zone IV (Western plain zone) had low level of knowledge for mitigation of water pollution. Comparatively, zone I (Sub-mountain undulating zone) and zone V (Western zone) were following maximum strategies to reduce water pollution. Other zones needed to be given more attention while imparting knowledge about water pollution. It is suggested that people could be sensitized to take serious action to mitigate the effects of water pollution using innovative behaviour change communication strategies.

Keywords: Agro-climatic zones, Farming families, Knowledge level, Mitigation, Water pollution

INTRODUCTION

Water is one of our most important natural resources and estimates suggest that nearly 1.5 billion people do not have reach to potable water. More than 2.2 million people died every year primarily in developing countries due to water borne diseases (Anonymous, 2020a). Polluted water can cause many diseases like cholera, typhoid, diarrhea, stomach and intestinal infection, skin diseases, eye infection, weakening of teeth on human health. Discharge from sewage treatment work, oil spoilage and industrial wastes pollute water by adding hazardous pollutants from agricultural and industrial sources. Biphenyl A (BPA) is one of the common toxic chemicals which frequently thrown into the water bodies from municipal waste like water treatments plants; however in present time excess use of chemicals fertilizers, insecticides pesticides etc. in agricultural crops also affects the quality of water. Pesticides have contaminated the drinking water so badly that it may not be incorrect to say that "PUNJAB IS BECOMING HOTSPOT FOR CANCER IN INDIA". Premature yellowish teeth, constipation, diarrhea, greying of hair, hair fall, typhoid, joint pain, are the major diseases existing in the region.These are due to the poor quality of drinking water which is impacting human health (Singh and Singh 2013).

There is a need to create awareness on the problems arising due to faulty agricultural and household practices, related consequences and to suggest means to reduce the

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stress on environment. Anbalagan and Shanthi (2015) in their study revealed that practical oriented teachings as well as development of sustainable practices like tree plantation, vermin compost of wastes, safe and clean drinking water are required to be promoted to save our environment. It is recommended that awareness about pollution hazard and knowledge of mitigation strategies will surely improve our environment. Thus, the present study was conducted with the objective to assess the knowledge level of respondents regarding causes, effects and mitigation practices for water pollution and to study the application of mitigation strategies by the respondents. Knowledge about water pollution and its mitigation is the only way to minimize the causes of water pollution and to reduce the harmful impact on environment in general and health in particular. Proper management of the environment is the only way to ensure continuous and sustained development of the society.

MATERIALS AND METHODS

The present study was conducted in all five Agro-Climatic Zones of Punjab state with the purpose to have representative sample of all farming families of Punjab. The five agro-climatic zones of Punjab are central plain zone, sub-mountain undulating zone, undulating plain zone, western plain zone and western zone. From each of the selected agro climatic zone, fifteen farm families were selected randomly, the male and female heads of the family were chosen for responses, thus, in total 150 respondents were randomly selected. Data was collected using pre-tested structured interview schedule. A knowledge test was also developed and pre tested for its reliability and validity. Knowledge level was studied with the help of self-developed and pre-tested knowledge test. Based on the scores gained by the respondents, the knowledge level was measured separately for knowledge of causes, effects and mitigation strategies of water pollution. Knowledge level was categorised into low, medium and high level using category interval method. Overall knowledge level of respondents was also calculated. The data was analyzed using Statistical Package for Social Sciences (SPSS) software.

RESULT AND DISCUSSION

Table 1 discusses the knowledge of respondents about causes of water pollution across all agro-climatic zones of Punjab. Almost all the respondents with the percentage of 99.3 per cent from five agro-climatic zones of Punjab knew that throwing religious material in river causes water pollution. Use of dish wash for cleaning utensils (92.6%) and excessive use of fertilizers/ pesticides/ herbicides (91.3) also were the reasons of water pollution as perceived by them. Most of the respondents knew that improper disposal of computers and laptops as e-waste (88.0%) and use of bad quality water for irrigation (84.0%) also cause water pollution. Majority of the respondents from all five agro-climatic zones of Punjab with the same percentage (86.0%) knew that increase in fast-food culture/ disposal packaging material and throwing used phenyl water after mopping floor causes water pollution. It can be concluded that most of the respondents had good amount of knowledge about causes of water pollution. The findings are in line with results reported by Obafemi *et al.* (2012).

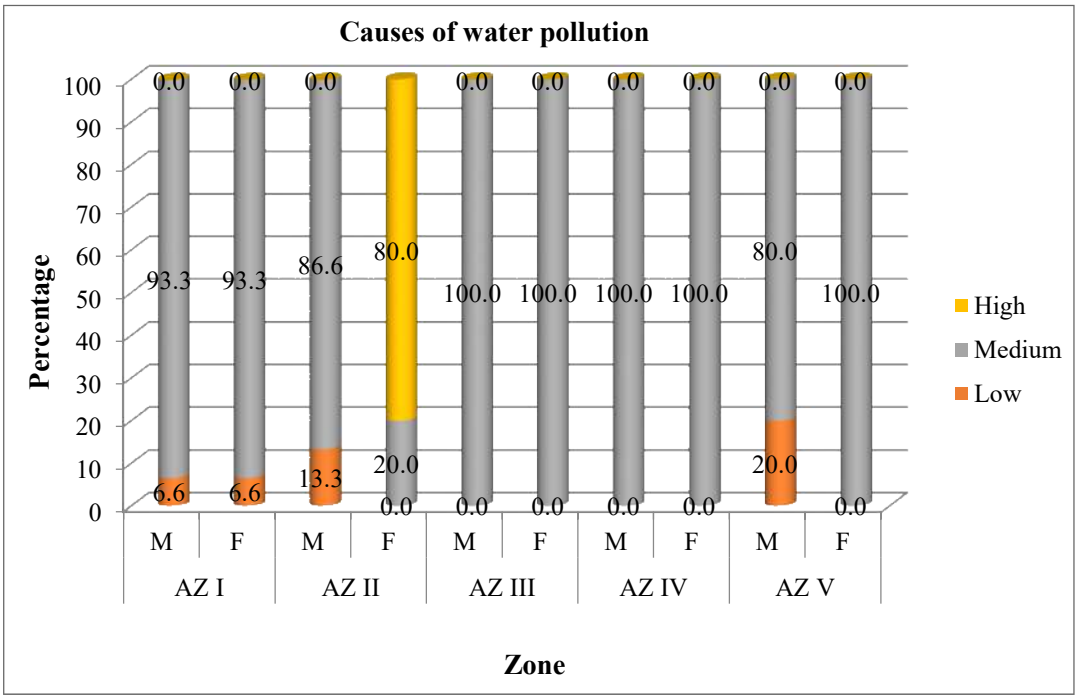
Table 1: Knowledge of respondents regarding causes of water pollution (n=150)

Causes	Frequency	Percentage
Increase in fast-food culture/disposal packaging material	129	86.0
Use of bad quality water for irrigation	126	84.0
Excessive use of fertilizers/pesticides/ herbicides	137	91.3
Throwing religious material in river	149	99.3
Throwing used phenyl water after mopping floor	129	86.0
Use of dish wash for cleaning utensils	139	92.6
Improper disposal of computers and laptops	132	88.0

It can further be stated that most of the male (92.0%) and female respondents (82.6%) across five agro-climatic zones had medium level of knowledge about causes of water pollution. It was further reported that cent per cent male respondents from agro-climatic zone III (Central plain zone) and IV (Western plain zone) followed by 93.3 per cent from agro-climatic zone I, 86.6 per cent from agro-climatic zone II and 80.0 per cent from agro-climatic zone V had medium level of knowledge regarding causes of water pollution. Similarly, cent per cent female respondents of agro-climatic zone III, IV and V followed by 93.3 per cent from agro-climatic zone I had medium level of knowledge regarding causes of water pollution.

Figure 1 while comparing agro-climatic zones shows that majority of the respondents of all agro-climatic zone

Figure 1: Zone wise knowledge disparities about causes of water pollution



had medium level of knowledge except agro-climatic zone II (Undulating plain zone) where most of the female respondents had high level of knowledge (80.0%) about causes of water pollution.

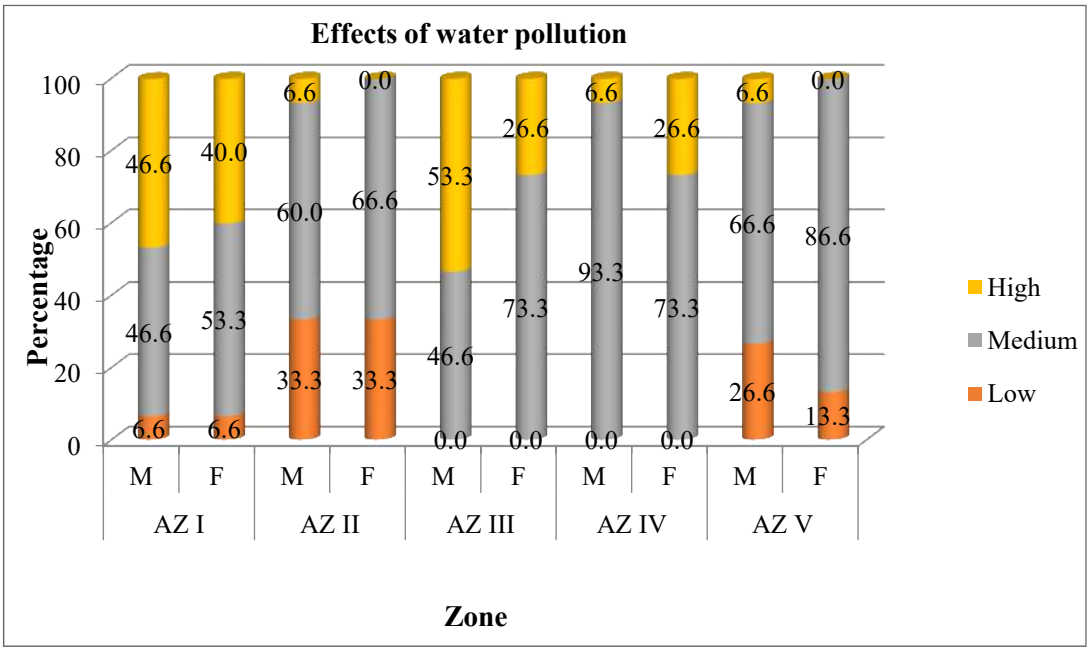
It is revealed that almost all the respondents (99.3%) from all five agro-climatic zones of Punjab knew that disease like constipation is caused by water pollution. Same percentage of respondents i.e. 97.3 per cent knew that diarrhoea; and loss of soil organic matter are the other effects of water pollution on health as well as on enviornment. Most of the respondents also had knowledge about effects of water polltion on environment such as water pollution causes flood like situation (94.6%) and increase water hycinth (91.3%). Most of the respondents also had knowledge of effects on human health like typhoid (89.3%), nausea (88.0%), mental retardation (86.6%), skin rash (85.3%) and cholera (84.0%). Majority of the respondents knew that allergies (78.0%) and infertility (60.0%) are the other effects of water pollution (Table 2).

It was further revealed that majority of the male (62.6%) and female (64.0%) respondents had medium level of knowledge about effects of water pollution. Data revealed that male respondents of agro-climatic zone IV (93.3%) followed by agro-climatic zone V (66.6%), agro-climatic zone II (60.0%) and agro-climatic zone I and III (46.6%) had medium level of knowledge regarding effects of water pollution. In case of female respondents of agro-climatic zone V (86.6%) followed by agro-climatic zone III and IV (73.3%), agro-climatic zone II (66.6%) and agro-climatic zone I (53.3%) had medium level of knowledge regarding effects of water pollution. While comparing agro-climatic zones, it was revealed that more than half of the male respondents from agro-climatic zone III (Central plain zone) had high level of knowledge followed by 46.6 per cent male respondents and 40.0 per cent female respondents from agro-climatic zone I had high level of knowledge.

Table 2: Knowledge of respondents regarding effects of water pollution (n=150)

Effects	Frequency	Percentage
Nausea	132	88.0
Diarrhea	146	97.3
Skin rash	128	85.3
Allergies	117	78.0
Typhoid	134	89.3
Constipation	149	99.3
Tonsils	136	90.6
Cholera	126	84.0
Infertility	90	60.0
Mental retardation	130	86.6
Loss of soil organic matter	146	97.3
Create flood like situation	142	94.6
Increase water hycinth	137	91.3

Figure 2: Zone wise knowledge disparities about effects of water pollution



It was further observed that nearly one-third of the respondents (33.3%) from agro-climatic zone II and 26.6 per cent male respondents from agro-climatic zone V had low level of knowledge (Fig 2). Singh *et al.* (2011) reported highest prevalence of water borne diseases in agro-climatic zone II (Undulating plain zone) in Punjab. The study conducted by Mittal *et al.* (2013) also reported maximum use of pesticide by the farmers of agro-climatic zone V which is the one of the major causes of water pollution. These findings provide evidence of low level of knowledge in agro-climatic zones II and V.

It can be concluded from Figure 2 that majority of the respondents across all agro-climatic zone had medium level of knowledge for effects of water pollution. The findings are in line with the results of the study conducted by Gopal *et al.* (2014) and Kumar (2014).

Data presented in Table 3 shows the knowledge of respondents about mitigation strategies for water pollution. It was found that almost 99.3 per cent of the respondents across all five agro-climatic zones knew that use of pipes for irrigating crops is a good strategy to reduce water pollution.

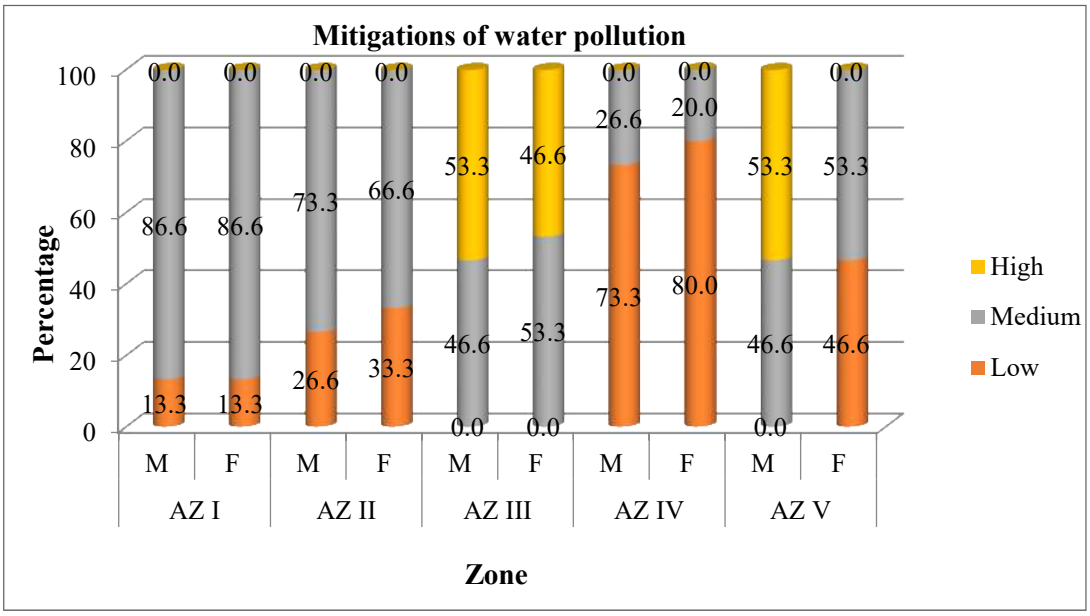
Most of the respondents with the same percentage of 98.6 knew that avoiding the use of infected water for irrigation and controlling the use of plastics can help in reducing the water pollution. It was followed by 90.0 per cent respondents who had knowledge that separating disposal of organic waste from synthetic waste can help reducing water pollution. The majority of the respondents with the percentage of 83.3 per cent knew about use of paper and cloth bags instead of plastic bags followed by use of clay idols in religious celebration (80.0%) and recycling of plastic (79.3%) are the other mitigation strategies to combat water pollution. It can be concluded that most of the respondents had excellent knowledge about mitigation of water pollution. The findings are in line with Nhemachena and Hassan (2017) and Shobeiri *et al.* (2007).

It can further be stated that more than half of the respondents (56.0%) had medium level of knowledge about mitigation of water pollution. It was reported that male respondents of agro-climatic zone I (86.6%) followed

Table 3: Knowledge of respondents regarding mitigation of water pollution (n=150)

Mitigation	Frequency	Percentage
Avoid infected water for irrigation	148	98.6
Recycling of plastic	119	79.3
Use of paper and cloth bags instead of plastic bags	125	83.3
Control the use of plastics	148	98.6
Use of clay idols in religious celebration	120	80.0
Separate disposal of organic waste from synthetic waste	135	90.0
Use pipes for irrigating crops	149	99.3

Figure 3: Zone wise knowledge disparities about mitigations of water pollution



by agro-climatic zone II (73.3%), agro-climatic zone III and V (46.6%) and agro-climatic zone IV (26.6%) had medium level of knowledge about mitigation of water pollution. Similarly, in females from agro-climatic zone I (86.6%) followed by agro-climatic zone II (66.6%), agro-climatic zone III and V (53.3%) and agro-climatic zone IV (20.0%) were found to have medium level of knowledge about mitigation of water pollution. While comparing agro-climatic zones, it was observed that more than half of the respondents of all agro-climatic zones had medium level of knowledge except agro-climatic zone IV (Western plain zone) where male (73.3%) and female (80.0%) respondents had low level of knowledge about mitigation of water pollution. Similarly, 46.6 per cent female respondents from agro-climatic zone V and 26.6 per cent male, 33.3 per cent female respondents from agro-climatic zone II had low level of knowledge (Figure 3).

Table 4 concludes that majority of the respondents across all agro-climatic zones had medium level of knowledge about causes, effects and mitigation of water pollution. Zone wise, most of the respondents of agro-climatic zone IV (Western plain zone) had low level of knowledge for mitigation of water pollution. The findings are in line with Nhemachena and Hassan (2017) and Shobeiri *et al.* (2007). Thus, it is suggested that more emphasis is required to provide knowledge of mitigation of water pollution through extension activities.

Most of the farm households (86.6%) of the agro-climatic zone III (Central plain zone) used pipes for irrigating crops followed by 60.0 per cent households from agro-climatic zone II, 53.3 per cent from agro-climatic zone V, 40.0 per cent from agro-climatic zone I and IV. Using pipes for irrigating crops is one way of reducing the possibility of polluting the ground water as well as soil (Table 5). Most of the farm households (93.3%) from agro-climatic zone V and agro-climatic zone III (46.6%) were using cloth bags instead of plastic bags. It reduces the throwing of plastic bags in water that ultimately reduces water pollution. Majority of the farm households i.e. 66.6 per cent from agro-climatic zone V (Western zone) followed by 40.0 per cent from agro-climatic zone II and 6.6 per cent from agro-climatic zone I reduced the use of plastic as far as possible. Throwing unusable plastic in water also cause water pollution (Table 5). Cent per cent farm household of agro-climatic zone I (Sub-mountain undulating zone) followed by 66.6 per cent from agro-climatic zone V and 13.3 per cent from agro-climatic zone IV practised separate disposal of organic waste from synthetic waste (Table 5). In order to reduce water pollution most of the farm households (86.6%) from agro-climatic zone I (Sub-mountain undulating zone) and 46.6 per cent of agro-climatic zone II (Undulating plain zone) preferred to use clay idols during religious celebrations.

It can be concluded that although majority of the respondents had medium level of knowledge about mitigation of water pollution but the practise of mitigation strategies was not up to the mark. Comparatively, zone I (Sub-mountain undulating zone) and zone V (Western zone) were following maximum strategies to reduce water pollution. The knowledge level of respondents of these

Table 4: Zone wise knowledge disparities about causes, effects and mitigation of water pollution (n=150)

Knowledge level		Causes			Effects			Mitigation strategies		
		L	M	H	L	M	H	L	M	H
AZ I	M (n_1=15)	1(6.6)	14(93.3)	0(0.0)	1(6.6)	7(46.6)	7(46.6)	2(13.3)	13(86.6)	0(0.0)
	F (n_2=15)	1(6.6)	14(93.3)	0(0)	1(6.6)	8(53.3)	6(40.0)	2(13.3)	13(86.6)	0(0.0)
AZ II	M (n_1=15)	2(13.3)	13(86.6)	0(0.0)	5(33.3)	9(60.0)	1(6.6)	4(26.6)	11(73.3)	0(0.0)
	F (n_2=15)	0(0.0)	3(20.0)	12(80.0)	5(33.3)	10(66.6)	0(0.0)	5(33.3)	10(66.6)	0(0.0)
AZ III	M (n_1=15)	0(0.0)	15(100.0)	0(0.0)	0(0.0)	7(46.6)	8(53.3)	0(0.0)	7(46.6)	8(53.3)
	F (n_2=15)	0(0.0)	15(100.0)	0(0.0)	0(0.0)	11(73.3)	4(26.6)	0(0.0)	8(53.3)	7(46.6)
AZ IV	M (n_1=15)	0(0.0)	15(100.0)	0(0.0)	0(0.0)	14(93.3)	1(6.6)	11(73.3)	4(26.6)	0(0.0)
	F (n_2=15)	0(0.0)	15(100.0)	0(0.0)	0(0.0)	11(73.3)	4(26.6)	12(80.0)	3(20.0)	0(0.0)
AZ V	M (n_1=15)	3(20.0)	12(80.0)	0(0.0)	4(26.6)	10(66.6)	1(6.6)	0(0.0)	7(46.6)	8(53.3)
	F (n_2=15)	0(0.0)	15(100.0)	0(0.0)	2(13.3)	13(86.6)	0(0.0)	7(46.6)	8(53.3)	0(0.0)
Overall	M (n_1=75)	6(8.0)	69(92.0)	0(0.0)	10(13.3)	47(62.6)	18(24.0)	17(22.6)	42(56.0)	16(21.3)
	F (n_2=75)	7(9.3)	62(82.6)	12(16.0)	8(10.6)	48(64.0)	14(18.6)	26(34.6)	42(56.0)	7(9.3)
	Total (n=150)	7(4.6)	131(87.3)	12(8.0)	18(12.0)	95(63.3)	32(21.3)	43(28.6)	84(56.0)	23(15.3)

Score range	Causes of water pollution	Effects of water pollution	Mitigation of water pollution
Low	2-4.5	7-9	3 -6
Medium	4.6-7	9.1-11.1	6.1-9.1
High	7.1-9.5	11.2-13.1	9.2-12.3

Table 5: Application of mitigation strategies to combat water pollution by farm households (n=75)

Water pollution mitigation strategies	AZ I (n= 15)		AZ II (n= 15)		AZ III (n= 15)		AZ IV (n= 15)		AZ V (n= 15)	
	f	%	f	%	f	%	f	%	f	%
Use of pipes for irrigating crops	6	40.0	9	60.0	13	86.6	6	40.0	8	53.3
Separate disposal of organic waste from synthetic waste	15	100.0	0	0.0	0	0.0	2	13.3	10	66.6
Use of paper and cloth bags instead of plastic bags	0	0.0	0	0.0	7	46.6	0	0.0	14	93.3
Reduce the use of plastics	1	6.6	6	40.0	0	0.0	0	0.0	10	66.6
Use of clay idols in religious celebration	13	86.6	7	46.6	0	0.0	0	0.0	0	0.0

zones was also comparatively higher than other zones. The findings of the study conducted by Ishaya and Abaje (2008) and Barnard *et al.* (2009) also revealed the same trend.

CONCLUSION

The paper concludes that most of the respondents had medium level of knowledge about water pollution. They had medium level of knowledge regarding effects of water pollution. Majority of the respondents across all agro-climatic zones had medium level of knowledge for mitigation of water pollution. It is further concluded that zone wise, most of the respondents of agro-climatic zone IV (Western plain zone) had low level of knowledge for mitigation of water pollution. Majority of the respondents had medium level of knowledge about mitigation of water pollution but the practise of mitigation strategy was not up to the mark. Comparatively, zone I (Sub-mountain undulating zone) and zone V (Western zone) were following maximum strategies to reduce water pollution. These other zones need to be given more attention while imparting knowledge about water pollution. It is suggested that in extension trainings/ camps more emphasis should be given on information about effects of water pollution, so that people could be sensitized to take serious action to mitigate the effects of water pollution. Innovative behaviour change communication strategies need to be

applied to improve the practical application of knowledge gained. Based upon the findings of the present research, intervention for each agro climatic zone of Punjab can be planned.

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NGO Based Community Radio Stations: Mobilizing Community Voices in Rural Development

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ABSTRACT

Non-governmental organization (NGO) based community radio stations (CRS) have played a crucial role at microlevel by mobilizing community participation in grassroot development. The study revealed that CRS owned by NGOs were more aligned to the community needs and aspirations. On the other hand, it was also found that the NGO owned CRS regularly confronted the issues of financial sustainability and a major thrust of these radios was towards the struggle for financial assistance for survival. Their impact was found to be substantial whereas the government support was found to be negligible. Thus, it is inferred that the government should make structured investment into programme production and community participation processes of community radios across the country to strengthen this very effective grassroot media.

Keywords: Community participation, Financial sustainability, Grassroot communication, NGO based community radio stations, Rural development

INTRODUCTION

The concept of communication for development emerged with the Modernization theory, which developed its roots after World War II. Wilbur Schramm and Daniel Lerner, the two major proponents of this theory opined that the major obstacle to development was the psychology of the undeveloped citizens. The communication models under modernization paradigm observed communication process as the transfer of message from sender to receiver (Lasswell, 1948). It was found that communication theories like two step-flow, diffusion theory, or the early extension approaches were quite harmonious with the top-down modernization theory. After the Modernization paradigm, an another theory of communication for development emerged named as Dependency theory. Dependency theorist like Jean Servaes (1996) criticized the broadcasting and other mass-media systems as they tended to support modernization and were anti-development; also they were inclined to promote the political agenda. Solution to underdevelopment of third world countries require major changes in media structure that were dominated by commercial principles and foreign interests into media structures which are self-reliant and community oriented (Servaes 2002). In 1970s scholars such as Paulo Freire and Nora C. Quebral started pleading in favour of bottom-up development theories which led to evolution of a new development paradigm called the multiplicity paradigm. This paradigm conceptualised the basic idea that development is integral, multidimensional and dialectic process which can differ from one society to another (Okigbo and Eribo, 2004). Multiplicity paradigm led to emergence of a new form of communication called participatory communication. Though the perspectives of communication for development has changed over the years but multiple researches revealed that communication played a critical role in the process of development. FAO's Communication for Development Group has been one of the leading practitioners of applied communication for improvising agriculture and related sectors in the developing world since its establishment in1969. The corresponding shift towards approaches of participatory development (Chambers, 1994; Brown *et al.*, 2002) signifies that a greater apprehension of community perspectives is required to identify the local resources that can be built on to cater local needs.

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Community Radio: A Participatory Communication Tool

According to UNESCO, the community can be territorial or geographical or a group of people with common interests, who are not necessarily living in one defined territory (Tabing, 2002). Similarly, AMARC defined it as a "collective or group of people sharing common characters or interests" (Mtimde *et al.*, 1998). The important point in the various definitions is that, the community is identified as a group, not simply a mass of people that the broadcasting signal happens to cover. A group of people who form relationships over time by interacting regularly around shared experiences, which are of interest to all of them for varying individual reasons is a community.

'Participation' is often highlighted as a key characteristic, distinguishing community radio from most other kinds of media (Mtimde *et al.*, 1998). Bruce Girard (2001), proposed that the "most distinguishing characteristic of community radio, is its commitment to community participation at all levels". AMARC reffered community participation to continuous interaction between the broadcast station and the community about their needs, concerns and interests (Plaugher and Solervicens, 2007). Community radio promotes local discussion within the community to assess their environment, the causes for their problems and explores possible actions can be took to address the situations. According to Sharma (2013), Community Radio reaches out to various people simultaneously and in diverse locations. The end user just need to have FM access to listen to the broadcast. Radio can play an important role in holding local authorities to account by playing the watchdog's role for the community. In its original design, community radio actively encourages, support and seeks out the participation of members of the community in all sorts of different programme and roles in the radio. Listeners can get inspired, listening to their peers, and learn about best practices of others. Over the time community radio station has emerged as the voice of community being people centered, development oriented and inclusive. Another difference with the community radio is that, there is a democratisation of communication wherein community participation is of paramount importance (Elliot, 2010). People feel ownership of community radio as one can create, access, utilize, share information and knowledge. It helps people to achieve their full potential in promoting and improving their quality of life. As a 2007 UNESCO report put it, "Just hearing themselves on radio is an empowering experience for people, who realize that this, truly, can be their voice and help them get a better deal from the government and other castes. It is the first time Dalits, tribals and women have found an opportunity to speak out."

Non-Government Organization based Community Radio Stations

The grassroot communication involving community voices in development models has a prime and instrumental role in rural development. Community radio has emerged as an efficient tool to instigate community participation in grassroot development process in which the community radio stations owned by Non-government organizations have played a distinct and crucial role at microlevel. On February 1995, the Supreme Court of India declared in its historic judgment that "airwaves are public property" and inspired the campaign to legitimize community radio in India. The famous "Pastapur Initiative" issued in a UNESCO sponsored workshop, hosted by an NGO, Deccan Development Society in July 2000 urged the government to decentralize the broadcasting service not only to private players but also to communities. In the year 2003, government released the first community radio guidelines, but restricted the eligibility to only educational institutions. However, this could not limit the intense urge of the grassroot people to reach out to their communities and voice their concerns and opinion. Pioneer Community radio supported by NGOs like Sangham radio and Namma Dhwani started producing and recording radio programmes but were either narrowcasted or telecasted through TV's without video. In 2006, Government of India notified new Community Radio Guidelines, which permitted Non-governmental Organizations (NGOs) to own and operate community radio stations. At present NGOs with an experience of three years in community development work are provided with the license to broadcast within a radius of 12-30 km. As on 18/11/2020(mib.gov.in), out of total 310 operational community radio stations in India approx. 50% are owned by NGOs. The present study highlights the important role played by Non-government organizations in raising community voices through community radio stations. The study reviews the cases of two successful and pioneer NGO based community radio stations in terms of their focus areas, target audience, key programmes, strategy of raising community voices, sustainability and overall impact.

CASE of two pioneer and demonstrative community radio stations of India

1. Deccan Development Society, Medak, Telangana (Radio Sangham): Deccan Development Society (DDS) is a non-government organization working with Sanghams (village level groups) of rural women, most of which are Dalits. The Society envisions empowering the marginalized groups of women to emerge as vibrant organs of the local governance. It aims at facilitating rural communities to attain autonomy in access and contol and with that inspiration the groups have worked to achieve the autonomy over food production, seeds, natural resources, autonomous market and autonomous media. Transcending their barrier of illiteracy the women members of Deccan Development Society (DDS) strived hard to learn media usage to raise dialogue within their groups and inform the world about the dent they are making in the society (http://www.ddsindia.com/). On October 15, 2008, Sangham Radio, the first NGO based community radio station of India was launched at Machnoor village in Medak district. Sangham Radio emerged as a platform to raise the needs, aspirations and experiences of the community around. DDS has worked with the people of Medak district, most of which are farmers, for more than a decade and identified the potential of community radio to encourage two-way communication between the people of one the most undeveloped regions of the nation with the rest of the country (Rikzana and Neelamalar, 2015).

Hyderabad Narsamma and Nalugindla Narasamma, the two Dalit women who look after the community radio broadcast are educated upto 10th Class with a team of reporters including both men and women mostly illiterate or semi-literate. The entire staff is paid by DDS. In day time, they work as farmers and as the night approaches, they turn into broadcasters. The radio covers a radius of 25 km broadcasting in about 100 villages with about 50,000 listeners (Nirmala 2015). While speaking about the establishment of the radio station, the Director of DDS, PV Satheesh said, "We were identified as a partner for UNESCO's 'Women Speak to Women' project. As part of this, we established the radio station with the programming content aimed at serving the information, education, and cultural needs of the region." The women are using community radio to save their dying language and cultures, spread their message of sisterhood, ecological agriculture, women's control over seeds and a host of different issues (Avadhani, 2017).

Sangham radio broadcast for 2 hours daily from 7 to 9 PM in Telugu language, the programs are related to social messages, folk songs, farming and health tips, and also has information about fairs and festivals in their area. They mainly use short skits and dramas as programming methodology share educational messages to women and other people. "Villagers feel happy when they hear their voice on the radio in the form of songs or discussions. They will also share this joyfully with their neighbours. The song the community radio plays depends on the season, whether it time to plough, plant seeds, irrigate or harvest. The songs recall our tiring work at the field in the morning," said Begari Sammamma of the village of Bidakanne in an interview with the Hindu newspaper (Avadhani, 2017). Over the years, Sangham radio has gathered about 2,500 songs sung by community members. In this way, Sangham radio in its journey of about 12 years, has created an aware community, given voice to the marginalized women of the society and promoted local culture, language, indigenous knowledge, innovations and good governance in the area.

Sustainability: Sangham Radio was initially established by DDS with financial support of the donor agency, UNESCO. UNESCO sponsored DDS through its projects to purchase the transmitter and other equipments essential for establishing community radio. The women of various sanghams (self-help groups) unders DDS also contributed Rs. 5 each to bring up their own radio station (Negash, 2016). The radio sustained somehow for ten years, but in the year 2018, a crowdfunding plea was raised as campaign to help the radio station overcome its financial and technical crisis. The technical problem was reported due to its impaired transmitter, which is required to reach an area of 30km but now barely covers a 3 km radius. "Very soon even this may fail and Sangham Radio may be silenced forever," said the statement, which hopes to raise a fund of Rs. 10 lakh, the minimum needed for continued survival. The government has not paid for the advertisements aired and its dues to Sangham Radio over the last three years has totaled to Rs. 3.25 lakhs," declared the appeal (Avadhani, 2018). Thus, though the community radio has been able to put the women of the community at the frontiers of communication, but the financial sustainability issue often threatens the existence of the radio.

2. The Mysore Resettlement and Development Agency, Kolar, Karnataka (Namma Dhwani): MYRADA NGO was established in 1968. It is a NGO working in backward areas of Tamil Nadu, Andhra

Pradesh and Karnataka. It aims at supporting the marginalized segment to develop their own livelihood strategies, access resources and manage their own institutions. Budikote is a poor village in southeastern part of Karnataka, with population involved in agriculture and people were organized into self-help groups. It also has media-penetration and cable connection. Although, the programmes of All India Radio were transmitted to Budikote in three languages, but the community felt that they were not suited to their needs. In 1999 a baseline survey was conducted to assess information needs and preferred media revealed that people preferred an audio channel because of low comprehension, illiteracy and poverty. They revealed to have locally relevant information about agriculture, health, governance etc. Keeping in view the needs and preference of the local community and their urge to have a radio of their own in their own dialect and with voices of their own people, Budikote community with two NGOs MYRADA and VOICES, started creating locally relevant audio programme and narrowcasted them in the meeting of Self-help groups. The success of the narrowcasting encouraged the establishment of an audio production center "Namma Dhwani" in Budikote with the help of UNESCO in the year 2001. The audio programmes were scripted, produced and recorded by the volunteers of various self-help groups, who were initially trained in interviewing, recording, scripting, editing, and mixing skills. To reach every household of the nearby villages, in 2003, a direct to home cable connection was established in collaboration with the local cable operator (Kumar, 2008).

With the support of NGOs and UNESCO funds, Namma Dhwani also bought few computers for its center through which it acted as a resource center for villagers providing computer trainings and other market related information through internet. Namma Dhwani established itself as a demonstrative model of empowering community voices even before the grant of permission to NGOs to get license of community radio. After 2006, Namma Dhwani got its own community radio and was ready with its already prepared 800 hours of audio programmes which could now broadcast through radio. Namma Dhwani is a fully operational community multimedia center with radio, video and internet facility (Anthony, 2004). All the programmes are made by volunteers of Namma Dhwani, who are mostly the self-help group members and with participation of the community. It has made impact by creating awareness among the women regarding health, sanitation, family planning, education etc. in particular and all the members of community in general. It was also found capable in generating leadership behaviour among the women of community (Nirmala, 2015).

Few cases highlight the impact Namma Dhwani has created in the lives of the local people. For about eight days budikote village was deprived of water supply because of some issue with pipes. The community women gathered in front of the building, discussing their problems. One of volunteers of Namma Dhwani, Nagaraj, 20, recorded the opinions of the women ad hoc and played back the audio recording infront of the Panchayat Secretary, who promised to look into the matter and got it fixed within the next two days. Community radio has proved to be helpful in solving various other problem of the community related to electricity, streetlights, drainage etc.

Moreover, it has been of great help in solving the problems of individuals. Narayanswamy was earning livelihood by selling milk, but after the death of her only cow, her sole hope was on the insurance money. She went to the insurance office a dozen times to claim for the insurance money, but the agent was trying to cheat her. Then, she talked about her problem on the community radio station. The next day, the agent gave her the entire money. Narayanswamy while reflecting on the importance of radio said, "This radio station is ours because it speaks about us, in our language and in our accent. When I turn it on, I hear the voices of people I know." (Kantharaj, 2014). Thus, Namma Dhwani represents the community's voice airing content focused on social evils such as dowry harassment, environment protection, local news, general knowledge, folk music, agriculture etc.

Sustainability: Namma Dhwani has broadened its scope by acting as a community resource center. In 2001, UNESCO provided funds to set up an audio recording center in the space allotted by MYRADA, and a Namma Dhwani Management Committee (NDMC) was formed to look after the operations of community radio. At its initial phase, each Self Help Group involved made a onetime contribution of Rs. 1000.00 to cover the cost of running the studio. Namma Dhwani generates funds for its operations by providing additional services and training to rural youth and women through its setup of computers. These computers have created a significant impression on the youth of Budikote. In association with a computer institute in Kolar, Namma Dhwani also offered certificate

courses on Microsoft Office package to young people from Budikote.

Opportunities and Challenges for NGO based Community Radio

As depicted by the cases of Sangham Radio and Namma Dhwani, it is evident that Non-Government Organizations have lead the community radio movement in the country and have been successful in mobilizing communities to establish and run their own radio station for their own development. Many other successful cases like Manadakini ki Aawaz (Mandakini ki Aawaz Sewa Samiti, Uttarakhand), Radio Tilonia (Social Work and Research Center, Rajasthan), Radio Alfaz-e-Mewat (S.M. Sehghal Foundation, Haryana), Radio Bundelkhand (The Society for Development Alternatives, Madhya-Pradesh), Radio Kotagiri (Key-stone foundation, Tamil Nadu) etc. have also highlighted that community radio leads to social, economic and cultural empowerment of the communities. Its programmes ensures a wide diversity of voices and views from marginalized groups, such as women and youth, and it promotes and protects the interests, culture, and linguistic diversity of ethnic minorities in the community. However, financial constraint always pose diverse challenges to the functioning of community radio. It primarily relies on varied sources for financial support, which many include, grants, membership fees, donations, advertising or sponsorship.

According to the new policy guidelines of the Ministry of Information and Broadcasting applicants who can arrange for foreign funding for setting up of community radio stations can now obtain it through FCRA Clearance under Foreign Contribution Regulation Act, 1976. Apart from this the policy guidelines of the Government of India in regard to community radio clearly state: "Transmission of sponsored programmes shall not be permitted except programmes sponsored by Central and State Governments and other organisations to broadcast public interest information. In addition, limited advertising and announcements relating to local events, local businesses and services and employment opportunities shall be allowed. The maximum duration of such limited advertising will be restricted to 5 (Five) minutes per hour of broadcast." The liberty of broadcasting of advertisements for 5 minute/ hour can also prove as mutually beneficial for both community radio stations and local business, entrepreneurs etc. Many researches, also suggested that community radio being non-profit and owned by grassroot community, the license fees of getting a community radio is very high which can be waived off, especially for the peoples' radio. Looking into the significant role of the NGO operated community radio stations, it is desirable to have a large number of radio stations in the country, which is at present very less in comparison to the expectation. Structured investment by the government into programme production and community participation process of community radio across the country has been refereed as one of the most important solutions for overcoming financial constraint of these radio stations to make them sustainable.

CONCLUSION

Communication has a critical role in the process of development. However, communication needs to be participatory, involving people's voices and dialogical process. With participation as its key component and the power to broadcast the concerns, voices, opinions, needs and experiences of poor and marginalized people, community radio has emerged as one of the most essential tool of communication for development. Non-government organization like MYRADA and Deccan Development Society have been pioneers in the community radio movement of the country. NGOs with their grassroot connect, reach among communities and focus on developmental aspects; were found to be successful in mobilizing and supporting the rural people to establish and run their community radio station. The study revealed that the community radio owned by Non-governmental organization was more aligned to the community needs and aspirations. It was found that the unheard voices at grassroots got a channel through these radios which mostly depended on community based programs which raised critical issues o livelihood generation, youth aspiration, women empowerment, primary education, health and hygiene and environmental issues. On the other hand, it was also found that the NGO owned community radios regularly confronted the issues of financial sustainability and a major thrust of these radio was focused towards the struggle for financial assistance for survival. Looking into the impact and contribution of NGO based community radios in contrast to the government support, the impact was found to be substantial and significant whereas the government support was found to be negligible. It is inferred that the government should make structured investment into programme production and community participation processes of community radios

across the country to strengthen this very effective grassroot media, which will payback manyfold as compared to the investment ever made to grassroot development.

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Participation of Tribal Women in Agricultural and Allied Activities in Tribal Valley Gurez Jammu and Kashmir

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ABSTRACT

A study on "Participation of tribal women in Agriculture and allied in Gurez valley of Jammu and Kashmir" was carried out in six villages of Baghtour block of Gurez of Bandipora district of Jammu and Kashmir with total of 90 respondents to carry out the investigation about the extent of participation of tribal women in agricultural and allied activities. The data was collected with the help of pre-structured interview schedule and the collected data was then subjected to appropriate statistical analysis to yield the results such as, Tribal women are almost engaged in all the agricultural activities right from selection of land, preparation of land and up to the final storage of the produce. Apart from agricultural activities, the tribal women were found to take active role in some allied activities also which include post-harvest management and livestock rearing.

Keywords: Allied activities, Participation, Tribal women in agriculture

INTRODUCTION

Farm women are the backbone of Agriculture. The rural women are extensively involved in various agricultural activities and are doing almost all the agricultural activities starting from seed sowing up to the harvesting and even take active part in the processing of agricultural produce. Participation of women in agriculture and allied activities is an important issue in the countries like India as the tribal women constitute more than half of the work force among the tribals living in India.

Tribal women constitute half of the total work force involved in various agricultural activities in India. Tribal women have been seen mostly doing agricultural activities in the Indian context and are being discriminated. Inspite of their huge contribution towards agriculture and allied sectors, they are not being given due respect in the tribal belts of rural India. They are now actively involved in all the important activities of agriculture including threshing and ploughing activities and they have little access to the knowledge of latest technologies of agriculture and related natural resources. The objective of the present study is to ascertain the work participation rate, their contribution to the family income and role performance of tribal women. A sample of 100 tribal farm women twenty five each from four Gram Panchayats viz. (Tarbal, Baghtour, Izmarg, Kurgbal, Dangan and Bajran) in the tribal valley of Bandipora District of Jammu and Kashmir were selected based on stratified random sampling procedure. The tribal women work mostly about 10 to 12 hours per day involving in agriculture and other allied activities. The tribal women collect minor dry forest fuel wood during the winter months apart from being involved in several indoor activities like feeding and milking of milch cows, preparation of ghee, butter etc.to keep their children healthy and sell some of these products in the nearby market and exchange the produce for their daily requirements through barter system. Results reveal that the work participation rate and role performance of tribal women in agriculture and allied sectors is very high compared to their male counterparts and contribute good share to their family income. The study revealed that lower the economic status of the family, the higher will be the contribution towards their family income.

MATERIALS AND METHODS

The present study was carried out in four villages of Gurez valley in the Bandipora district of Jammu and Kashmir. The Gurez valley is the largest tribal belt in the valley of Kashmir. The Agriculture and allied activities like livestock

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rearing is the main occupation of the people of the valley. Out of 68 villages of the valley, six villages were purposely selected for the present study and a total of 90 respondents were taken i.e. 15 from each village were randomly selected for the study. The structured interview schedule keeping in view the objectives of the study was prepared and the data was collected by personal interview method with the help of the interview schedule. The relevant scales and measurement techniques were employed to ensure the correct responses of the respondents. The data collected was then coded, tabulated and analysed in accordance with the objectives of the study. The appropriate statistical tools like frequency, percentage, mean, standard deviation and correlation co-efficient were also employed to interpret the collected data.

RESULT AND DISCUSSIONS

In the present study eight different characteristics of the tribal women were investigated which include their age, education, family size, annual income, media exposure, trainings received, organizational participation and knowledge of agricultural activities. The age of the tribal women engaged in agriculture ranged from 18 to 65 years with an average of 38.6 years and standard deviation of 9.07. On the basis of the age of the respondents (tribal women) were classified into three categories as shown in Table 1. The findings of the present study indicate that most of the women 68.88 per cent engaged in agriculture in the study area were middle aged while 19.0 per cent belonged to old age group and 12.2 per cent were from young aged group. The results thus indicate that the middle aged women are highly motivated towards agricultural activities besides their own household work.

The data presented in Table 2, depicts the distribution of respondents according to their level of education. The results in Table 2 revealed that about 35.5 per cent women had educational level up to higher secondary followed by the women having educational level up to middle school 26.8 per cent. The results shown in the table further revealed that 15.5 per cent women engaged in agriculture were having educational level up to graduation followed by the women 12.2 per cent having the education up to primary level and only 10.0 per cent of women engaged in agriculture were found illiterate. Therefore the study revealed that most of the women engaged in agricultural activities are having good educational background.

Table 1: Distribution of respondents according to their age

Category	Respondents		Mean	S.D.
	No.	%		
Young (upto 25 years)	11	12.2	36.0	8.06
Middle (26-50 years)	62	68.8		
Old (above 50 years)	17	19.0		

Table 2: Distribution of respondents according to their level of education

Category	Respondents		Mean	S.D.
	No.	%		
Illiterate	09	10.0	5.7	3.10
Primary level	11	12.2		
Middle level	24	26.8		
Higher Secondary level	32	35.5		
Graduate	14	15.5		

The respondents (tribal women) were classified in to three categories on the basis of their size of families. The results depicted in Table 3, clearly indicated that most of the respondents 50.0 per cent were from medium group of families followed by the respondents 36.6 per cent belonged to large families and only 13.4 per cent of the respondents engaged in farm activities belonged to small families having members up to 5. Hence it may be concluded that most of the farm women 50.0 per cent were from the families having members up to 8.

Based on the size of farm and keeping in view the small size of land holdings in the valley, the respondents were classified in to three categories as small, medium and large. The results shown in Table 3, depicts that most of the respondents 62.2 per cent engaged in farm activities were having the land holdings up to 0.2 hectares followed by the respondents 24.4 per cent having land holding up to 0.4 hectares and only 13.4 per cent of respondents were having land holding up to 0.4 hectares. The result clearly indicates that most the farm women engaged in agriculture were having small size of land holdings.

Table 3: Distribution of respondents according to their family size

Category	Respondents		Mean	S.D.
	No.	%		
Small (upto 5 members)	12	13.4	5.68	1.86
Medium (6-8 members)	45	50.00		
Large (above 8 members)	33	36.6		

Table 4: Distribution of respondents according to their size of farm

Category	Respondents		Mean	S.D.
	No.	%		
Small (0.1-0.2 ha)	56	62.2	1.56	0.92
Medium (0.2-0.4 ha)	22	24.4		
Large (above 0.4 ha)	12	13.4		

All the respondents were grouped in to three categories to analyse the mass media exposure of the women engaged in agriculture and allied activities. The results depicted in the Table 4, revealed that majority 57.8 per cent of the respondents were having medium level of mass media exposure followed by the respondents 31.2 per cent having high mass media exposure and only 11.0 per cent of the respondents were having low level of mass media exposure.

Table 5: Distribution of respondents according to their mass media exposure

Category	Respondents		Mean	S.D.
	No.	%		
Low (upto 5)	10	11.0	8.4	1.65
Medium (6-9)	52	57.8		
High (above 9)	28	31.2		

Trainings played an important role in updating the skill of the participants besides the trainees are also being exposed to various schemes launched by the government from time to time and making them aware about the marketing perspectives in Agriculture and allied sectors. From the analysis of the data presented in Table 6, revealed that 42.20 per cent of the respondents did not receive any trainings related to agriculture while as majority of the respondents 57.8 per cent received the trainings in agriculture and allied sectors to update their skills in farming.

The respondents were grouped in to three categories as depicted in Table 7 to study the score of knowledge ranging from 12 to 18 with a mean of and standard

Table 6: Distribution of respondents according to trainings received

Category	Respondents	
	Number	Percentage
No training received	38	42.20
Trainings received	52	57.80

Table 7: Distribution of respondents according to their knowledge about some specific agricultural practices

Category	Respondents		Mean	S.D.
	No.	%		
Low (upto 10)	16	17.8	14.5	3.65
Medium (11-20)	64	71.2		
High (above 20)	10	11.0		

deviation. It was observed that majority of the respondents 71.2 per cent were having medium knowledge about some specific agricultural practices followed by the respondents 17.8 per cent having low level of knowledge and 11.0 per cent of respondents came under the category having high knowledge about the agricultural practices.

Different agricultural activities such as land selection, land preparation, seed sowing, irrigation, weeding, manuring, harvesting etc. as shown in Table 8, were identified to study the participation of tribal women in the farming activities. Analysis of the data presented in the same table revealed that most of the tribal women take part in Storage of the vegetables with rank I as during the winter months, the valley remains cut off from rest of the world for more than four months followed by weeding operations in their respective fields with rank II, majority of the tribal women regularly took part in harvesting and seed sowing operations with rank III and IV respectively.

Based on the results about participation of tribal women in the cultivation of potato and other vegetable crops as the potato is the main crop of the valley and most of women in the valley are engaged in farming activities. All the respondents were classified in to four categories regarding their participation viz. very low, low, medium and high. The data presented in the table below revealed that the majority of the respondents 53.4 per cent were in high category followed by the respondents' medium category 23.2 per cent of participation and 17.8 per cent were found in low participation category. However only 5.6 per cent of the respondents were found in the category with very low participation. Higher participation of the women may be due to the involvement of local women in various awareness programmes organized by the Mountain Agriculture Research and Extension Station of SKUAST-Kashmir which is located in the close vicinity of the study area.

The women in this tribal valley are engaged in post-harvest activities since ancient times as the local women

Table 8: Participation of women in Potato and other vegetables cultivation

Operation	Extent of participation percentage				Rank
	Regular	Occasional	Rare	Never	
Land selection	12.4	23.6	54.6	9.6	X
Land preparation	36.8	34.2	18.3	10.7	IX
Seed sowing	62.4	24.6	9.6	3.4	IV
Irrigation and drainage	56.2	34.8	6.4	2.6	VII
Preparation of furrows	59.6	32.6	5.8	2.0	V
Application of manure	45.5	38.5	11.0	5.0	VIII
Weeding	67.4	16.6	9.5	6.5	II
Harvesting	65.8	24.2	7.5	2.5	III
Collection and grading	58.8	32.2	6.4	4.4	VI
Storage	69.4	14.6	10.5	5.5	I

Table 9: Distribution of respondents according to their extent of participation in Potato and other vegetables cultivation

Category	Respondents		Mean	S.D.
	No.	%		
Very low participation	05	5.6	14.75	3.86
Low participation	16	17.8		
Medium participation	21	23.2		
High participation	48	53.4		

played an important role in collecting, drying and dehydration of vegetables to make them available during the harsh winter months, when no fresh vegetables are available anywhere in the valley due to the closure of Bandipora Gurez road as the valley receives heavy to very heavy snowfall during the winter months. the results shown in Table 10 below revealed that the most of the respondents 64.4 per cent are in high participation category followed by medium participation 17.8 per cent and low participation 12.2 per cent respectively. However only 5.6 per cent of the respondents were shown in the category of very low participation regarding post-harvest activities. The good participation of farm women in post-harvesting of vegetables may be due to the fact as the mountain agriculture research and extension station of SKUAST-Kashmir is regularly organizing the training programmes specially for tribal women in the field of post-harvest technologies.

Table 10: Distribution of respondents according to their extent of participation in Post-harvest activities

Category	Respondents		Mean	S.D.
	No.	%		
Very low participation	05	5.6	12.85	3.24
Low participation	11	12.2		
Medium participation	16	17.8		
High participation	58	64.4		

The tribal women are mostly engaged in livestock rearing in the hill and mountain agro-ecosystem. Livestock is an important source of food and played an important role as supplementary income of the farm families. The data presented in Table 11, clearly revealed that majority of the respondents 61.1 per cent showed high participation in Livestock rearing followed by medium participation 23.3 per cent in medium participation category and 8.9 per cent in low participation category. However only 6.7 per cent of the respondents were found in very low participation category. The reason might be that the tribal women are very much inclined towards the livestock rearing.

Table 11: Distribution of respondents according to their extent of participation in livestock rearing

Category	Respondents		Mean	S.D.
	No.	%		
Very low participation (upto 5)	06	6.7	14.65	3.01
Low participation (6-10)	08	8.9		
Medium participation (11-15)	21	23.3		
High participation (Above 15)	55	61.1		

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Personal Profile, Impact and Constraints of National Horticulture Mission Beneficiaries in Davanagere District of Karnataka

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ABSTRACT

The present study was conducted in all the six blocks of Davanagere district of Karnataka state in India. The sample size was 144 randomly selected National Horticulture Mission beneficiaries from 24 villages. The data were collected through personal interview method. The personal, socio-economic and psychological characters of NHM beneficiaries were grouped in to low, medium and high categories based on mean and standard deviation as measure of check. The chi-square analysis to find association between dependent variable and independent variables of NHM beneficiaries revealed that education, horticulture farming experience, extension contact, innovative proneness, achievement motivation, risk orientation and scientific orientation were found significantly association with standard of living after participation in NHM programme, whereas variables namely; age, family size, land holding, sources of information, mass media participation, extension participation, cosmopoliteness, management orientation and deferred gratification had no significant association with standard of living after NHM programme. The high production costs of horticulture crops (95.83%) was the major constraint followed by poor follow up of activities by the NHM personnel (90.97%) and less subsidies under NHM scheme (86.80%) are the major constraints expressed by the NHM beneficiaries. The major suggestions given by the beneficiaries for effective implementation NHM scheme are subsidies under NHM needs to be increased (77.78%) followed by proper follow up of activities (29.16%) and training programmes needs to be increased (16.67%).

Keywords: Achievement motivation, Constraints, Education, Extension contact, Horticulture farming experience, Innovative proneness, National horticulture mission, Risk orientation, Scientific orientation, Suggestions

INTRODUCTION

Agricultural extension services are one of the important instruments for increased productivity. India has, in fact, one of the largest institutional agricultural extension systems in the world. Majority of agricultural development programmes are implemented through these institutionalized extension system for overall development of the sector. National Horticulture Mission (NHM) was initiated during 2005-06 by Government of India to promote holistic growth of the horticulture sector and income support to farmers and another sectors through an area based regionally differentiated strategies. The important components of the NHM programme is to help farmers in increase their area under horticulture crops through resource provision like seedling/nursery, plant protection chemicals, bio-fertilizers, poly house/green houses, insect-proof nets, irrigation facilities, support to organic farming and other direct subsidies. Besides NHM also take up the activities of providing market facilities, processing and value addition in horticulture crops, capacity building through trainings and extension activities. The NHM programme has brought few visible changes in India namely; the fruits and vegetables which are occasionally consumed by the common people became regular diet and for the first time after independence, GDP from horticulture sector has over taken GDP of agriculture sector. In this background it is necessary to study the socio-economic and personal characteristics, their influence on

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standard of living and constraints and to enlist suggestions of beneficiaries effective implementation of the programme are needed to study scientifically at individual beneficiary level.

MATERIALS AND METHODS

The study was conducted in all the six taluks of the Davanagere district namely; Channagiri, Honnali, Davangere, Harihara, Jagalur and Harapanahlli. Four villages having the highest number of NHM beneficiaries from each taluk were selected for the study. From each these 24 selected villages, 6 beneficiaries were selected randomly considering the criteria that the farmers who are beneficiaries under NHM programme from 2008-09 to 2013-14. Thus total sample size for the study was 144 beneficiaries. The data were collected with the help of a pre-tested interview schedule from the respondents included in the sample. The data were analysed using statistical tests including frequency, percentage, mean, standard deviation, chi-square. Ex-post facto research design employed for the study.

RESULTS AND DISCUSSION

The personal, socio-economic and psychological characteristics of National Horticulture Mission beneficiaries were analysed using percentage, mean, standard deviation and categorized in low, medium and high categories (Table 1). The chi-square analysis 16 independent variables with dependent variable standard of living of NHM beneficiaries revealed that, seven independent variables viz., education, horticulture farming experience, extension contact, innovative proneness, achievement motivation, risk orientation and scientific orientation were found significantly association with standard of living after NHM programme, whereas remaining variables namely; age, family size, land holding, sources of information, mass media participation, extension participation, cosmopoliteness, management orientation and deferred gratification had no significant association with standard of living after NHM programme (Table 2).

The significant association between education and standard of living might be that, the higher educational qualification helps in acquiring more information from all possible sources. Further, high educational level increases mental horizon of beneficiaries which helps in rational decision making, good understanding capacity and application of acquired information. Similar findings were reported by Shashikumar (1998); Satyanarayana (2002); Vinay Kumar *et al.* (2015) and differ with finding of Srinath (1992) and Koushik (1993).

Table 1: Distribution of NHM beneficiaries according their personal, socio-economic and psychological characteristics (n=144)

S.No	Characteristics	Category	NHM Beneficiaries		Mean	SD
			Frequency	Percentage		
1	Age	Young	5	03.47	53.19	13.86
		Middle	63	43.75		
		Old	76	52.78		
2	Education	Low	48	33.33	3.89	2.81
		Medium	40	27.78		
		High	56	38.89		
3	Family Size	Small	61	42.36	9.09	5.27
		Medium	43	29.86		
		Large	40	27.78		
4	Land Holding	Low	53	36.80	9.35	7.95
		Medium	67	46.53		
		High	24	16.67		
5	Horticulture Farming Experience	Low	58	40.28	13.23	10.15
		Medium	54	37.50		
		High	32	22.22		
6	Sources of Information	Low	43	29.86	11.86	9.65
		Medium	60	41.66		
		High	41	28.48		

Table 1 contd....

S.No	Characteristics	Category	NHM Beneficiaries		Mean	SD
			Frequency	Percentage		
7	Mass Media Participation	Low	52	36.11	07.53	03.82
		Medium	51	35.42		
		High	41	28.47		
8	Extension Contact	Low	54	37.50	8.44	6.36
		Medium	40	27.77		
		High	50	34.73		
9	Extension Participation	Low	39	27.08	7.89	5.88
		Medium	49	34.02		
		High	56	38.90		
10	Innovative Proneness	Low	28	19.44	17.00	2.60
		Medium	71	49.31		
		High	45	31.25		
11	Cosmopoliteness	Low	59	40.97	4.15	0.87
		Medium	30	20.83		
		High	55	38.20		
12	Achievement Motivation	Low	35	24.31	24.93	2.45
		Medium	64	44.44		
		High	45	31.25		
13	Risk orientation	Low	51	35.42	4.58	0.72
		Medium	00	0.00		
		High	93	64.58		
14	Scientific Orientation	Low	44	30.56	21.63	1.22
		Medium	77	53.47		
		High	23	15.97		
15	Management Orientation	Low	69	47.22	10.77	01.14
		Medium	49	34.03		
		High	26	18.75		
16	Deferred Gratification	Low	00	0.00	1.06	0.41
		Medium	141	97.92		
		High	3	2.08		

Experience of beneficiaries regarding farming activities helps in utilization of all possible resources including men, material and natural resources to the full extent to get higher yield and income. Higher the experience means lesser mistakes in farm activities and leads to better decision making in planning, production and marketing activities.

Extension contact had significant association with standard of living. It is quite natural that beneficiaries with higher level of extension contact acquire more information, skills to improve farm and adopt new technologies. During interaction with various extension agencies the beneficiaries might have updated knowledge level regarding cropping pattern, management of farm, exposure to various schemes of development department. The above findings are in conformity with Shashikumar (1998); Vinay Kumar *et al.* (2015) and Balakrishna (2016).

The possible reasons may be that higher the innovative proneness implies seeking more information from all possible sources and always in forefront to try new things in their farm. These beneficiaries have better understanding of happenings in horticulture sector, better decision taking ability and problem solving capacity. These beneficiaries might have better interaction within social system and also outside the social system. This helps to know successful beneficiaries and quickly adopt the technologies in their own farm. Adoption of new technologies invariably increases farm income and brings sustainability and contributes to increased standard of living.

The self-motivated beneficiaries set their target to be achieved in time frame and work to fulfill the goals. This sets the agenda for beneficiaries to participate in NHM

Table 2: Association between personal characters and standard of living of beneficiaries after NHM (n=144)

S. No.	Personal and socio-economic characteristics	Standard of living								χ^2 value
		Low (n= 87)		Medium (n=45)		High (n=12)		Total (n=144)		
		F	%	F	%	F	%	F	%	
1	**Age**									
	Young	04	80.00	1	20.00	0	0.00	05	100.0	2.176 NS
	Middle	38	60.32	18	28.57	07	11.11	63	100.0	
	Old	45	59.21	26	34.21	05	6.58	76	100.0	
2	**Education**									
	Low	33	68.75	10	20.83	05	10.42	48	100.0	11.327*
	Medium	16	40.00	20	50.00	04	10.00	40	100.0	
	High	38	67.86	15	26.79	03	5.36	56	100.0	
3	**Family size**									
	Small	34	55.74	22	36.07	05	8.20	61	100.0	2.008 NS
	Medium	29	67.44	10	23.26	04	9.30	43	100.0	
	Large	24	60.00	13	32.50	03	7.50	40	100.0	
4	**Land holding**									
	Small	34	64.15	15	28.30	04	7.55	53	100.0	1.653 NS
	Medium	41	61.19	20	29.85	06	8.96	67	100.0	
	Large	12	50.00	10	41.67	02	8.33	24	100.0	
5	**Horticulture farming experience**									
	Low	39	67.25	13	22.41	6	10.34	58	100.0	11.009*
	Medium	36	66.67	16	29.63	2	3.70	54	100.0	
	High	12	37.50	16	50.00	4	12.50	32	100.0	
6	**Sources of information**									
	Low	27	62.79	13	30.23	3	6.98	43	100.0	5.168 NS
	Medium	41	68.33	15	25.00	4	6.67	60	100.0	
	High	19	46.34	17	41.46	5	12.20	41	100.0	
7	**Mass media participation**									
	Low	34	65.39	14	26.92	4	7.69	52	100.0	2.976 NS
	Medium	26	50.98	20	39.22	5	9.80	51	100.0	
	High	27	65.85	11	26.83	3	7.32	41	100.0	
8	**Extension contact**									
	Low	36	66.67	13	24.07	5	9.26	54	100.0	10.892 *
	Medium	26	65.00	10	25.00	4	10.00	40	100.0	
	High	25	50.00	22	44.00	3	6.00	50	100.0	
9	**Extension participation**									
	Low	21	53.85	16	41.03	2	5.12	39	100.0	2.910 NS
	Medium	31	63.27	14	28.57	4	8.16	49	100.0	
	High	35	62.50	15	26.79	6	10.71	56	100.0	
10	**Innovative proneness**									
	Low	09	32.14	16	57.14	3	10.72	28	100.0	15.348**
	Medium	50	70.42	18	25.35	3	4.23	71	100.0	
	High	28	62.23	11	24.44	6	13.33	45	100.0	
11	**Cosmopoliteness**									
	Low	19	63.34	10	33.33	1	3.33	30	100.0	1.459 NS
	Medium	32	58.18	18	32.73	5	9.09	55	100.0	
	High	36	61.02	17	28.81	6	10.17	59	100.0	
12	**Achievement motivation**									
	Low	16	45.72	17	48.57	2	5.71	35	100.0	8.210 *
	Medium	43	67.19	17	26.56	4	6.25	64	100.0	
	High	28	62.23	11	24.44	6	13.33	45	100.0	

Table 2 contd...

S. No.	Personal and socio-economic characteristics	Standard of living								χ^2 value
		Low(n= 87)		Medium (n=45)		High (n=12)		Total (n=144)		
		F	%	F	%	F	%	F	%	
13	**Risk orientation**									
	Low	32	62.75	17	33.33	2	3.92	51	100.0	40.832**
	Medium	0	0.00	0	0.00	0	0.00	0	0.000	
	High	55	59.14	28	30.11	10	10.75	93	100.0	
14	**Scientific orientation**									
	Low	24	54.55	15	34.09	5	11.36	44	100.0	19.643**
	Medium	42	54.55	29	37.66	6	7.79	77	100.0	
	High	21	91.30	1	4.35	1	4.35	23	100.0	
15	**Management orientation**									
	Low	41	60.29	21	30.88	6	8.83	68	100.0	0.165 NS
	Medium	30	61.22	15	30.62	4	8.16	49	100.0	
	High	16	59.25	9	33.33	2	7.42	27	100.0	
16	**Deferred gratification**									
	Low	0	0.00	0	0.00	0	0.00	0	100.0	2.674 NS
	Medium	86	60.99	44	31.21	11	7.80	141	100.0	
	High	1	33.33	1	33.33	1	33.34	3	100.0	

NS= Non-Significant; X^2 =9.48 for 4df at 5% level X^2 =13.27 for 4df at 1% level; *Significant at 5% level **Significant at 1% level

programme and derive benefits to maximum extent. It is their inner urge to excel in all aspects of farming and show by example to other members of social system and the aspiration to gain rewards, build their image and act as opinion leaders. This may be the reason that the standard of living was increased after participation in NHM programme. The results are in line with the findings of the Shivalingegowda (1996) and Jayant Roy (2011).

There was a significant association between risk orientation with standard of living of NHM beneficiaries. The possible reasons for this kind result might be that, being horticulture farmers with considerable initial investment had expressed more risk taking ability. The education level of beneficiaries, management orientation, cosmopoliteness coupled with their extension participation, extension contact and deferred gratification would have helped them to take rational decisions on farm activities. These beneficiaries will look into the attributes of technologies like relative advantages, compatibility and complexity. The inner urge to achieve more in their life drives these beneficiaries to acquire more information and succeed with special achievements which others can follow and adopt. The findings are in agreement with the study conducted by Vinay Kumar *et al.* (2015).

There was a significant association between scientific orientation and standard of living. It is the degree to which a beneficiaries is oriented to take risk and has courage to face uncertainties in any enterprise. A beneficiary who is having this particular trait normally will have better knowledge. These beneficiaries had better management orientation, participation in extension activities and cosmopoliteness and this helps them take rational decisions. Further application of scientific technologies in farms might have helped increased standard of living. The findings are conformity with the findings of Vinay Kumar *et al.* (2015).

The constraints as perceived by NHM beneficiaries were presented in Table 3. The Table clearly indicates that among different constraints majority of the beneficiaries perceived high production costs of horticulture crops (95.83%, Rank I) was the major constraint followed by poor follow up of activities by the NHM personnel (90.97%, Rank II), less subsidy (86.80%, Rank III), low productivity of horticulture crops (86.11%, Rank IV), high post-harvest and handling losses (76.39%, Rank V), less number of trainings (47.92%, Rank VI), less numbers of extension activities (34.03%, Rank VII), less prices in the market (25.69%, Rank VIII), lack of transpiration and cold storage facilities (15.97%, Rank IX) and frequent transfer of personnel (4.86%, Rank X). Irrespective of market prices for farm produce, the prices inputs increases every year and decreases net income. The concerned personnel might have thought that identification of beneficiaries and providing subsidies is the implementation of NHM

Table 3: Constraints faced by the NHM beneficiaries (n=144)

S.No.	Constraints	Number	Percentage	Rank
1	High production costs of horticulture crops	138	95.83	I
2	Poor fallow up of activities under NHM by personnel	131	90.97	II
3	Subsidy under NHM less for different activities	125	86.80	III
4	Low productivity of horticulture crops	124	86.11	IV
5	High post-harvest and handling losses	110	76.39	V
6	Less number of trainings conducted under NHM to impart technical knowledge	69	47.92	VI
7	Less number of extension activities under NHM for technological knowledge	49	34.03	VII
8	Less prices in the market for farmer produce	37	25.69	VIII
9	Lack of transportation and cold storage facilities	23	15.97	IX
10	Frequent transfer of officials from one place to another is making it difficult to keep continuity in NHM activities	7	4.86	X

*Multiple responses

Table 4: Suggestions for effective implementation of NHM (n=144)

S.No	Suggestions	Number	Percentage
1	Increase subsidies under NHM programme	112	77.78
2	Proper follow-up of activities under NHM programme	42	29.16
3	Increase number of training programmes under NHM	24	16.67
4	Provide more technical information in extension programme under NHM	12	8.34
5	Give importance to integrated farming system under NHM programme	9	6.25

*Multiple responses

programme. Funds allocation from higher authority coupled with large number of farmers might be the reason for lesser subsidy to individual beneficiaries. Depleted soil health conditions and lack of knowledge on climate change effects might have decreased the yield levels of horticulture crops. Lack of trainings on

post-harvest technologies and value addition coupled with lack of storage structures could have resulted in post-harvest and handling losses. Lack of supervision by the personnel in the actual implementation of the NHM programme activities might be the reason for less number of trainings and extension activities. Frequent transfer of personnel might have affected the implementation NHM programme since majority of horticulture crops are perennial in nature.

The suggestions given by the beneficiaries for effective implementation of NHM programme are presented in Table 4. The findings revealed that majority of NHM beneficiaries were of the opinion that subsidies under NHM needs to be increased (77.78%, Rank I), followed by proper follow up of activities (29.16%, Rank II), Training programmes needs to be increased (16.67%, Rank III), more technical information needs to be provided under NHM programme (08.34%, Rank IV) and need of integrated farming system approaches under NHM (06.25%, Rank V). Horticulture crops needs high initial investment and perennial cropping nature takes few years to give income to the beneficiaries. The activity based increase in subsidy could be considered. The personnel needs to be follow-up of the implementation of programme at beneficiaries level continuously and not end up with only identification of beneficiaries. The implementing agency needs to organize need based trainings and other technical programmes in collaboration with scientists from Krishi Vigyan Kendras and research stations. The NHM programme emphasized on particular activities and not follows the integrated approach. The higher income will only be realized through integrated farming system concept and Government agenda of doubling farmers income will be possible through this approach.

CONCLUSION

The variables namely; education, horticulture farming experience, extension contact, innovative proneness,

achievement motivation, risk orientation and scientific orientation which are found significantly association with standard of living after NHM programme. The policy makers and implementing agencies need to emphasize more on these aspects. The identified constraints viz; high production costs of horticulture crops, poor fallow up of the activities under NHM by personnel and less number of trainings and extension activities need to be addressed by the implementing agency. The suggestions like increase in subsidies and to include the component of integrated farming system under NHM programme may be considered by policy makers.

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Food Safety Management in Market Value Chain of Mango in Uttar Pradesh: Issues, Challenges and Opportunities

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ABSTRACT

The study highlighted the pertaining market value chain of mango in "Malihabad-Kakori" mango belt of district Lucknow, Uttar Pradesh in order to cohesion with food safety measures at each level of process of the value chain. Results of the investigation showed that the market value chain of mango in the study area confronted in the adoption of various food safety laws required to flow of quality mango from producers to consumers due to large network of value chain actors, lack of activity-oriented food safety measures/ practices for the mango value chain in the Nation's food safety law and also disparity among the various food safety laws (public, private and international food safety laws). The findings of study further showed that due to influential position of actors who engaged in the consumption unit side or buyer driven part of same chain, the homogeneity in compliance of food safety standards over the entire mango value chain is affected. Study results indicated that the small mango growers in the study area were excluded from the high value market (buyer driven market) because their powerlessness to meet private food safety standards. A substantial percentage of value chain actors in the study area have unaware about food safety procedures and standards assigned for various level of handling of fresh mango and its products. Study findings highlighted the need of effective implementation of food safety measures whether it is public and/or private can be ensured in short value chain of mango wherein small number of linkages between the mango growers and the consumers in the study area.

Keywords: Food safety, Mango, Quality, Stakeholder, Value chain mapping

INTRODUCTION

Mango (*Mangifera indica*) is the national fruit of India and is considered the king of fruits on account of its nutritive value, taste, aroma and health promoting qualities. Across the country, mango is the most cherished fruit, eaten fresh or processed into different products. Mango is used at all stages of its development: as raw fruit it is used to make pickles, chutney, mango sauce and green mango beverages. The ripe fruit is processed into jams, jellies, frozen slices, canned products, dehydrated slices and ready-to-serve beverages (F.A.O., 2018). Mango being a part of high value agriculture has got marvelous scope to increase the income of the mango growers with its high potential yield, hence it can transform the economic conditions to them. Further, Indian mangoes have the greatest potential and demand in domestic and international market.

India is the largest producer and exporter of mango in the world accounted about 40 per cent and 19 per cent in world's mango production and export, respectively. Mango production in the country is estimated to increase 4.24 per cent to 21.12 million tonnes in the year 2020-21 (Ministry of Agriculture, GoI, 2021). Mango is grown in almost all the states of India and Uttar Pradesh is one of the leading producers accounted about 24 per cent in the country's production. Similarly, out of 15 mango producing belts in the state, "Malihabad-Kakori" belt of district Lucknow produces 90 per cent of famous "Dussehri" mango and has about 30-35 thousand hectares area dedicated to mango production, comprising 30-40 per cent of annual mango production in Uttar Pradesh (APEDA, 2021).

The value chain is a series of primary and supporting activities that adds value to products or services i.e., it connects the supply side with the demand side of the entrepreneur's business (Plazibat, 2013). The mango value chain can be defined as the full range of activities required in bringing mango to final consumers passing through the

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different phases of production, processing and delivery (Malik and Rao, 2011). The value chain of fruit and vegetables has its own specific features due to the characteristics and types of fruit and vegetables (Plazibat, 2013). The value chain of mango has its own peculiarities like inefficient markets, unavailable formal finance, low prices to farmers, and infrastructure bottlenecks etc. (Pallavi, 2013).

Traditional trade in horticultural products in wholesale markets is changing due to increasing urbanisation, changing consumer preferences towards horticultural products, changing patterns in the wholesale/ retail industry and the renewed regulatory thrust by the Government on horticulture production, processing, exports, food safety, hygiene, sustainability and better nutrition. These developments have started pushing retailers to source better quality produce and growers to adopt high quality and safe production practices and operations. At the same time, organized retail forms less than 10 per cent of the Indian fruit and vegetable market, with the bulk of the market still unorganized making it harder to monitor and enforce food safety regulations (Netherlands and Horti Tech India, 2020). Alam (2018) observed that market value chain of mango needs to be proper food safety management practices to deliver good quality mango to the market and ultimately to the consumer to command buyer attention. Similarly. the Sanitary and Phyto-sanitary (SPS) measures adopted by different developed countries can also affect the volume and pattern of trade by increasing the costs of imports or prohibiting entirely (Idris *et al*., 2015). The importance of food safety is broadly understood and practiced in the market value chain of fresh mango as well as in the its processed products, intended for export markets. However, food safety issues are still grave throughout the market value chain of mango.

Most of the prior studies have been overlooked the effect of food safety measures in their analysis of value chain of mango. By examining the importance of food safety issues in value chain the need of further research on how adoption of food safety measures affects the organisation of the supply chain (Hammoudia, 2009) and vice versa. Further, risk associated with mango regarding food safety measures are well known, needs a meticulous analysis of market value chains of mango through which ultimately the fruit reaches to the consumers in respect of food safety measures stipulated in the various food safety laws. The present study, therefore, was framed and carried out with objectives of mapping of value chain of mango fruit existed; spotting the value creation activity, prominent actors influencing the value chain and identification of framework of food safety regulations and its compliance status in the value chain of mango existed in the "Malihabad-Kakori" mango belt of district Lucknow, Uttar Pradesh. The analysis conducted in this study was with the purpose of providing a knowledge map to develop food safety-oriented mango value chain by proper policy interventions.

MATERIALS AND METHODS

Spotting the value chains of a commodity like mango is a difficult task as it might seem due to the involvements of a series of value chain actors between production to final consumption activities in it. Hence, it has planned a sound research design to arrest all the aspects with a precision as anticipated. The study is descriptive and illative in nature, and concerned with mapping the value chain of mango and characteristics of value chain actors with special emphasis to depict the possible relationships of all value creating activities. The subsequent step to do the present study was sampling methodology. The state Uttar Pradesh and district Lucknow were selected purposively as Uttar Pradesh is the leading producer of mango, accounted about 24 per cent in the country's production and similarly, "Malihabad-Kakori" belt of district Lucknow produces about 30-40 per cent of annual mango production in Uttar Pradesh (APEDA, 2021). Multistage random sampling procedure was adopted to select the final respondents. A total 80 mango growers, 08 input providers, 04 nursery developers, 15 aggregators, 15 pre-harvest contractors, 10 commission agents, 08 wholesalers', 03 processors, and 20 retailers were selected randomly.

The persuasive data collection methods like structured and semi structured interviews, group meetings and purposive focus group discussions were carried out to elicit the meaningful data. Conscientious analysis of the value chain identified in the area with respect to the variables related to the food safety measures were carried out in a systematic method (Dubey *et al*., 2019). Secondary data related to food safety practices in the mango value chain was collected from published materials. Stakeholders' analysis was used to identify the key actors in the market value chain as suggested by Sah *et al*. (2014). The key stakeholders were identified as per predefined criteria. Then the lists of all possible stakeholders were developed and finally, the stakeholders were ranked according to their

importance and influence in the market value chain of mango (Sanga *et al.*, 2013; Nadhika and Krishnankutty, 2017).

RESULTS AND DISCUSSION

The actors and their roles in the market value chain of mango in "Malihabad-Kakori" mango belt of Lucknow district were identified through interviews with respective respondents. The input providers/nursery developers, mango growers, pre-harvest contractors, aggregators, commission agent, wholesalers, processors, cart vender, traditional retailer, mall, juice maker were major actors engaged in various level of market value chain of mango in the study area. Table 1 lists out the actors and their respective functions prevailed in various levels of market value chain of mango in "Malihabad-Kakori" mango belt of Lucknow district of Uttar Pradesh.

Mango growers of "Malihabad-Kakori" mango belt of Lucknow district were engaged in cultivation activities in the capacity of orchard owners, leased contractors, farmer cum merchants. The pre-harvest contractors were made agreement with the mango growers for the entire production for one or more seasons and, in turn, finance the farm activities and supplied the farm inputs for that particular season. Similarly, commission agents were pay cash in advance to mango growers at the pre flowering stage and procure the whole produce, then the fresh mangoes were moved to traders at distant markets and/or processing units. Nearly 75 percent of the mango growers under the study were sold their produce through either pre-harvest contractors or commission agents. Small mango growers were selling the fresh mangoes to local assemblers who instantly pay cash for their produce. Wholesalers and retailers of fresh mangoes were placed in the distant markets. They procure mangoes from pre-harvest contractors and commission agents. About 23 per cent of fresh mango was processed into various value-added products. The small processors were procured fresh mangoes directly from the mango growers. However, larger processing unit were supplied required quantity of mango by pre-harvest contractors and wholesalers. Various form of retailers was existed to sell mango and mango products in the study area. The traditional retailer, cart vender, mall, juice maker was performed retailing activities. Retailers procured smaller quantities of the products from wholesalers.

Stakeholders' analysis was used to identify the key stakeholders engaged in the form of actors as per their importance and influence in the market value chain of mango. Table 2 illustrates the position-wise catalogue of stakeholders involved in the value chain of mango in the "Malihabad-Kakori" mango belt of district Lucknow. The position of stakeholders or value chain actors is based on their importance, influence and final score (obtained by adding the both scores). The study results showed that value chain actors like wholesalers, commission agents and aggregators were dominating in the value chain as they were secured highest influence ranking (total score) and indicates that wholesalers, commission agents and aggregators were acted with most influencing power in comparison to other actors to channelizing the mango in the value chain in the study area.

Contrary, on the other hand, Table 2 also explicit the ranking of actors according to their importance in the value chain. It was found that mango growers and consumers were given higher importance in the value chain but their assigned roles were incapable to make decisions regarding channelizing the mango in the value chain (as they lost their ranks in the total score) even though they were important.

Table 1: Market value chain of mango prevailed in the "Malihabad-Kakori" mango belt of Uttar Pradesh

Stages	Value chain process	Value chain actors
Ist	Input Supply including supply of quality planting materials	Input Providers (IP) / Nursery Developer-ND
IInd	Production	Small Mango Growers-SMG (< 2 ha) Medium & Large Mango Grower-MLMG (> 2 ha)
IIIrd	Contracting	Pre-harvest Contractor (PHC) / Commission Agent-AC
IVth	Assembling	Aggregators/Assemblers
Vth	Processing, Pulping, Packaging, Branding and Dispersion	Wholesaler and Processor-W/PS
VIth	Retailing	Cart Vender, Traditional Retailer, Mall, JuiceMaker

Source: Author's Survey based compilation, 2017-18.

Table 2: Stakeholders' analysis (mango value chain of mango in U.P.): importance-influence matrix

Stakeholders	Importance rank	Influence rank	Total score
Input Providers (IP)/ Nursery Developer-ND	6	8	14
Mango Growers-MG	1(I)	9	10
Pre-harvest Contractor (PHC)	7	4	11
Aggregator-AG	5	3	8(III)
Commission Agent-AC	4	2	6(II)
Wholesaler-WS	2(II)	1	3(I)
Processor	8	5	13
Cart Vender, Traditional Retailer, Mall, Juice Maker	9	6	15
Consumer	3(III)	7	10

Source: Author's Survey based compilation, 2017-18.

The food industries in several nations are adopting the international concept of Food Safety Objective (FSO) to manage food risks hazards. It is recognized that the entire food chain of production and distribution holds the responsibility to supply safe and healthy food (Jairath and Purohit, 2013). Accordingly, India has also adopted science-based standards and regulations in the form of Food Safety and Standards Act 2006 and related regulations based on international legislations, instrumentalities and Codex Alimentarius Commission for better food quality control.

The food safety and standards Act 2006 and its regulations is the mandatory national public food safety law operated to regulate the food safety issues in fruits and vegetables including mango in Indian states. Holzapfel and Milagrosa (2020) observed that the Indian fruits and vegetables industry is also exercised the voluntary public food safety programme like HACCP advantages and organic programme and similarly, private sustainability standards like GlobalGAP, IndGAP standards and ISO Certifications to ensure the qualitative fruits as per global demand in changing consumer preferences scenario. Jaffee *et al.* (2019) found that India had 21,822 hectares of land certified under GlobalGAP for fruits and vegetables in 2017. During the study it was observed that actors engaged in value chain of mango in the study area were practiced both public and private food safety standards unproportionally across the value chain. Further, large number of small mango growers were unable to adopted the prescribed food safety measures particularly private food safety measures at their level resulting that they were excluded from the high value segments of mango market which have capacity to provides the remunerative prices to the mango growers in the study area.

Food safety regulations and standards for market value chain of mangoes was compiled from FSS (Food Products Standards and Food Additives) Regulations, 2011; FSS (Licensing and Registration of Food Businesses) Regulations, 2011 and FSS (Prohibition & restriction on Sales) regulation, 2011. It revealed that regulations 5.3.11 & 12, 5.3.26, 5.8.23, 5.8.24, 7.3.6 under Food safety and Standards (Food Products Standards and Food Additives), 2011 ensures the quality of fresh mangoes and processed products, standards of product contents, microbiological limits and food additives. Similarly, Schedule IV of the Food safety and Standards (Licensing and Registration of Food Businesses) Regulations 2011 ensures the concept of Food Safety Management System (FSMS) based on implementation of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) by mango businesses. The Regulation 2.3.5 of Food safety and Standards (Prohibition & restriction on Sales) Regulation, 2011 prohibited the use of carbide gas in ripening of fruits. It also restricted the sale of fruits which have been artificially ripened by use of acetylene gas (carbide gas). During the study, it was found that the abovesaid food safety mechanisms were capable to addressed the food safety issues in the entire value chain of mango at a significant extent. But due to lack of activity-oriented food safety measures/ practices for the mango value chain in the Nation's food safety law and also disparity among the various food safety laws (public, private and international food safety laws), the mango value chain actors in the study area were stagnant to followed the food safety measures.

Actors' wise compliance status of food safety measures in mango value chain in the study area was examined and presented in Table 3. For that purpose, specific food safety

measures for each value chain actor level were categorized and assessed. At the level of production, the mango growers in the study area were followed general food safety measures (63 per cent) and hygienic harvest (79 per cent) to greater extent. However, they were facing constraints to implement organic programme for mango production as only 13 per cent of mango growers were accepted it in their orchards in the form of Good Agricultural Practices (GAP) under which they were practiced integrated pest management, soil testing, integrated nutrient management, judicious application of agrochemicals and suitable post-harvest handling activities. Similarly, at the level of contracting, the pre-harvest contractors and commission agents involved in the market value chain of mango in "Malihabad-Kakori" belt of district Lucknow was well practiced hygienic harvest, Quality ripening substance and personal and place hygiene accounted 72, 57 and 78 per cent respectively. But implementation of food safety management plan (FSMP) at contracting level was restricted to 13 per cent of pre-harvest contractors/ commission agents. It indicates that Schedule IV of the FSS (Licensing and Registration of Food Businesses) Regulations 2011 has not implemented effectively by food Authority in the study area because 48 per cent of responsible actors unaware with Food Safety Management System plan. Mango aggregators or assemblers in the value chain had followed food safety measures accordance with prescribed food safety measures. Wholesalers and processors were key actors for implementation of food safety measures in the value chain as they involved in the performance of series of activity related to movement of produce and processing. Wholesaler and processors were practiced assigned food safety measures in the handling of produce at greater range except private food safety and quality standards and HACCP advantages because actors were unaware with those food safety standards. At the level of retailing, the various form of retailers was engaged in retailing of fresh mangoes and its processed products. 66 per cent retailers were supplied the produce with proper personal and place hygiene to the final consumers. While 31 per cent of retailers were not practiced the personal and place hygiene due to location and mode of retailing. Similarly, 31 per cent of retailers were not adopted preventive measures of bio contaminants and 14 per cent of retailers were engaged in the sale of carbide ripened mangoes in the study area.

The market value chain of mango in the study area establishes a large network of value chain actors, which

Table 3: Actors' wise compliance status of food safety measures in value chain of mango in U.P.

Value chain level	Responsible actors	Food safety measures	Compliance status (%)		
			Practiced	Unpracticed	Unaware
Production	Mango Growers	-General food safety compliance	63	16	21
		-Hygienic harvesting	79	13	08
		-Organic Programme	12	53	35
Contracting	Pre-harvest Contractors (PHCs) /Commission Agents-CAs	-Food safety management plan	13	39	48
		-hygienic harvesting	72	09	19
		-Quality ripening substance	57	12	31
		-Personal and place hygiene	78	09	11
Assembling & Transportation	Aggregators-AGs	-Extraneous matter	67	15	18
		-Quality ripening substance	69	13	18
		-Personal and place hygiene	71	24	07
Processing, Packaging, Branding & Dispersion	Wholesaler & Processor-W/PS	-Food safety management plan	32	21	47
		-Standard ripening substance	74	14	12
		-Quality Packaging materials	58	24	18
		-Extraneous matter	79	08	13
		-Preventive measures of bio contaminants	59	30	11
		-Private Food Safety & Quality Standards	–	03	97
		-HACCP advantages	29	26	45
		-Personal and place hygiene	85	06	09
Retailing	Cart Vender, Traditional Retailer, Mall, Juice Maker	-Personal and place hygiene	66	31	03
		-Preventive measures of bio contaminants	57	31	12
		-Sale of carbide ripened mango	14	78	08

made complications in the adoption of various food safety laws. Discrimination in decision-making power among the various value chain actors in the movement of mangoes at different levels of handling of produce (Table 2), makes further constraints to followed the respective food safety norms particularly small mango growers in the study area and resulting that mango growers particularly small growers have limited to the access in high-value markets because of their inability to meet private food safety standards. A substantial percentage of value chain actors were unaware about food safety procedures and standards assigned for various level of handling of fresh mango and its products (Table 3). It has also been observed (Table 3) that there is positive relationship between compliance of food safety measures and higher level of actors (actors closed to consumption unit or Buyer-driven) in the value chain and vice-versa. It indicates the transfer of burden of compliance of food safety norms to successive levels of actors by previous actors in the value chain as less pressure for adoption of food safety norms in producer driven chain. Further, market value chain of mango in the study area was ineffective to followed the dynamic food safety measures like private foods and quality standards, HACCP advantages, organic programme that have required to meet out the global demand in changing food habit scenario. Due to absence of co-operative strategies, processes focused strategies and prevention-oriented strategies for compliance of food safety measures in the market value chain of mango, the food safety Authority was faced challenges to comply the food safety laws in the various aspects of food safety in the value chain of mango in the study area. Most of the consumers are likely to favour products that have some indication of quality so that consumers' food safety concerns can also be an opportunity for mango growers. The effective implementation of food safety measures either it is public or private can be ensured in short value chain of mangoes wherein small number of linkages between the mango growers and the consumers in the study area.

Food safety and quality standards have significantly transmuted across the countries in recent eras due to changing food habits and globalization. Value chains analysis play an important role in identifying dynamic linkages between actors regarding value added activities and respective food safety measures as well as the context in which the chain operates. Hence the in-depth analysis of each value chain process in context of food safety measures is important to suggest suitable forms of value chain that ensure the flows of wholesome foods to the consumers. Study results indicated that the small mango growers in the study area were excluded from the high value market (buyer driven market) because their inability to meet private food safety standards. Further, a substantial percentage of value chain actors of mango in the study area have unable to implement the organic programme and private food safety standards, which is required to meet out the changing global food demand, due to lack of proper information, improper produce certification mechanism and also dilemma about public and private food safety standards among value chain actors of mango in the study area. The study further revealed that due to influential position of actors who engaged in the consumption unit side or buyer driven part of same chain, the homogeneity in compliance of food safety standards over the entire mango value chain is affected. The present study suggested that to create small mango grower oriented short value chain structure in the study area to enhanced the cohesion with food safety measures at each level of process in the value chain by proper policy intervention so that effective inclusion of small mango growers of in the buyer driven markets to be assured.

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Study of Socio-economic and Psychological Characteristics of Distress Farmers of Beed District

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ABSTRACT

A study was carried out to evaluated stress levels amongst the farmers of Beed district of Maharashtra. The data was collected through conducting personal interview with the help of questionnaire. The observations were categorized under different sets according to related parameters responsible for stress development. The study revealed many factors associated for distress condition like mono-cropping, incompatible social behavior, unplanned financial management, aversion to accept and adopt new trends in farming and allied activities.

Keywords: Distress, Psychological behavior, Debt, Hyperness

INTRODUCTION

The United Nations Commission on Sustainable Development (UNCSD) reported that in India one farmer ended his life every 32 minutes between 1997 and 2005. Farmer suicides have become a major concern in India with profound socio-economic implications. This was further increased to 42 per cent in 2015. 15 farmers committed suicide every day in the country during 2014 which went up to 21 in 2015.

Indian economy is known fourth largest economy. In India 70 per cent of population depends on agricultural sector. In Maharashtra, rural economy is solely dependent on rainfall and the freaky monsoon. However, it is recorded that for the last few decades the percentage of rainfall has declined in several Indian states including Maharashtra. The incidences of farmer's suicide are increasing year by year. Mostly five states in India having large ratio of farmers' suicide. These five states are Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh. While comparing with other states it is found that farmer's suicide ratio is high in Maharashtra. Maharashtra is divided in Western, southern, North, Central Maharashtra, Marathwada and Vidarbha regions. Out of these regions Marathwada region has maximum suicide cases. The main cash crop of Marathwada region is cotton. The cotton cultivation has been changing over the years and the farmers have not been able to adjust themselves in the fast changing nature of agriculture. The seed availability was also a problem for cotton cultivators. Most of the farmers who ended their lives through committing suicide are cotton growers. The productivity has also decreased over the years. It has also increased the gap between expenditure and income. Hence cotton growers found themselves in the vicious trap of indebtedness. It has become one of the reasons of the distress act of suicides by farmers in the Marathwada region of the state. The continuity in financial loss kept the cotton growers in state of psychological distress over long period.

The corrective measures to increase the productivity can be manifold like water management, natural farming, special agricultural zone, multiple crop system, supportive sources for farmers, Weather risk management system, providing effective loan schemes, scientific innovation in agriculture.

The efforts to clearly and operationally define a particular form of behavior as suicidal one have so far been problematic for both researchers and clinicians (O'Carroll *et al.,* 1996). This is because of the difficulty to prove posthumously any intention to die. Researchers are still grappling with the fine and subtle distinction between non-suicidal self injurious behavior and suicidal behavior. While this academic debate takes centre stage in international

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journals and at world conferences the statistics on suicide, and more especially adolescent suicides, keep mounting.

Maharashtra recorded 51837 farmer suicides during 1995-2014, which represents 22.50 per cent of total suicides in the country. The number of farmers' suicide has increased sharply in Maharashtra than other states. Considering the base year 1995, farmers' suicides have increased by 284 per cent during the first decade (1995-2004) and 270 per cent during second decade (2005-2014). In the Marathwada region which has 11 districts, the district of Beed was found to be more consistent with suicide cases over the years.

MATERIAL AND METHODS

Six blocks of Beed district of Marathwada region were purposefully selected for the study because of more number of suicidal cases in last 2 years. List of distress farmers was collected with the consultation of village leaders/ key informant. From each selected village, distress farmers were selected randomly. There are 81 sample cases for the study. The information was collected from fellow farmers, CM fellow and other villagers. The two blocks were selected out of six based on the collected information. The years are 2017-18 & 2018-19.

The interview schedule was prepared based on the objectives of the study. The schedule consisted of the background information of the respondent along with the components of the management orientation. The schedule was formulated in consultation with the experts in the field of extension education and by reviewing the relevant literature. Basically, this format was divided in two parts. The first part consisted of 17 questions in concern with farmers basic background, age, education, farming, credit and addiction if any. The second part had 12 questions concern with amount of stress level. Only those were selected for second part who answered question no. 6, 8, 10, 11, 13, 14, 15, 17 affirmatively.

While preparing the interview schedule care was taken to avoid dual meaning questions and contradictory statements. The language of the questions was kept simple for easy understanding. The questions on the various personal characteristics of the farmers having possible correlation with their management orientation and also the constraints faced by the farmer in maintaining their enterprise and their suggestions were included in the schedule.

Score of level of distress levels

Score (Positive Score)	Distress level
0-3	No distress
4-6	Mild distress
7-9	Medium distress
10-12	High distress

The schedule was pre-tested by interviewing 10 farmers in a non-sampled area against ambiguity and redundancy. In the light of the pre-test experience, the interview schedule was modified and used for the data collection after preparing number of requisite copies.

The data were collected with the help of pre-designed interview schedule by contacting the sample farmers personally. The help of local Leaders, Gramsevaks, Talathies, Agricultural Assistants from State Department of Agriculture and Revenue were taken. The interviews were conducted during April to December 2019. On an average the time taken for the interview of a single farmer was about forty five minutes.

RESULTS AND DISCUSSION

It was observed from the Table 1 that, the majority of the respondents (56.79%) belonged to 'middle' age category; while 12.35 per cent were in 'old' category and 30.865 per cent were in 'young' category. The probable reason for majority of the respondents being under middle age category might be due to the fact that most of the young people are not interested in farming and are looking for better livelihood options in urban area. This finding is supported by Panwar *et al.* (2019).

Table 1: Distribution of respondents according to their age

Age Category (years)	Frequency	Percentage
Young (upto 35)	29	30.86
Middle (36-50)	40	56.79
Old (Above 51)	12	12.35
Total	81	100

The Table 2 indicates that 14.81 per cent victims have obtained primary education, followed by 54.32 percent education at secondary level whereas 16.05 per cent were graduated and 11.11 percent were post graduate. Only 3.70 per cent victims were found illiterate. This means majority of the victims had some sort of education. This finding is supported by Panwar *et al.* (2019).

Table 2: Distribution of respondents according to their education

Education Category	Frequency	Percentage
Illiterate	3	3.70
Primary	12	14.81
Secondary	44	54.32
Graduation	13	16.05
Post Graduation	9	11.11
Total	81	100

The Table 3 revealed that, 80.25 per cent of the respondents had medium family size followed by small to large family size, with 19.75 per cent and no family was found without having siblings. The probable reasons behind these findings could be that young and middle age people would prefer to live in nuclear families and old age people prefer joint family. The findings are similar with the findings of Kale (2008) and Parande (2011).

Table 3: Distribution of respondents according to their family size

Family size (members)	Frequency	Percentage
Up to 2	0	0
3-6 members	65	80.25
7-9 members	16	19.75
Total	81	100.00

It was evident from Table 4 that, majority of respondents belonged to low (50.62%), annual income group, followed by medium (38.27%) and high (11.11%) monthly income, respectively. It was observed that majority of the distressed farmers had low monthly income. The probable reason might be due to their source of income being only dry-land farming. Similar findings were reported by Hanchinal (1999) and Parande (2011).

Table 4: Distribution of respondents according to their monthly income

Monthly income (Rs.)	Frequency	Percentage
Up to 5000 (Low)	41	50.62
5001 – 15000 (Medium)	31	38.27
15001-25000 (High)	9	11.11
Total	81	100

The Table 5 revealed that 43.21 per cent belongs to small farmers category, followed by semi-medium 23.46 percent, marginal 16.05 percent, medium 14.81 percent and large 2.47 per cent. It shows that majority of the victims were small and marginal farmers. Similar findings were also reported by Panwar AP *et al.* (2019).

Table 5: Category of farmers according to land holding

Category	Frequency	Percentage
Marginal (Upto 1 ha)	13	16.05
Small (1.01-2.0 ha)	35	43.21
Semi-medium (2.01-4.0ha)	19	23.46
Medium (4.01-10.0 ha)	12	14.81
Large (10.01 and more)	2	2.47
Total	81	100.00

It is evident from the Table 6 that more than half of the victims (51.00%) were having the agriculture + allied occupation like dairy, poultry, goatry, Bee keeping, vermicomposting, vegetable production. It was followed by 49.00 per cent who were engaged in sole agriculture as their main occupation. They were not aware about allied activities and also were not interested in allied activities. They used to say that it is the sheer wastage of money and it is very much time consuming. Few of them claimed that their cast and customs does not allow them to get engaged in goatry and poultry type of allied business.

Table 6: Category of farmer engaged in agriculture allied enterprises

Category	Frequency	Percentage
Engaged in Agricultural +Dairy, Poultry, Goatry, Bee keeping, Nutritional gardening	41	51
Only agriculture No other allied activity	40	49
Total	81	100

As per the Table 7 it is evident that 70.37 per cent farmers are under debt. The farmers generally preferred nationalized banks for obtaining loans. But during survey most of the farmers complained about the difficulties in getting loans approved from nationalized banks. As far as non debt farmers were concerned out of 24 (29.63%) farmers, 12 (14.81%) farmers had good income because of adoption of agriculture + allied enterprises. The remaining 14.81 per cent farmers availed the debt waive scheme by the government.

The Table 8 depicts that of 81 farmers, 71 farmers (87.65%) succeeded to obtain the loan from nationalized banks, followed by 4.94 each from money lenders and

Table 7: Category of farmers according to loan borrowing

Category	Frequency	Percentage
Farmer with debt	57	70.37
Non-debt farmer	24	29.63
Debt repaid through income	12	14.81
Debt waive off by Govt.	12	14.81
Total	81	100.00

Table 8: Category of farmers according to loan borrowed from

Category	Frequency	Percentage
Bank	71	87.65
Money lender	4	4.94
Relatives	4	4.94
Friends	2	2.47
Total	81	100.00

relatives while only 2.47 percent got it from friends. Those who were not having good social-economical status, good relationships with rich people of the society, had to obtain the loan from money lenders at higher interest rates. Rest of the 6(7.41%) farmers took loan from their relatives and friends for a very short period. However, these farmers had to return the money as soon as the crops were harvested and marketed. This finding was also confirmed by Satish Kumar and Rao (2004).

With regard to credit and indebtedness of the victims, it is observed (Table 9) that only 11.11 per cent of victims are regularly repaying the loan and majority of farmers 88.89 per cent were not able to repay of their loans. It is because of their irregular income as most of the farmers were engaged only in agricultural business and not indulged in any other agriculture allied enterprise. This is the main crux for their distress. The findings are similar with the findings of Hanchinal (1999) and Parande (2011).

With regard to credit and indebtedness of the victims, it is observed (Table 10) that only 26 (32.10 percent) of victims are having problems of marriage of their adolescent girls. It is because of vicious tradition of high

Table 9: Category of farmers according to regular loan repayment

Category	Frequency	Percentage
Regular loan repayment	9	11.11
Irregular loan repayment	72	88.89
Total	81	100.00

Table 10: Category of farmers according to having adolescent girl in family

Category	Frequency	Percentage
Having adolescent girl	26	32.10
Not having adolescent girl	55	67.90
Total	81	100.00

dowry. This was prime reason for having high stress symptoms.

As depicted in Table 11 out of 81 farmers 61 farmers replied that they never felt sad/disappointed. The probable reasons might be manifold. As they were habitual of doing domestic and social works, they never felt tired. They also did not see any drastic changes in weight gain. They were punctual in following scheduled routine which kept them free from any stress condition. Due to their focused and planned timely activities, they were financially strong. As a result, they never had insecure feeling either socially or economically. In nut shell though these farmers had some problems, they were not in severely distressed condition but were on the marginal level.

Table 11: Category of farmers according to symptoms

Problems faced	Frequency	Percentage
Not Feeling sad/disappointed	61	75.31
Feeling sad/disappointed	20	24.69
Total	81	100.00

Table 12: Category of positive for questions

Category	Positive for questions	Frequency	Percentage
Mild stress	4-6	13	65.0
Medium stress	7-9	4	20.0
Severe stress	10-19	3	15.0
Total			100.00

There were only 20 respondents answering positively for these queries. Those 20 farmers were then put to another set of questions (19 questions) to gauge the stress level (Table 12).

The stress symptoms exhibited in these three categories were different.

The maximum no. of respondents were from mild category 13 (65.0%). They had shown the following symptoms.

1. Least interest in others activities
2. Unable to take proper decisions when required
3. Emotionally disturbed after seeing other miseries
4. Avoiding the company of relatives or friends
5. Frequently food dejection

There were only 04 (20.0%) showing medium level of stressed symptoms and those are:

1. Loss of interest in everything
2. Difficult to cool down after showing hyperness
3. Unwilling to share emotions with others
4. Easily irritable
5. Dejected feeling all the time
6. Gets upset to seed other's sadness
7. Do not have sound sleep
8. Feels that everything is useless

The third category of severe stress level was observed in 03 (15.0%) respondents and those had shown following symptoms:

1. Feel trouble while breathing
2. Hurt himself rather than accusing others
3. Escape from relatives and friends
4. Feel lump in the throat
5. Gets upset to seed other's sadness
6. Feel worried about upset stomach or constipation
7. Difficult to get back to sleep once wake up
8. Do not have sound sleep
9. Feel irritated all the time
10. Never share their happy moments with others
11. Lost all the hopes from relatives and friends
12. Difficult to cool down once got excited
13. Seldom attend the family gathering
14. Feel dejected all the time

CONCLUSION

The study revealed many conclusions. The problem of this stress was more evident in those farmers who were having a cash crop like cotton, sugarcane as their sole income generating crop under mono-cropping system. Further those farmers were having almost all dependency on borrowed loans. They had small land holding area with bigger family size. They were not update with new technologies and were averse to adopt it. They had not managed their income properly to suffice till the next season. The absence of any allied activity also added to their miseries. They were not socially compatible. They had shown no interest in village level group activities. They were also averse to share their emotions and miseries with fellow farmers and family members. As such they were lone ranger in society. This led to emergence of many physical and psychological aliments which they could not cope up with. The long lasting problems led to sever distress conditions which brought them on the brinks of taking ultimate decision.

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Achievement Motivation and Management Orientation of Self Help Group Members in Akola District of Maharashtra

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ABSTRACT

The SHG is a group of rural poor who have volunteered to organize themselves into a group for eradication of poverty of the members. SHGs are presently promoted by Govt., development banks and voluntary agencies with focus on social and economic issues, mainly thrift and credit programme. The present study was carried out in the Akola district of Maharashtra state during the year 2018-19 with a sample size of 120 to define the achievement motivation and management orientation of self help group members in the Akola district of Maharashtra.

Keywords: Achievement motivation, Management orientation, Women, Programmes, Self-help group

INTRODUCTION

In the 21st century, as the competition increases in each phase of life, motivation appears as the pivotal concept for the self help group individuals who would like to attain their ideal life standards. It has been vital in areas of social relations and business life, self help group members motivation level is measured by their profits or their efforts to do best depending on the climate they are part of and effective utilization of available resources to make larger incomes out of it. One's motivational tendencies are included in each niche of life, ranging from social to working settings, motivated behaviors are taken into consideration as the key elements of success. In accordance with that, achievement motivation emerges as the cornerstone of attaining accomplishments of self help group goals. Most of the women join self help groups to increase their financial condition and achieve something higher than the current situation. It could be due to the increased confidence, support from the group members, government and other non-governmental organizational levels and success of their groups had reinforced them to retain high achievement motivation. Self help groups bring together people who share a common life experience for support, education and mutual aid. While self help groups are beneficial to most members, the potential for negative effects and problematic issues also exists. Implementing the training recommendations and practices described in this study will minimize the potential for problems and maximize the benefits. Therefore, management orientation plays a crucial role in empowering and motivate group participants. Most leaders of the group should welcome the opportunities to maximize the effectiveness of their group. They must be aware of the group needs and areas in which to seek new directions through the measurement process. Group leaders and members should assess the status of the self help group in a timely manner in order to sort out the negatives and work on them to get the best results. A good leader with a great managerial skills drive the members towards higher profits, hence management orientation plays a pivotal role in case self help groups.

MATERIALS AND METHODS

Three talukas namely Akola, Balapur and Telhara of Akola district were purposively selected for the study as they were having self help groups which were actively running, reaping profits and sustaining their livelihoods when compared to other talukas in Akola district.

In Akola, Balapur and Telhara talukas four villages from each taluka were selected randomly on the basis of actively running SHGs in respective villages. Comprising total sample of 12 villages was selected for the present study.

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Out of three talukas 4 villages were selected from each taluka and from each village 10 self help group members as respondents were selected randomly. Thus, total 120 respondents were constituted for the present study. It covers twelve villages in three Panchayat samities of Akola district.

Achievement motivation in present investigation refers to the desire to do well, not so much for the sake of social recognition or prestige but to attain an inner feeling of personal accomplishment. It was measured with the help of procedure adopted by Chandrapaul (1998). In this scale, there are 6 statements and responses obtained on three point continuum namely agree, undecided and disagree with a score of 3, 2 and 1, respectively and reverse scoring was done for negative statements. Scores of all 6 statements of the scale was summed up and categorized on the basis of equal interval method.

Management orientation in the present investigation means the degree to which members were oriented towards effective planning following better production techniques and marketing of products as major components of enterprise. The same was measured by using the scale of Samanta and Ray (1981) with slight modifications. Under planning orientation, there are six statements, six statements under production orientation and six statements under market orientation. The responses of the respondents was measured on five point continuum such as strongly agree, agree, undecided, disagree and strongly disagree with scores of 5, 4, 3, 2 and 1, respectively and reverse for negative statements. After obtaining the score it was categorized on the basis of equal interval method.

RESULTS AND DISCUSSION

Table 1 it is clear that, 96.66 per cent respondents agreed to no matter what I have done I always want to do more, whereas 86.66 per cent of respondents agreed with I would like to try hard at something really difficult even if it provides that I cannot do it, 85.00 per cent of respondents agreed to work should come first even if one cannot get proper rest in order to achieve ones goals.

Based on the achievement motivation levels of SHG members they classified into three categories as low, medium and high and were depicted in the Table 2. Results presented in the Table 2 revealed that, three- fourth (75.00%) of the respondents had high level of achievement motivation, followed by medium (20.00%) and only 05.00 per cent of the respondents had low level of achievement motivation. It could be inferred that, most of the women had high level of achievement motivation. It is due to the increased confidence, support from the group members, government and other non-governmental organizational levels and success of their groups had reinforced them to retain high achievement motivation.

Table 3 it was concluded that, under planning orientation 81.67 per cent of respondents strongly agreed with the statement it is possible to improve the financial aspects of the family through SHG, 70.84 per cent of respondents strongly agreed with the statement the amount of materials, inputs and other required facilities needed for mobilizing a group should be assessed before establishment and 45.00 per cent of respondents strongly

Table 2: Distribution of the self help group members according to overall achievement motivation (n=120)

Category	Frequency	Percentage
Low	06	05.00
Medium	24	20.00
High	90	75.00
Total	120	100.00

Table 1: Statement wise distribution of the self help group members according to achievement motivation

S.No.	Statements	Agree	Undecided	Disagree
1	Work should come first even if one cannot get proper rest in order to achieve ones goals.	102(85.00%)	04(03.34%)	14(11.66%)
2	No matter what I have done I always want to do more	116(96.66%)	00(00.00%)	04(03.34%)
3	It is better to be content with whatever little one has than to be struggling for more	00(00.00%)	09(07.50%)	111(92.50%)
4	The way things are now a day discourage one to work hard	07(05.83%)	04(03.33%)	109(90.84%)
5	One should succeed in occupation even if one has to neglect their family	06(5.00%)	05(04.17%)	109(90.83%)
6	I would like to try hard at something really difficult even if it provides that I cannot do it	104(86.66%)	07(05.84%)	09(07.50%)

Table 3: Statement wise distribution of the SHG members according to management orientation

S.No	Statements	SA	A	UD	DA	SD
A	**Planning orientation**					
1	Each year one should think about the new activities to be undertaken in SHGs.	54(45.00)	64(53.34)	02(01.66)	00(00.00)	00(00.00)
2	It is not necessary to make prior decisions about the different activities to be covered in SHGs.	00(00.00)	00(00.00)	04(03.33)	34(28.34)	82(68.33)
3	The amount of materials, inputs and other required facilities needed for mobilizing a group should be assessed before establishment.	85(70.84)	27(22.50)	03(02.50)	05(04.16)	00(00.00)
4	It is not necessary to think of total cost involved in running SHG activities	00(00.00)	04(03.34)	04(03.34)	48(40.00)	64(53.32)
5	One need not concern any SHG leaders for planning of group	09(07.50)	11(09.16)	08(06.67)	47(39.17)	45(37.50)
6	It is possible to improve the financial aspects of the family through SHG.	98(81.67)	20(16.67)	02(01.66)	00(00.00)	00(00.00)
B	**Production orientation**					
1	Timely production of the products ensures good profits.	72(60.00)	38(31.66)	06(05.00)	04(03.34)	00(00.00)
2	One should invest minimum inputs to get maximum profit.	53(44.17)	49(40.83)	06(05.00)	08(06.67)	04(03.33)
3	Technical information should be followed	64(53.33)	50(41.67)	02(01.67)	04(03.33)	00(00.00)
4	Good quality products harvest good price	85(70.83)	31(25.83)	04(03.34)	00(00.00)	00(00.00)
5	For timely production one should use suitable technology	57(47.50)	60(50.00)	03(02.50)	00(00.00)	00(00.00)
6	With low input rates one should use more inputs as available.	57(47.50)	49(40.84)	14(11.66)	00(00.00)	00(00.00)
C	**Market orientation**					
1	Market news will be useful to the SHG member	86(71.66)	30(25.00)	04(03.34)	00(00.00)	00(00.00)
2	SHG member can get good price by grading their product	52(43.34)	55(45.84)	08(06.66)	05(04.16)	00(00.00)
3	Storage can help the SHG to get better prices for their produce	61(50.84)	39(32.50)	02(01.66)	16(13.33)	02(01.67)
4	One should sell their produce to the nearest market irrespective of price	00(00.00)	13(10.84)	05(04.16)	57(47.50)	45(37.50)
5	Government should create the marketing facilities	36(30.00)	58(48.34)	06(05.00)	12(10.00)	08(06.66)
6	One should start their enterprises which have more market	45(37.50)	67(55.84)	04(03.33)	04(03.33)	00(00.00)

agreed with the statement each year one should think about the new activities to be undertaken in SHGs. Under production orientation, 70.83 per cent of respondents strongly agreed with the good quality products harvest good price, 60.00 per cent of respondents strongly agreed with the statement timely production of the products ensures good profits and 53.33 per cent of respondents strongly agreed with the statement technical information should be followed. Under market orientation, 71.66 per cent of respondents strongly agreed with the statement market news will be useful to the SHG member, 50.84 per cent of respondents strongly agreed with the statement storage can help the SHG to get better prices for their produce. Based on management orientation they were classified into three categories of low, medium and high and are depicted in Table 4. The data in Table 4 showed that, majority (68.33%) of respondents found in medium level of management orientation towards planning, production and marketing, followed by 20.84 per cent of them in high, whereas the remaining 10.83 per cent of respondents had low level of management orientation. It

Table 4: Distribution of the self help group members according to overall management orientation (n=120)

Category	Frequency	Percentage
Low	13	10.83
Medium	82	68.33
High	25	20.84
Total	120	100.00

could be inferred that the management within selfhelp group members observed to be medium in planning to production. Women needed to improve to enhance the productivity of the activities they perform. Management skills plays a key role for effective functioning of a self help group.

CONCLUSION

Therefore in this paper it is clear that women in the self help group members were high in their achievement motivation, the main reason is to improve themselves and the work they do in performing their activities to enhance their livelihood and improve the standard of living and support their families economically. Whereas in Management Orientation it was seen as medium level where women were facing problem in managing their activities, this area need to be focussed and plan, categorize and allot every department of the group to certain work. This way there can be more efficiency in performing the activities in a better manner.

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Inclusive Growth in India and its Elements: A Review

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ABSTRACT

India is 5th in the world in terms of Gross Domestic Product. Its GDP in nominal prices was Rs. 190.1 lakh crore (US$ 2.7 trillion) in 2018-19. As reported by UNDP, India ranks 129th in Human Development Index with a value of 0.649. India ranks 62 among 74 emerging economies in Inclusive Development Index. Several schemes are being implemented by the government for inclusive growth. MGNREGA has benefitted 22.5 per cent of the rural households by providing wage employment for about 43 days. It has increased the income of rural households and has been successful in reducing the poverty level by 4 per cent. PM-KISAN has helped those who are relatively more dependent on agriculture. It is critical that the policy recommendations are in accordance with inclusive development of the country. This requires a holistic approach that considers factors such as education, health, skill development and social inclusion including employment.

Keywords: Agriculture, Gross domestic product, Inclusive growth, Poverty, Social sector development

The Organization for Economic Co-operation and Development (OECD) defines inclusive growth as the economic growth that is distributed fairly across society and creates opportunities for all people. The top 10 per cent of income earners take home over ten times more pay than the bottom 10 per cent. Sreedhar (2017) in his study confirmed that the poorest 40 per cent of the world's population account for only 5.0 per cent of world income. On the other hand, the richest 20 per cent account for 75 per cent of global income. We need to develop new and improved models and focus on ensuring growth that actually improves lives of people. In other words, inclusive economic growth is not only about expanding national economies but also about ensuring that benefits must reach the most vulnerable sections of the society. The "equality of opportunity" and "participation in growth by all" with a special focus on the working poor and the unemployed are the very basis of inclusive growth (UNDP).

The growth of Indian economy is projected at rate of 5.8 per cent in 2020. India's per capita income, a gauge for measuring living standard, is estimated to be Rs. 96,563 (2018-19). India's GDP in nominal prices was Rs. 190.10 lakh crores (US$ 2.7 trillion) in 2018-19 (Economic Affairs, 2018-19). Although India is 5th in the world in terms of GDP but exclusion in terms of low agricultural growth rate, poor education, inadequate healthcare services, low quality employment, rural-urban divide, social inequalities and regional disparities etc. are the key problems for the nation. Child labour, illiteracy, poverty, poor quality of education and women harassment etc. are some vital factors which demand the importance of inclusive growth in India.

Developing India's stellar gross domestic product (GDP) growth rates have concealed rapidly rising relative and absolute inequalities, leading to two faces of India (Shukla, 2009). 'The Shining India' segment can be said to have propelled India to its present rates of remarkable sustained economic growth. It constitutes India's captains of industry, its industrialists, its enterprising businessmen, India's middle-middle class and upper-middle class. Whereas, a "suffering India", not as well publicized by media but even more significant, constitutes the population who are underprivileged and helpless. India is a country where 102 billionaires (Forbes, 2020) live alongside 230 million others living below poverty line without basic everyday necessities. These two faces of India are both a symbol of hope and a sign of despair. Merging these two

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faces will bring what we referred to as the Inclusive Growth. Inclusive growth was targeted for sustainable development and impartial distribution of wealth in India during 11th and 12th five year plan.

Global Economy

India is 5th in the world in terms of Gross Domestic Product. Its GDP in nominal prices was Rs. 190.1 lakh crore (US$ 2.7 trillion) in 2018-19. As reported by UNDP, India ranks 129th in Human Development Index with a value of 0.649. India, with an improving trend, ranks 62nd out of 74 emerging economies in Inclusive Development Index. The country performs best (44th) in terms of Intergenerational Equity and Sustainability, profiting from a low dependency ratio that is set to further decline as the economy reaps the dividends of an extremely young population (28% of the Indian population was younger than 14 years in 2017). However, despite this, India is ranked below the neighbouring countries of Pakistan (47), Sri Lanka (40) and Nepal (22) in terms of Inclusive Development Index.

Scenario of Indian Economy

India's GDP at current market prices and constant market prices stood at 204.4 and 147.8 Rs. Lakh crores (2019-20) respectively with an annual growth rate of 5 per cent (Economic Affairs, 2018-19). The per capita net national income at current prices was estimated Rs. 1,35,050 (2019-20) showing a rise of 6.8 per cent as compared to Rs. 1,26,406 (2018-19) with the growth rate of 10.0 per cent (PIB, Govt. of India). The growth rate in Gross Value Added (GVA) at constant prices is 5.8 per cent (2017-18) and the share of primary, secondary and tertiary sectors is 19.5, 27.0 and 53.5 per cent respectively. The per capita income of India at constant prices has increased from Rs. 63462 in 2011-12 to Rs. 96563 in 2019-20. The share of agriculture and allied sectors in total GVA of the country is Rs. 3047187 crore. The overall farm mechanization in India is about 40 per cent, which is lower compared to China (59.5%) and Brazil (75%). Indian tractor industry is the largest in the world, accounting for one-third of the total global tractor production. The total tractor sales have increased from 6.26 lakh in 2015-16 to 8.97 lakh in 2018-19. The milk production of country has also increased from 4.64 million tonnes in 2010-11 to 6.47 million tonnes in 2018-19 with a growth rate of 6.47 per cent.

India with a value of 0.649 stood at 129th position in terms of Human Development Index (HDI) among 189 countries, Norway being on the top with value 0.954. Among G20 economies, India ranks second last, ahead of only South Africa. Though the incidence of poverty has declined in India over the past five years, 6 out of 10 Indians still live on less than $3.20 per day. Both labor productivity and GDP per capita posted strong growth rates over the past five years, while employment growth has slowed. Healthy life expectancy also increased by approximately three years reached to 59.6 years. According to the study, Norway tops the chart followed by Iceland and Luxemburg in advanced economies.

Scenario of Haryana

The Economic Survey of Haryana reveals that the Gross State Domestic Product of Haryana has increased from Rs. 297538.52 in 2011-12 to Rs. 531085.19 in 2018-19. The per capita income of Haryana has increased from Rs. 106085 in 2011-12 to Rs. 180026 in 2019-20. The share of Agriculture and allied sector, Industry sector and Service sector in state's economy is 16.6, 32.8 and 50.6 per cent respectively.

Elements of Inclusive Growth

Several factors as inter-related components of inclusive growth strategy comprised of expansion of investment in rural areas, improvement in rural infrastructure, increase in rural employment, access to essential services by all the people of society, good governance, women empowerment, increase in public spending on healthcare and education, skill building and equality of opportunity.

The major elements of Inclusive Growth can be summarized as-

1. Poverty reduction: The poverty ratio has declined from 45.3 per cent in 1993-95 to 18.7 per cent in 2013-14 and the number of poor persons has declined from 403.7 million to 230.8 million during the same period (Table 1 and 2). Chhattisgarh have the maximum number of people i.e. 104.11 lakhs (39.93 per cent of total population) below poverty line. In Haryana, about 11 per cent of the total population is under the below poverty line. There are many poverty alleviation programs like Jawahar Gram Samridhi Yojana, Pradhan Mantri Gramin Awaas Yojana, Integrated Rural Development Programme, National Old Age Pension Scheme etc being implemented by government of India. Bayineni (2006) in his study explained about the philosophy underlying these programs i.e. to reduce the rural poverty by providing training to the poor for raising

Table 1: Number and percentage of population below poverty line in India: 2011-2012

Geographical Zones	State/ UT	Population below poverty line					
		Rural		Urban		Total	
		No. of persons (lakhs)	% of persons	No. of persons (lakhs)	% of persons	No. of persons (lakhs)	% of persons
Western	Rajasthan	84.19	16.05	18.73	10.69	102.92	14.72
	Gujarat	75.35	21.5	26.88	10.14	102.23	16.63
	Maharashtra	150.56	24.22	47.36	9.12	197.92	17.35
	Goa	0.37	6.81	0.38	4.09	0.75	5.09
North-western	Punjab	13.35	7.66	9.82	9.24	23.18	8.26
	Haryana	19.42	11.64	9.41	10.28	28.83	11.16
	Uttar Pradesh	479.35	30.4	118.84	26.06	598.19	29.43
Southern	Tamil Nadu	59.23	15.83	23.4	6.54	82.63	11.28
	Karnataka	92.8	24.53	36.96	15.25	129.76	20.91
	Kerala	15.48	9.14	8.46	4.97	23.95	7.05
	Andhra Pradesh	61.8	10.96	16.98	5.81	78.78	9.2
Eastern	Bihar	320.4	34.06	37.75	31.23	358.15	33.74
	West Bengal	141.14	22.52	43.83	14.66	184.98	19.98
	Orissa	126.14	35.69	12.39	17.29	138.53	32.59
	Jharkhand	104.09	40.84	20.24	24.83	124.33	36.96
Central	Madhya Pradesh	190.95	35.74	43.1	21	234.06	31.65
	Chhattisgarh	88.9	44.61	15.22	24.75	104.11	39.93
Hill states	Himachal Pradesh	5.29	8.48	0.3	4.33	5.59	8.06
	Uttarakhand	8.25	11.62	3.35	10.48	11.6	11.26
	J & K	10.73	11.54	2.53	7.2	13.27	10.35
North-eastern	Assam	92.06	33.89	9.21	30.49	101.27	31.98
	Tripura	4.49	16.53	0.75	7.42	5.24	14.05
	Mizoram	1.91	35.43	0.37	6.36	2.27	20.4
	Meghalaya	3.04	12.53	0.57	9.26	3.61	11.87
	Manipur	7.45	38.8	2.78	32.59	10.22	36.89
	Nagaland	2.76	19.93	1	16.48	3.76	18.88
	Arunachal Pradesh	4.25	38.93	0.66	20.33	4.91	34.67
	Sikkim	0.45	9.85	0.06	3.66	0.51	8.19
Union Territories	Delhi	0.5	12.92	16.46	9.84	16.96	9.91
	Lakshadweep	0	0	0.02	3.44	0.02	2.77
	A &N Islands	0.04	1.57	0	0	0.04	1
	Puducherry	0.69	17.06	0.55	6.3	1.24	9.69
	Daman & Diu	0	0	0.26	12.62	0.26	9.86
	Dadra & Nagar Haveli	1.15	62.59	0.28	15.38	1.43	39.31
	Chandigarh	0	1	2.34	22.31	2.35	21.81

Table 2: Trends of poverty ratio in India over the years

Year	Poverty Ratio (%)			Number of poor in millions		
	Rural	Urban	Total	Rural	Urban	Total
1993-95	50.1	31.8	45.3	328.6	74.5	403.7
2004-05	41.8	25.7	37.2	326.3	80.8	407.1
2009-10	33.8	20.9	29.8	278.2	76.5	354.7
2011-12	25.7	13.7	21.9	216.7	53.1	269.8
2013-14	20.6	11.3	18.7	183.6	47.2	230.8

their skills and providing them with productive assets so that they are assured of a regular stream of employment and income in raising themselves above the poverty line.

2. Agricultural development: Agriculture has been considered as central instrument for growth due to two main reasons i.e. first, it has a big share of GDP and, second, it stimulates the structural transformation means moving resources from low productivity sectors to higher productivity sectors (Ramesh, 2017). Kaur (2013) has identified three key roles of agriculture in promoting inclusive growth which are summarized as stimulating economic growth, reducing poverty, and creating employment. The agricultural credit flow target for 2019-20 has been fixed at Rs. 13,50,000 crores, and till 30th November, 2019, a sum of Rs. 9,07,843.37 crores has been disbursed. Agriculture is vital input for better access improved production technologies for improving farm productivity. The regional distribution of agricultural credit in India is highly skewed. It is observed that credit is low in North Eastern, Hilly and Eastern states. The share of North Eastern states has been less than one (1.0%) percent in total agricultural credit disbursement.

At least 10,349 people working in the farm sector (consisting of 5,763 farmers/cultivators and 4,586 agricultural labourers) ended their lives in 2018, accounting for 7.7 per cent of the total number of suicides in the country (1,34,516) according to the National Crime Records Bureau (NCRB). Majority of suicides were reported in Maharashtra (17,972) followed by Tamil Nadu (13,896), West Bengal (13,255), Madhya Pradesh (11,775) and Karnataka (11,561), accounting for 13.40, 10.30, 9.90, 8.80 and 8.60 per cent respectively. These five states together accounted for 50.90 per cent of the total suicides reported in the country. The remaining 49.10 per cent suicides were reported in the remaining 24 states and 7 UTs. Uttar Pradesh, the most populous state with 16.90 per cent share of the country's population, has comparatively lower percentage share of suicidal deaths, sharing only 3.6 per cent of the total suicides in the country in 2018 as most of agriculture area is irrigated and less effected from drought conditions. Delhi, which is the most-populous UT, has reported the highest number of suicides (2,526) among UTs, followed by Puducherry (500). Behera (2015) made an overall analysis on the growth performance of agriculture and allied activities of Gujarat and India. It was found out that Gujarat has facilitated inclusive development in agriculture by increasing farm income and farm sector growth through the path of livestock and horticulture sectors. Ranade (2020) in his book stated that even if agriculture growth will take place at an accelerated rate, the leakages in the linkage of agriculture with non-tradable sectors will pose a binding constraint on poverty alleviation and inclusive development. So our policies should be framed to reduce these leakages.

3. Social sector development: A review of earlier studies finds that social sector development and economic growth are closely inter-related. Pattayat and Rani (2017) in their study suggested that there exists a high degree of correlation between economic growth and the expenditures on social sector development. The policy measures focusing on infrastructure development are highly anticipated for commencing social sector development and for the long run economic growth, there should be provision for better healthcare, sanitation facilities and skill development measures.

Sharma (2014) advocated that the human development of a country can be enhanced through education and healthcare, the demand for which will be increased if the general level of per capita income will be increased. Secondly, the poorer sections of the population will enjoy the fruits of growth as economic growth is also associated with the poverty reduction and ultimately it will have a better impact on human development indicators.

The Human Development Index (HDI) of India has increased from 0.467 in 1990 to 0.708 in 2018. Kerala tops among the states in HDI with the value of 0.779 depicting high human development (Table 3 and 4). Haryana has the HDI value of 0.708. The lowest rank among all the states and UTs has been occupied by Madhya Pradesh with HDI value of 0.606.

Rani (1999) in her study concluded that the highest share of the lowest HDI ranked districts fall in the states of Uttar Pradesh, Madhya Pradesh, Bihar and Rajasthan. The study suggested that these states need serious and immediate steps for improving the social and economic condition. The lowest HDI ranked states in 2018 are Bihar, Uttar Pradesh, Jharkhand and Madhya Pradesh.

4. Regional disparities: Regional disparities or imbalances mean wide differences in level of industrialization, per capita income, health and education services, literacy rates, etc. between different regions. Regions may be either states or various regions within a state. Regional imbalance is a threat to the goal of inclusive growth and reduction of

Table 3: Status of various parameters for Human Development Index in India: 1990-2018

Year	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2011 PPP$)	HDI value India	HDI value Haryana
1990	57.9	7.6	3.0	1882	0.431	0.467
1995	60.3	8.2	3.5	2188	0.463	0.506
2000	62.5	8.3	4.4	2683	0.497	0.549
2005	64.5	9.7	4.8	3387	0.539	0.591
2010	66.7	10.8	5.4	4403	0.581	0.634
2015	68.6	12.0	6.2	5674	0.627	0.686
2016	68.9	12.3	6.4	6075	0.637	-
2017	69.2	12.3	6.5	6446	0.643	-
2018	69.4	12.3	6.5	6829	0.647	0.708

Table 4: Human Development Index of different states and union territories of India: 2018

Geographical Zones	State/ UT	HDI	Geographical Zones	State/ UT	HDI
Western	Rajasthan	0.629	Hill states	Himachal Pradesh	0.725
	Gujarat	0.672		Uttarakhand	0.684
	Maharashtra	0.696		J & K	0.688
	Goa	0.761	North eastern	Assam	0.614
North western	Punjab	0.723		Tripura	0.658
	Haryana	0.708		Mizoram	0.705
	Uttar Pradesh	0.596		Meghalaya	0.656
Southern	Tamil Nadu	0.708		Manipur	0.696
	Karnataka	0.682		Nagaland	0.679
	Telangana	0.669		Arunachal Pradesh	0.66
	Kerala	0.779		Sikkim	0.716
	Andhra Pradesh	0.65	Union Territories	Delhi	0.746
Eastern	Bihar	0.576		Lakshadweep	0.75
	West Bengal	0.641		A &N Islands	0.739
	Orissa	0.606		Puducherry	0.738
	Jharkhand	0.599		Daman & Diu	0.708
Central	Madhya Pradesh	0.606		Dadra & Nagar Haveli	0.663
	Chhattisgarh	0.613		Chandigarh	0.775

poverty (Kumar, 2016). The increasing regional disparities are the main reason for reduced speed of further economic reforms, and hence may act as a hindrance in India's future economic growth. These inequalities are a worldwide phenomenon and occur in both developed and developing economies. India is a country with huge regional disparities where the National State Domestic Product per capita taken on the basis of three years average (2017-20) varies from Rs. 4.40 lakh in Goa to only 0.41 lakh in Bihar with national average of Rs. 1.25 lakh as shown in Table 5.

Kumar and Rani (2019) in their study found Kerala as the best state among all states and UTs in terms of social progress. Haryana, Punjab, Uttar Pradesh and Rajasthan are at the bottom on the lowest in the ranking scale and can be characterized as socially backward states. Haryana stands at 5th among all states and Union Territories with NSDP per capita of Rs. 2.64 lakh. The disparities can also be depicted from the state wise gap in literacy rates of males and females which is as high as 23.20 in Rajasthan and as low as 2.20 in Kerala with Indian average of 14.40. Gender gap in literacy rates in rural Haryana is found to be 19.40 whereas in urban Haryana it is found to be 14.0 with state average of 16.70. The literacy rates in India have increased from 67.30 in 2004-05 (NSS 61th Round) to 76.9 in 2017-18 (PLFS). Rani (1999) suggests that much of the inequalities in human development at district level come from the regional disparity in the levels of income. Literacy, particularly the rural female literacy, across states also brought out the regional disparity.

5. Gender Disparity: Gender disparity refers to the differences in women's and men's access to resources, status and well-being, which usually favour to men and are often institutionalized through law, justice and social norms. In an era of globalization, no country can develop and achieve its full potential if half of its population is locked in non-remunerative, less productive and non-economic activities (World Bank, 2011). Klasen and Lamanna (2009) in their study also supported that the current obstructions to female employment are not only detrimental to women, but also seem to reduce economic growth in developing countries like India. Moreover, reducing existing gender inequality in education and employment will not only promote economic growth but also further reinforce the other valuable development goals such as reductions in fertility, child mortality and under-nutrition. The vast majority of theories reviewed imply that gender inequality is an obstacle to development, particularly over the long run (Klasen and Silva, 2018). Gender disparity in India's labour market widened due to decline in female labour force participation especially in rural areas and around 60 per cent of

Table 5: Status of per capita Net State Domestic Production (NSDP) in various states and union territories of India

Geographical Zones	State/ UT	2017-2020	Geographical Zones	State/ UT	2017-2020
Western	Rajasthan	104986	Eastern	Bihar	41226
	Gujarat	185263		West Bengal	101601
	Maharashtra	191855		Orissa	93749
	Goa	440229		Jharkhand	72642
North-western	Punjab	148736	North-eastern	Assam	78131
	Haryana	237293		Tripura	106789
	Uttar Pradesh	65250		Mizoram	172377
Southern	Tamil Nadu	193190		Meghalaya	89424
	Karnataka	199268		Manipur	67493
	Telangana	204399		Nagaland	110781
	Kerala	193770		Arunachal Pradesh	134892
	Andhra Pradesh	145426		Sikkim	337388
Hill states	Himachal Pradesh	180495	Union Territories	Delhi	347257
	Uttarakhand	190529		A &N Islands	159664
	J & K	87296		Puducherry	220441
Central	Madhya Pradesh	86969		Chandigarh	312821
	Chhattisgarh	96887		**India**	125265

productive age (15-59) group are engaged in full time domestic duties (Economic Affairs, 2019).

The female labour force participation rate in India has decreased from 45.20 in 1993-94 to 25.30 in 2017-18 with major decline in rural sector from 52.10 to 26.60 during same period and less decline in urban sector from 25.10 to 22.30. The ratio of female to male labour force participation rate has also declined in the rural as well as urban sector during the same period with national average of 0.3 to 0.28. The status of crime against women is also increasing over the years with 3.29 lakh in 2015 to 3.60 lakh of cases in 2017. The gender gap in the literacy rates of males and females in last two decades was found to be highest in Rajasthan (23.20) and lowest in the state of Kerala (2.20) with national average of 14.40 (Table 6). These data reflects that India is so far from calling itself a 'gender neutral' country and these gaps are rooted in cultural and social practices of our nation. So it is not easy to provide simple and direct solutions to minimize these gaps. Possibly, the change will come only with awareness, cultural/ fundamental restructuring, mindset shifting and through widening access to public service delivery without discrimination on a gender basis (Singh, 2016). Jayachandran (2014) gives several mechanisms through which gender disparity decreases as countries grow. First, a sectoral shift away from agriculture toward services occurs. Second, technological advances reduce the time needed for household chores. Third, decline in the frequency and risk of childbearing. All these factors increase women's participation in the labor force, thereby increasing human capital investment.

GOVERNMENT INITIATIVES FOR INCLUSIVE GROWTH

Several schemes are being implemented by the government of India for achieving the inclusive growth. It would be cumbersome to include all the schemes in one go. So based on the maximum budget expenditure allocated for the schemes such as Mahatma Gandhi National Rural Employment Guarantee Act Scheme (51.20% of total allocation to Ministry of Rural Development) and Pradhan Mantri Kisan Sammaan Nidhi, (53% of total allocation to Ministry of Agriculture and Farmer's Welfare) are reviewed in this study.

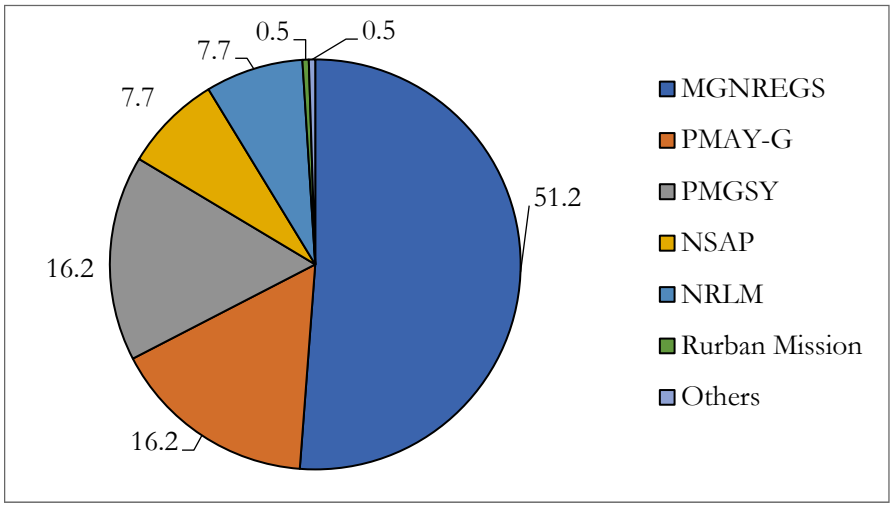
1) MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act): The main aim of MGNREGA is achieving social development by providing employment opportunities and livelihood to all segments/sections of the society. Over 53 per cent of the total employment provided in the past eight years has been undertaken by women. Aadhar based transfers as well as improving the banking network (through both formal banking as well as by making India Post as core banking compliant) has improved livelihood among the poor in the rural areas. The extent of employment is more in agriculturally backward districts as compared to the agriculturally-advanced districts (Usha *et al.,* 2011). Despite being a source of employment, MGNREGA has not been

Table 6: Status of gender gap in the literacy rates in various states of India in last two decades

State/ UT	Gender Gap			State/ UT	Gender Gap		
	Rural	Urban	Total		Rural	Urban	Total
Andhra Pradesh	14.1	13.2	13.9	Madhya Pradesh	16.9	11.9	15.7
Assam	9.5	-5.1	8.9	Maharashtra	15.6	7.7	12.3
Bihar	19.9	20.2	19.2	Odisha	14.7	8.5	13.7
Chhattisgarh	18.4	7.0	16.7	Punjab	11.5	7.1	10.0
Delhi	0.0	8.4	11.3	**Rajasthan**	**25.0**	**16.5**	**23.2**
Gujarat	17.7	7.8	14.7	Tamil Nadu	13.4	6.4	10.0
Haryana	**19.4**	**14.0**	**16.7**	Telangana	16.9	12.7	15.4
Himachal Pradesh	13.1	4.8	12.4	Uttarakhand	14.1	11.5	13.6
J & K	18.9	12.8	17.7	Uttar Pradesh	20.1	11.9	18.4
Jharkhand	19.2	14.0	18.3	West Bengal	9.4	6.7	8.7
Karnataka	15.1	8.8	12.9	**India**	**16.5**	**9.4**	**14.4**
Kerala	**2.6**	**1.8**	**2.2**				

Source: NSS 75th Round, Jul. 2017-Jun. 2018; * Gender Gap=Literacy rate for males-Literacy rate for females

Figure 1: The percentage of total allocation for various schemes implemented by Ministry of Rural Development



able to check the migration from the developed region because of higher market wage rates at destinations. Farmers owning large size of landholdings and having more number of animals are not much interested in participating in MGNREGA activities. These activities have been divided into 10 broad categories like watershed, irrigation and flood management works, agricultural and livestock related works, fisheries and works in coastal areas and the rural drinking water and sanitation related works.

Across the different land classes of farmers, the number of MGNREGA job card holders was maximum in landless (29.2%), sub-marginal (37.5%) and marginal (30.8%) households and was minimum but still substantial, for large households (19.7%). Job seekers represent the number of job card holders who sought employment among the total job card holders. The mandate of MGNREGA is to provide 100 days of wage employment in a year, but no rural household could achieve this target of 100 days employment. As the large households could manage to get work for 67 man days and the landless and small households, could get employment for 41-46 man days only (Table 7). It was found that job card holders under MGNREGA spent a higher percentage (57%) of their income on food commodities compared to non-job card holders (51%). In case of non-food commodities, non-job card holders spent a higher percentage (49%) as compared to job card holders (43%). The expenditure (Rs./capita/day) was also high for the non-job card holders (Table 8).

The constraints being faced by the beneficiaries of MGNREGA were listed by Sarkar et al (2011). Most of the beneficiaries (63%) reported the delay in wage payment as the major constraint, followed by non-availability of regular work (34%), political disturbances associated with

Table 7: Coverage of MGNREGA scheme in rural India

Category	No. of sample rural house-holds	MGNREGA job card holders		MGNREGA job seekers		MGNREGA beneficiaries			
		No. of house-holds	% of house-holds	No. of house-holds	% of house-holds	No. of house-holds	% of job seekers	Employ-ment (No. of days in a year)	% of sample rural house-holds
Landless	25087	7314	29.2	6243	85.4	5156	82.6	41.3	20.6
Sub-marginal (<0.5 ha)	21266	7974	37.5	6905	86.6	5797	84.0	42.9	27.3
Marginal (0.5-1.0 ha)	8158	2514	30.8	2040	81.1	1734	85.0	45.7	21.3
Small (1-2 ha)	2816	735	26.1	516	70.2	415	80.4	51.3	14.7
Medium (2-4 ha)	1330	379	28.5	225	59.4	185	82.2	52.4	13.9
Large (>4 ha)	472	93	19.7	45	48.4	39	86.7	67.2	8.3

Source: Kumar and Joshi, 2013.

Table 8: Impact of MGNREGA on Expenditure pattern of rural households

Socio-economic dimension	MGNREGA job card holders	MGNREGA non-job card holders	MGNREGA job card holders		
			Job seekers		Non-job seekers
			Beneficiaries	Non- beneficiaries	
Share of food expenditure in total expenditure %					
Food commodities	57	51	58	58	54
Non- food commodities	43	49	42	42	46
Expenditure (Rs/ capita/ day)	28.80	37.20	28.60	26.60	31.60

Table 9: Opportunities and constraints faced by the beneficiaries

Constraints	Respondent identifying the constraints (No.)
Delay in wage payment	52(63)
Non-availability of regular work	28(34)
Political disturbances	21(26)
No special provisions for elderly persons	17(21)
Hectic process of Bank/ Post Office payments	12(15)
Corruption	7(9)
Nepotism	4(5)
Non-availability of work site facility	5(6)

MGNREGA works (26%) and lack of special provision for the old persons (21%) (Table 9).

EMPLOYMENT PROVIDED

The scheme guarantees 100 days of employment. However, from 2012 to 2018, the average number of days of employment has been 45.5 days, with a maximum of 49 days of employment in 2015-16. As MGNREGA is a demand driven scheme, this could be due to either lower demand for such work (signalling sufficient opportunities to obtain work in the open market) or not providing employment when demanded.

2) Pardhan Mantri-Kisan Samman Nidhi (PM-KISAN): Ministry of Agriculture and Farmers Welfare, Government of India has got an allocation of Rs. 1,42,762 crores (5% of total central budget) in 2020-21. The government believes that the welfare of farmers will improve if there is an increase in net income from the farms. Keeping this in view, more than 78 per cent of the Ministry's budget was proposed to be spent on three schemes being implemented i.e. PM-KISAN (53%), Interest Subvention Scheme (15%), and Pradhan Mantri Fasal Bima Yojana (11%). PM-KISAN accounted for 53 per cent of the allocation i.e. 75000 crores to the Ministry in 2020-21 (Fig 2). The PM-KISAN scheme was launched in February 2019 to provide income support of Rs. 6,000 per year (disbursed in three installments of Rs. 2,000) to farmer families with the aim of supplementing their financial needs in procuring inputs for appropriate crop health and yields. Earlier, only small and marginal landholder farmer families, i.e. families with total cultivable landholding of up to two hectares, were eligible for the scheme. In May 2019, the Union Cabinet approved extension of the scheme to all farmer families irrespective of their size of landholdings. PM-KISAN has significantly helped those who are relatively more dependent on agriculture and have poor access to credit. Moreover, scheme has significantly stimulated the KVK's impact on the adoption of modern cultivars (IFPRI Discussion paper, 2020). Uttar Pradesh (2,02,34,707) has the maximum number of beneficiaries of PM-KISAN followed by Maharashtra (90,73,782) and Rajasthan (59,54,395). PM-KISAN beneficiaries in Haryana accounts for 15,42,748 (Table 10). The first installment of PM-KISAN was majorly spent on agricultural activities (52%), whereas, in second

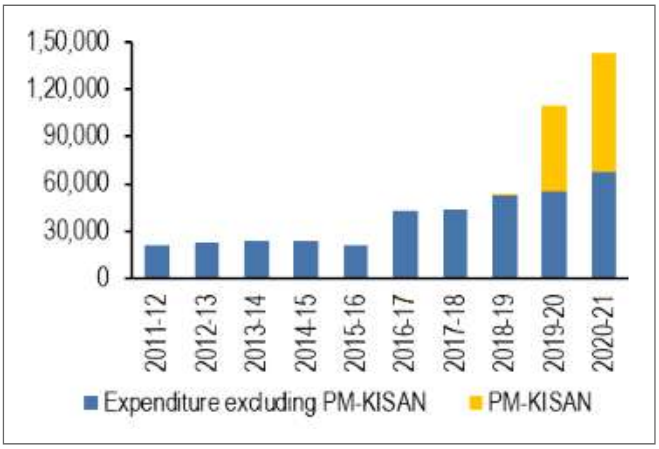


Figure 2: Expenditure incurred in implementation of various centrally sponsored schemes: 2011-21 (Rs crore)

Table 10: State-wise number of beneficiaries under PM-KISAN scheme (As on Feb 11, 2020)

State	Number of Beneficiaries	State	Number of Beneficiaries	State	Number of Beneficiaries
A&N Islands	16,584	Haryana	15,42,748	Mizoram	69,420
Andhra Pradesh	51,54,980	Himachal Pradesh	8,75,212	Nagaland	1,70,286
Arunachal Pradesh	56,628	J&K	9,57,049	Odisha	36,54,583
Assam	31,07,195	Jharkhand	15,15,528	Puducherry	9,778
Bihar	54,98,078	Karnataka	49,73,543	Punjab	22,39,849
Chandigarh	457	Kerala	28,23,238	Rajasthan	59,54,395
Chhattisgarh	19,81,216	Lakshadweep	1,516	Sikkim	8,849
D&N Haveli	10,564	Madhya Pradesh	57,53,671	Telangana	35,02,566
Daman & Diu	3,587	Maharashtra	90,73,782	Tripura	1,96,462
Delhi	13,727	Manipur	2,05,549	UP	2,02,34,707
Goa	8,339	Meghalaya	72,690	Uttarakhand	7,14,783
Gujarat	47,88,238				

Source: Website of PM-KISAN scheme as accessed on February 12, 2020; PRS

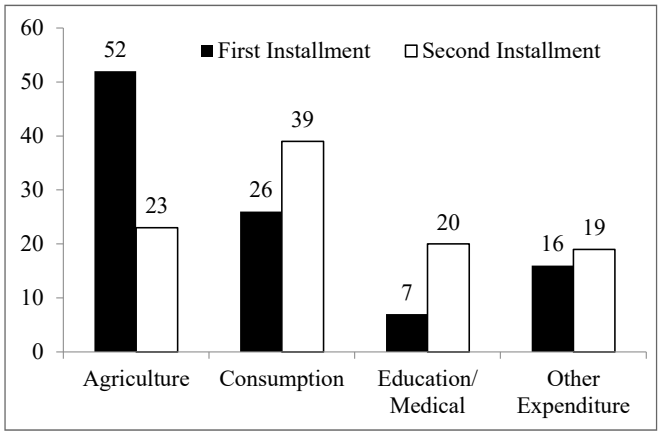


Figure 3: Spending pattern of PM-KISAN beneficiaries in Uttar Pradesh

Source: Indian Council of Agricultural Research-IFPRI, 2019

Note: "Other expenditure" includes incidental expenses such as festivals, marriages etc.

installment the major expenditure i.e. 39 per cent was incurred on consumption (ICAR-IFPRI, 2019).

CONCLUSION

There are strong social, economic and political reasons for achieving broader and inclusive growth. Socially, lack of inclusive growth leads to unrest among many people. There is also an economic argument. The measures which raise equity also promote economic growth. Lastly, the political argument is that no government in a democracy can afford to ignore large sections of workers and non-working population. If it is not inclusive it can generate very severe social tensions. Thus, politically, for having a stable and democratic society one needs to have inclusive growth. India, with an improving trend, ranks 62nd in terms of Inclusive Development Index out of 74 emerging economies and 129th in terms of Human Development Index. Several schemes are being implemented by the government for inclusive growth. MGNREGA has benefitted 22.5 per cent of the rural households by providing, on an average, wage employment for about 43 days. It has increased the income of rural households and has been successful in reducing the poverty level by 4 per cent (Kumar and Joshi, 2013). PM-KISAN has significantly helped those who are relatively more dependent on agriculture and have poor access to credit. Moreover, scheme has significantly stimulated the KVK's impact on the adoption of modern cultivars (IFPRI Discussion paper, 2020). It is critical that the policy recommendations are in accordance with inclusive development of the country. This requires a holistic approach that considers factors such as education, health, skill development and social inclusion apart from the employment.

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Genotype x Environment Interaction and Stability Analysis in Cherry Tomato (*Solanum lycopersicum* L. var. *cerasiforme* Mill.) under temperate conditions of Kashmir

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ABSTRACT

An experiment was carried out to evaluate fifteen cherry tomato genotypes collected from various agro-climatic regions of India for their stability at three locations in Kashmir valley during Kharif 2019. Pooled analysis of variance for stability of genotypes for the quantitative traits revealed significant differences among the genotypes and environments for all the traits studied. The interaction component genotype x environment was also significant for all the traits. The genotypes stable for yield and most of the traits were SK-CT-13, SK-CT-14, SK-CT-15 and SK-CT-21 and could be recommended to farmers for cultivation after further testing and evaluation.

Keywords: Environments, Genotype x environment interaction, Genotypes, Stability, Cherry tomato

INTRODUCTION

Cherry tomato (*Solanum lycopersicum* L. var. c*erasiforme* Mill.) regarded as a botanical variety of cultivated tomato. It is typically a day neutral plant, that often requires long growing periods to fetch more harvests and is one of the promising crop under protected structures (Vidyadhar *et al.*, 2014) and sensibly tolerant to heat and drought. It is also known as salad tomato as its fruits are consumed more as a fruit rather than as a vegetable (Islam *et al.*, 2012). Cherry tomato has become more popular all over the world because of its favourable characteristics such as good source of vitamin A and C, sugars, taste and low calories and fruit set even at higher temperature (Prema *et al.*, 2011). Due to the increasing popularity and demand of cherry tomatoes, it has become imperative to develop high yielding varieties with resistance to biotic and abiotic stresses and suitability to fresh market and processing. Therefore, potential value of cherry tomatoes has to be improved by evaluating the cultivated species for their desirable characters under various agro-climatic regions. Considering the potentiality of this crop, there is also need to improve and develop varieties suited to specific agro-ecological conditions and for specific end use.

Genotype x environment interaction is expected in plant breeding experiments that involve cultivars of diverse genetic background and diverse test sites (Kang *et al.*, 2006). The availability of phenotypically stable genotypes is of great importance, because the environmental condition varies from region to region and from year to year. Wide adaptation to a range of environments and consistent performance of genotypes is one of the main objectives in breeding programme. Genotype x environment interaction study is important to breeders to develop not only improved but also stable varieties, suitable for particular location or multi-location. The stable genotypes are one which interact less with the environment giving a near consistent performance across different environments. Although a number of varieties have been evaluated in temperate conditions, the information on the stability is lacking for the agro-climatic conditions of Kashmir. So there is necessity to evaluate and screen the potential genotypes giving consistent performance over different environments and years and to select the genotypes on the basis of stability parameters for important yield and maturity attributes (Kalloo, 1998).

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MATERIAL AND METHODS

The present study was conducted during kharif 2019 at three locations in Kashmir valley viz., Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences & technology of Kashmir, Shalimar, Srinagar; Krishi Vigyan Kendra (KVK), Malangpora, Pulwama and Faculty of Agriculture (FOA), Wadura, Baramulla. The experimental material comprised of fifteen diverse genotypes of cherry tomato collected from diverse agro-climatic regions of the country. The experiment was conducted in Randomized Block Design with three replications at each location. The row to row and plant to plant spacing was maintained at 70 cm x 40 cm. Recommended package of practices were adopted to raise a healthy crop at each location. Observations were recorded on days to first flowering, days to first fruit harvest, plant height, number of flowers cluster^{-1}, number of flower clusters plant^{-1}, number of fruits cluster^{-1}, number of fruits plant^{-1}, average fruit length (cm), average fruit width (cm), average fruit weight (g), average fruit yield plant^{-1}, average fruit yield plot^{-1}, harvest duration, number of seeds fruit^{-1} and average seed yield plant^{-1}. Data was analysed statistically as per technique proposed by Eberhart and Russell (1966) to estimate the stability parameters and G x E interaction with respect to different characters.

RESULTS AND DISCUSSION

The analysis of variance for stability (Table 1) revealed significant variation among genotypes for all the traits studied indicating presence of large amount of variability in the genotypes used. The mean sum of square due to environments was also significant for all the traits indicating the environments selected to conduct the study were variable and influenced the expression of traits. The interaction component genotype x environment was significant for all the traits indicating considerable response of the genotypes to different environments. Similar results have been reported by Tiwari and Lal (2014); Ummyiah *et al.* (2015); Spaldon *et al.* (2017); Marbhal *et al.* (2016) etc.

The partitioning of environment and G × E mean squares depicted that Environments (linear) component of variance was significant for all the traits indicating that variation among environments was linear. It signifies unit change in environmental index for each unit change in environmental conditions, suggesting that environmental effects were predictable. These results agree with the findings of Marbhal *et al.* (2016); Tiwari and Lal (2014); Jyothi *et al.* (2012); Panthee *et al.* (2012); Ummyiah *et al.* (2015); Spaldon *et al.* (2017); Patel *et al.* (2017). The linear component of genotype × environment was significant only for days to first fruit harvest, number of flower clusters plant^{-1}, average fruit width, average fruit yield plant^{-1} and average fruit yield plot^{-1} indicating the significant linear response of genotype to environmental changes for these traits. Non-significant effect of genotype × environment (linear) for rest of the traits indicated that the different genotypes did not differ genetically in their response to

Table 1a: Mean squares of stability analysis for maturity and yield attributing traits in cherry tomato (S*olanum lycopersicum* L. var. *cerasiforme* Mill.)

Source of variation	df	Days to first flowering	Days to first fruit harvest	Plant height (cm)	Number of flowers cluster^{-1}	Number flower clusters plant^{-1}	Number of fruits cluster^{-1}	Number of fruits plant^{-1}	Average fruit length (cm)
Rep within Env.	6	0.969	0.857**	1.581	0.070**	0.165	0.356**	214.497**	0.057**
Genotypes	14	50.090**	26.936**	1571.33**	2.475**	50492**	1.989**	3503.316**	1.331**
Environment + (genotype× Env.)	30	3.480**	2.439**	2.334**	0.014	0.374**	0.017**	12.189**	0.002**
Environments	2	48.118**	27.883**	20566**	0.087**	3.249**	0.190**	126.111**	0.017**
Genotype × Env.	28	0.287*	0.622**	1.032**	0.018*	0.169*	0.065*	4.051*	0.051**
Environments (L)	1	96.377**	55.766**	41.132**	0.175**	6.497**	0.381**	252.222**	0.033**
Genotype × Env. (L)	14	0.189	1.170**	1.294	0.026	0.259*	0.005	4.677	0.001
Pooled Deviation	15	0.359	0.069	0.719	0.009	0.074	0.004	3.197	0.001
Pooled Error	84	0.261	0.211	0.507	0.071	0.155	0.049	3.211	0.001
Total	44	18.310	10.234	501.625	0.797	16.321	0.645	123.002	0.425

***** and****** significant at 5% and 1% respectively

Table 1b: Mean squares of stability analysis for maturity and yield attributing traits in cherry tomato (*Solanum lycopersicum* L. var. c*erasiforme* Mill.)

Source of variation	df	Average fruit width (cm)	Average fruit weight (g)	Average fruit yield plant^{-1} (kg)	Average fruit yield plot^{-1} (kg)	Harvest duration (days)	Number of seeds fruit^{-1}	Average seed yield plant^{-1} (g)
Rep within Env.	6	0.030**	0.016**	0.008**	0.204**	0.182	0.163	0.128*
Genotypes	14	0.876**	13.617**	0.257**	6.451**	140.413**	449.086**	60.234**
Environment + (genotype× Env.)	30	0.002**	0.005**	0.001**	0.0020**	0.875	0.763*	0.041
Environments	2	0.027**	0.059**	0.008**	0.190**	6.838**	8.531**	0.253**
Genotype× Env.	28	1.000**	0.025**	0.003*	0.070*	0.450*	0.208*	0.026*
Environments (L)	1	0.055**	0.118**	0.015**	0.381**	13.676**	17.062**	0.506**
Genotype × Env. (L)	14	0.001*	0.001	0.002*	0.211*	0.253	0.161	0.019
Pooled Deviation	15	0.00	0.001	0.000	0.003	0.603**	0.239*	0.031
Pooled Error	84	0.027	0.001	0.001	0.068	0.131	0.126	0.023
Total	44	0.280	4.336	0.082	2.066	45.274	143.411	19.195

*and ** significant at 5% and 1% respectively

different environments. The linear component was found to be greater in magnitude than the corresponding non-linear component for most of the traits suggesting that the performance of genotypes across environments could be predicted with greater precision for these traits. The pooled deviation was significant for harvest duration and number of seeds fruit^{-1} indicating the important contribution of non-predictable component in respect of these traits. Similar results have been reported by Kumar *et al.* (2018); Ummyiah *et al.* (2015); Marbhal *et al.* (2016); Spaldon *et al.* (2017); Patel *et al.* (2017); Bhalala and Acharya (2019).

According to Eberhart and Russel (1966), the genotype with non-significant regression coefficient (close to unity) and non-significant deviation from regression (close to zero) indicate average stability of a genotype across different environments. The genotype with significant but less than one value of regression coefficient and non-significant deviation from regression indicate above average stability (specifically adapted to unfavourable environments) whereas genotype with significant but greater than one value of regression coefficient and non-significant deviation from regression indicates below average stability (specifically adapted to favourable environments). The genotype with significant deviation from regression irrespective of whether the corresponding regression coefficient estimate is significant or non-significant suggests that the behaviour of a genotype is unpredictable. Further, variation among regression coefficients for a given character indicate that the genotypes also differ for degree of response to changed environments, suggesting that alleles which confer broader adaptation may be important for stability across environments (Ortiz and Izquierdo, 1994). The above three measures of assessing the stability of genotype viz, mean, regression coefficient (b_i) and the mean square deviation (S^2d_i) were employed in assessing the stability of genotypes included in the present study.

As indicated by the stability parameters (Table 2), the genotypes that were well adapted to all the environments (i.e., mean higher than population mean, $b_i = 1$, low/non-significant S^2d_i) were SK-CT-10, SK-CT-11, SK-CT-13, SK-CT-14, SK-CT-20, SK-CT-21 and SK-CT-22 for days to first flowering; SK-CT-20 for days to first fruit harvest; SK-CT-05 for plant height; SK-CT-14 and SK-CT-21 for number of flowers cluster^{-1}; SK-CT-15 for number of flower clusters plant^{-1}; SK-CT-09, SK-CT-11, SK-CT-13, SK-CT-14 and SK-CT-15 for number of fruits cluster^{-1}; SK-CT-14, SK-CT-21 and SK-CT-26 for average fruit length; SK-CT-21 and SK-CT-26 for average fruit width; SK-CT-14, SK-CT-15, SK-CT-18, SK-CT-20 and SK-CT-21 for average fruit weight; SK-CT-13, SK-CT-15 and SK-CT-21 for average fruit yield plant^{-1} and average fruit yield plot^{-1}; SK-CT-16, SK-CT-18 and SK-CT-19 for number of seeds fruit^{-1}; SK-CT-15 and SK-CT-16 for

Table 2a: Stability parameters for various maturity and yield attributing traits in cherry tomato genotypes (*Solanum lycopersicum* L. var *cerasiforme* Mill.)

Genotypes	Days to first flowering			Days to first harvest			Plant height (cm)			Number of flowers cluster^{-1}			Number of flower clusters plant^{-1}		
	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di
SK-CT-05	31.17	1.323	3.183**	84.66	1.477	-0.256	142.58	0.806	0.061	8.91	1.247	-0.061	24.80	2.36	0.551*
SK-CT-09	28.72	0.767	-0.424	77.60	1.867	-0.233	132.81	2.368	3.577**	8.40	0.021	-0.051	21.83	1.22	-0.142
SK-CT-10	22.67	0.876	-0.055	78.08	1.662	-0.245	125.21	0.978	-0.483	7.27	0.778	-0.051	23.79	1.30	-0.154
SK-CT-11	21.62	0.981	-0.045	79.81	1.429	-0.257	161.60	1.615	0.350	7.46	0.741	-0.049	19.73	1.94	0.152
SK-CT-13	22.36	1.107	-0.385	75.05	0.078*	-0.258	123.86	1.570	-0.351	8.32	-0.900	-0.057	17.91	0.59	-0.131
SK-CT-14	25.22	0.801	-0.445	79.31	0.722	-0.248	136.29	2.024	0.374	9.20	1.125	-0.065	27.10	1.40	-0.165
SK-CT-15	30.03	0.985	0.382	82.77	0.999	-0.253	158.91	1.647	0.296	8.87	0.757*	-0.071	22.20	0.84	-0.142
SK-CT-16	30.25	1.810	-0.268	81.11	1.368	0.63	162.17	0.611	0.778	6.29	1.014	-0.068	19.41	0.33	-0.125
SK-CT-17	31.48	0.971	-0.427	81.37	0.537	-0.220	142.32	0.372	-0.529	7.14	1.624	-0.070	29.87	2.44*	-0.152
SK-CT-18	31.27	1.179	-0.405	78.94	0.259	-0.245	113.92	-0.085*	-0.562	7.56	1.771	-0.068	16.90	0.21*	-0.146
SK-CT-19	32.43	1.229	-0.228	77.62	0.395*	-0.253	101.50	0.504	-0.375	7.21	1.256	-0.068	15.59	0.39	-0.132
SK-CT-20	24.65	1.189	-0.358	76.54	1.085	-0.261	81.84	0.480	-0.297	8.13	1.513*	-0.071	16.21	0.031*	-0.151
SK-CT-21	22.98	1.005	-0.430	85.79	0.416**	-0.261	154.89	0.611	-0.118	8.39	1.014	-0.068	19.31	0.95	-0.142
SK-CT-22	24.04	0.926	-0.313	77.49	1.437*	-0.261	148.68	0.696	-0.047	8.07	0.778	-0.051	18.72	0.21	-0.151
SK-CT-26	32.02	0.849	-0.393	78.53	1.267**	-0.262	128.43	0.803*	-0.579	6.20	2.261	-0.049	18.70	0.77	-0.140
Population mean	27.40	1.000		79.64	1.000		134.328	1.000		7.83	1.000		20.80	1.000	
S.E.	±0.423	±0.236		±0.186	± 0.137		± 0.6	±0.2		± 0.07	±0.300		±0.192	± 0.412	

***** and****** significant at 5% and 1% respectively

Table 2b: Stability parameters for various maturity and yield attributing traits in cherry tomato genotypes (*Solanum lycopersicum* L. var *cerasiforme* Mill.)

Genotypes	Number of fruits cluster^{-1}			Number of fruits plant^{-1}			Average fruit length (cm)			Average fruit width (cm)			Average fruit weight (g)		
	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di
SK-CT-05	6.51	0.78	-0.064	165.36	1.26	-56.79	1.36	1.27	-0.0512	1.23	0.94*	-0.028	4.02	0.77	-0.023
SK-CT-09	7.53	1.00	-0.068	247.09	1.68	-55.88	1.83	1.60	-0.0514	2.01	1.30*	-0.027	4.27	1.79	-0.022
SK-CT-10	6.31	0.95	-0.065	155.42	0.79	-54.38	1.30	0.92	-0.0518	1.31	1.22	-0.025	3.20	0.76	-0.024
SK-CT-11	7.33	1.00	-0.068	254.87	1.76	-47.98	1.15	0.28	-0.0518	1.27	1.31	-0.024	2.07	0.73	-0.025
SK-CT-13	7.51	0.95	-0.065	158.13	0.78	-56.05	2.81	3.11	-0.0506	1.96	1.84	-0.026	8.07	0.76*	-0.025
SK-CT-14	7.22	0.89	-0.066	165.44	-0.18	-55.47	2.80	0.80	-0.0472	1.77	1.16	-0.027	7.17	1.15	-0.023
SK-CT-15	7.83	1.18	-0.058	169.97	0.73	-54.85	2.53	0.74	-0.0518	2.25	0.47*	-0.028	6.23	0.94	-0.024
SK-CT-16	5.05	1.90	-0.062	157.14	1.12	-48.79	3.10	0.65	-0.0518	3.37	0.52	-0.027	9.17	1.26	-0.021
SK-CT-17	5.74	1.06	-0.066	185.81	0.59	-52.98	1.28	0.74	-0.0518	1.45	0.34	-0.026	2.95	0.73	-0.024
SK-CT-18	6.15	1.23	-0.069	146.79	1.60	-53.17	2.01	0.53	-0.0515	1.98	0.65	-0.027	6.08	0.87	-0.023
SK-CT-19	6.56	1.24	-0.069	159.13	1.65**	-57.45	2.13	0.33	-0.0510	2.05	0.54	-0.025	6.03	0.33*	-0.025
SK-CT-20	5.64	0.45	-0.062	137.85	1.07	-53.68	2.53	1.50	-0.0517	2.33	1.27	-0.026	8.25	1.28	-0.026
SK-CT-21	7.40	1.51	-0.067	158.48	0.83	-56.87	2.98	0.85	-0.0516	2.27	1.09	-0.027	7.86	1.11	-0.025
SK-CT-22	6.53	1.00	-0.068	145.62	0.69	-53.03	1.67	0.53	-0.0516	1.72	1.26	-0.025	5.67	0.65	-0.026
SK-CT-26	6.17	-0.16	-0.063	166.62	0.63	-56.35	2.30	1.14	-0.0517	2.00	1.08	-0.027	5.24	1.86**	-0.025
Population mean	6.63	1.000		171.58	1.000		2.12	1.000		1.93	1.000	-0.027	5.75	1.000	
S.E	± 0.044	± 0.39		± 1.3	± 0.21		± 0.017	± 0.32		± 0.011	± 0.25		± 0.018	± 0.283	

***** and****** significant at 5% and 1% respectively

Table 2c: Stability parameters for various maturity and yield attributing traits in cherry tomato genotypes (*Solanum lycopersicum* L. var *cerasiforme* Mill.)

Genotypes	Average fruit yield plant^{-1} (kg)			Average fruit yield plot^{-1} (kg)			Harvest duration (days)			Number of seeds fruit^{-1}			Average seed yield plant^{-1} (g)		
	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di	μ	Bi	S^2di
SK-CT-05	0.663	1.07	-0.0030	3.315	1.07	-0.074	70.40	1.33	0.25	23.74	1.10	0.59*	4.34	0.38	-0.080
SK-CT-09	1.052	2.19	-0.0028	5.259	2.19	-0.069	65.21	1.22	0.32	45.73	1.41	-0.07	11.87	1.49	-0.069
SK-CT-10	0.499	0.31	-0.0032	2.492	0.30	-0.076	74.21	1.29	-1.22	39.68	1.03	1.03**	6.57	0.90	-0.061
SK-CT-11	0.525	1.02	-0.0031	2.626	1.015	-0.075	65.94	0.71	-0.09	35.44	0.97	-0.12	9.93	1.97	-0.076
SK-CT-13	1.278	1.15	-0.0031	6.392	1.15	-0.075	58.67	0.83	-0.02	34.73	1.20	0.24	7.63	0.69	-0.083
SK-CT-14	1.185	0.40	-0.0026	5.927	0.40	-0.072	60.17	2.08	6.72**	33.00	0.69	-0.10	7.73	0.77	-0.082
SK-CT-15	1.059	0.97	-0.0032	5.293	0.95	-0.076	49.51	0.71	0.37	35.03	0.38	-0.04	8.52	0.95	-0.084
SK-CT-16	1.442	1.84	-0.0030	7.226	1.93	-0.074	65.73	0.42	-0.10	57.40	1.15	-0.11	12.38	1.14	-0.083
SK-CT-17	0.548	0.42	-0.0033	2.739	0.42	-0.077	65.49	0.67	0.25	51.14	0.50	-0.01	8.52	1.88	-0.084
SK-CT-18	0.918	-0.36	-0.0023	4.589	-0.36	-0.063	74.03	0.30*	-0.13	49.21	0.80	0.27	11.64	0.12*	-0.083
SK-CT-19	0.960	1.29	-0.0033	4.800	1.29	-0.077	68.26	0.72	-0.13	56.36	1.09	-0.06	13.78	2.55	0.317*
SK-CT-20	1.138	1.66	-0.0029	5.688	1.66	-0.072	72.58	1.49	-0.02	55.40	1.84*	-0.13	11.38	0.41	-0.079
SK-CT-21	1.246	1.07	-0.0030	6.228	1.07	-0.074	65.53	1.73	-0.10	16.63	0.61	-0.10	5.18	0.06*	-0.083
SK-CT-22	0.827	0.69	-0.0028	4.133	0.69	-0.069	56.30	1.18	-0.06	39.94	1.32	-0.11	6.45	1.58	-0.079
SK-CT-26	0.873	1.27	-0.0033	4.356	1.20	-0.077	61.73	0.31	-0.10	29.31	0.91	0.38	6.15	0.12*	-0.083
Population mean	0.947	1.000		4.737	1.000		64.92	1.000		40.18	1.000		8.80	1.000	
S.E	±0.009	± 0.393		± 0.041	± 0.368		± 0.55	± 0.342		±0.345	± 0.251		± 0.124	± 0.35	

***** and****** significant at 5% and 1% respectively

Table 3: Stability of genotypes of cherry tomato (*Solanum lycopersicum* L. var *cerasiforme* Mill.) with respect to different characters

S.No.	Genotypes	Traits for which genotypes show average stability
1.	SK-CT-05	Plant height
2.	SK-CT-09	Number of flowers cluster^{-1}, number of fruits cluster^{-1}
3.	SK-CT-10	Days to first flowering
4.	SK-CT-11	Number of fruits cluster^{-1}
5.	SK-CT-13	Days to first flowering, number of fruits cluster^{-1}, average fruit yield plant^{-1}, average fruit yield plot^{-1}
6.	SK-CT-14	Days to first flowering, number of flowers cluster^{-1}, number of fruits cluster^{-1}, average fruit length, average fruit weight
7.	SK-CT-15	Number of flower clusters plant^{-1}, number of fruits cluster^{-1}, average fruit weight, average fruit yield plant^{-1}, average fruit yield plot^{-1}, average seed yield plant^{-1}
8.	SK-CT-16	Number of seeds fruit^{-1}, average seed yield plant^{-1}
9.	SK-CT-17	-
10.	SK-CT-18	Average fruit weight, number of seeds fruit^{-1}
11.	SK-CT-19	Number of seeds fruit^{-1}
12.	SK-CT-20	Days to first flowering, days to first fruit harvest, average fruit weight
13.	SK-CT-21	Days to first flowering, number of flowers cluster^{-1}, average fruit length, average fruit width, average fruit weight, average fruit yield plant^{-1}, average fruit yield plot^{-1}
14.	SK-CT-22	Days to first flowering
15.	SK-CT-26	Average fruit length, average fruit width

average seed yield plant^{-1}. Similar results with respect to various traits have been reported by Jyothi *et al.* (2012); Marbhal *et al.* (2016); Ummyiah *et al.* (2015); Shankar *et al.* (2017); Patel *et al.* (2017); Kumar *et al.* (2018); Bhalala and Acharya (2019).

Of the 15 genotypes (Table 3), SK-CT-21, SK-CT-15, SK-CT-14 and SK-CT-13 were found to be stable for most of the traits. Hence, based on the present study, the genotypes SK-CT-13, SK-CT-14, SK-CT-15 and SK-CT-21 could be recommended to farmers for cultivation after further testing and evaluation.

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Usage of Farming Mobile Apps by Field Functionaries in Jammu and Kashmir

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ABSTRACT

Information and Communication Technologies (ICTs) are the integral part of modern society as a mode of effective communication. It is a known fact that an effective communication between farmers, Government agencies and extension functionaries can help in enhancing agricultural growth and development with increase in income of major stakeholder i.e. farmers. Government agencies have been trying hard to deliver requisite information and services at the locations convenient to farmers for easy accessibility. There has been a constant improvement in such modes using which rural mass and farming community in particular are able to utilize the power of ICT for their knowledge and solutions. In farm sector, Government agencies and private partners have developed many useful apps for farmers as well as extension functionaries. The present study evaluates the usage of farming apps namely; MKisan App, Farm-o-pedia; crop Insurance, Agri Market, Pusa Krishi, Kisan Suvidha, Kisaan Market, Krishi Gyan, Smart crop, Kisan Yojana, IFFCO Kisan, Farmer Friendly Poultry App, Pashu Prajnan etc. by field functionaries of agriculture and line departments in hilly districts of Reasi and Doda of Jammu region of Jammu and Kashmir. The knowledge of field functionaries as well as the use of apps was very limited in delivering the professional services. The use of ICT and apps is likely to be more among functionaries fall under lower age group and higher educational qualification. Lesser compatibility with ICT tools, poor internet connection and lack of motivation are considered to be the main reasons for low use of ICT.

Keywords: ICT, Mobile apps, Farming, Jammu & Kashmir

INTRODUCTION

Small farmers with less land holding which dominate the GDP of developing countries need to improve farming through acquiring adequate knowledge and information. Information has a vital role in improving and sustaining agricultural production of any nation. Therefore, it is necessary to identify the nature and type of information that farmers need so as to provide them with relevant, reliable, and timely information not only to help them make accurate decisions, but also contribute to increase productivity. Panda *et al.* (2019) and Sharma *et al.* (2019) highlighted the importance of adequate familiarity and expertise in ICT and Inservice training for using/producing ICTs by KVKs scientists. Increasing production is a major challenge facing present agriculture. Doubling the farmers' income in India by 2022 is a major thrust area of the government which ultimately cannot be achieved without the help ICT applications and tools. The inventions in technology in agriculture domain are not getting to the farmers; because of either most of them are illiterates or due to unawareness of the location from where they can have information. Hence, utmost of the farmers is being failed in acquisition of the possible production rate (Patel and Patel, 2016). Among the technologies invented in the past few decades, smartphones have gained large market shares among various users of different sectors because of various reasons. The latest forecast by eMarketer, the US-based market research firm suggests that more than a quarter of India's population will be using smartphones by the end of 2021.

According to statista.com, the penetration rate of smartphone in India reached 42 per cent in the year 2020 and is estimated to reach 51 per cent in financial year 2025, more than doubled from financial year 2016, when only 24 per cent of the mobile subscribers were using smartphones. In 2020, the volume of smartphone

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shipments across India was around 149.7 million. In developing countries also, people have more access to mobile phones than to older technologies like telephone landlines, newspapers, and radio (Zewge *et al.,* 2015).

Many industries have adopted smartphones to facilitate their work, such as health care (Habib *et al.,* 2014) and education. Now-a-days low cost smartphone are opening new opportunities for rural farmers who previously had limited access to up-to-date agricultural information (e.g., market, weather, and crop disease news) and assistance from agricultural experts and government extension workers. Meanwhile, farmers in large-scale farms, who already adopt assistance from other information technologies, can now utilize smartphone-based sensors to increase productivity and facilitate various tasks throughout the farming cycle. One factor that enhances the smartphones' ability to assist users to perform various tasks is the numerous built-in sensors (e.g., positioning sensors, motion sensors, and cameras microphones). (Pongnumkul, *et al.,* 2015). Das *et al.* (2020) studied farmers' perception on Use of Mobile phones for Agricultural Information and recommended that the capacity building of farmers in use of ICTs is essential. Krishi Vigyan Kendras are effective institutions for bringing change in farmers' lives through training and demonstrations of technologies, including farm and ICTs (Sharma *et al.,* 2020).

Extension personnel are considered to be the most credible source of information followed by radio, television, newspaper and computer (Kumar and Lal, 2018). In Kolar district of Karnataka the farmers are willing to buy even the inputs through m-commerce because of the certain advantages associated with ICT (Nazhat *et al.,* 2016). In Surguja district of Chattisgarh, 52 per cent of respondents considered the information received via Kisan Suvidha timely, need based and useful in crop production.

The use of Information and Communication Technology (ICT) in agriculture is vital as it allows constant flow of information without any compulsory physical involvement of resource person. The development of apps in agriculture as a tool to disseminate information has been taken up by many national and international level organizations. The present study is an attempt to analyse the extent of use of apps by the field functionaries and the factors affecting their use. Keeping in view the importance of extension functionaries in agriculture, the present study was undertaken to review the penetration of mobile Apps developed by Government organizations and its usage by the extension officers of agriculture and line departments in hilly districts of Reasi and Doda in Union Territory (UT) of J&K. The basic hypothesis on which the study is planned is that once the Extension functionaries will start using apps in the various fields of agriculture, the farmers will also be aware and start using apps developed for serving their purpose.

MATERIALS AND METHODS

The present study is conducted in Reasi and Doda districts of Jammu & Kashmir. Reasi district is divided into nine Tehsils and it has 22 Niabats. There are 12 Development Blocks with 147 Panchayat Halqas. The primary occupation of the people is agriculture and allied activities and it is economically an under developed district. Maize and wheat are the main crops grown in the district and farmers are moving towards diversity in horticulture & vegetable crops. Doda District is largest district in eastern part of Jammu Division. It has 01 Sub-district, 03 Sub-divisions, 18 Tehsils and 406 villages and 237 panchayat Halqas. Major crops of the district are Maize, Paddy, wheat and barley, pulses especially (beans), vegetables, spices, marigold and mushroom. The average productivity of major crops of maize, paddy and wheat is 17.50, 18.00 and 17.45 quintals per hectare respectively.

Both the districts are headed by one Chief Agriculture Officer and each Block is headed by one Agriculture Extension officer (AEO) who is supported by Junior Agriculture Extension Officers (JAEO). There are about 125 agriculture officers recruited in both the districts. Besides, more than 20 officers of horticulture department and 30 officers in the field of Animal and Sheep Husbandry departments are working in each of the selected Reasi and Doda district. Telephone and internet connectivity is not good because of hilly terrain and poor infrastructure. The present study is based on the data collected from 50 officers/officials of Agriculture/Horticulture and Veterinary Extension officers working in Reasi and Doda district using convenient sampling, making the total sample size of 100 for the present study.

The respondents were asked questions according to pre-framed questionnaire and the objectives of the study. The respondents were also enquired about their knowledge/usage from the list of mobile apps developed by Government organizations' like MKisan App, Farm-o-pedia, Crop insurance, AgriMarket, Pusa Krishi, Kisan

Suvidha, Kissan Market, Krishi Gyan, Smart crop, Kisan Yojana, IFFCO Kisan, Pashu Prajanan, Application for Poultry, Shukar Palan, Horticulture App etc. Though a large number of Mobile apps developed by private organizations are also available but our study was limited to usage of apps developed by Government organizations only.

The binary Logit model was employed as the statistical modelling framework to determine the possible factors influencing adoption of farming apps by field functionaries. The response variable i.e. the use of apps assumed dichotomous values. The inferences about the effect of a dependent variable on the outcome are determined by its marginal effect, holding all other variables constant.

RESULTS AND DISCUSSION

Overview of agriculture apps: An overview of seventeen apps developed by Government agencies (Source: Mkisan Portal), including their genesis, work area and relative benefits are discussed below:

1. MKisan App: It is developed by an in-house IT team of DAC with the help of C-DAC Pune, this app provides a platform for sending alerts to farmers. Farmers can themselves register for messages etc.

2. Farm-o-pedia: The application developed by CDAC Mumbai is a multilingual Android application targeted for rural Gujarat. The application is informative as well as can be used for daily routines. The app is useful for farmers or anyone related to agriculture. It is available in English and Gujarati languages.

The main functionalities of the app are:

1. To get suitable crops as per soil and season
2. To get crop information
3. Check weather
4. Manage the cattle of farmer

3. Crop Insurance: Developed by Department of Agriculture Cooperation Family Welfare Govt. of India, Crop insurance mobile app can be used to calculate the insurance premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer. It can also be used to get details of normal sum insured, extended sum insured, premium details and subsidy information of any notified crop in any notified.

4. AgriMarket: AgriMarket mobile app can be used to get the market price of crops in the markets within 50 km of the device's location. This app automatically captures the location of person using mobile GPS and fetches the market price of crops in those markets which falls within the range of 50 km. There is another option to get price of any market and any crop in case person does not want to use GPS location.

5. Pusa Krishi: Using this mobile app, farmers can get easy solutions to their problems. Farmers can get information about weather and accordingly they can take measures to save crops. The app also provide farmers with information related to new varieties of crops developed by Indian Council of Agriculture Research (ICAR), resource conserving cultivation practices as well as farm machinery and its implementation.

6. Kisan Suvidha: Kisan Suvidha is an omnibus mobile app developed to help farmers by providing relevant information to them quickly. With click of a button, they can get the information on weather of current day and next 5 days, dealers, market prices, agro advisories, plant protection, IPM Practices etc. Unique features like extreme weather alerts and market prices of commodity in nearest area and the maximum price in state as well as India have been added to empower farmers in the best possible manner.

7. Kisaan Market: Kisaan Market empowers Indian Farmers to connect directly with buyers and saves brokerages and transport spending. which ultimately multiplies their benefits and insights, latest updates on Mandi prices, Krushi Tips, weather and news as per their location in preferred language.

- Agriculture news on government announcements, policy decisions, market intelligence etc.
- Available on any android mobile phone across all operators with internet connection.
- All the information is personalized, and farmers can update markets. location and language.
- Information can also be shared with fellow farmers.

8. Horticulture App: It describes cultivation, practices for growing fruits, vegetables, flowers and crops like spices condiments and other plantation crops. Besides, it also provides weather related information.

9. IFFCO Kisan: "IFFCO Kisan" is an Indian agriculture farmer suvidha App, which helps the Indian farmer/

Kisaan to take informed decisions by accessing customized agricultural information related to their need. Our agriculture suvidha app is for Kisan suvidha and provides the latest mandi prices, weather forecast, agricultural advisory, best practices tips related to agriculture, Animal Husbandry, horticulture; a buyer and seller platform, and all agriculture related news and govt. schemes. This Indian farmer app is for Kisan suvidha (Suvidha is a Hindi word which means to facilitate/ enable/ assist/ make capable enough) to provide agriculture alerts and agriculture advisories in 11 Indian languages in text as well as agriculture audio clip for the convenience of the farmers who are most comfortable in their own language.

10. Kisan Yojna: This App provides useful information about Government's Schemes to farmers from their respective State Agriculture Department. Users can easily access to Main Schemes along with the information of exactly what Benefits they will get from particular scheme & eligibility to access it. Contact point details for the schemes are also mentioned in the app.

11. Krishi Gyan: It is developed by ISAP India (A non-profit society) in 2019. This application enable Indian farmers to connect with Krishi Gyan experts and ask their questions related to farming and get the answers within the application through notification. The farmers as well as agriculture enthusiast can also share their answer with each other.

12. Pashu Prajnan (Animal Reproduction): Animal Reproduction App, designed and developed by ICAR-IVRI, Izatnagar & IASRI, New Delhi is targeted to impart knowledge and act as a ready reckoner for the graduating veterinarians, veterinary officers and livestock entrepreneurs about reproductive problems in cattle and buffaloes and measures to treat and control them. The major reproductive diseases /disorders covered in the App are Anoestrus, Repeat Breeding, Silent Estrus, Uterine Torsion, Dystocia, Abortion, Uterine Prolapse, Retention of Foetal Membranes, Metritis, Brucellosis, Campylobacteriosis and IBR - IPV. The App additionally provides basic information on Artificial Insemination in cattle and buffaloes. The App is presently available in Hindi, English, Punjabi, Assamese, Bengali, Gujarati, Tamil and Malayalam languages.

13. Farmer Friendly Poultry App: The app is developed by the scientists of KVK Reasi and gives hands-on information on poultry farming and backyard poultry, diseases and their control measures.

14. Shetkari Masik Android App: The application is developed and hosted at Science and Technology Park (STP), Pune, which an agency promoted by DST (Dept. of Science & Technology, Govt. of India). The Android app for Shetkari magazine has a very simple interface and requires mobile internet or Wi-Fi connectivity to register and download the issues. Once downloaded, the magazine can be read without internet connectivity.

15. Shukar Palan (Pig farming): This app is developed by IVRI. It give information about commercial pig farming. This App is presently available in hindi and punjabi languages.

16. Pashu Poshan: Pashu Poshan app is developed by National Dairy Development Board (NDDB) for phones and tablets. With the help of this software balanced ration is formulated while optimizing the cost considering animal profile, i.e. cattle or buffalo, age, milk production, milk fat, and feeding regime etc. and milk producers are advised to adjust the quantity of locally available feed ingredients offered to their animals along with mineral mixture.

17. Meghdoot App: It is developed by IMD, The app gives out timely weather forecast-based agro advisories to farmers in 10 languages.

Demographics of respondent field functionaries: Out of the 100 respondents, only 6 per cent were women and the rest 94 per cent were men (Table 1). The majority of respondents (51%), including male and female fall under the age group category of 35 to 45 years, followed by 45 to 55 years age category (28%).

The respondents by virtue of the job they possessed were supposed to be formally educated, atleast upto the Graduate level. However, many of the respondents were qualified more than the minimum eligibility required for the post. Out of the 100 respondents, 55 per cent male and 67 per cent female were graduate (Table 1), whereas 41 per cent of male and 33 per cent of female were Post-Graduate. 3 per cent of respondents male were Ph.D. whereas no female respondent were having Ph.D. qualification.

Similarly, out of the three major agriculture and line departments, the majority of the respondents belong to agriculture department, followed by horticulture and animal and sheep husbandry departments.

Knowledge of internet: Data was collected to assess whether the respondents were having some basic working

Table 1: Demographics of field functionaries

Characteristics	All respondents (n = 100)		Reasi district (n = 50)		Doda district (n = 50)	
	Male (n = 94)	Female (n=6)	Male (n = 48)	Female (n=2)	Male (n = 46)	Female (n=4)
Age						
25-35	8(8.51)	0(0.00)	3(6.25)	0(0.00)	5(10.86)	0(0.00)
35-45	48(51.06)	3(50.00)	26(54.16)	1(50.00)	22(47.82)	2(50.00)
45-55	26(27.66)	3(50.00)	16(33.33)	1(50.00)	10(21.73)	2(50.00)
55-60	12(12.77)	0(0.00)	3(6.25)	0(0.00)	9(19.56)	0(0.00)
Education						
Graduate	52(55.32)	4(66.67)	23(47.91)	2(100.00)	29(63.04)	2(50.0)
Post Graduate	39(41.49)	2(33.33)	23(47.91)	0(0.00)	16(34.78)	2(50.0)
Ph.D.	3(3.19)	0(0.00)	2(4.16)	2(0.00)	1(2.17)	0(0.00)
Department						
Agriculture	70(74.46)	3(50.0)	35(72.91)	1(50.0)	35(76.08)	2(50.0)
Horticulture	13(13.82)	2(33.33)	8(16.66)	1(50.0)	5(10.86)	1(25.0)
Animal & Sheep Husbandry	11(11.72)	1(16.67)	5(10.41)	0(0.0)	6(13.04)	1(25.0)

Note: Figures in parentheses shows percentages

Table 2: Working knowledge of internet

Characteristics	All respondents (n = 100)		Working knowledge of internet			
	Male (n = 94)	Female (n=6)	Male (no.)	Female (no.)	Male (%)	Female (%)
Age						
25-35	8(8.51)	0(0.00)	8	0	100.00	0.00
35-45	48(51.06)	3(50.00)	36	2	75.00	66.67
45-55	26(27.66)	3(50.00)	16	2	61.54	66.67
55-60	12(12.77)	0(0.00)	6	0	50.00	0.00
Education						
Graduate	52(55.32)	4(66.67)	42	2	80.77	50.00
Post Graduate	39(41.49)	2(33.33)	22	2	56.41	100.00
Ph.D.	3(3.19)	0(0.00)	2	0	66.67	0.00
Department						
Agriculture	70(74.46)	3(50.0)	49	2	70.00	66.67
Horticulture	13(13.82)	2(33.33)	9	2	69.23	100.00
Animal & Sheep Husbandry	11(11.72)	1(16.67)	8	0	72.73	0.00

Note: Figures in parentheses shows percentages

knowledge of internet or not. All the respondents belonging to age group of 25-35 years have working knowledge about the functioning and usage of internet. It is revealed that as age of respondents' increases, the usage of internet for searching information decreases. The graduates are more internet savvy (80.77%) as compared to the respondents having higher qualification. This indicated that specialized higher qualification; namely Post-Graduation and Post-Doctoral degree does not have any positive effect on use of internet facilities. All the departments have similar number of respondents with knowledge of internet and its usage (Table 2).

Use of internet for professional duties: The use of internet is almost imperative in delivering services in every sphere of life. Despite the majority of respondents were having working knowledge of internet, the use of internet for obtaining professional information is limited. Similar

number of respondents from department of agriculture and horticulture (around 60%) are using internet for delivering their services effectively. A lesser percentage of respondents from animal & sheep husbandry department (36.36%) are using internet for their professional services. The number of respondents using internet for professional information also reduces with increase in age of respondents. Education does not have any direct effect of use of internet for professional services. Male are more frequent user of internet as compared to female respondents (Table 3).

Knowledge about farming and veterinary apps: There are large numbers of apps developed by national and international organizations on different aspects of farming. The respondents were asked about whether they are having any knowledge about such apps in agriculture, horticulture and veterinary aspects. The younger age group respondents were found to have more knowledge about farming apps, followed by middle age and elder professionals. The respondents with Ph.D. degree found to have more knowledge about these apps as compare to graduate and post-graduate. The respondents belonging to horticulture department had more knowledge compared to those working in agriculture and veterinary fields.

Use of farming apps: The respondents who were found to have knowledge about farming apps, were asked about their use and recommendation to farmers. The practical use of apps was found highest in lower age group which reduces with increase in age of respondents. The respondents with post-graduate qualification found to use farming apps more frequent. The respondents belonging to horticulture department are using apps more than agriculture and veterinary departments. The reasons behind the low use of apps is high cost of technology (mainly good storage mobile phone), lack of ICT skills, poor and expensive connectivity, language barriers, and less encouragement by the concerned departments to explore the efficient use of apps in different identified fields of agriculture, horticulture and veterinary fields. The average internet connection speed on mobile networks in India was 4.9 Mbps (Pandey *et al.,* 2021) but hilly areas of J&K are far behind.

Modelling the factors affecting use of apps: The logit model employed for assessing the factors affecting the use of apps was significant (Log likelihood = -47.686656; Prob>chi^2: 0.000; LR chi^2 (3): 23.22) which indicates that the explanatory variables together influence the probability of usage of apps by the field functionaries (Table 6). The results of the model revealed that education has a positive and significant relationship with the adoption of ICT i.e. usage of apps. The field functionaries with higher educational qualification were 22.5 per cent more likely to use the mobile apps, compared to those having lesser qualification. Similarly, male are more likely to use mobile apps compared to their female counterparts, although the coefficient was non-significant. Contrary to these, age has

Table 3: Use of Internet for professional information

Characteristics	All respondents (n = 100)		Use of Internet for professional duties			
	Male (n = 94)	Female (n=6)	Male (no.)	Female (no.)	Male (%)	Female (%)
Age						
25-35	8(8.51)	0(0.00)	6	0	75.00	0.00
35-45	48(51.06)	3(50.00)	32	2	66.67	66.67
45-55	26(27.66)	3(50.00)	13	1	50.00	33.33
55-60	12(12.77)	0(0.00)	2	0	16.67	0.00
Education						
Graduate	52(55.32)	4(66.67)	31	2	59.62	50.00
Post Graduate	39(41.49)	2(33.33)	20	1	51.28	50.00
Ph.D.	3(3.19)	0(0.00)	2	0	66.67	0.00
Department						
Agriculture	70(74.46)	3(50.0)	41	1	58.57	33.33
Horticulture	13(13.82)	2(33.33)	8	2	61.54	100.00
Animal & Sheep Husbandry	11(11.72)	1(16.67)	4	0	36.36	0.00

Note: Figures in parentheses shows percentages

Table 4: Knowledge about farming apps

Characteristics	All respondents (n = 100)		Knowledge about farming apps			
	Male (n = 94)	Female (n=6)	Male (no.)	Female (no.)	Male (%)	Female (%)
Age						
25-35	8(8.51)	0(0.00)	4	0	50.00	0.00
35-45	48(51.06)	3(50.00)	14	1	29.17	33.33
45-55	26(27.66)	3(50.00)	11	0	42.31	0.00
55-60	12(12.77)	0(0.00)	2	0	16.67	0.00
Education						
Graduate	52(55.32)	4(66.67)	19	1	36.54	25.00
Post Graduate	39(41.49)	2(33.33)	10	0	25.64	0.00
Ph.D.	3(3.19)	0(0.00)	2	0	66.67	0.00
Department						
Agriculture	70(74.46)	3(50.0)	22	1	31.43	33.33
Horticulture	13(13.82)	2(33.33)	6	0	46.15	0.00
Animal & Sheep Husbandry	11(11.72)	1(16.67)	3	0	27.27	0.00

Note: Figures in parentheses shows percentage

Table 5: Self-use of apps and recommendation to farmers

Characteristics	All respondents (n = 100)		Self-use of apps & recommendation to farmers			
	Male (n = 31)	Female (n=1)	Male (no.)	Female (no.)	Male (%)	Female (%)
Age						
25-35	4(12.90)	0(0.00)	3	0	50.00	0.00
35-45	14(45.16)	1(100.00)	14	0	28.57	33.33
45-55	11(35.48)	0(0.00)	10	0	18.18	0.00
55-60	2(6.45)	0(0.00)	1	0	0.00	0.00
Education						
Graduate	19(61.29)	1(100.00)	4	0	21.05	50.00
Post Graduate	10(32.26)	0(0.00)	3	0	66.67	50.00
Ph.D.	2(6.45)	0(0.00)	1	0	50.00	0.00
Department						
Agriculture	22(70.97)	1(100.00)	6	0	27.27	0.00
Horticulture	6(19.35)	0(0.00)	2	0	33.33	0.00
Animal & Sheep Husbandry	3(9.68)	0(0.00)	0	0	0.00	0.00

Note: Figures in parentheses shows percentage

a negative and significant relationship with the usage of apps. With increase in age by one year, the field functionaries were 1.7 per cent less likely to use the mobile apps.

The margin plots for age (Figure 2) and education (Figure 3) clearly indicates that the former affects the likelihood of using mobile farming apps negatively whereas the latter has a positive effect of using farming apps by the field functionaries. The extent of knowledge about individual Government Mobile Apps was also assessed (Figure 3). The farmers were asked whether they have heard about these apps and recommended farmers to use them by asking each respondent about apps. The three top most apps known to the respondents included Crop-insurance, MKisan and AgriMarket, whereas the top three apps recommended to farmers included Crop-insurance, MKisan, AgriMarket and Farm-o-pedia.

Table 6: Maximum likelihood estimates and marginal effects from the Binary Logit Model

Variable	Coefficient (Std. Error)	Odds Ratio (Std. Error)	Marginal effect (dy/dx)
Constant	1.049(2.445)	2.855(6.98)	
Sex (1=male; 0= female)	.659(1.139)	1.934(2.20)	0.102(0.175)
Age (years)	-.111**(.044)	0.894**(0.04)	-0.017**(0.006)
Education (1=graduation; 2=PG & 3=Ph.D.)	1.448***(0.486)	4.256***(2.07)	0.225 ***(0.063)

Number of observations: 100; Log likelihood = -47.686656; Prob>chi2: 0.000; LR chi^2(3): 23.22; Pseudo R^2: 0.1958***& ** denote significant at 1% and 5% levels, respectively.

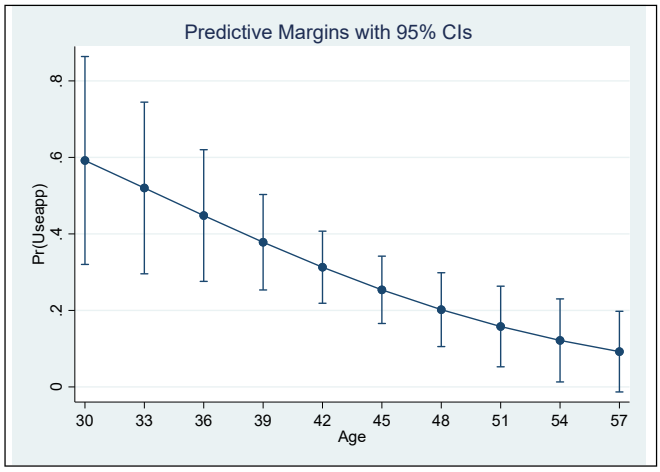

Figure 1: Margin plots on impact of age on using apps

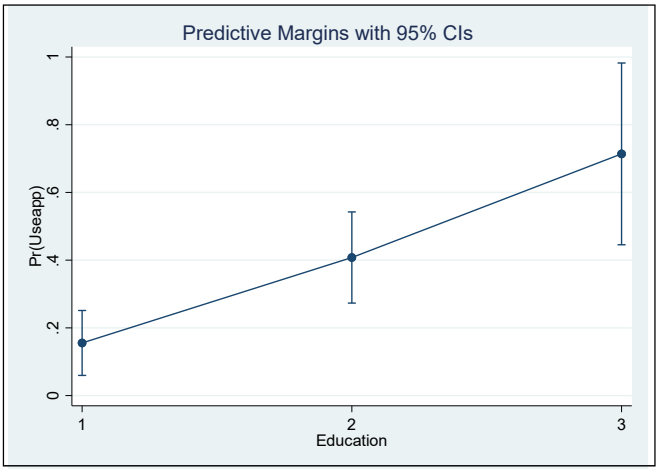

Figure 2: Margin plots on impact of education on using apps

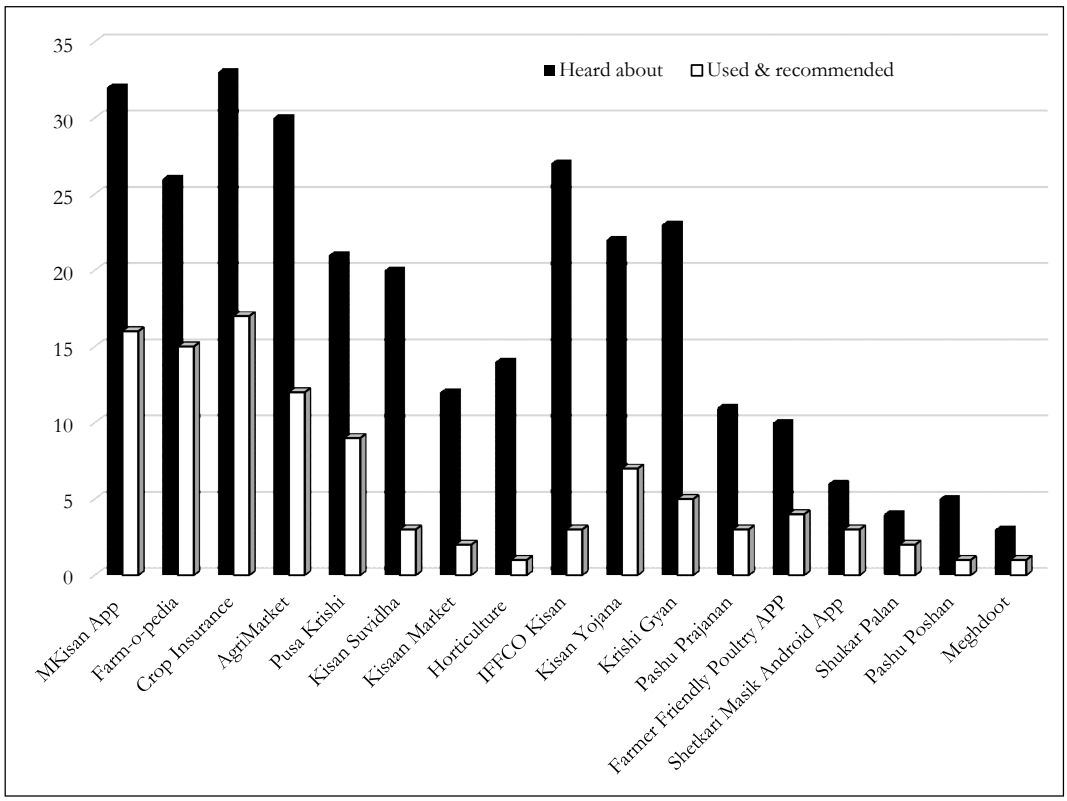

Figure 3: Knowledge and usage of farming apps by field functionaries

CONCLUSION

The extension functionaries are having limited knowledge of farm based mobile apps and those who are aware of these apps were not enthusiastic about its usage. The lesser knowledge about the latest apps developed for agriculture and allied departments is an area of concern, as it keeps the potential farmers distant from taking the advantage of these apps. It can be concluded that special trainings should be organised to make field functionaries aware about the usage of farming apps and to boost their interest in ICT. The poor internet connectivity is no doubt a problem to be addressed by the Government. Static apps should be replaced by dynamic apps having both ways interface to make it more realistic and appealing. The local apps catering to problems of local areas, providing advisories and solutions to local problems, especially at the district level would also be an encouraging idea.

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Comparative Study in Un-bagged and Bagged Fruit with effect of Pruning time on Quality of Guava (*Psidium guajava* L.) Genotypes

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ABSTRACT

The present investigations were conducted on seven different genotypes namely RHR-Guv-58, RHR-Guv-60, RHR-Guv-14, RHR-Guv-16, RHR-Guv-3, RHR-Guv-6 and Sardar with five pruning time i.e. 15th May, 15th June, 15th July, 15th August, 15th September and no pruning (control). In order to quality improvement an additional treatment bagging of fruit was undertaken. The results revealed that the significantly maximum TSS of un-bagged fruit (12.33 °Brix) and bagged fruit (13.77 °Brix) was observed in G_1 (Sardar). The maximum total sugars (8.08 and 8.94%), reducing sugars (5.07 and 5.52%), sugar: acid ratio (22.33 and 26.17) with minimum acidity (0.36 and 0.34%) were recorded in G_3 (RHR-Guv-58) genotype of un-bagged and bagged fruit, respectively. The maximum ascorbic acid of un-bagged fruit (225.50 mg/100 g) and bagged fruit (250.25 mg/100 g) and shelf life of un-bagged fruit (9.75 days) and bagged fruit (8.80 days) was recorded in G_4 (RHR-Guv-14) genotype with 15th May pruning time. The maximum B:C ratio was recorded in 15th May pruning time (3.33) and RHR-Guv-14 genotype (2.84) was recorded in bagged fruit. Very crispy pulp texture and fruit luster was observed in all genotypes rather than Sardar. Fruit quality of genotypes was remained more or less similar irrespective to pruning time. In general, it is observed that, maximum TSS, total sugars, reducing sugars, ascorbic acid and B:C ratio were recorded in bagged fruits compare to un-bagged fruits. The minimum acidity was in the same treatment.

Keywords: Pruning time, Genotypes, Quality, Un-bagged and Bagged fruit, Shel-life, B:C ratio

INTRODUCTION

Guava (*Psidium guajava* L.) is belonging to Myrtaceae family popularly known as "poor man's fruit" or "apple of tropics" (Singh, 2013). It is native to tropical America stretching from Mexico to Peru and was introduced in India by the Portuguese during 17th century (Dinesh and Vasugi, 2010). Guava is the fourth most important fruit crop in India after Mango, Banana and Citrus (Nagar *et al.,* 2017) and is popular due to its round year availability, rich nutritional and medicinal value and affordable price, suitability for transportation, handling and consumer preference. It exceeds most other fruits in productivity, hardiness, adoptability and vitamin C content (Singh *et al.,* 2012). Guava is often marketed as "super fruit", being rich in vitamins 'A' and 'C' with seeds that are rich in omega-3, omega-6 polyun saturated fatty acids and especially dietary fiber (Nimisha *et al.,* 2013). It is a popular fruit of India due to its delightful taste, flavour and easy availability. Guava is used for preparation of jams, jellies, juices, cakes, pies, ice-cream, milk shakes, sauces, butter, cheese, marmalade, chutney, relish, pickle, puree, beverages, ethanol, wine, animal feed, baby food, soft-drinks, as source of pectin, etc. (Nagar *et al.,* 2017).

Guava trees bear terminally, that's why pruning influences more sprouting of shoots, flowering, fruiting and consequently increase in the yield and quality of guava. In recent years, the climatic aberrations such as sudden rise in the temperature and humidity, abnormal rains especially during fruit development are often experienced. It had not only affected the external appearance of the fruit but also aggravated the pest such as fruit fly, which further added in the losses. The affected fruits gain poor price in the market and such fruits are also rejected for processing. It causes serious economic loss to guava growers. Bagging is a physical protection technique, not only protects fruit from pests and diseases but also effects the quality of the

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produce by changing microenvironment of fruit during development (Son and Lee, 2008). Bagging of different fruits during development can reduce the chances of physical damage, improve colour at harvest (Muchui *et al.*, 2010) and high yield with quality fruit (Edirimanna *et al.,* 2015). However, the technique is seldom attempted in guava in India. Hence, an experiment was undertaken to comparative study in un-bagged and bagged fruit with effect of pruning time on quality of guava (*Psidium guajava* L.) genotypes with the objective to effect of pruning on quality of un-bagged and bagged fruit.

MATERIALS AND METHODS

The experiment was conducted during the year 2016 and 2017 at the Instructional-cum-Research Farm, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. The present investigations were conducted on seven different genotypes namely Sardar (G_1), RHR-Guv-58 (G_2), RHR-Guv-60 (G_3), RHR-Guv-14 (G_4), RHR-Guv-16 (G_5), RHR-Guv-3 (G_6) and RHR-Guv-6 (G_7) with five pruning time i.e. 15th May (P_1), 15th June (P_2), 15th July (P_3), 15th August (P_4), 15th Sept (P_5) and no pruning (control) (P_6). The genotypes were pruned 75 per cent of current season growth of guava plants. In order to quality improvement an additional treatment bagging of fruits was undertaken. Fruits were bagged of the guava plant, when they are about 2.5-3 cm in diameter at the fruit peduncle with a stapled to prevent the entrance of insect pest. Bags are non-woven poly fabric in gray colour (23 GSM, 22 x 15 cm) purchased by Sidwin Fabric Pvt. Ltd. manufacturer of AGRIWIN™. The experiment was laid out in Factorial Randomized Block Design with forty two treatments and was replicated two times. Guava fruits were analyzed at 3/4 ripening stage for quality. Five un-bagged and bagged fruits from each treatment per replication were selected randomly and halved by Knife which was further pulped through a mixer. Eventually, homogenized fruit pulp sample was taken for biochemical analysis. Total soluble solids of fruits were determined with the help of a hand refractometer (Erma Tokyo-A°32), total sugars, reducing sugars and non-reducing sugars of fruits were determined by volumetric method reported by Lane and Eynon (1960) ascorbic acid of fruits were estimated by direct titration method using 2-6 dichlorophenol indophenol dye (A.O.A.C., 1990) and also determined with the help of a NIR machine. The statistical analysis of the data for both the experiment was done as per the standard procedure laid down by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

T.S.S. (°Brix) of un-bagged and bagged fruit: The data on T.S.S. of un-bagged and bagged fruit are displayed in Table 1. Individual effect of pruning time revealed that, the maximum T.S.S. of un-bagged fruit (11.43 °Brix) and bagged fruit (12.96 °Brix) was recorded in P_1 treatment and minimum T.S.S. of un-bagged fruit (11.16 °Brix) and bagged fruit (12.39 °Brix) in P_2 treatment. Effect of various genotypes was recorded the significantly maximum T.S.S. of un-bagged fruit (12.23 °Brix) and bagged fruit (13.83 °Brix) in G_1 genotype and the minimum T.S.S. of un-bagged fruit (11.04 °Brix) and bagged fruit (13.71 °Brix) in G_3 genotype. Data regarding interaction effect among the various pruning time and genotypes was noted that, the maximum T.S.S. of un-bagged fruit (12.46 °Brix) and bagged fruit (14.22 °Brix) was noted in P_1G_1 treatment combination, while the minimum T.S.S. of un-bagged fruit (11.00 °Brix) in P_2G_2, P_2G_3, P_3G_3 and P_2G_7 treatment and bagged fruit in (12.15 °Brix) in P_2G_3 and P_2G_7 treatment combinations in the pooled data. Results have been indicated that there were increases in T.S.S. of bagged fruit as compared to un-bagged fruit. Bagging controls the temperature and makes it favourable for the proper growth and as temperature slowly increased in bagged fruit. Temperature is major factor which effects the quality of fruits thus improves T.S.S. of bagged fruit. The increase of T.S.S. in bagged fruit is due to the conservation of carbohydrates into simple sugars by hydrolysis of insoluble starch. Edirimanna *et al.* (2015) reported that, highest T.S.S content was found in white polythene bag (13.60 °Brix) and the lowest was in control condition (9.90 °Brix) in guava. Such results after bagging that there is improvement in T.S.S is partially supported by the findings of Singh *et al.* (2007); Meena *et al.* (2016) and Rahman *et al.* (2017) in guava, Dutta and Majumder (2012) in mango and Sharma *et al.* (2013) in apple.

Total Sugars (%) of un-bagged and bagged fruit: Data presented in Table 2 showed that, the statistically significant differences were recorded for the total sugars of un-bagged fruit due to the various treatments of pruning time. Pooled results of pruning time indicated that, significantly maximum total sugars of un-bagged fruit and bagged fruit (8.04 and 9.05%, respectively) was observed in P_1 (15th May pruning) treatment. In case of genotypes, significantly maximum total sugars of un-bagged fruit (8.08%) and bagged fruit (8.94%) was recorded by G_3 (RHR-Guv-60) genotype. The interactions among the

Table 1: Effect of pruning time and genotypes on T.S.S. (°Brix) of un-bagged and bagged fruit

Treatment	Guava genotypes															
	T.S.S. of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								T.S.S. of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean
P_1	12.46	11.17	11.14	11.31	11.34	11.29	11.30	11.43	14.22	12.67	12.65	12.87	12.80	12.78	12.75	12.96
P_2	11.82	11.00	11.00	11.12	11.12	11.04	11.00	11.16	13.23	12.21	12.15	12.30	12.26	12.41	12.15	12.39
P_3	12.13	11.02	11.00	11.05	11.10	11.09	11.06	11.21	13.37	12.20	12.50	12.31	12.46	12.20	12.58	12.52
P_4	12.23	11.09	11.02	11.14	11.37	11.02	11.06	11.28	13.83	12.49	12.32	12.62	12.79	12.26	12.29	12.66
P_5	12.34	11.07	11.03	11.14	11.09	11.02	11.26	11.28	13.97	12.48	12.33	12.59	12.58	12.31	12.55	12.69
P_6 (Control)	12.41	11.09	11.07	11.22	11.25	11.17	11.20	11.34	14.00	12.47	12.37	12.59	12.51	12.61	12.51	12.72
Mean	12.23	11.07	11.04	11.16	11.21	11.10	11.14	11.28	13.77	12.42	12.39	12.55	12.57	12.43	12.47	12.66
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.10		0.11		0.27				0.12		0.13		0.32			
CD 5%	NS		0.30		NS				NS		0.37		NS			

Table 2: Effect of pruning time and genotypes on total sugars (%) of un-bagged and bagged fruit

Treatment	Guava genotypes															
	Total sugars of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Total sugars of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean
P_1	7.75	7.90	8.38	8.01	7.98	8.27	8.02	8.04	8.81	8.90	9.36	9.00	8.99	9.25	9.03	9.05
P_2	7.63	7.65	8.21	7.87	7.82	8.14	7.85	7.88	8.50	8.67	9.18	8.84	8.84	9.12	8.85	8.86
P_3	7.33	7.52	7.96	7.70	7.60	7.90	7.62	7.66	8.10	8.39	8.56	8.54	8.49	8.75	8.50	8.47
P_4	7.50	7.65	7.83	7.77	7.72	7.67	7.39	7.65	8.28	8.37	8.66	8.49	8.54	8.47	8.10	8.41
P_5	7.31	7.61	7.94	7.77	7.50	7.73	7.42	7.61	8.07	8.39	8.70	8.54	8.31	8.49	8.22	8.39
P_6 (Control)	7.53	7.68	8.15	7.80	7.75	8.10	7.82	7.83	8.53	8.70	9.16	8.80	8.79	9.10	8.85	8.85
Mean	7.51	7.67	8.08	7.82	7.73	7.97	7.69	7.78	8.38	8.57	8.94	8.70	8.66	8.86	8.59	8.67
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.06		0.06		0.16				0.07		0.07		0.18			
CD 5%	0.16		0.18		NS				0.19		0.21		NS			

various pruning time and different genotypes were found to be non-significant for total sugars of un-bagged and bagged fruit. Overall considering the results revealed that there were increases in total sugars of bagged fruit as compared to un-bagged fruit. As bagging is important procedure of covering the fruit. It effects on many properties which enhance the quality because it creates a micro climate in which temperature raise but not so simultaneously it ensure the temperature raising slowly which effect the fruit in a beneficial way by improving the aroma and total sugar. When the fruits become mature, acids are converted into sugars making guavas sweeter. This can be justified by several researches i.e. Zhou and Guo (2005) in grapes, Watanawan *et al.* (2008) in mango and Meena *et al.* (2016) in guava. Their research result clarified that bagging material improves the total sugar and many other chemical quality, morphological quality and physical properties of guava.

Reducing sugars (%) of un-bagged and bagged fruit: The data on reducing sugars of fruit have been presented in Table 3. Significantly maximum reducing sugars of un-bagged fruit (4.99%) and bagged fruit (5.59%) was noted in P_1 (15th May pruning) treatment. Pooled results of genotypes indicated that, significantly maximum reducing sugars of un-bagged fruit and bagged fruit (5.07 and 5.52%) was observed in G_3 (RHR-Guv-60) genotype. Reducing sugars of un-bagged and bagged fruit was observed non-significant for interaction among the pruning time and different genotypes. It was more in bagged fruit compare to un-bagged fruit. The present results indicated that there were increases in reducing sugars of bagged fruit as compared to un-bagged fruit. Temperature and solar radiation are the environmental variables which mainly give variation in sugar accumulations. It also affects the rate of respiration and helps in steady control. The transparent bag readily absorbs the light and raises the micro-climate temperature instantly under bagging. The outer temperature causes early maturation and demolition of sugar accumulation after ripening. The results are conformity with findings of Zhou and Guo (2005) found increase in sugars in grapes after bagging. Meena *et al.* (2016) also indicated that the same result after bagging of guava.

Non-reducing sugars (%) of un-bagged and bagged fruit: The data are displayed in Table 4indicated that, the G_3 (RHR-Guv-60) genotype was observed significantly minimum non-reducing sugars of un-bagged fruit (3.00%) in pooled results. The effect of time of pruning and interactions between the various pruning time and different genotypes were found to be non-significant for non-reducing sugars of un-bagged and bagged fruit. The results indicated from the data that there were increases in non-reducing sugars of bagged fruit as compared to un-bagged fruit. Effect of bagging is found in research carried by (Zhou and Guo, 2005, Meena *et al.,* 2016 and Watanawan *et al.,* 2008) in grapes, guava and mango is same that there is improvement of non-reducing sugar after bagging because it might control the temperature and the light with various wavelength which is one of the environmental factor of ripening and maturation. Bags are thermo resistor and also reduce the penetration of light and provide affordable microclimate and temperature where as transparent polythene is capable of absorb the light and also raise the temperature and increase the humidity of surrounding which mainly detoriate the non-reducing sugar.

Acidity (%) of un-bagged and bagged fruit: The data related to the acidity of guava fruit are presented in Table 5. This is very important biochemical parameter decides taste blend of guava. Pooled results of genotypes indicated that, the minimum acidity of un-bagged fruit (0.36%) and bagged fruit (0.34%) was noted in G_3 (RHR-Guv-60) genotype and it was at par with G_2 (RHR-Guv-58), G_6 (RHR-Guv-3) and G_7 (RHR-Guv-6) genotype. The effect of pruning time and interactions among the various pruning time and different genotypes were found to be non-significant for acidity of un-bagged and bagged fruit. The results indicated that there was decrease in acidity of bagged fruit as compared to un-bagged fruit. Bags are resist light and temperature and provide proper aeration which limits the titrable acidity. The decrease of titrable acidity might be attributed to the utilization of organic acids in respiration process and other bio-degradable reactions during ripening (Ulrich, 1970). These findings is conformity by Singh *et al.* (2007) reported low acidity in bagged guava fruit than un-bagged one, this might be happen because bagging delayed the ripening process and transpiration feature thus fruit produces less titrable acid. Dutta and Majumder (2012) also found acidity is gradually decreased in bagged fruits of mango.

Ascorbic acid (mg/100 g) of un-bagged and bagged fruit: The data in Table 6 related to ascorbic acid of fruit are revealed that significantly maximum ascorbic acid of un-bagged fruit (207.68 mg/100 g) bagged fruit (235.43 mg/100 g) was noted in P_2 (15th June pruning) treatment in pooled results. In case of the data on effect of genotypes,

Table 3: Effect of pruning time and genotypes on reducing sugars (%) of un-bagged and bagged fruit

Treatment	Guava genotypes															
	Reducing sugars of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Reducing sugars of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	**G_1**	**G_2**	**G_3**	**G_4**	**G_5**	**G_6**	**G_7**	**Mean**	**G_1**	**G_2**	**G_3**	**G_4**	**G_5**	**G_6**	**G_7**	**Mean**
P_1	4.51	4.92	5.46	5.07	4.89	5.28	4.81	4.99	5.19	5.56	6.05	5.65	5.49	5.81	5.41	5.59
P_2	4.46	4.62	5.26	4.87	4.75	5.03	4.61	4.80	5.02	5.24	5.79	5.43	5.32	5.54	5.19	5.36
P_3	4.16	4.28	4.88	4.48	4.39	4.92	4.45	4.51	4.49	4.82	5.14	4.96	4.88	5.34	4.95	4.94
P_4	4.22	4.38	4.82	4.52	4.52	4.67	4.12	4.46	4.70	4.87	5.23	4.94	4.95	5.05	4.57	4.90
P_5	4.02	4.29	4.80	4.50	4.34	4.60	4.06	4.37	4.40	4.73	5.17	4.88	4.73	4.98	4.46	4.76
P_6 (Control)	4.29	4.49	5.24	4.69	4.52	5.11	4.59	4.70	4.90	5.16	5.73	5.30	5.14	5.67	5.22	5.30
Mean	4.28	4.50	5.07	4.69	4.57	4.93	4.44	4.64	4.78	5.06	5.52	5.19	5.08	5.40	4.97	5.14
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.04		0.05		0.11				0.04		0.04		0.11			
CD 5%	0.12		0.13		NS				0.11		0.12		NS			

Table 4: Effect of pruning time and genotypes on non-reducing sugars (%) of un-bagged and bagged fruit

Treatment	Guava genotypes															
	Non-reducing sugars of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Non-reducing sugars of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	**G_1**	**G_2**	**G_3**	**G_4**	**G_5**	**G_6**	**G_7**	**Mean**	**G_1**	**G_2**	**G_3**	**G_4**	**G_5**	**G_6**	**G_7**	**Mean**
P_1	3.25	2.98	2.92	2.95	3.08	3.00	3.21	3.05	3.62	3.34	3.31	3.35	3.51	3.44	3.62	3.45
P_2	3.17	3.05	2.95	3.00	3.07	3.11	3.23	3.08	3.49	3.43	3.39	3.42	3.52	3.58	3.66	3.50
P_3	3.17	3.24	3.08	3.21	3.21	2.98	3.17	3.15	3.61	3.57	3.42	3.58	3.61	3.40	3.55	3.53
P_4	3.28	3.27	3.01	3.25	3.21	3.00	3.27	3.18	3.58	3.50	3.43	3.55	3.59	3.43	3.53	3.51
P_5	3.29	3.31	3.14	3.27	3.16	3.13	3.36	3.24	3.68	3.66	3.53	3.65	3.58	3.51	3.76	3.62
P_6 (Control)	3.24	3.19	2.93	3.11	3.23	2.99	3.24	3.13	3.63	3.54	3.43	3.50	3.65	3.43	3.64	3.54
Mean	3.23	3.17	3.00	3.13	3.16	3.03	3.25	3.14	3.60	3.50	3.42	3.51	3.57	3.46	3.62	3.53
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.05		0.05		0.12				0.10		0.11		0.27			
CD 5%	NS		0.14		NS				NS		NS		NS			

Table 5: Effect of pruning time and genotypes on acidity (%) of un-bagged and bagged fruit

Treatment	Guava genotypes															
	Acidity of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Acidity of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean
P_1	0.47	0.36	0.36	0.39	0.40	0.36	0.36	0.39	0.42	0.35	0.34	0.38	0.38	0.34	0.34	0.36
P_2	0.43	0.34	0.34	0.38	0.38	0.35	0.34	0.37	0.40	0.31	0.31	0.34	0.35	0.32	0.32	0.34
P_3	0.46	0.36	0.37	0.39	0.39	0.37	0.39	0.39	0.42	0.35	0.36	0.36	0.37	0.35	0.37	0.37
P_4	0.47	0.38	0.38	0.40	0.40	0.39	0.39	0.40	0.43	0.36	0.35	0.39	0.38	0.36	0.37	0.38
P_5	0.48	0.39	0.38	0.41	0.40	0.39	0.39	0.40	0.45	0.36	0.36	0.39	0.38	0.38	0.37	0.38
P_6 (Control)	0.46	0.37	0.35	0.38	0.39	0.35	0.38	0.38	0.41	0.35	0.34	0.37	0.36	0.33	0.36	0.36
Mean	0.46	0.37	0.36	0.39	0.39	0.37	0.37	0.39	0.42	0.35	0.34	0.37	0.37	0.35	0.35	0.36
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.00		0.01		0.01				0.01		0.01		0.02			
CD 5%	NS		0.01		NS				0.02		0.02		NS			

Table 6: Effect of pruning time and genotypes on ascorbic acid (mg /100 g) of un-bagged and bagged fruit

Treatment	Guava genotypes															
	Ascorbic acid of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Ascorbic acid of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean
P_1	191.25	198.25	201.25	210.50	204.25	201.00	194.25	200.11	213.25	221.00	224.00	233.25	227.00	223.75	217.00	222.75
P_2	199.00	203.00	208.75	222.50	210.25	209.75	200.50	207.68	226.75	230.75	236.50	250.25	238.00	237.50	228.25	235.43
P_3	192.00	198.00	202.00	210.75	203.75	199.50	195.25	200.18	213.00	219.00	223.00	231.75	224.75	220.50	216.25	221.18
P_4	183.75	190.63	197.75	204.00	191.50	193.50	189.50	192.95	204.25	211.13	218.25	224.50	207.50	214.00	210.00	212.80
P_5	177.00	190.13	197.00	202.25	188.00	195.25	186.25	190.84	195.75	208.88	215.75	221.00	206.75	214.00	205.00	209.59
P_6 (Control)	186.75	199.75	201.50	200.00	197.75	201.75	193.00	197.21	207.75	220.75	219.50	221.00	218.75	222.75	214.00	217.79
Mean	188.29	196.63	201.38	208.33	199.25	200.13	193.13	198.16	210.13	218.58	222.83	230.29	220.46	222.08	215.08	219.92
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.81		0.87		2.14				0.86		0.93		2.29			
CD 5%	2.24		2.42		5.93				2.40		2.59		6.34			

significantly maximum ascorbic acid of un-bagged and bagged fruit (208.33 and 230.29 mg/100 g) was observed in G_4 (RHR-Guv-14) genotype. As regards to interaction, maximum ascorbic acid of un-bagged fruit and bagged was recorded in P_2G_4 (222.50 and 250.25 mg/100 g, respectively) treatment. It was more in bagged fruit compare to un-bagged fruit. In the obtained results, ascorbic acid content in fruit increased with pruning as compared to control. Similarly there were increases in ascorbic acid of bagged fruit as compared to un-bagged fruit. This might be due to the changed microenvironment around fruit during its growth and development. The bagged fruits recorded highest content of vitamin C, sucrose, glucose and fructose over control in Zill mango Hongxia *et al.* (2009). The results coincided with the findings of Meena *et al.* (2016) in guava. They found the highest vitamin-C content under bagged guava fruit.

Sugar: Acid ratio of un-bagged and bagged fruit: The data in respect to sugar: acid ratio of un-bagged and bagged fruit is presented in Table 7. Significant differences in sugar: acid ratio of un-bagged fruit was recorded due to effect of pruning time and genotypes. Pooled results of genotypes indicated that, maximum sugar: acid ratio of un-bagged fruit (22.33) and bagged fruit (26.17) was noticed in G_3 (RHR-Guv-60) genotype, which was at par with G_6 (RHR-Guv-3) genotype. In case of pruning time, significantly maximum sugar: acid ratio of un-bagged and bagged fruit (21.71 and 26.64) was recorded in P_2 (15^{th} June pruning) treatment. The interaction between different times of pruning and genotypes was found to be non-significant for sugar: acid ratio. It was more in bagged fruit compare to un-bagged fruit. The present results indicated that there were increases in sugar: acid ratio of bagged fruit as compared to un-bagged fruit. Sugar: acid is combined parameter of sugar and acidity in percentage when sugar is higher than acidity it directly increases the parameter of sugar: acid ratio vice versa. But acidity is inversely proportion to Sugar: acid ratio. As bagging increase the sugar: acid ratio this statement had justified in research carried by Meena *et al.* (2016) in guava.

Shelf life of un-bagged and bagged fruit (days): The data on shelf life of un-bagged fruit are displayed in Table 8. The maximum shelf life of un-bagged and bagged fruit (9.20 and 8.27 days) was noted in G_4 (RHR-Guv-14) genotype and it was at par with G_3 (RHR-Guv-58) genotype (9.11 and 8.16 days) in pooled results of genotypes. In case of pruning time revealed that, maximum shelf life of un-bagged fruit (8.44 days) and bagged fruit (7.58 days) was observed in P_1 (15^{th} May pruning) treatment, which was at par with P_2 (15^{th} June pruning) treatment. In interaction pooled results showed that, significantly maximum shelf life of un-bagged and bagged fruit (9.75 and 8.80 days) was recorded in P_2G_4 treatment combination. Overall considering the results indicated that there was slight decrease in shelf life of bagged fruit as compared to un-bagged fruit. Bagging modified the microenvironment near fruit especially in respect to temperature and humidity. The humidity as well as temperature in bag was greater than that in control ones. The slightly decrease shelf life of bagged fruit indicated that the effect of bagging persisted after ripening. These fruits exhibited higher rate of respiration in terms of CO_2production, O_2 depletion rate and ethylene evolution which may cause reduction in shelf life of bagged fruit in guava. The results are similar findings of Singh *et al.* (1981) in guava.

Pulp texture: Information regarding the pulp texture of genotypes G_2, G_3, G_4, G_5, G_6 and G_7 is having very crisp pulp texture at maturity and at ripe stage also. Genotype G_1 has soft pulp texture at mature stage of fruit and mashy pulp texture at ripe stage of fruit (Table 9). Pulp texture is very important quality parameter of fruits of guava that is related to less or more preference of fruits of guava by consumers in the market.

Economics of un-bagged and bagged fruit: Data regarding on cost of cultivation ha^{-1}, gross income ha^{-1}, net income ha^{-1} and B:C ratio are presented in Table 10. Cost of cultivation 1,52,203 Rs. ha^{-1}bagged fruit and 113067 Rs. ha^{-1} un-bagged fruit was in P_1 P_2 P_3 P_4 P_5 treatment while, 150319 Rs. ha^{-1} and 111183 Rs. ha^{-1} P_6 (Control) treatment, respectively. The maximum gross income 506981 Rs. ha^{-1}, net income 354778 Rs. ha^{-1} and B:C ratio 3.33 of bagged fruit was recorded in P_1 (15^{th} May pruning time) treatment while, gross income 286300 Rs. ha^{-1}, net income 173233 Rs. ha^{-1} and B:C ratio 2.53 of un-bagged fruit was recorded in P_3 (15^{th} July pruning time) treatment. In case of genotype, Cost of cultivation 151889 Rs. ha^{-1} bagged fruit and 112753 Rs. ha^{-1} un-bagged. The G_4 (RHR-Guv-14) treatment was recorded highest gross income 431948 Rs. ha^{-1}, net income 280058 Rs. ha^{-1} and B:C ratio 2.84 of bagged fruit while, gross income 237791 Rs. ha^{-1}, net income 125038 Rs. ha^{-1} and B:C ratio 2.11 of un-bagged fruit was recorded in G_1 (Sardar) followed by

Table 7: Effect of pruning time and genotypes on sugar: acid ratio of un-bagged and bagged fruit

Treatment	Guava genotypes															
	Sugar: acid ratio of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Sugar: acid ratio of bagged fruit(Pooled data of 2 years- 2016 & 2017)							
Pruning time	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean
P_1	16.71	21.82	23.34	20.57	20.10	23.20	22.29	21.15	21.10	25.83	27.46	24.05	24.03	27.07	26.46	25.14
P_2	17.76	22.37	24.17	20.72	20.50	23.49	22.98	21.71	21.21	27.74	29.87	26.22	25.14	28.38	27.94	26.64
P_3	16.07	20.81	21.41	20.01	19.48	21.25	19.58	19.80	19.57	24.23	23.61	23.64	23.00	25.21	22.95	23.17
P_4	15.88	20.44	20.77	19.42	19.32	19.97	18.97	19.25	19.18	23.15	24.77	21.79	22.80	23.56	21.91	22.45
P_5	15.38	19.76	21.04	19.13	18.89	19.71	19.05	18.99	17.95	23.15	24.07	22.05	21.87	22.67	22.22	22.00
P_6 (Control)	16.48	21.09	23.24	20.54	20.15	23.35	20.88	20.82	21.10	24.91	27.25	24.14	24.64	27.42	25.02	24.93
Mean	16.38	21.05	22.33	20.07	19.74	21.83	20.62	20.29	20.02	24.84	26.17	23.65	23.58	25.72	24.41	24.06
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.32		0.34		0.84				0.43		0.46		1.13			
CD 5%	0.88		0.95		NS				1.19		1.28		NS			

Table 8: Effect of pruning time and genotypes on shelf life of un-bagged and bagged fruit (days)

Treatment	Guava genotypes															
	Shelf life of un-bagged fruit (Pooled data of 2 years- 2016 & 2017)								Shelf life of bagged fruit (Pooled data of 2 years- 2016 & 2017)							
Pruning time	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean	G_1	G_2	G_3	G_4	G_5	G_6	G_7	Mean
P_1	3.70	8.86	9.60	9.75	8.75	9.56	8.88	8.44	3.58	7.92	8.59	8.80	7.66	8.62	7.92	7.58
P_2	3.60	8.72	9.53	9.63	8.58	9.51	8.55	8.30	3.50	7.72	8.60	8.72	7.39	8.56	7.69	7.45
P_3	3.63	8.47	8.99	9.11	8.42	9.15	8.53	8.04	3.48	7.44	7.93	8.44	7.39	8.29	7.44	7.20
P_4	3.53	8.11	9.01	9.08	8.19	9.01	8.14	7.87	3.43	7.03	8.01	8.25	7.16	8.12	7.08	7.01
P_5	3.28	7.36	8.12	8.11	7.41	7.84	7.80	7.13	3.08	6.28	7.15	7.25	6.25	6.82	6.80	6.23
P_6 (Control)	3.70	8.39	9.39	9.50	8.50	9.51	8.83	8.26	3.50	7.69	8.69	8.16	7.58	8.07	7.78	7.35
Mean	3.57	8.32	9.11	9.20	8.31	9.09	8.45	8.01	3.43	7.34	8.16	8.27	7.24	8.08	7.45	7.14
Year 2016 & 2017	Pruning time		Guava genotypes		Interaction (P×G)				Pruning time		Guava genotypes		Interaction (P×G)			
SE(m) ±	0.06		0.06		0.15				0.06		0.07		0.17			
CD 5%	0.16		0.17		0.41				0.18		0.19		0.47			

Table 9: Effect of genotypes on pulp texture

Treatment details	Pulp texture	
	Mature	**Ripe**
G_1 = Sardar	Soft	Mashy
G_2 = RHR-Guv-58	Very crisp	Very crisp
G_3 = RHR-Guv-60	Very crisp	Very crisp
G_4 = RHR-Guv-14	Very crisp	Very crisp
G_5 = RHR-Guv-16	Very crisp	Very crisp
G_6 = RHR-Guv-3	Very crisp	Very crisp
G_7 = RHR-Guv-6	Very crisp	Very crisp
SE (m) ±	-	-
C.D. at 5%	-	-

G_4 treatment. The results revealed that, there was increase B:C ratio of bagged fruits as compared to un-bagged fruits by not only reduced yield loss due to pest attack, but also improved the fruit appearance, there by market price. Bagged fruit was observed produce the larger profit and increase the returns on investment by increased quality and marketable yield of the fruits. The results are similar findings with Mondal *et al.* (2015) in guava.

CONCLUSION

The results of present research it can be concluded that, the genotype RHR-Guv-60 is better in quality parameters like lustrous fruit, crispy pulp texture, maximum total

Table 10: Effect of pruning time and genotypes on Cost of cultivation ha^{-1}, Gross income ha^{-1}, Net income ha^{-1} and B:C ratio (Pooled data of 2 years- 2016 & 2017)

Treatments	Cost of cultivation (Rs. ha^{-1})		Gross income (Rs. ha^{-1})		Net-income (Rs. ha^{-1})		B:C ratio	
	Bagged	**Un-bagged**	**Bagged**	**Un-bagged**	**Bagged**	**Un-bagged**	**Bagged**	**Un-bagged**
A. Pruning Time (P)								
P_1 - 15th May	152203	113067	506981	206825	354778	93758	3.33	1.83
P_2 - 15th June	152203	113067	493621	223350	341418	110283	3.24	1.98
P_3 - 15th May	152203	113067	362447	286300	210244	173233	2.38	2.53
P_4 - 15th May	152203	113067	304119	216375	151915	103308	2.00	1.91
P_5 - 15th May	152203	113067	228036	165654	75833	52587	1.50	1.47
P_6 (Control)	150319	111183	458584	176125	308265	64942	3.05	1.58
B. Genotypes (G)								
G_1 - Sardar	151889	112753	406380	237791	254491	125038	2.68	2.11
G_2 - RHR-Guv-58	151889	112753	388124	203945	236235	91192	2.56	1.81
G_3 - RHR-Guv-60	151889	112753	404893	217019	253004	104266	2.67	1.92
G_4 - RHR-Guv-14	151889	112753	431948	234973	280058	122221	2.84	2.08
G_5 - RHR-Guv-16	151889	112753	366058	194762	214169	82009	2.41	1.73
G_6 - RHR-Guv-3	151889	112753	398733	213627	246844	100874	2.63	1.89
G_7 - RHR-Guv-6	151889	112753	349950	184951	198061	72198	2.30	1.64
C. Interaction (P x G)								
P_1G_1	152203	113067	523600	235550	371397	122483	3.44	2.08
P_1G_2	152203	113067	529760	201950	377557	88883	3.48	1.79
P_1G_3	152203	113067	524815	208425	372612	95358	3.45	1.84
P_1G_4	152203	113067	549325	226100	397122	113033	3.61	2.00
P_1G_5	152203	113067	456230	184100	304027	71033	3.00	1.63
P_1G_6	152203	113067	509120	209650	356917	96583	3.34	1.85
P_1G_7	152203	113067	456015	182000	303812	68933	3.00	1.61
P_2G_1	152203	113067	512000	250425	359797	137358	3.36	2.21
P_2G_2	152203	113067	501810	222425	349607	109358	3.30	1.97
P_2G_3	152203	113067	509765	229425	357562	116358	3.35	2.03

Table 10 contd....

Treatments	Cost of cultivation (Rs. ha^{-1})		Gross income (Rs. ha^{-1})		Net-income (Rs. ha^{-1})		B:C ratio	
	Bagged	Un-bagged	Bagged	Un-bagged	Bagged	Un-bagged	Bagged	Un-bagged
P_2G_4	152203	113067	539865	246925	387662	133858	3.55	2.18
P_2G_5	152203	113067	446555	197050	294352	83983	2.93	1.74
P_2G_6	152203	113067	492350	219450	340147	106383	3.23	1.94
P_2G_7	152203	113067	453005	197750	300802	84683	2.98	1.75
P_3G_1	152203	113067	382400	321300	230197	208233	2.51	2.84
P_3G_2	152203	113067	350880	278425	198677	165358	2.30	2.46
P_3G_3	152203	113067	363780	288400	211577	175333	2.39	2.55
P_3G_4	152203	113067	397105	306250	244902	193183	2.61	2.71
P_3G_5	152203	113067	337765	264250	185562	151183	2.22	2.34
P_3G_6	152203	113067	375605	285425	223402	172358	2.47	2.52
P_3G_7	152203	113067	329595	260050	177392	146983	2.16	2.30
P_4G_1	152203	113067	313800	232925	161597	119858	2.06	2.06
P_4G_2	152203	113067	286165	201425	133962	88358	1.88	1.78
P_4G_3	152203	113067	313470	223650	161267	110583	2.06	1.98
P_4G_4	152203	113067	348300	245700	196097	132633	2.29	2.17
P_4G_5	152203	113067	288745	207025	136542	93958	1.90	1.83
P_4G_6	152203	113067	315405	218925	163202	105858	2.07	1.94
P_4G_7	152203	113067	262945	184975	110742	71908	1.73	1.64
P_5G_1	152203	113067	241080	187220	88877	74153	1.58	1.66
P_5G_2	152203	113067	214650	156695	62447	43628	1.41	1.39
P_5G_3	152203	113067	229050	167240	76847	54173	1.50	1.48
P_5G_4	152203	113067	258075	188515	105872	75448	1.70	1.67
P_5G_5	152203	113067	220500	153920	68297	40853	1.45	1.36
P_5G_6	152203	113067	239175	169460	86972	56393	1.57	1.50
P_5G_7	152203	113067	193725	136530	41522	23463	1.27	1.21
P_6G_1	150319	111183	465400	199325	315081	88142	3.10	1.79
P_6G_2	150319	111183	445480	162750	295161	51567	2.96	1.46
P_6G_3	150319	111183	488480	184975	338161	73792	3.25	1.66
P_6G_4	150319	111183	499015	196350	348696	85167	3.32	1.77
P_6G_5	150319	111183	446555	162225	296236	51042	2.97	1.46
P_6G_6	150319	111183	460745	178850	310426	67667	3.06	1.61
P_6G_7	150319	111183	404415	148400	254096	37217	2.69	1.33

sugars, reducing sugars and sugar acid ratio with minimum acidity thus it can be evaluated for cultivation as *mrighhar* crop. The pruning time 15th May was best to obtain maximum B:C ratio of bagged fruit. In general, it is observed that, maximum TSS, total sugars, reducing sugars, ascorbic acid and B:C ratio with minimum acidity were recorded in bagged fruits compare to un-bagged fruits.

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Farmers Perceptions of Dairy Cooperatives: Evidence from Subtropics of Jammu

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ABSTRACT

The present study was conducted in the subtropics of Jammu region of UT of Jammu and Kashmir with the objective of knowing the perceptions of cooperative dairy farmers towards various aspects of Jammu and Kashmir Milk Producers Union Limited (JKMPCL). Multistage sampling technique was employed for selection of respondent dairy farmers from two zones namely, Kathua and Akhnoor. The total sample size was 120 member dairy farmers of JKMPCL. Likert-type rating scale was constructed to measure the perceptions of respondent dairy farmers towards dairy cooperative. The Weighted Average Index (WAI) calculated from the individual responses for all the identified statements revealed that member farmers' perceptions about JKMPCL were "Medium."

Keywords: Dairy cooperatives, Subtropics, JKMPCL, Likert type, WAI, Perceptions

INTRODUCTION

The livestock sector is an important segment of the economy of the Jammu and Kashmir state. About 11 per cent of the state Gross Domestic Product can be attributed to livestock sector (Economic Survey, 2007). The diverse agroclimatic conditions of the state favour livestock rearing. About 75 per cent population of the state lives in rural areas with agriculture and allied activities as mainstay. These two sectors of rural economy are interdependent. According to Wani and Wani (2010), the distribution of milk in the state has been quite exploitative and traditional with organised sector handling only 1.70 and five per cent of the total liquid milk produced and marketed surplus, respectively.

In late sixties, Government of Jammu and Kashmir decided to make pasteurized and quality milk available to the Urban Population. In this connection exotic cattle farms were established by the Department of Animal Husbandry both in Jammu and Kashmir province with the aim to make quality milk available to the milk plants for processing and standardization which were likely to be constructed. First milk plant in the state was constructed in 1959 named as Milk Supply Scheme and in 1970 another Milk Plant came into existence in Jammu. Both these milk plants were under the administrative control of Animal Husbandry Departments. Since 1970, after the launch of Operation Flood the scenario of the dairy industry changed dramatically and it had its effect on the psyche of the administrators in the state and it was planned to have the share of the development in the dairy sector. In this connection proposal for launch of Operation Flood was submitted to National Dairy Development Board (NDDB) through Indian Dairy Corporation (IDC) in the State. As per the cabinet decision both Milk Supply Schemes were converted to Kashmir Valley Milk Producers Cooperative Federation in Kashmir and Jammu Milk Cooperative Federation in Jammu in 1983. Both these federations started registering Dairy Cooperative Societies (DCS) and as such established network of societies who started supplying milk to these federations until 2004 when due to mounting losses both these federations could not sustain the regular operations of procurement and processing as such were liquidated.

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As per the initiative of Jammu and Kashmir Government in 2004 and subsequently the cabinet decision of Jammu and Kashmir Government an MoU was inked between Gujarat Co-operative Milk Marketing Federation Ltd. (AMUL) and the Jammu and Kashmir Government, for revival of the two liquidated Milk Federations of state on AMUL pattern. As the erstwhile two Milk Federations of J&K State were liquidated as these were running on losses and a new organization in the name and style of "Jammu & Kashmir Milk Producers' Co-operative Limited" (JKMPCL) came into existence for dairy development activities in the state with proactive support of AMUL.

As on 31st march 2015, 10 milk routes covering 208 village-level milk producers cooperative societies have been operational in the Kashmir region and 8 milk routes covering 157 village-level milk producers cooperative societies have been operational in the Jammu region. The processes of getting them registered have been started. Registrar Co-operative Societies, J&K have already registered 180 Milk Producers Co-operatives under Self Reliant Act, 1999 of J&K State.

Within the present structure of dairy sector in the state, dairy cooperative societies (DCSs) represent the link in the value chain between dairy farmers and milk processing industry. The main target of JKMPCL is to ensure successful running of co-operative organization for the welfare of milk producers of our state and be managed by the milk producers themselves. Dairy cooperatives can reduce time and transport costs as well as provide a market guarantee for farmers. They also reduce collection costs for the processing industries (Demirbas *et al.,* 2009; Belmar *et al.,* 2017). Moreover, JKMPCL play a vital role in food safety and quality assurance by using cooling tanks to preserve milk for longer storage and testing milk quality on a daily basis. Since raw milk is a perishable product, it must be quickly transported to milk collection centers within a short time frame after milking.

Despite the several benefits of cooperatives for dairy farmers, studies on farmers' perceptions of JKMPCL are negligible. Existing studies, therefore, have tended not to consider JKMPCL's from farmers perspectives and rigorous empirical evidence on farmers' perceptions of dairy cooperative of Jammu and Kashmir is scarce.

This article, therefore, aims to assess dairy farmers' perceptions of JKMPCL regarding various aspects namely, membership, management, decision making, transparency in procedures, distance between farm and milk collection centers, provision of inputs, sanitation and hygiene, timely payments, payment of bonus and price comparison. This study shall provide relevant inputs for the government's efforts to design appropriate policies and programmes, to assist the JKMPCL to meet the requirements of farmers, and to improve its position in the milk value chain.

MATERIALS AND METHODS

The study was conducted in the subtropics of Jammu region of the state of Jammu and Kashmir. Multistage sampling technique was employed for selecting the respondent dairy farmers. Two zones namely Kathua and Akhnoor were selected purposively as societies of only these two zones were functional for more than one year. Seven societies namely Lower Devipur, Garar, Mattuan, Pangali, Sangrampura, Chanjwan and Chak Morh were

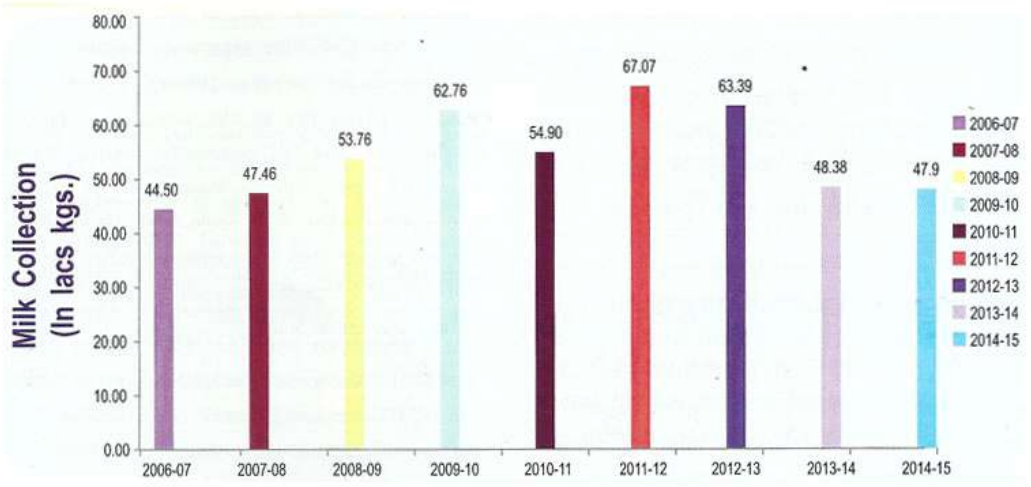

Figure 1: Annual milk procurement by JKMPCL
Source: Annual report (2014-15)

Table 1: Sampling plan

Societies sampled	No. of dairy farmers in each society (N)	Sample size from each society (n)
Akhnoor zone		
Lower Devipur	12	7
Garar	9	6
Mattuan	11	6
Pangali	7	3
Sangrampura	7	5
Chanjwan	39	30
Chak Morh	6	3
Total	**91**	**60**
Kathua zone		
Mehrajpur	24	21
Dholian Jattan	31	28
Salalpur	8	7
Pattal	6	2
Marheen	4	2
Total	**73**	**60**
Grand Total	**164**	**120**

finally selected from Akhnoor zone; and five societies namely Mehrajpur, Dhollian Jattan, Salalpur, Pattal and Marheen were finally selected from Kathua zone for selection of respondent dairy farmers. Systematic sampling method was employed to finally select 60 member dairy farmers from each zone making a total sample size of 120.

Both primary and secondary data were used. Primary data were gathered through face-to-face interviews using a structured questionnaire in the form of three-point Likert scale and informal interviews. Data were collected on farmers' perceptions of the JKMPCL's role regarding various aspects of its functioning.

For analytical statistics, the weighted average index (WAI) was used to analyse farmers' perceptions. The WAI is specified as follows, as described by Shivakoti *et al.* (2016):

$$\text{WAI} = \sum \frac{SiFi}{N}$$

where, WAI stands for the weighted average index ($0 \leq \text{WAI} \leq 1$), Si denotes the scale value assigned based on the response, Fi denotes the frequency of responses, and N denotes the total number of responses. The level of perception was measured on a three-point scale with varying weights. The degree to which they perceived was weighted as "1" for agree, "0.5" for neutral / undecided and "0" for disagree.

RESULTS AND DISCUSSION

Table 2 shows the results of the survey based on face-to-face interviews. The level of dairy farmers' perceptions of JKMPCL was analysed using the WAI and ranked based on the values obtained following classification by Shivakoti *et al.* (2016).

Overall, the results of dairy farmers perception about the role of cooperative were classified into 3 levels: strong (e"0.65), medium (0.41-0.64), weak (>0.64). The perception index calculated from individual responses for all the identified items revealed that the voluntary membership in dairy cooperative societies has been perceived as strongest and top among all the statements. This was followed by sanitary and hygienic practices followed by the cooperatives during collection, transport and storage of milk; timely milk payments, regular payment of bonus and democratic management within societies which were also considered strong. Transparency in procedures adopted by the dairy cooperative societies was rated as medium. The farmers' perceptions about the role of JKMPCL in offering remunerative prices of milk, providing dairy processing machines and supply of low rate feeds, subsidised equipments and free veterinary services; and price competitiveness were rated as weak. The overall perception of dairy farmers about JKMPCL was rated medium. This indicates the level of commitment of dairy farmers towards JKMPCL.

Perception of dairy farmers about the role of members in forming policies and decision making were also rated strong. Perception about transparency in procedures like correct weighment, fat and solids-not-fat (SNF) evaluation were rated as medium for JKMPCL. These finding are consistent with previous studies conducted by Nishi *et al.* (2011) and Wani *et al.* (2016). Perceptions of member dairy farmers were reported to be weak when they were asked about the prices offered by the cooperatives being remunerative. Since JKMPCL have their client base in rural areas and there are widespread discrepancies in prices between rural and urban markets. On an average the prices of milk per litre in the urban

Table 2: Farmers' perceptions of role of JKMPCL (n=120)

S.No.	Perception statements	JKMPCL members	
		WAI	**I***
1.	Membership is voluntary and members are free to join or leave the cooperative.	1.000	S
2.	The affairs of the dairy co-operative society are managed in a democratic manner.	0.725	S
3.	Members play a role in setting policies and making decisions regarding the working of the village dairy Society.	0.717	S
4.	Transparency in procedures adopted by the cooperatives	0.629	M
5.	Milk collection centers are located within reach.	0.70	S
6.	Provision of dairy processing machines to member farmers.	0.000	W
7.	Supply of feeds, feed supplement and veterinary services.	0.000	W
8.	Strict sanitary and hygienic practices are followed during collection and transportation of milk by the societies.	0.862	S
9.	Timely milk payments.	0.862	S
10.	Prices offered by the society are remunerative.	0.308	W
11.	Regular payment of bonus.	0.791	S
12.	High prices of milk as compared to other private competitors.	0.150	W
	Overall perception	**0.510**	**M**

*Note: * "I" denotes interpretation*

areas are Rs 8-10 higher than those in the villages because of high demand in cities. In general, the prices offered by the cooperatives are lower than those prevailing in the local market and those offered by the vendors. The same is the case with JKMPCL. Birthal *et al.* (2017) and Wani *et al.* (2016) also reported similar trends in prices offered by the dairy cooperatives.

CONCLUSION

Dairy cooperatives are a vertical coordination that provide logistic and economic link between milk farming and the milk processing industry. They play a significant role in the milk marketing of dairy farmers. As such JKMPCL have ample opportunities and enormous potential to transform rural dairy landscape. Thus, for a deeper understanding of JKMPCL's role from dairy farmers' perspectives, this study has investigated member farmers' perceptions. As revealed by the study, the farmers' perceptions about membership, democratic management, members' role in decision making, approachability of collection centers, sanitation and hygiene; and regular and timely milk payments were strong. However, at the same time, the dairy farmers perceive JKMPCL synonymous with low price as they perceive the prices paid by the cooperative are neither remunerative nor at par with those offered in the open market. One of the core reasons for this perception is the rampant adulteration of milk which is endemic in rural areas. Independent dairy producers selling milk to local traders get much higher prices than cooperative dairy farmers. These farmers are further compensated by resorting to adulteration. Additionally, there is trust deficit among the dairy farmers about JKMPCL as revealed by perceptions about transparency in procedures adopted by the cooperatives in weighment and evaluation of fat and SNF content. Also, the perceptions of the dairy farmers about provision of subsidised feed, feed supplements, dairy equipments and free veterinary services were very low.

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Measuring the Stubble Burning Behaviour of farmers in Punjab

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ABSTRACT

The use of mechanical combine harvesters for major crops like rice and wheat is popular among farmers in the northern India. The mechanized harvesting of paddy leaves a large quantity of stubble on field which takes a lot of time to decompose in the soil and thus, farmers burn a significant portion of the stubble on-farm. Stubble burning not only causes environmental pollution but also harms the soil and human health. Over the years, the stubble burning has become a major issue, threatening the air quality with numerous other ill effects. Despite herculean efforts at various levels by the governments, it seems that the problem of stubble burning is difficult to be solved by technical or legal interventions alone. Various aspects of stubble burning have been researched upon but the gap lies in identifying the determinants of stubble burning behaviour. The present study utilized the Theory of Planned Behaviour for understanding the determinants of stubble burning behaviour of the farmers. This will prove helpful in designing appropriate interventions in bringing behaviour change of farmers.

Keywords: Stubble burning, Stubble burning behaviour, Theory of planned behaviour, Farmers

INTRODUCTION

The rice-wheat production systems in Indo-Gangetic Plains assumes paramount importance in contributing to the national pool as well as providing employment and livelihood to the millions of rural poor. The states of Uttar Pradesh, Haryana and Punjab represent an extremely productive paddy-wheat region in the Indo-Gangetic Plains. In this region, around 12 million hectares is accounted for rice and wheat crop rotation and hence, is called as the "food bowl of India". Agriculture in the states of Indo-Gangetic Plains is typically characterized by two growing seasons: a predominantly winter (*rabi*) wheat crop, harvested in April-May, and a predominantly summer (*kharif*) rice crop, harvested in October-November. In the recent years, farmers have adopted mechanized harvesting due to several reasons. Studies have found that in states like Punjab, Haryana and Uttar Pradesh, more than 75 per cent of paddy is harvested using combine harvesters. Increasing utilization of mechanized harvesters over the last 30 years has decreased costs and improved efficiency for farmers. However, this harvesting method leaves more stubble on the fields than traditional methods using a sickle, and many farmers burn this residue to ready fields for the next growing season. This method of removing dry stubble by burning it to prepare the field for subsequent planting of next crop is called as stubble burning.

India generates around 600 Mt of stubble which includes about 90-140 Mt of surplus stubble and is likely to be burned in the field (Jain *et al.,* 2014*).* Multipurpose use of stubble includes animal feeding, soil mulching, bio-manure, thatching for rural homes and fuel for domestic and industrial use. Despite knowing about alternative methods of stubble management, farmers burn a significant portion of the crop stubble on-farm so that the succeeding crop can be sown on a cleared field. Mechanized farming coupled with lack of availability of farm labour and high cost associated with the process further exacerbates the problem of stubble burning. In fact, according to a study conducted by International Food Policy Research Institute, air pollution due to stubble burning in northern India causes an estimated economic loss of around USD 30 billion annually, and is a leading cause of acute respiratory infections, especially among children; apart from various ill-effects to environment (Chakrabarti *et al.,* 2019). The particulate matter emitted from crop burning across India in a year is more than 17

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times the total annual particulate pollution in Delhi from all sources such as vehicles, garbage burning and industries. In Punjab, total cereal stubble generated is 45.58 million tonnes/year and residue burned (based on IARI coefficients) is 21.32 million tonnes/year. In Haryana, total cereal stubble generated is 24.73 million tonnes/year and residue burned (based on IARI coefficients) is 9.18 million tonnes/year (Yadav *et al*., 2017). In 2019, the System of Air Quality and Weather Forecasting and Research (SAFAR) by the Ministry of Earth Sciences (MoES) reported that the share of stubble burning in air pollution in Delhi-NCR rose to about 46 per cent and thus, public health emergency was declared in the region.

The governments at different levels have attempted to restrict the stubble burning through numerous measures and campaigns designed to promote sustainable management methods. The National Green Tribunal banned stubble burning in 2015 but it had little or no effect in northern states. A Project on "Promotion of Agricultural Mechanization for *In-situ* Management of Crop Residue" has been initiated during 2018-19 in Punjab, Haryana and Uttar Pradesh by Indian Council of Agricultural Research in association with Government of India. The project broadly focuses on: (i) Establishing Farm Machinery Banks or Custom Hiring Centers of in-situ crop residue management machinery; (ii) Procurement of Agriculture Machinery and Equipment for in-situ crop residue management (iii) Information, Education and Communication for awareness on in-situ crop residue management. Under this project, a package of machines would be made available to farmer-groups (Self-help Groups/Co-operatives/Societies etc.) on a subsidized basis for the *in-situ* incorporation of the paddy stubble. The charging of monetary penalties from the farmers who burn the stubble and FIRs against them has only politicized the issue rather than putting a brake on it. In spite of the provision of the subsidies for mechanized measures, they are also not reaching the farmers due to bureaucracy and other factors. However, it would be interesting to see the latest direction of the apex court to the Punjab government to provide incentives at the rate of Rs. 100 per quintal to the farmers who do not burn the stubble in the upcoming seasons.

The topic of stubble burning has been researched upon from various angles in the past. Some of these include the pros and cons of burning and retaining the stubble on field (Verma and Bhagat, 1992), amount of nutrient-loss (Gupta *et al.,* 2004), quantity of stubble burnt (Sidhu and Beri, 2005), areas in Punjab with maximum and minimum area under stubble burning (Punia *et al.,* 2008), problems faced by people in areas where stubble is burnt (Kumar *et al.,* 2015), perception and knowledge level of farmers and extension personnel regarding measures to avoid stubble burning (Lyngdoh and Dhaliwal, 2018), quantifying health loss due to stubble burning in monetary terms (Chakrabarti *et al.,* 2019) and developing engineering interventions to prevent stubble burning through microbial degradation (Muzamil *et al.,* 2020) etc.

As of today, despite enormous efforts and measures, the desirable results to bring change in farmers' behaviour to stop stubble burning is still awaited. It seems that the problem of stubble burning is difficult to be solved by technical or legal interventions alone. Research studies have shown that simply trying to tell people to change, or giving them information and expecting them to act on it, may not work if the determinants of certain behaviours are not considered. There is a need to sensitize the farming community by using interventions which can enable farmers to rethink and change their behaviour and have a new perspective in this regard. In order to understand and change behaviour, social scientists rely heavily on appropriate behavioural theories to identify determinants of a particular behaviour. The present study utilized the Theory of Planned Behaviour (Ajzen, 1991) in the Indian context to the problem of stubble burning. According to the Theory of Planned Behaviour (TPB), the behaviour under concern is determined by the intention to perform the behaviour, which in turn is governed by various factors like attitude, subjective norms and perceived behavioural control. The TPB would enable us to understand which behavioural determinants are leading farmers to burn the stubble. Also, knowing why farmers behave the way they do is vital to design suitable interventions which could consequently result in their behaviour change.

MATERIALS AND METHODS

For the present study, descriptive design was used which includes surveys and fact-finding enquiries of different kinds. The multi-stage sampling procedure adopted for the present study is as follows. According to Kumar *et al.* (2019), the majority of the stubble burning incidents in North India were recorded in Punjab alone. While in Punjab, the Malwa region accounted for almost 95 per cent of the total crop stubble burning incidents (Chhabra *et al*., 2019). Therefore, the Malwa region was selected

purposively as the locale for the study. From Malwa region, three districts namely Bathinda, Sangrur and Ludhiana were randomly selected. One block from each selected district were selected through Simple Random Sampling without replacement. Thus, a total of three blocks; Bathinda, Sunam and Khanna from respective districts of Malwa region were selected for the study. The selected blocks are the major growers of rice and wheat. This also indicates that the farmers in the selected blocks follow rice-wheat cropping pattern. The selection thus meets the basic requirement of the study. Further, two villages from each block were selected through Simple Random Sampling without replacement. As a result, villages named Khialiwala and Amargarh from Bathinda block; Goh and Lalheri from Khanna block; and Lakhmirwala and Kharial villages from Sunam block were selected randomly for the study. For selecting farmers from the villages, appropriate sample size was estimated by using Cochran's formula, which is given below:

$$n_0 = \frac{Z^2\, pq}{e^2}$$

Where,

n_0 = sample size

Z = selected critical value of desired confidence level

p = estimated proportion of an attribute that is present in the population and q= (1-p)

e = desired level of precision

Assuming the variability to 20 per cent (i.e. q=0.2) and taking 95% confidence level with ±5 per cent precision, the required sample size was calculated as follows:

As, q = 0.2

p =1-0.2 = 0.8

e = 0.05

z =1.96

$$n_0 = \frac{(1.96)^2\,(0.8)\,(0.2)}{(0.05)^2} \quad 245.86=246(\text{approx.})$$

Therefore, 246 farmers were selected as respondents through proportional allocation for the study.

Theory of Planned Behaviour (TPB) constructs

Stubble burning behaviour: The Theory of Planned Behaviour starts with an explicit definition of the behaviour of interest in terms of its target, the action involved, the context in which it occurs, and the time frame (Ajzen, 2020). Hence, for the present study, the Stubble Burning Behaviour was defined as "Burning (action) the paddy stubble (target) on field (context) after harvesting and before sowing of the subsequent wheat crop (time frame)."

***behavioural intention regarding stubble burning*:** Intention is defined as the motivation; willingness and the effort individuals make to perform a given behaviour. So, behavioural intention regarding stubble burning refers to the degree of readiness of the farmer to perform the act of paddy stubble burning. According to theory, there is a positive relationship between intention and behaviour. The stronger the intention of the farmer means that the higher the likelihood of stubble burning being practiced.

***attitude towards stubble burning*:** Attitude refers to the extent to which an individual has favourable or unfavourable evaluation or appraisal of the behaviour in question based on their evaluative or affective judgment. So, attitude towards stubble burning refers to the overall positive or negative evaluation of performing the stubble burning by the farmers. The theory posits that more favourable an attitude is towards the behaviour in question, the higher the intention to perform the behaviour.

***subjective norms associated with stubble burning*:** Subjective norms refer to perceived social pressure to perform the behaviour and the willingness of the individual to comply with the perceived pressures exerted by his/her significant others. So, subjective norms associated with Stubble Burning refer to the overall compliance with the influences of the opinions of significant others to the respondent for the act of paddy stubble burning. If individuals perceive that society expects them to perform a particular behaviour, then they are more likely to do so. Conversely, if social expectations were that people should not perform the behaviour, then the individual would be less likely to take actions to perform the behaviour.

***perceived behavioural control related to stubble burning*:** Perceived Behavioural Control refers to the perceived ease or difficulty of performing the behaviour, which may come from past experience or anticipated impediments or obstacle. So, for the purpose of study, it will refer to the perceived ease or difficulty of performing the act of paddy stubble burning. The more control the farmer feels in burning the paddy stubble, the more likely it is, that he or she will take steps to burn it.

All of the above Theory of Planned Behaviour constructs were measured using statements adapted and modified from available literature, past studies such as Wang *et al.* 2018 and after consultation with experts of the field. The statements were scored from 1(Most likely) to 5 (Least likely) and were categorized into three categories based on Mean and Standard Deviation given in Table 1.

RESULTS AND DISCUSSION

Attitude towards stubble burning: The perusal of the data in Table 2 indicates that majority of the respondents (51.63%) showed positive attitude towards stubble burning, followed by neutral (35.37%) attitude and negative (13.00%) attitude towards stubble burning. The majority of the respondents were found to be in the favour of stubble burning as they considered burning as the most economical of all the available stubble management measures. Further, burning the stubble also helps in timely sowing of the subsequent wheat crop after paddy harvesting. Most of the farmers believed that burning the stubble kills some of the weeds and pests which, otherwise, emerge again in succeeding crops after taking shelter in the left-over stubble on the fields. So, they considered it wise to burn the paddy stubble after harvesting.

***Subjective norms associated with stubble burning*:** The data in Table 2 also reveals that the maximum number of respondents (42.68%) possessed strong level of subjective norms associated with stubble burning. On the other hand, 41.47 per cent of farmer respondents had moderate level whereas 15.85 per cent of them had low level of subjective norms associated with stubble burning. The results may be explained by the fact that most of the farmers imitated the actions of fellow farmers. During the course of investigation, it was revealed that amid restrictions on stubble burning, it was basically a group imitation and farmers followed each other if they had to burn the stubble. So, mostly the farmers relied on their fellow farmers or neighbouring farmers for this particular

Table 1: Theory of planned behaviour constructs

Constructs	Statements		Mean	S.D.
Attitude towards stubble burning	ATT1	Burning is the most economic stubble management measure	24.17	2.06
	ATT2	Stubble burning helps in timely sowing of subsequent wheat crop		
	ATT3	Stubble burning causes environmental pollution		
	ATT4	Stubble burning is bad for human health		
	ATT5	Stubble burning is helpful in controlling weeds		
	ATT6	Stubble burning should be banned		
Subjective norms associated with stubble burning	SN1	My fellow farmers support the idea of stubble burning	12.81	2.81
	SN2	The farmer groups in my area favour the practice of stubble burning		
	SN3	People who are important to me think that I should burn the stubble		
	SN4	People who influence my behaviour think it is preferable to burn the stubble		
Perceived behavioural control related to stubble burning	PBC1	Burning the stubble is the easiest way to manage it	18.31	2.33
	PBC2	There is nobody to stop or monitor the stubble burning incidents in my area		
	PBC3	The monetary penalties for burning the stubble are affordable		
	PBC4	It is a cumbersome procedure to apply for subsidies for machines to manage the stubble		
	PBC5	It's totally up to me whether I burn the stubble		
Behavioural intention regarding stubble burning	BI1	I plan to burn the stubble after the forthcoming harvesting of rice crop	10.22	1.85
	BI2	It is likely that I will continue burning stubble in foreseeable future		
	BI3	I intend to burn the stubble until a better alternative is available		
Stubble burning behaviour	SBB1	I have been burning the stubble from many years	7.51	1.85
	SBB2	I burn the total proportion of the stubble left on the field irrespective of the next crop to be sown		

practice as there was a chance of incident being reported to the police and other authorities. If one of the farmers burnt the stubble, then the others would also do the same. Since most of the farmers were in favour of the idea of stubble burning, this affected the overall practice in the study area.

Perceived behavioural control related to stubble burning: The data in Table 2 shows that the majority of the respondents (58.54%) showed 'high' degree of Perceived Behavioural Control, followed by farmers showing 'medium' (27.23%) and 'low' (14.23%) degree of Perceived Behavioural Control respectively. The findings might be explained by the fact that burning the stubble is practically the easiest measure to manage it after harvesting, thus, giving high degree of perceived behavioural control to the farmer respondents. The lack of monitoring and affordable penalties added to the convenience for farmers for burning the stubble, thereby providing them a higher degree of perceived behavioural control for stubble burning. The discussions with the farmers also revealed that the procedure to apply for subsidies provided by the government on machines and implements to the farmer societies was very cumbersome and was not fruitful. All this has led the farmers to stick to the easy method of stubble burning in the study area for managing the paddy stubble.

Behavioural intention regarding stubble burning: It can be inferred from the data in Table 2 that maximum number of respondents (41.06%) were categorised under 'medium' level of readiness or intention to burn the stubble after harvesting at the time of investigation. It was further noted that almost equal proportion of farmers were categorized under 'high' category (40.24%). Lastly, those farmers who were categorised under 'low' category constituted only 18.70 per cent of the total respondents. During the period of investigation, it was found that most of the farmers were ready to burn the stubble in that on-going season, despite of penalties and restrictions. Hence, they were categorized under 'high' category. Many respondents also expressed that they will probably continue burning the stubble in the foreseeable future as well, amid the dearth of viable and affordable alternative stubble management measures.

Stubble burning behaviour: The stubble burning behaviour was studied using two components, (i) frequency of engagement in stubble burning behaviour and (ii) the proportion of the total produced paddy stubble managed through burning. The 'frequency' referred to the number of occasions on which the farmer burnt the stubble on field after harvesting in past five years (considering one occasion per year as paddy is grown once a year in the study area). While the 'proportion' referred to the part of the total produced stubble which was managed through

Table 2: Distribution of respondents on the basis of theory of planned behaviour constructs

Construct	Frequency	Percentage
Attitude towards stubble burning		
Negative (less than 22)	32	13.00
Neutral (In between 22 and 26)	87	35.37
Positive (more than 26)	127	51.63
Subjective norms associated with stubble burning		
Weak (less than 10)	39	15.85
Moderate (In between 10 and 14)	102	41.47
Strong (more than 14)	105	42.68
Perceived behavioural control related to stubble burning		
Low (less than 16)	35	14.23
Medium (In between 16 and 20)	67	27.23
High (more than 20)	144	58.54
Behavioural intention regarding stubble burning		
Low (less than 8)	46	18.70
Medium (In between 8 and 12)	101	41.06
High (more than 12)	99	40.24
Frequency of engagement in stubble burning behaviour since past 5 years		
Very low (Once)	8	3.25
Low (Twice)	10	4.06
Medium (Thrice)	24	9.76
High (Four times)	61	24.80
Very High (Five times)	143	58.13
Proportion of the total produced stubble managed through burning		
Very little (Less than 20%)	13	5.28
Little (20% to 40%)	15	6.10
Medium (40% to 60%)	26	10.57
Large (60% to 80%)	71	28.86
Very large (More than 80%)	121	49.19
Stubble burning behaviour		
Low (less than 6)	49	19.92
Medium (In between 6 and 9)	65	26.42
High (9 and above)	132	53.66

burning, in case other stubble management methods were also used by the farmer.

Frequency of engagement in stubble burning behaviour: The data in Table 2 states that majority of farmer respondents were engaged in stubble burning every year in the last five years, thus classified under 'very high' frequency (58.13%). Around a quarter of farmer respondents (24.80%) burnt the paddy stubble after harvesting in four out of five years while 9.76 per cent of the farmer respondents had burnt the stubble in last three out of five years, thus categorised under 'high' and 'medium' frequency categories respectively. The data also shows that 4.06 per cent of the farmer respondents burnt the stubble on field twice in last five years while 3.25 per cent of the respondents had burnt the stubble just once during the time period which were put under 'low' and 'very low' frequency categories respectively.

Proportion of the total produced paddy stubble managed through burning: The data in Table 2 indicates that the maximum number of respondents (49.19%) burnt more than 80 per cent of the total stubble produced on their field and were classified under 'very large' proportion category. They were followed by the farmers who burnt 60-80 percent of the total stubble produced, thus classified under 'large' proportion category. The farmers who burnt 40-60 per cent (medium), 20-40 per cent (little) and less than 20 per cent (very little) proportions of the total stubble produced on their fields accounted for 28.86 per cent, 10.57 per cent, 6.10 per cent and 5.28 per cent respectively.

The scores of the respondents regarding both the above components were summed up and the respondents were classified under three categories of low, medium and high performance of stubble burning behaviour. The same is depicted in the Table 2. The data indicates that the majority of farmer respondents showed 'high' performance of stubble burning behaviour (53.66%) followed by 'medium' (26.42%) and 'low' (19.92%) performers of stubble burning behaviour respectively. Beyond the numbers and figures, it was found that most of the farmers were ready to give up stubble burning in case they had another economical and suitable alternative to their needs.

CONCLUSION

The findings of the study revealed that maximum number of respondents showed positive attitude towards stubble burning (51.63%), strong subjective norms associated with stubble burning (42.68%), high perceived behavioural control (58.54%) and medium level of behavioural intention regarding stubble burning (41.06%). Results also showed that majority of the respondents (58.13%) have been burning the paddy stubble on their field since last five or more years. It was also revealed that most of the farmers (49.19%) burnt more than 80 per cent of the total stubble produced and manages the rest by other measures such as incorporation using Super Seeder etc. It was also found that the majority of respondents (53.66%) showed 'high' performance of the overall stubble behaviour. It was revealed that most of the farmers were ready to quit burning the stubble on field if they are provided with another suitable low-cost alternative. So, keeping these findings in mind, further analysis of strength of effect of these TPB constructs could be found out and suitable interventions could be tailored to inculcate behaviour change in the target farmers.

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Prospects of Integrated Farming System in Punjab

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ABSTRACT

The present study was undertaken to analyse the most profitable integrated farming system and high employment generating farming system under Punjab conditions. Various farming systems approaches are being practiced by the farmers of Punjab which fulfill their needs by maintaining balance of ecology. They manage farm enterprises like crops, dairying, poultry, fishery, sericulture, piggery, tree crops etc. in such a way that they could get more profit from these multiple enterprises. The study was conducted in five agro ecological zones in Punjab and two villages were selected from each agro ecological zone. The total number of 200 respondents was selected for the study in which 100 respondents were engaged in integrated farming and 100 were engaged in non-integrated farming. It was found that nearly half of the farmers adopting integrated farming system belonged to middle age group with nuclear families. The level of education of major category involved is upto matriculate level with less social participation. (Crop + Dairy) and (Crop + Dairy + Fruits) were major integrated systems practiced by most of the respondents. The results indicated that the plans of direct marketing and contracts with private companies are more prominent than direct export. The main sources of interest were their own interest and high profits. All the farmers agreed that Integrated farming system fulfill diverse needs of agriculture.

Keywords: Benefits, Future prospects, Integrated farming system, Problems, Punjab

INTRODUCTION

Agriculture has been the fundamental source of survival for mankind over thousands of years and it provides a livelihood to half of the global population. Indian agriculture is well-known for its multi-functionalities of providing employment, livelihood, food, nutrient and ecological securities. In India, more than 80 per cent of farmers are categorized as small and marginal holders, and such farms are hardly economically viable under the existing technological scenario (ASG, 2017). Different methods have always been explored to harvest the resources for food, clothing and shelter. Punjab is important contributor in terms of agriculture in India. The progressive character of the state is passing through multifaceted problems such as soil degradation, declining water table, appearance of multi-nutrient deficiencies which is further coupled with effects of climate changes leading to deceleration of the agricultural growth. To combat the problems in our country and foremost in the state, we must ensure the livelihood security to all those who are dependent on agriculture as only source of income. With the increase of mechanization, only agriculture is not enough to fulfill income and employment needs of rural people. Extensive research is being done in all developing countries to increase the productivity, to fulfill food and employment requirements along with the maintenance of sustainability of the agriculture without the depletion of natural resources and imbalance the environment (Ugwumba *et al.,* 2010).

The traditional monoculture and disciplinary approach is unable to meet the growing and changing food demand and improve the livelihood of these smallholders on a sustainable basis (Mahapatra and Behera, 2011). Integrated farming system (IFS) is a unique approach to solve all these problems in different enterprises because in Integrated Farming System (IFS) different systems are developed on the basis of geographical locations and available resources (Soni *et al.,* 2014).

MATERIALS AND METHODS

Study was conducted in five agro ecological zones in Punjab. Two villages were selected from each Agro ecological zone. The respondents were selected randomly

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from the 5 agro-ecological zones of Punjab. The five districts were selected and from each district two villages were selected. The total numbers of 20 respondents were selected from each village among which 10 respondents were those engaged in integrated farming and 10 were engaged in non-integrated farming. The total number of 200 respondents was selected for the study in which 100 respondents were engaged in integrated farming and 100 were engaged in non-integrated farming. The data were collected personally by visiting the study area and interviewing the respondents. Proper precautions were taken to ensure unbiased response of the respondents by providing them necessary instructions after explaining the objectives of study. The data was analyzed with the help of appropriate statistical tools such as frequencies, percentage, cumulative frequency and range method.

RESULTS AND DISCUSSIONS

Prospects of Integrated Farming

Year of starting: Forty three per cent of the farmers started the integrated farming system in the period (1998-2005) followed by 32 per cent in period (1991-1998) and 25 per cent in period (2005-2012).

Plans of Diversification: The distribution of respondents regarding the year of starting and plans of diversification indicate that the system is profitable as responded by 100% respondents in the Integrated- farming system.

Expansion plans: The data reveal that more than 50 per cent of the farmers wanted to expand their integrated farming system, in most of the combinations tried. When further probed about the type of expansion 19.8 per cent of the respondents want to expand the area under the system and 28.3 per cent of the farmers want to increase number of the systems in their integrated farming system.

Table 1: Distribution of respondents regarding year of starting and plans of diversification (n=100)

Aspects	Categories	Integrated
		f (%)
Year of starting	1991-1998	32
	1998-2005	43
	2005-2012	25
Further diversification	Yes	82
	No	18
Profitable over current system	Yes	100
	No	0

*Multiple response

Satisfaction: The satisfaction level of the respondents analysed on the basic survey shown that the satisfaction level was more than 57 per cent, in all the Integrated farming system methods with highest in (crop + fishery) combination i.e. 75 per cent followed by (crop + diary) and (crop + piggery + Forestry) with 69 and 66per cent, respectively.

Plans for export: Export is marketing the products outside the country. This is a new and profitable way of marketing the products. The results indicated that the plans of direct marketing and contracts with private companies were more prominent than direct export in simple two system combination whereas export is taken as fcc4fa choice by three system combination.

Source of interest: The respondents were asked about their source of interest in Integrated farming system due to which they started doing integrated farming. The information regarding source of interest is presented in Table 2. From the table it is evident main sources of interest were their own interest and high profits. Majority of farmers are engaged in Integrated farming system for their own consumption and eighty nine per cent of the farmers said they were suggested by fellow farmers.

Table 2: Distribution of respondents according to their source of interest in Integrated farming system (n=100)

Source	Integrated
	f (%)
Due to own interest	100
High profits	100
Advised/suggested by fellow farmers/person	89
Own consumption	65

*Multiple response

Needs fulfilled by Integrated farming system: The needs fulfilled by Integrated farming system are shown in the Table 3 from which it can be concluded that all the farmers agreed that Integrated farming system fulfilled diverse needs of agriculture. Most of the farmers responded that Integrated farming system fulfilled their need of increased production. Nearly half of the respondents said that Integrated farming system provide sustainable amount of farm inputs. It can be concluded that Integrated farming system is capable of fulfilling the different needs of farmers.

Table 3: Distribution of respondents according to response on needs fulfilled by Integrated farming system (n=100)

Aspects	Integrated
	f (%)
Diverse production of Agriculture	100
Increased production	88
Fulfilled the domestic and commercial needs	90
Provided sustainable amount of farm inputs	55
Increased farm income	85

*Multiple response

CONCLUSION

It was found that nearly half of the farmers practicing integrated farming system belonged to middle age group and having nuclear families with average size up to 4 members. Nearly half of integrated farming system farmers were matriculate. About 40 per cent of the farmers in IFS have medium land holding. Electric motor and canal water were main source of irrigation in integrated farming systems. Almost all the farmers in Integrated farming system are member of cooperative societies. Integrated Farming system had a mix response with different influential factors but more than 50 per cent of the farmers wanted to expand their integrated farming system. The satisfaction level was more than 57 per cent, in all the integrated farming system methods with highest in (crop + fishery) combination. The results indicated that the plans of direct marketing and contracts with private companies are more prominent than direct export. The main sources of interest were their own interest and high profits. All the farmers agree that Integrated farming system fulfills diverse needs of agriculture. Therefore, the involvement of government is necessary to encourage the farmers engaged in different integrated farming system by providing them with the solutions of various problems faced by them.

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Benefits and Challenges of ATMA Kisan Bazaar in Ludhiana District of Punjab

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ABSTRACT

The present study has been conducted in Ludhiana district of Punjab. ATMA Kisan bazaar or farmers' market helps farmers in bringing and selling their produce directly to consumers without the involvement of middlemen. In the present study 130 respondents (10 Organizers, 20 Progressive farmers, and 100 Consumers) were selected randomly to find the problems, benefits, regarding ATMA Kisan bazaar. Data were collected with the help of a structured interview schedule. The findings of the present study revealed that organizers 50% of ATMA Kisan Bazaar belonged to the young age group (26-36 years), 60 per cent of them had annual income 1-5 lakh rupees and had 2 years of experience of organizing ATMA Kisan bazaar were reported that formation of social groups are very beneficial to the farmers. In case of progressive farmers, half (50%) of them were in the middle age group (46-58 years), 60 per cent of progressive farmers have 1-5 lakh income, all of progressive farmers benefited from direct sell without middle-men in ATMA Kisan bazaar, a large majority (90%) of progressive farmers faced marketing problems in the bazaar. In case of consumers 54 per cent were in them young age group (21-41 years), 51 per cent of consumers had an annual income 1-5 lakh, problem of improper packaging ranked at the 1st among the problems by the consumers in the ATMA kisan bazaar, environment friendly benefit of the ATMA Kisan bazaar ranked at the 1st by the consumers.

Keywords: ATMA, Kisan, Bazaar, Organizers, Progressive farmers, Consumers, Benefits, Problems

INTRODUCTION

Agriculture Technology Management Agency (ATMA) is a registered society at the district level, which works with different agriculture related institutions for sustainable agriculture development. The main objective of this body is to coordinate the various research and extension activities at the district level. It is also responsible for decentralization of public agriculture technology system.

The project process involves adopting bottom up planning procedures for setting the research and extension agency in order to make the technology dissemination farmer driven and farmer accountable. The extension delivery is oriented towards group approach catering to the location specific requirement of the farmers. Gender concerns are given adequate emphasis under the project. It functions as a registered society at district level and serves as a focal point for integrating research and extension activities and helps in decentralizing the management of agricultural technology transfer. Formation of 'Farmer's Interest Group (FIGs)' with the help of public organizations, private organizations, NGOs, para extension worker and private input dealers in all the blocks and villages of the district are major objectives of ATMA (Anonymous, 2019a).

In order to address the key constraints faced by agricultural extension system in the country with respect to reducing capacity of public extension services, its lack of decentralized and demand driven focus, the Innovations in technology dissemination component of National Agricultural Technology Project (NATP) was implemented in 1998 in seven States in the country namely, Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand, Orissa, Maharashtra and Punjab through four project districts in each State. The purpose of NATP's innovation in technology dissemination component is to pilot test new organizational arrangements and operational procedures and not merely strengthening the existing extension system. The principle concepts behind this were; the creation of

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Agricultural Technology Management Agency (ATMA) at the district level for decentralization in decision-making process, increase farmers input into programme planning and resource allocation especially at the block level and increase accountability to stakeholders. The strengthening of leadership and management structure of the programme was also given importance so that the programme's core objectives such as farming system innovations, farmers' organization, technology gaps and natural resource management can be more effectively and efficiently implemented (Anonymous 2019; 2019a).

ATMA *KISAN* BAZAAR' is a booster for progressive farmers and self-help groups (SHGs). Direct marketing of agricultural products at farmers' markets has become an important sales outlet for small and marginal farmers nationwide. Enhancing income of farm families through value addition and product diversification has been one of the thrust areas of Agriculture Technology Management Agency. ATMA handhold the entrepreneurs to create brands, register them, obtain licenses and advertise. It established a unique facility, namely, ATMA *KISAN* BAZAAR to display its branded value added products and to attract the buyers. ATMA *Kisan* bazaar is giving them an opportunity to introduce their products to public and obtain consumer feedback. Farmer's Interest Groups (FIGs), Common Interest Groups (CIGs) and progressive farmers, in which more than 20 farmer organizations were registered with ATMA in Ludhiana district of Punjab State for marketing of their produce with this approach. Farmers are able to sell their products on this platform, initiated by the district administration since April 2018. The market is set up in the premises of the District Agriculture Office from 3 pm to 7 pm every Sunday. This innovation was seen as a way to provide a profitable market outlet for small scale producers and processors and a strategy to increase customer interest in local food products within a growing global market place. The motive behind starting this bazaar is to provide a place to progressive farmers and registered SHGs for selling their products without the presence of middlemen under the Agriculture Technology Management Agency (ATMA) programme. Farmers sell products within the range of Rs. 5 to Rs. 2000 and farmers have also earned good profits. Farmers usually sell products viz. vegetables, pickle, honey, wheat flour, pulses, dairy, chutney, spices and other products and the SHGs sell various types of bags. No rent is taken from farmers and SHGs for installing their stalls in the market. Most products are organic which are safe to use. The city residents have also given energetic response to the market and about 150 to 200 people visit ATMA *Kisan* bazaar each Sunday and it is increasing day by day (Anonymous, 2018).

Mishra and Prusty (2006) made an attempt to analyse the "Functioning of Krushak Bazaars of Orissa". They have undertaken a comparative study of two leading Krushak Bazaars (farmers markets) located at Baragarh and Rourkela districts. The main objective of the present study was to highlight the constraints faced by the farmer sellers at the Krushak Bazaars and suggest some suitable remedial measures; Both the Krushak Bazaars are running on bi-weekly basis without proper backward linkages.

Namasivayam and Karuppuchamy (2010) emphasized upon the fact that unless the producers who are the target group of regulated markets, participate successfully for which these markets were established would be defeated. They suggested that the advocacy machinery of the market committee should be geared up so as to make the producers aware of the advantages of dealing in the regulated markets. They insist that a sound marketing system safeguard reasonable advantages to the farmers and consumers.

Shiimi *et al.* (2010) found that problems with transport and accessibility to market-related information are significant factors affecting choice of a marketing outlet.

Subhendu (2012) in "Rythu bazaars - A study of the benefits received by farmers". looked at the supply side to study the benefits accrued by the farmers operating at these markets. It also studies the current satisfaction level of the farmers.

Sawairam (2014) highlighted the benefits for the participating farmers to market their excess production through the company as the company was providing appropriate knowledge to generate excess production from within the community in order to maintain linkages to the target markets. The small and marginal farmers faced several constraints which included the inability to create scale of economies, low bargaining power because of low quantities of marketable surplus, scarcity of capital, lack of market access, lack of knowledge and information, market imperfections, and poor infrastructure and communications. The farmers' organization provided a wide range of services to their members related to marketing, finance, technology, production and welfare.

MATERIALS AND METHODS

The study was conducted in Ludhiana district of Punjab state. A list of all of the stakeholders' of the ATMA *Kisan* bazaar namely progressive farmers, Consumers and Organizing officials of ATMA *Kisan* bazaar were involved in the study. 20 Progressive farmers, SHGs, CIGs and FIGS members were selected randomly as the respondents whereas 100 consumers and 10 organizers were also selected randomly. The parameters considered were benefits and problems, whilst the independent variables were age, gender, family type, family size, level of education and annual income.

RESULTS AND DISCUSSION

The age of the respondents is one of the most important characteristics in understanding their views about the particular problems; by and large, age indicates the level of maturity of individuals in that sense age becomes more important to examine the response. It is evident from Table 1 that on average age of the respondents are 42 years of age and the range of the ages were found to be 31 years starting from 26 to 56 years the age of the respondents were classified into three categories. Half of the respondents belonged to the young age group of 26-36 years (50%), while 30 per cent of them aged between 37-46 years and 20 per cent of them aged between 47-56 years. Gender is a socially constructed definition of women and men. It is not the same as sex (biological characteristics of women and men) and it is not the same as women. Gender is determined by the conception of tasks, functions, and roles attributed to women and men in society and public and private life. The data in Table 1 revealed that (60%) of the respondents were found male and 40 per cent of them were belonged to female gender.

The type of family in which a person lives and gets socialized has immense importance in deciding his values, beliefs, and behaviors patterns which are likely to affect his or her attitudes towards a particular problem, hence the family type plays its role in giving the response of an individual and therefore it was thought important to understand the family type of the respondents. It was found from Table 1 that 60 per cent of the respondents were belonged to the nuclear family and 40 per cent of the respondents were belonged to the joint family.

It was observed from Table 1 that majority (70%) of the respondents were belonged to the family size of (<4) members, 20 per cent of the respondents were belonged to the family size of (5-6) members while 10 per cent of the respondents were belonged to the family size of (>8) members. Similar findings by Singh (2019) and Sharma (2016) reported that the majority of the respondents belonged to the nuclear family type. And Yasmin (2009) reported that the majority of the respondents i.e. 63.53 per cent were 5-8 members in their family. Education is one of the most important characteristics that might affect the person's attitudes and the way of looking and understanding any particular social phenomena. In a way, the response of an individual is likely to be determined by his educational status and therefore it becomes imperative to know the educational background of the respondents. It is assumed that the educational background of the respondents plays a significant role in making them innovative; with this frame in mind, the educational qualification of the respondents was studied. It is observed from Table 1 that the majority (80%) of the respondents were studied up to the post-graduation level followed by 20 per cent were studied up to graduation level. It is observed that among respondents practicing ATMA *Kisan* bazaar majority post-graduated and the education

Table 1: Distribution of respondents (organizers of ATMA *Kisan* bazaar) according to their socio- personal profile (n=10)

Socio-personal characteristics of organizers	Category/Range	Frequency	Percentage
Age groups (years)	Young (26-36)	5	50
	Middle (37-46)	3	30
	Old (47-56)	2	20
Gender	Male	6	60
	Female	4	40
Type of Family	Nuclear	6	60
	Joint	4	40
Size of Family	Small (<4)	7	70
	Medium (5-6)	2	20
	Large (>8)	1	10
Education	Graduation	2	20
	Post-Graduation	8	80
Annual income (Rs)	1-5 Lakh	6	60
	5-10 Lakh	3	30
	More than 15 Lakh	1	10

qualification was higher among the respondents. A similar finding by Pinky (2014) showed that the majority of the respondents i.e. 60 per cent graduated.

The income of a person plays an important role in shaping the economic conditions of an individual which in turn is likely to have bearing on the responses about a problem posed to him. Therefore, this study attempted to investigate the income as a variable, and it is studied based on two aspects, 1st the annual income of respondents from ATMA *Kisan* bazaar, 2nd the total annual income of respondents which they earn from other occupations like farming, service, business, etc. and it was found that all (100%) of their annual income is from services. A perusal of the data in Table 1 showed that 60 per cent of the respondents had an annual income in the range of 1-5 lakhs followed by 30 per cent who had an annual income between 5-10 lakhs and only 10 per cent of the respondents had annual income more than 15 lakhs.

The age of the respondents is one of the most important characteristics in understanding their views about the particular problems; by and large, age indicates the level of maturity of individuals in that sense age becomes more important to examine the response. It is evident from Table 2 that the average age of the respondents is 31 years of age and the range of the ages were found to be 38 years starting from 32 to 70 years the age of the respondents was classified into three categories. Half of the respondents were found to belonged the middle age group of 46-58 years i.e. 50 per cent while 40 per cent of them were between 32-45 years age. 10 per cent of them were between 59-70 years age. Similar findings reported by Babu (1992); Khanjibhai (2008) and Yasmin (2009) who stated the majority of the respondents in their study were from the middle age group. While in other similar studies by Singh (2013), Gupta and Rahman (2011), and Kalra *et al.* (2012) reported the majority of the respondents belonged to the middle age group.

Gender is a socially constructed definition of women and men. It is not the same as sex (biological characteristics of women and men) and it is not the same as women. Gender is determined by the conception of tasks, functions, and roles attributed to women and men in society and public and private life. The data in Table 2 revealed that 65 per cent of the respondents were belonged to male gender and 35 per cent of respondents were belonged to female gender. The type of family in which a person lives and gets socialized has immense importance in deciding his values, beliefs, and behaviors patterns which are likely to affect his or her attitudes towards a particular problem, hence the family type plays its role in giving the response of an individual and therefore it was thought important to understand the family type of the respondents. It was found from Table 2 that 65 per cent of the respondents were belonged to the nuclear family and 35 per cent of the respondents were belonged to the joint family. It was observed from Table 2 that more than half (55%) of the respondents were belonged to the small size families (2-4) members, 35 per cent of the respondents were belonged to the medium family size of (5-6) members while 10 per cent of the respondents were belonged to the family size of (7-8) members.

Education is one of the most important characteristics that might affect the person's attitudes and the way of looking and understanding any particular social phenomena. In a way, the response of an individual is likely to be determined by his educational status and therefore it becomes imperative to know the educational

Table 2: Distribution of respondents (progressive farmers of ATMA *Kisan* bazaar) according to their socio-personal profile (n=20)

Socio-personal characteristics of progressive farmers	Category/Range	Frequency	Percentage
Age groups (years)	Young (32-45)	8	40
	Middle (46-58)	10	50
	Older (59-70)	2	10
Gender	Male	13	65
	Female	7	35
Type of Family	Nuclear	13	65
	Joint	7	35
Size of Family	Small (2-4)	11	55
	Medium (5-6)	7	35
	Large (7-8)	2	10
Education	Primary	3	15
	Matriculation	5	25
	10+2	6	30
	Graduation	5	25
	Post-Graduation	1	5
Annual income (Rs)	1-5 Lakh	12	60
	5-10 Lakh	7	35
	More than 15 Lakh	1	5

background of the respondents. It is assumed that the educational background of the respondents plays a significant role in making them innovative; with this frame in mind, the educational qualification of the respondents was studied. It is observed from Table 2 that 30 per cent of respondents were studied up to 10+2 followed by 25 per cent were studied up to matriculation, 25 per cent of respondents were studied up to graduation, 15 per cent of respondents were studied up to primary level and just five per cent of respondents were studied up to post-graduation level. The income of a person plays an important role in shaping the economic conditions of an individual which in turn is likely to have bearing on the responses about a problem posed to him. therefore, this study attempted to investigate the income as a variable, and it is studied based on two aspects, 1st the annual income of respondents were from ATMA *Kisan* bazaar, 2nd the total annual income of respondents were which they earn from other occupations like farming, service, business, etc. and it was found that all (100%) of their annual income was from small businesses. A perusal of the data in the Table 2 showed that more than half (60%) of the respondents had an annual income in the range of 1-5 lakhs followed by 35 per cent who had an annual income between 5-10 lakhs and only five percent of the respondents had annual income more than 15 lakhs rupees.

The age of the respondents is one of the most important characteristics in understanding their views about the particular problems; by and large, age indicates the level of maturity of individuals in that sense age becomes more important to examine the response. It is evident from Table 3 that the average age of the respondents was 51 years of age and the range of the ages was found to be 61 years starting from 21 to 82 years the age of the respondents was classified into three categories. More than half of the respondents found to be belonged to the young age group of 21-41 years i.e. (54 %), while 38 per cent of the respondents were in the middle-age group between 42-61 years and only eight percent of the respondents were in older age group between (62-82) years. These findings were in line with the finding of Kaur (2017).

Gender is a socially constructed definition of women and men. It is not the same as sex (biological characteristics of women and men) and it is not the same as women. Gender is determined by the conception of tasks, functions, and roles attributed to women and men in society and public and private life. The data in Table 3, revealed that majority (86%) of the respondents were belonged to male gender and 14 per cent were belonged to female gender. The type of family in which a person lives and gets socialized has immense importance in deciding his values, beliefs, and behaviors patterns which are likely to affect his or her attitudes towards a particular problem, hence the family type plays its role in giving the response of an individual and therefore it was thought important to understand the family type of the respondents. It was found that 51 per cent of the respondents were belonged to joint families and 49 per cent of the respondents were belonged to nuclear families. It was observed from Table 3, that more than half (57%) of the respondents were belonged to the middle size of families (4-6) members, 31 per cent of the respondents were belonged to the large family size of (7-10) members while 12 per cent of the respondents were belonged to the small family size of (up to 3) members.

Education is one of the most important characteristics that might affect the person's attitudes and the way of looking and understanding any particular social phenomena. In a way, the response of an individual is likely to be determined by his educational status and therefore it becomes imperative to know the educational background of the respondents. It is assumed that the educational background of the respondents plays a significant role in making them innovative; with this frame in mind, the educational qualification of the respondents was studied. It is observed from Table 3, that 40 per cent of the respondents were studied up to graduation level followed by 25 per cent were studied up to post-graduation level, 17 per cent of respondents were studied up to 10+2 level, 13 per cent of respondents were studied up to matriculation level and just five percent of respondents were studied up to primary level.

The income of a person plays an important role in shaping the economic conditions of an individual which in turn is likely to have bearing on the responses about a problem posed to him. therefore, this study attempted to investigate the income as a variable, and it is studied based on two aspects, 1st the annual income of respondents from ATMA *Kisan* bazaar, 2nd the total annual income of respondents which they earn from other occupations like farming, service, business, etc. and it was found that all (100%) of their annual income was from services and businesses. A perusal of the data in Table 3, showed that 51 per cent of the respondents had annual income in the

range of 1-5 lakhs followed by 41 per cent who had an annual income between 5-10 lakhs, six percent of respondents had annual income (10-15) and only two percent of the respondents had annual income more than 15 lakhs Indian rupees.

Table 3: Distribution of respondents (consumers) according to their socio-personal profile (n=100)

Socio-personal characteristics	Category/Range	Frequency	Percentage
Age (years)	Young (21-41)	54	54
	Middle (42-61)	38	38
	Older (62-82)	8	8
Gender	Male	86	86
	Female	14	14
Type of Family	Nuclear	49	49
	Joint	51	51
Size of Family	Small (up to-3)	12	12
	Medium (4-6)	57	57
	Large (7-10)	31	31
Education	Primary	5	5
	Matriculation	13	13
	10+2	17	17
	Graduation	40	40
	Post-Graduation	25	25
Annual income (Rs)	1-5 Lakh	51	51
	5-10 Lakh	41	41
	10-15 Lakh	6	6
	More than 15 Lakh	2	2

It is revealed from the Table 4, that according to the benefits perceived by organizers from facilities and activities provided by them in the ATMA kisan bazaar, providing regular trainings to progressive farmers, hygiene of the bazaar and formation of social groups with mean score 3 were ranked at the 1st, jointly decision making with stakeholders and providing shelter facility to the bazaar with mean score 2.9 were ranked at the 2nd, providing proper guidance to the consumers with mean score 2.7 ranked at the 3rd, helping farmers to brand their products ranked, close coordination among stakeholders and control of prices in the bazaar with mean score of 2.6 were ranked at the 4th and helping farmers to certified their products with mean score of 2.5 ranked at the 5th by the organizers of ATMA kisan bazaar.

It is revealed from the Table 5, that according to problems faced by the organizers from facilities and activities provided by them in ATMA kisan bazaar, small area of the bazaar with mean score of 3 ranked at the 1st, less number of location of the bazaar with mean score of 2.9 ranked at the 2nd, comparative higher prices with mean score 2.7 ranked at the 3rd, unavailability of needy instruments with mean score of 2.6 ranked at the 4th, poor infrastructure of the bazaar with mean score of 2.4 ranked at the 5th, poor awareness of the farmers and consumers regarding ATMA kisan bazaar with mean score of 1.6 ranked at the 6th, insufficient sources available in the bazaar with mean score of 1.5 ranked at the 7th, inappropriate location of the bazaar with mean score of 1.4 ranked at the 8th, insufficient number of staff and poor coordination

Table 4: Distribution of respondents according to the benefits perceived by organizers from facilities and activities provided by them in the ATMA kisan bazaar (n= 10)

S.No.	Benefits of organizers	Less beneficial		Beneficial		More beneficial		Score	Rank	Mean score
		f	%	f	%	f	%			
1.	Proper guidance to consumers in the bazaar	0	0	3	30	7	70	27	3	2.7
2.	Providing regular trainings to progressive farmers	0	0	0	0	10	100	30	1	3.0
3.	Helping farmers to brand their products	0	0	4	40	6	60	26	4	2.6
4.	Helping farmers to certified their products	2	0	1	10	7	70	25	5	2.5
5.	Providing shelter facility to the farmers	0	0	1	10	9	90	29	2	2.9
6.	Formation of social groups	0	0	0	0	10	100	30	1	3.0
7.	Close coordination among stakeholders	2	20	0	0	8	80	26	4	2.6
8.	Control of prices in the bazaar	1		2	0	7	70	26	4	2.6
9.	Hygiene of the bazaar	0	0	0	0	10	100	30	1	3.0
10.	Jointly decision making by stakeholders	0	0	1	10	9	90	29	2	2.9

Table 5: Distribution of respondents according to the problems faced by the organizers from facilities and activities provided by them in the ATMA kisan bazaar (n=10)

S.No.	Problems faced by the organizers of ATMA kisan bazaar	Less severe		Severe		More severe		Score	Rank	Mean score
		f	%	f	%	f	%			
1.	Inappropriate Location of the bazaar	6	60	4	40	0	0	14	8	1.4
2.	Poor Infrastructure of the bazaar	1	10	4	40	5	50	24	5	2.4
3.	Insufficient sources available in the bazaar	6	60	3	30	1	10	15	7	1.5
4.	Insufficient number of staff	7	70	3	30	0	0	13	9	1.3
5.	Unavailability of needy instruments in the bazaar	0	0	4	40	6	60	26	4	2.6
6.	Poor coordination among stakeholders	7	70	3	30	0	0	13	9	1.3
7.	Less number of locations	0	0	1	10	9	90	29	2	2.9
8.	Small area of the bazaar	0	0	0	0	10	100	30	1	3
9.	Poor awareness of famers and consumers regarding ATMA kisan bazaar	5	50	4	40	1	10	16	6	1.6
10.	Comparative higher prices	0	0	3	30	7	70	27	3	2.7

Table 6: Distribution of respondents according to the benefits perceived from ATMA *Kisan* bazaar (n=20)

S.No.	Benefits	Low		Medium		High		Score	Rank	Mean score
		f	%	f	%	f	%			
1.	Branding of the business	8	40	12	60	0	0	32	5	1.6
2.	Less time needs of storage	0	0	12	60	8	40	48	3	2.4
3.	Easy handling	12	60	8	40	0	0	28	6	1.4
4.	No need of cold storage	15	75	5	25	0	0	25	7	1.25
5.	No middle-men	0	0	0	0	20	100	60	1	3.0
6.	Better price	3	15	8	40	9	45	46	4	2.3
7.	Developed skill in marketing	2	10	0	0	18	90	56	2	2.8

among stakeholders with the mean score of 1.3 stood at the 9th by the organizers of ATMA kisan bazaar.

It can be seen in Table 6, that according to benefits perceived from ATMA *Kisan* bazaar regarding no middle-men all of the respondents were selected high option which ranked 1st, in case of developed skill in marketing majority (90%) of the respondents were selected high option and 10 per cent were selected low option which ranked at the 2nd, in the part of less time needs of storage 60 per cent of respondents were selected medium option and 40 per cent of respondents were highly benefited which ranked at the 3rd, in case of better price perceived by respondents of ATMA *Kisan* bazaar 45 per cent of respondents were highly benefited, 40 per cent of them medium and 15 per cent of respondents were low benefited which better price ranked at the 4th. In case of branding of the business perceived benefit by respondents 60 per cent of respondents were benefited medium and 40 per cent of them lowly benefited which ranked at the 5th, in case of easy handling 60 per cent of respondents were benefited low while 40 per cent of respondents were benefited medium from which ranked at the 6th, benefit perceived by the respondent in case of no need of cold storage 75 per cent of respondents were benefited low and 25 per cent of respondents were benefited at medium which ranked at the 7th.

It is observed from the Table 7, that the problems faced by respondents in ATMA *Kisan* bazaar marketing problems (advertisements, information, experiences) ranked 1st with mean score (2.85), financial problems (capital, credit, insurance, subsides) stood at 2nd with mean score (2.65), production problems (quality of products, quantity of products) ranked 3rd with mean score (2.55), transportation problems (vehicle, parking, distance) ranked

Table 7: Distribution of respondents regarding problems faced by them in ATMA *Kisan* bazaar (n=20)

S.No.	Problems	Less severe		Severe		More severe		Score	Rank	Mean score
		f	%	f	%	f	%			
1.	Transportation problems:	4	20	3	10	13	65	49	4	2.45
	a. Vehicle	4	20	3	10	13	65			
	b. Parking	4	20	3	10	13	65			
	c. Distance	4	20	3	10	13	65			
2.	Production problems:	2	10	5	25	13	65	51	3	2.55
	a. Quality of products	2	10	5	25	13	65			
	b. Quantity of products	2	10	5	25	13	65			
3.	Financial Problems:	2	10	3	15	15	75	53	2	2.65
	a. Captial	2	10	3	15	15	75			
	b. Credit	2	10	3	15	15	75			
	c. Insurance	2	10	3	15	15	75			
	d. Subsidies	2	10	3	15	15	75			
4.	Marketing problems:	0	0	3	15	17	85	57	1	2.85
	a. Advertisements	0	0	3	15	17	85			
	b. Information	0	0	3	15	17	85			
	c. Experiences	0	0	3	15	17	85			
5.	Communication Problems:	5	25	6	30	9	45	44	5	2.2
	a. Linguastic	5	25	6	30	9	45			
	b. Written	5	25	6	30	9	45			
	c. coordination	5	25	6	30	9	45			
6.	Technological problems:	8	40	5	25	7	35	39	6	1.95
	a. Higher cost	8	40	5	25	7	35			
	b. Skill to use	8	40	5	25	7	35			

4th with mean score (2.45), communication problems (linguistic, written, coordination) ranked 5th with mean score (2.2), technological problems (higher cost, skill to use) stood at 6th with a mean score (1.95).

It is observed from the Table 8, that the benefits driven by respondents from ATMA *Kisan* bazaar the more respondents were benefited from environment friendly which ranked at 1st with mean score (4.2), and organic produce ranked at 2nd with mean score (4.05), direct purchasing ranked at 3rd with mean score (4.03), ATMA *Kisan* bazaar as a joyful place for an outdoor walk ranked at 4th with mean score (3.96), healthier produce ranked at 5th with mean score (3.92), fresh products ranked at 6thwith mean score (3.9), a place to meet a neighbor and chat with them ranked at 7th with mean score (3.44) and typically lower prices in ATMA *Kisan* bazaar ranked at 8th with mean score (2.69) as a benefit which driven by the respondent in ATMA *Kisan* bazaar.

It can be seen in the Table 9, that according to problems faced by respondents in ATMA *Kisan* bazaar improper package problem stood at the 1st with mean score (2.62), poor water drainage problem ranked at the 2nd with mean score of (2.66), poor hygiene problem ranked at 3rd with mean score (2.75), cleanliness problem of the bazaar ranked at 4th with mean score (2.88), inappropriate location problem of the bazaar ranked at 5th with mean score (2.84), leftover produce problem of the bazaar ranked at the 6th with mean score (2.87), parking problem of the bazaar ranked at the 7th with mean score (2.88), overcrowding problem in the bazaar ranked at 8th with mean (3.07), and free carry bags were the problem which ranked it at the 9th with mean score (3.62) in ATMA *Kisan* bazaar.

Table 8: Distribution of respondents regarding benefits driven by from ATMA *Kisan* bazaar (n=100)

S.No.	Benefits	Very less beneficial		Less beneficial		Neutral		Beneficial		Very beneficial		Score	Rank	Mean score
		f	%	f	%	f	%	f	%	f	%			
1.	Healthier products	0	0	3	3	20	20	59	59	18	18	392	5	3.92
2.	Fresh products	2	2	3	3	18	18	57	57	20	20	390	6	3.9
3.	Organic produce	0	0	5	5	10	10	60	60	25	25	405	2	4.05
4.	A place to meet neighbors, chat...	5	5	7	7	30	30	55	55	3	3	344	7	3.44
5.	A place to enjoy an outdoor walk while purchasing from ATMA *Kisan* bazaar	0	0	3	3	20	20	55	55	22	22	396	4	3.96
6.	Typically cheaper prices	17	17	26	26	35	35	15	15	7	7	269	8	2.69
7.	Direct purchasing from farmers	0	0	0	0	22	22	53	53	25	25	403	3	4.03
8.	Environment friendly (less plastic, lower transportation, less energy use)	0	0	0	0	12	12	56	56	32	32	420	1	4.2

Table 9: Distribution of respondents according to the problems faced by them in ATMA *Kisan* bazaar (n=100)

S.No	Problems	Always		Sometimes		Never		During holidays		Rarely		Score	Rank	Mean score
		f	%	f	%	f	%	f	%	f	%			
1.	Parking problem	7	7	16	16	68	68	0	0	9	9	288	7	2.88
2.	Over crowding	6	6	8	8	71	71	3	3	12	12	307	8	3.07
3.	Poor water drainage	10	10	24	24	61	61	0	0	5	5	266	2	2.66
4.	Poor hygiene	7	7	26	26	58	58	3	3	6	6	275	3	2.75
5.	Improper packaging	8	8	38	38	45	45	2	2	7	7	262	1	2.62
6.	Left over produce	4	4	22	22	65	65	1	1	8	8	287	6	2.87
7.	Cleanliness	6	6	27	27	55	55	5	5	7	7	280	4	2.80
8.	Inappropriate location	7	7	6	6	84	84	2	2	1	1	284	5	2.84
9.	Free carry bags	5	5	27	27	16	16	4	4	48	48	363	9	3.63

CONCLUSION

From the research it can therefore be concluded that farmers have got benefited on account of increase in their earnings, immediate cash realization, higher rates for their products, and especially to organizers for providing facilities and different activities as well enhancing their capacities, to farmer from direct sell and for consumers purchasing fresh and healthy products directly from the farmers in the bazaar which could eradicate the middle-men around from. However, the farmers did not get benefited on the account of storage facility, proper trainings and short-long term courses in marketing and packaging of the products yet which the authorities should take note of and provide it at the earliest.

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A Case Study of A Crossbred Dairy Cattle Farm in Ludhiana District of Punjab

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ABSTRACT

The occupation of successful dairy farming is the gateway for livelihood and nutritional security of farm families. The case study conducted for such a dairy farm reveals the performance and the technology used at farm level. The selected farmer was rearing crossbred cattle of Holstein-Friesian (HF) cross and Jersey cross under semi loose housing system on area of one acre. He was interviewed personally using standard procedure with predesigned questionnaire. He has been trained on dairy farming for one month from Punjab Dairy Development Department at Dairy Training and Extension Centre, Bija and started his dairy farm with 20 cattle of HF cross cows in 2010. His family is also involved in the enterprise and has engaged two permanent labourers at his farm. The selected farmer, Mr. Manjeet Singh Thind; has been raising his own female calves since 2015. On an average he used to add nearly 8-10 animals by raising his own calves. Animals were well fed by the home made silage prepared from maize all over the year. The cows are machine milked twice per day milking frequency and the he sells the milk through society called Progressive Dairy Solution (PDS) associated with PDFA. During the year 2017-18, the farm having lactating 14 HF cross and 03 Jersey cross cows on an average yield of 21 litres/day. The mean lactation length was found to be similar in HF cross and Jersey cross cows that is 270±10 days. The farm was found to be economically viable, earning net profit of Rs. 23,608.2 per animal per year. A successful dairy enterprise can be practised with proper training, technology of AI & marketing with organized sector of milk procurement sector etc.

Keywords: Crossbred, Dairy farm, Production, Economics

INTRODUCTION

Entrepreneurship has been considered as an effective tool for widening the financial background of the farmers having small holdings. An entrepreneurial farmer is one who initiates, organizes the activities, manages and controls the affairs of business unit combining the factors of production to supply goods and services. Farmers deciding to take particular crop/enterprise or use scientific methods to grow crops also exhibit entrepreneurial behavior. Dairy farming is a crucial component of rural economy that has the highest potential of generating income and employment. It generates daily income for the livelihood of the farming families i.e. for the purchase of goods and services; meeting the education and medical expenses; or investment for the future, etc. Milk provides a high nutrition to the society in general and the farming families in particular and also reduces the malnutrition. Milk production and its value addition generate employment opportunities for the society. The dairy farmers in the country demand high yielding animals, which can cater to their needs to boost the overall productivity of the animals. The most important determinant for the success of this farming is Crossbred dairy cattle. Due to higher production of milk (ranging between 20-40 kg/day) it increases the profit for dairy farmers. Apart from milk, dairy animals also provide manure for the farm and calves for sale. It also acts as an insurance against unforeseen contingencies and is also viewed as a status symbol (Karanja, 2003; Ouma *et al*., 2004; Moyo and Swanepoel, 2010). Keeping in view the importance of dairy farming as an entrepreneurial venture for small and marginal farmers and also landless agricultural labourers a descriptive case study has been undertaken on a dairy farm of crossbred cows being reared by a progressive farmer of a village Mohiein

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Ludhiana district of Punjab. This case study involves evaluation of the performance, system and technology used for successful dairy farming.

MATERIALS AND METHODS

The selected study area "Mohie" is a small village of Sudhar block in Ludhiana district of Punjab state that is nearly 22km away from Ludhiana city. The dairy farmer carried out mixed farming, comprised of crops and livestock. The farmer was rearing crossbred cattle of HF cross and Jersey cross cows under semi-loose housing system on an area of one acre. The successful dairy farmer owner of commercial dairy named "Satnam Dairy Farm, Manjeet Singh, Mohie" was interviewed personally using standard procedure with pre-designed questionnaire. This dairy enterprise was selected purposively since he is a small farmer with land ownership of 1.5 acres but a successful entrepreneurial farmer. The data of the farm was collected for the year 2017-18 and analyzed to evaluate its performance and viability.

RESULTS AND DISCUSSION

Introduction of the respondent farmer: S. Manjeet Singh Thind owner of the dairy farm running the 'Satnam Dairy Farm' at his own village Mohie in Ludhiana district of Punjab with 17 milch animals on the land of 1.0 acres. He owns operational land of 1.5 acres and leased in 20 acres. Mr. Singh, his wife were fully engaged in the dairy farm practices and his student son was also helping them during his leisure time. Mr. Thind has also engaged two permanent laborers at his farm. The services of these two persons are partially used on dairy farm and partially on the general arable farm.

History of success: In 2009, S. Manjeet Singh Thind acquired training of dairy farming for one month from Punjab Dairy Development Department at Dairy Training and Extension Centre, Bija and started his dairy farm with 20 cattle of Holstein-Friesian (HF) cross cows in 2010. After 2015 onwards, he started using the imported sexed semen of HF bull and with the help of Artificial insemination (AI), he start raising his own female calves. Then in 2017, he purchased two Jersey cows and crossed them with HF bull semen. Every year he used to rear his own home produced female calves to increase the number of animals at his farm. On an average he used to add nearly 8-10 animals by raising his own calves. At present, he has total 17 milch animals in which 14 are HF and 03 are Jersey cross cows. He usually updated his knowledge from time to time as he is associated with "Progressive Dairy Farmers Association (PDFA)" of Punjab. Animals were kept under semi-loose housing system where they were well-fed by the home-made silage prepared from maize all over the year. Feed ingredients for total mixed ration (TMR) were assorted by him from the market and fed twice daily. Artificial insemination (AI) technique was used for better conception with the help of expert/ technicians. Proper vaccination schedule was followed on the farm and on regular interval deworming of all the animals was done. Cows were machine milked with twice per day milking frequency either by the farmer himself or by his family members. He used to sell the daily milk production to the society called Progressive Dairy Solution (PDS) associated with PDFA.

Table 1: Profile of the farmer

Name	S. Manjeet Singh Thind
Age	48 years
Education	Matriculation
Family type and number	Nuclear; 3 family members
Operational land holding	1.5 acres & leased in 20 acres
Total no. of permanent laborers hired	02
Crops grown	Wheat, Paddy and Maize
Year of start of the dairy enterprise	2010
Shed size	01 acre
No. of dairy animals	HF cross - 14 Jersey - 03
Farm implement owned	Milking machines Chaff cutter Tractor - trolley
Sources of credit	Own Borrowed from Bank
Source of information/training	Dairy Training & Extension Centre, Bija, Punjab Dairy Development Department
Source of marketing of produce	Progressive Dairy Solution (PDS) society

Productive and reproductive performance of the animals: The various parameters of productive and reproductive performance of HF and Jersey cross cows were represented in Table 2. The farm having lactating 14 HF and 03 Jersey cross cow son an average yield 21 litres/ day. The age at puberty of both HF cross and Jersey cross was found 09±1 month. The age at first calving for crossbred cows in this study averaged out 23±10 and 24±10 months for HF cross and Jersey cross respectively.

Table 2: Productive and reproductive performance of Crossbred cattle

Parameter	HF cross	Jersey cross
Age at puberty (months)	09±01	09±01
Age at first calving (months)	23±10	24±10
Calving interval (days)	425±20	425±20
Service per conception (number)	1.5±0.1	1.5±0.2
Birth weight (kg)	35±2.50	28±3.50
Gestation length (days)	275±15	275±15
Milk yield (lit/day)	22±5.50	16±5.00
Fat (%)	3.5-4	4.5-5
Lactation length (days)	270±10	270±10
Total lactation milk yield (lt.)	6500-7000	4500-5500
Post partum heat period (days)	60±10	60±10
Dry period (days)	60±2	60±2

A number of previous studies disclosed that management factors particularly nutrition determines pre-pubertal growth rates and reproductive development (Negussie *et al.,* 1998; Sarder *et al.,* 2001; Masama *et al.,* 2003). The better managed and well-nourished heifers grew quicker, served earlier and resulted in additional economic returns in terms of sales of pregnant heifers and or a lot of milk and calves produced during the life of the animal. The number of services per conception were found to be less than two as there was nearly 75 per cent success rate of conception after first service. The average birth weight of HF cross and Jersey cross was found 35±2.50 kg and 28±3.50 kg, respectively. There was no significant difference between the gestation length of both the breeds as it was found to be 275±15 days in HF and Jersey cross cows. The calving interval is the most important indicator of reproductive performance of a dairy cow. The calving interval of both HF cross and Jersey cross was found to be 425±20 days. The average daily milk production of HF cross (22±5.50 litre/day) was found to be higher than Jersey cross (16±5.85 litre/day) with fat percentage of 3.5-4 per cent and 4.5-5 per cent, respectively. Geetha and Lavanya (2013) reported that per day per animal milk production on an average of cross-bred cows was ranging from 10.24 to 19.63 litres per day. The mean lactation length was found to be similar in HF cross and Jersey cross cows that is 270±10 days which is lower than the standard 305day lactation period. This may be due to less economic return as the farmer said the cost of feeding after 270 days is more than the returns from milk production. The average total lactation milk yield of HF cross was found to be 6500-7000 litres which were higher than the average total lactation milk yield of Jersey cross (4500-5500 litres). There was no significant difference between the post partum heat period (60±10 days) and dry period (60±2 days) in both HF cross and Jersey cross cows. Similar findings were reported by Uddin *et al.*, 2008, Miazi *et al.*, 2007; Ali *et al.,* 2000; Kumar *et al.*, 2014 and Ashraf *et al.,* 2000.

The farmer rarely faced common problems of a dairy farm *viz:* repeat breeding, mastitis, dystocia, disease occurrence, lameness, fodder availability, veterinary services and other financial problems. This might be due to his proper management and systematic approach in dairy farming.

Table 3: Cost and returns from milk production per animal per day of crossbred dairy cattle farm (Rs./cow/day)

Particulars	Performance
a) Fixed cost	
Depreciation on fixed assets	25.38
Interest on fixed assets	27.37
Land rent	1.71
Total fixed cost	**54.46**
b) Variable cost	
Green fodder	160.0
Dry fodder	08.0
Concentrate	201.6
Minerals	10
Total feed cost	379.6
Labor charges	13.0
Veterinary expenses	10.0
Insurance	10.0
Misc. expenses	08.0
Total variable cost	**420.60**
Total cost (a+b)	475.06
c) Source of income	
Average milk yield (lt./cow/day)	21
Price of milk (Rs./cow/day)	24
Income of sale of milk (Rs./cow/day)	504
Income from sale of cow dung (Rs./cow/day)	1.49
Income from sale of young stock (Rs./cow/day)	34.25
Gross return	**539.74**
Net profit (Rs./cow/day) (Gross return – Total cost)	**64.68**

Economics of farming: The total costs and returns of Crossbred dairy cattle milk production are summarized in Table 3. The total cost per animal per day was estimated to be Rs. 475.06 out of which fixed and variable costs were Rs. 54.46 and Rs. 420.60, respectively. The feed and fodder cost was the major component of the total cost which is Rs. 379.6/cow/day. On an average of both the HF and Jersey crossbred cows, the milk production per animal per day was found to be 21 litres. The source of income such as sale of milk, cow dung and young stock was estimated to be Rs. 539.74 per animal per day. The farm was found to be economically viable, earning net profit of Rs. 23,608.2 per animal per year.

CONCLUSION

Dairy production was found to be a crucial enterprise and have the potential to be economically viable and greatly contribute to poverty alleviation, food security, improved family nutrition and financial gain and employment generation. From this study it can be concluded that the farming is a profitable entrepreneurial venture for rural farmers. It could be more profitable when carried out with proper training, technology of AI, in time vaccination and deworming at regular intervals and regular marketing with organized sector of milk procurement may be a society etc.

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Appraisal of Parental Attributes of Young Parents of Rural Uttarakhand

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ABSTRACT

Family is the fundamental unit of the society and has the most important influence in a child's life. Parents and family form a child's first relationships. Numerous researches have indicated that effective parenting is important to have a secure attachment that leads to a healthy social, emotional, cognitive development of children. Parenting is heavily influenced by culture, community and individual attitudes and traits. The present study is based on a research project on "Parenting and Reproductive health care in agrarian families" conducted by the research team of Child Development Unit of All India Coordinated Research Project, Pantnagar. The study seeks to assess parental factors like temperament, competency and styles of parenting of rural parents of Uttarakhand. The study comprised of a sample of 300 couples making a total of 600 respondents. Self-Structured Interview Schedules were used to collect data. The results revealed that majority of parents reported to have average temperament and competency. The results on parenting style reported authoritarian style as the most preferred parenting style followed by authoritative style. Permissive parenting was the least adopted style of parenting among parents.

Keywords: Parental competency, Parental temperament, Parenting styles

INTRODUCTION

Decades of research have demonstrated that the parent-child dyad and the environment of the family which includes all primary caregivers are at the basis of well being and healthy development for children. Learning begins right from birth and children heavily rely on their parents and caregivers. The impact of parents is significant during the early years of life, when a child's brain is rapidly developing and when nearly all of her or his experiences are created and influenced by parents. Parents help children in developing and refining their knowledge and skills, paving way for their well-being during childhood and beyond. The journey of parenting also affects parents themselves. It can be an enriching experience making their life more focused. For instance, it can bring happiness, fulfillment and plethora of other emotions.

There is something unmistakable about the importance of family as a social system. Children are affected by the society they live in but the influence of the family is comparatively more. The role family plays in developing creativity, morality and social development is of great significance. A harmonious relationship between parents and children affects their overall well-being. Studies have demonstrated that effective communication between parents and children is one important factor that affects children's fostering and healthy character (Kimble, 2014).

Parenting involves a number of parental practices, roles and behaviors that are directed at caring, nurturing and rearing of children (Èudina-Obradoviæ and Obradoviæ, 2006). It is a feeling that can be satisfying yet stressful. The feeling of satisfaction will depend on how happy the parent is with their relationship with the child and their own parental role (Sabatelli and Waldron, 1995; Waldron-Hennessey and Sabatelli, 1997).

Parent's relationship with child or style of parenting serves many ends. Among these purposes, some includes moral and psychological training, skill, abilities and talent development, familiarization with the rules and norms of the society from parent's perspective. "Parsons considers two basic functions for the family, i.e. socialization and development of the child's personality." It seems that the parenting patterns are likely to influence the personality

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characteristics of children (Eazazi, 1997). Parenting styles can be defined as a set or a system of behaviors that describes the parent and child interactions over a wide range of situations and creates an effective interaction atmosphere (Maher and Komaijani, 2006). Parenting style is a determining and effective factor that plays an important role in children's psychopathology and growth (Seif, 2014).

Given that child rearing is complex (Belsky, 1984; 2008; Bronfenbrenner, 1978, quoted in Bennett and Grimley, 2001), it cannot be claimed that the effects of child development are exclusively determined by effective parental activities (Ramaekers and Suissa, 2012; Smith, 2010).

Parenting is a rewarding but highly demanding and often daunting task as every decision a parent takes is keeping in mind the well-being of their child. It is fundamentally a social act that is heavily influenced by external and internal factors. External factors like cultural, norms and internal factors encompass things like parental attitude, behaviour etc. One such internal factor is the parent's temperament. Temperament is basically a person's manner of thinking, behaving, or reacting. One's temperament plays a major role in how you parent your child. Temperament influences how strict or permissive one will be with their child. It also plays a role in how much tolerance one will have for certain behaviors.

Researches have also demonstrated that parental competence is also an important variable in child developmental outcomes. Parental competence is closely linked to different factors, which may directly or indirectly influence parental behaviour. Parental competence is not just a matter of the acquisition of parenting skills. Competent parenting is defined as a child rearing style that helps the developing person to acquire the capacities necessary to cope effectively with the surroundings.

Parent temperament and competence often influence parenting styles adopted by the parents. Parenting style is a representation of the standard strategies used by parents to raise their offspring (Kordi and Baharudin, 2010) and therefore, as a psychological construct is dependent on the behavior and attitude of the parents. In addition, there appear to be gender differences in parenting style. In India, fathers are usually considered as the head and the breadwinner of the family, while the mother's bears significant childcare duties like feeding, nurturing and maintaining discipline. Conventional gender roles in India encourage mothers to be nurturing caregivers, while fathers have traditionally been encouraged to have little involvement in childrearing. Mothers, in general, are viewed as more authoritative and sometimes more permissive, while fathers are traditionally viewed as authoritarian (Barnhart *et al.,* 2013). However, there seems to be a change in such practices in recent years, and the active involvement of fathers in parenting is increasing (Bhattacharyya and Pradhan, 2015).

Over the last ten years, the researchers have begun to examine parenting styles, parent competency and temperament and its impact on children but there is a paucity of research studies exploring such factors in contemporary India. More so, the existing research has so far focused on mothers. A lack of research exists on how parenting may differ for fathers and other caregivers.

MATERIALS AND METHODS

Locale: The present study was part of All India Coordinated Research Project on 'Parenting and Reproductive Health Care in Agrarian Families' of G.B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India. It was carried out in seven adopted villages of the department viz. Buksora, Durgapur I, Durgapur II, Anjaniya and Pateri village of Distt. Udham Singh Nagar and Dogra and Suryajala village of Distt. Nainital of Uttarakhand.

Sample: The sample for the present study comprised of a total of 300 married women and their husbands making a total of 600 respondents having children of age up to 6 years.

Tools: Self structured scales were used to assess competency, temperament and parenting styles. The competency questionnaire comprised of 60 items answered on a two point rating i.e. Yes (1), No (0). The questionnaire pertaining to temperament was answered on three point rating scale i.e. often (3), sometimes (2) and rarely (1). Parenting style questionnaire was comprised of 29 items answered on a five point rating scale never (0), rarely (1), sometimes (2), very often (3) and always (4).

Pilot testing: The self structured scales were mailed to experts from the field of Psychology, Human Development, Social work and their suggestions were incorporated followed by a pilot study with 30 parents (not part of the study) to test the clarity of questions. Necessary modifications were made.

Procedure for data collection: The investigators were familiar with the aims and objectives of the study, the research design, and the ethical protocols. The first visit was done with an aim to get acquaintance with the area and form a rapport with the locals and anganwadi workers. The anganwadi workers were specifically approached as they have a better understanding of the region and they are in direct contact with the village people. Population who met the inclusion criteria were selected and briefed about the purpose of the study. A written consent was taken from the participants by explaining the contents and intention of the consent form.

RESULTS

A close view of Figure 1 reveals that 63 per cent of the mothers reported average (slow to warm-up) temperament followed by 24 per cent mothers having less positive (difficult) temperament and 13 per cent having highly positive (easy) temperament. Among fathers, more than half of the population (54%) reported average (slow to warm-up) temperament followed by 31 per cent having less positive (difficult) temperament and 15 per cent having highly positive (easy) temperament. Overall picture reveals that 59 per cent of the total population (both mothers and fathers) exhibited average (slow to warm-up) temperament followed by 27 per cent exhibiting less positive (difficult) temperament and 14 per cent having highly positive (easy) temperament.

It can be clearly seen from Figure 2 that 58 per cent of mothers reported average parental competency followed by 27 per cent reporting poor parental competency and 15 per cent reporting good parental competency. Similar picture was observed when parental competency was observed among the sample population of fathers, wherein 57 per cent of the population reported average parental competency followed by 30 per cent reporting poor parental competency and 13 per cent reporting good parental competency. The overall picture across parental competence reveals that more than half of the total population (both mothers and fathers) i.e. 58 per cent falls under average category of parental competency followed by 28 percent reporting poor parental competency and 14 per cent reporting good parental competency.

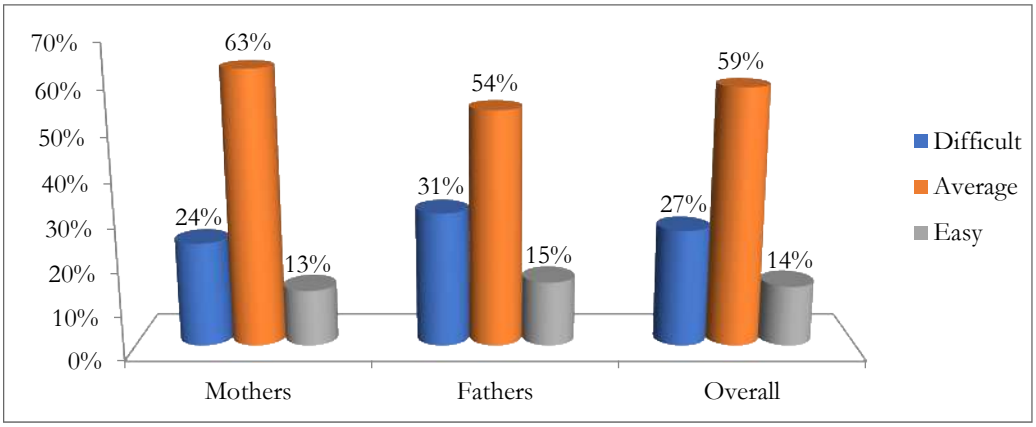

Figure 1: Percent Distribution of the parental temperament of the respondents (N=600)

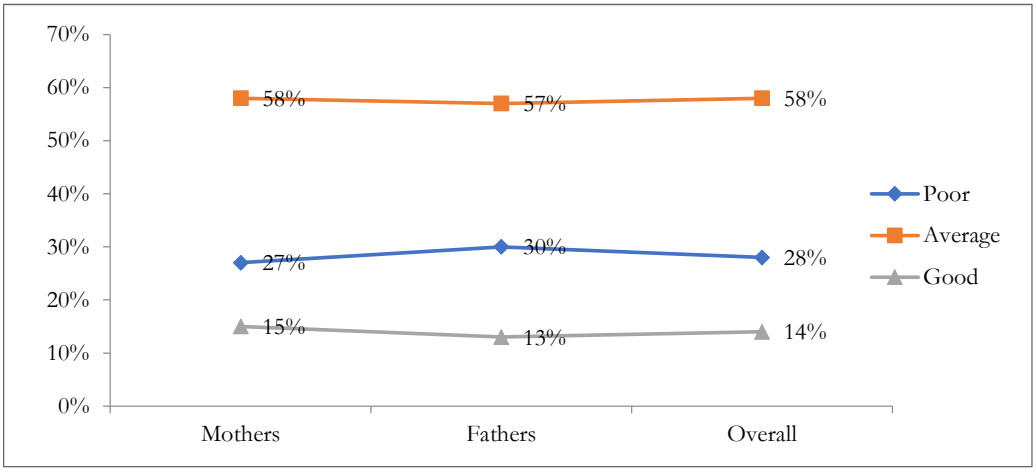

Figure 2: Percent distribution of parental competency of the respondents (N=600)

Figure 3: Percent distribution of parenting styles adopted by respondents (N=600)

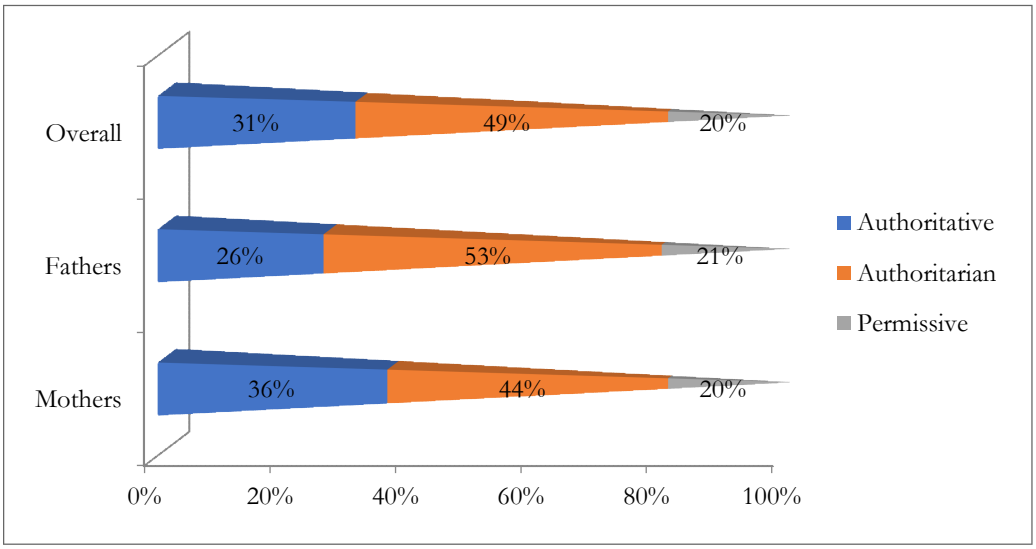

Figure 3 throws light on parenting styles adopted by the respondent. It was evident that around 44 percent of the mothers preferred authoritarian style of parenting followed by 36 per cent who preferred authoritative style of parenting. Permissive style of parenting was reported by only 20 percent of the mothers. The graph further elaborates on parenting style adopted by fathers. It was apparent that around half (53%) of the fathers preferred authoritarian style of parenting followed by 26 per cent who preferred authoritative style of parenting. There were around 21 per cent of fathers who reported using permissive style of parenting. The overall data reveals that around half (49%) of the parents preferred authoritarian style parenting followed by 31 per cent who used authoritative style. Around 20 per cent of the parents reported using permissive style of parenting.

DISCUSSION

The study assessed parent competency, parent temperament and parenting styles of rural parents of Uttarakhand. The test conducted for assessing parent temperament revealed that for both parents the results were more or less same. Majority of the parents lie in the average category followed by difficult and lastly easy, which is a point of concern as the temperament of parent play a significant role in the upbringing of the child. Difficult temperament in parents can make the child afraid of the parents. The situation may further worsen as this fear may lead to child being less interactive with the parents. In such case, the child would not be able to share his thought, feeling, fear or any concerns with the parents. This forms a vicious cycle in which the gap between parent and child goes on widening. This in the author's opinion is one of the reasons of increasing suicide rates among school and college going kids because difficult temperament of parents leads to a situation where children are so scared that they are not able to communicate with their parents even in the most difficult phase of their life.

Results pertaining to parent competency are similar to results for parent temperament. Majority of parents were having average competency followed by poor and very few were in good category. To a great extent the child's future depends upon the nurturing he receives from parents. Parents and teachers are the foundation on which a child's character, attitude and capabilities depend. Lack of parental competency would lead to chaos and void in a child's development since we as child look up to our parent for the majority of things that we usually face in day to day life. It seems that most of the parents were unaware of the impact of parenting in the development of the child. In the true essence parenting goes much beyond providing mere sustenance. For some parents, raising a child was not in their priority list. It was evident during some informal talks that some parents were not even giving sufficient time to their children as they were primarily engaged in jobs which were not allowing them to be with their family for a good period of time. It is important that they are made aware of the importance of their parenting in the healthy and all round development of their children. It goes without saying that lack of education is also critical as far as parental competency is concerned. The author proposes that some intervention program must also be the part of government initiatives to promote effective parenting.

Assessment of parenting styles was also part of the study. Authoritative parenting is known to be the most effective parenting style. It was satisfying to see that authoritative parenting was the second most adopted style of parenting among both mothers and fathers. Majority of parents were reported adopting authoritarian style of parenting. The results are in contrast to the study by Sharma and Sandhu (2006) which stated that the authoritarian style of parenting which involves an unquestionable obedience is an outdated thing and now days it is being replaced by a preference towards a sense of parental control.

Authoritarian style of parenting as the most preferred style among respondents raises concern because this style of parenting often restricts the child from expressing their view points or their ideas which becomes counter productive over a period of time. This severely restricts the child development as an individual and he becomes greatly dependent upon parents for every little thing. The child under authoritarian style of parenting will not be able to develop their true potential. It would inhibit leadership skills in child. It severely restricts ingenious and out of box thinking. It may also lead to lower self-esteem and confidence among child thus dooming them for their lifetime. Though the author strongly believes that discipline is very important but the method of inculcating it plays even a greater role. It is very important that after some point of time children are treated as friends where opinion of both are heard and any differences are sorted out by discussions.

CONCLUSION

Parenting is a neglected art in India which is a cause of worry as the child's all round development depends largely upon good parenting which comprises of the parental temperament, parental competencies and parenting styles. The children are going to be the working force in the coming years and as such they should achieve their true potential which would only be possible when good parenting is practiced at home. More of such studies can have social implications and it could help psychologist in developing training modules and intervention programmes on parenting. The government and the administration should bring this into their activity list if India has to achieve its importance and high place in the 21st Century.

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Achievement of Different Components of Livelihood Security Under Tribal Sub Plan in Manipur

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ABSTRACT

The tribals constitute a significant portion of Indian population. Development of an economy is positively related to the tribals-their social, cultural and the economic development. Most of the areas inhabited by the tribals are remote and underdeveloped. It is difficult to think of the balanced development of the state without improving the lot of the tribal people living in hill districts. The Government of India has been formulating policies, programs, projects and schemes focusing on tribal people and investing significant financial resources through every Five Year Plan to accelerate the rural development. Tribal Sub Plan is also one of the programmes initiated by the Government of India during Fifth Five Year Plan for socio-economic amelioration of the tribal communities in India. In Manipur, the Tribal Sub-Plan was intervened with an objective to provide tribal families a variety of welfare and development programmes. The present study was conducted in Kangpokpi and Chandel districts of Manipur with the objective of prioritizing the different components of livelihood security based on the benefit received by the beneficiaries. A total of 100 TSP beneficiaries were interviewed. For analysis of data, The Method of Paired Comparison was followed. It was found from the study that after commencement of TSP in the study area, food security is the component where the respondents (TSP beneficiaries) received maximum benefit followed by financial security, educational security, health security and habitat security.

Keywords: Tribal sub plan, Livelihood security, Method of paired comparison

INTRODUCTION

The Tribal area in Manipur covers more than 90 per cent of the total geographical area and ranks ninth in the human resource development index and twenty first in the poverty index in India (National Human Development reports 2001, Planning Commission). The State had problems of economic development and socio-economic transformation for a long period. With predominantly tribal population, shifting cultivation dominated economy, absence of industries and minimal urbanization, the hill districts of Manipur present a scene of poverty, unemployment, economic exploitation, social deprivation, poor health, illiteracy and lack of infrastructure.

National Commission for Scheduled Castes and Scheduled Tribes in their third report (2007) stated that "When our national leaders and constitution makers were occupied with the thoughts of making the new born India a better place to live in, of securing economic and social justice for the various people subjected to centuries of exploitation, of removing poverty, illiteracy, squalor, hunger and disease, they were very clear that all this is impossible without ensuring special treatment for the deprived."

As such it is difficult to think of the balanced development of the state without improving the lot of the tribal people living in hill districts. As a measure of this, the Government of India has been formulating policies, programs, projects and schemes focusing on tribal people and investing significant financial resources through every Five Year Plan to accelerate the rural development, identification of the components mostly preferred by the tribal people. The concept of Tribal Sub-Plan was launched in the Fifth Five year Plan aimed to ensure integrated development of the various scheduled tribe communities in the country with the aid of all pooled financial resources

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of the Centre and states, keeping in view their different economic and socio-cultural backgrounds (Planning Commission, 2006).

The Indian Council of Agricultural Research (ICAR) Complex for North Eastern Hill Region, Umiam, Meghalaya, have made ardent efforts for the socio economic development of hill tribes of North Eastern Region including Manipur through intervention in agricultural and allied areas from the financial support received under Tribal Sub plan during the last five year plan i.e. 2012-13 to 2016-17. In addition to this, the Indian Council of Agricultural Research, New Delhi has sanctioned under Tribal Sub-Plan (TSP) for the year 2016-17 to the Central Agricultural University, Manipur for the project entitled "Enhancing Socio-Economic Status and Livelihood Security of Tribal Farmers on North East Hill States through agricultural Interventions". Out of the above sanctioned the College of Agriculture, Imphal, Manipur has assigned the work on Tribal Sub-Plan for the Manipur State. The focus of TSP is on "securing budgetary allocations for tribal development at least proportionate to their population, in order to achieve livelihood security of the weaker section and to protect them from exploitation. Through the intervention of Tribal Sub Plan, the tribal people are involved in the developmental activities like food security, financial security, educational security, health security, habitat security carried out under TSP. However, if assessment is not done after implementing any development programme it is of no use as it will not be understood whether the programme has achieved its desired result or not. A post facto research work is needed to assess the socio-economic improvement of tribal beneficiaries under TSP. So, assessment of the programme implemented is necessary to know the progress and success of any scheme or programme. By comparing results of a policy intervention with target values it provides an information on effectiveness of a given policy intervention and achievability of more general societal goals (e.g. concerning growth or development).

Menon (2003) in their survey report on "Impact of the Tribal Sub-Plan Implementation in Improving the Socio-Economic Condition of the Tribal People with Special Focus on Reduction of Poverty Level covering the States of Assam and Tamil Nadu" experienced that in both the States of Assam and Tamil Nadu, TSP implementation has not made any perceptible impact on poverty reduction of tribal families. Barua (2013) carried out a study on "Impact Assessment of Tribal Sub Plan (TSP) on Livelihood Security of the Beneficiaries in West Bengal" found that livelihood security of tribal have changed significantly before and after the implementation of the programme. Positive changes in food security, occupational security, habitat security, educational security, social security were observed over the period and changes were found to be significant. However, in case of health security, no significant change was observed. According to Roy Burman (1985), Planning for tribals and their areas has become a gamble in ignorance. He emphasizes need of inter communication among planners, implementers, academicians of different disciplines and tribals. With the fast developing world, tribals required specific attention not only with monetary allocation but along with special interventions for their rapid socio-economic development.

MATERIALS AND METHODS

The study was conducted in Kangpokpi and Chandel districts of Manipur where TSP has been implemented. From the two districts, four blocks (two blocks each from each district) were selected purposively. A total sample of 100 Tribal Sub Plan beneficiaries (twenty five each from each block) has been selected as respondents. Data were collected by the researcher with the help of structured interview schedule in the month of October and November in 2019. For analysis of data the Method of Paired Comparisons (Edward, 1969) was followed.

Concept of components of livelihood security of Beneficiary: Livelihood security was operationalized as adequate and sustainable access to income and resources to meet basic needs (including adequate access to food, potable water, health facilities, educational opportunities, housing, time for community participation and social integration). Five components which were considered as most important for livelihood security were selected. The five areas are

1. Food security: It was operationalized as the availability and access to balance food at household level**.** Food security, as defined by World Food Summit (WFS) and Food and Agricultural Organization (FAO), 'exits when all people at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary and food preferences for an active life.

2. Financial security: It was operationalized as the access to regular and satisfied employment which can accrue financial support. It is the condition of having the resources

to support a standard of living now and in the foreseeable future.

3. Educational security: It included the educational level of the family and access to educational facilities including higher education.

4. Health security: It included the health status of the family and access to health care facilities. Global public health security is defined as the activities required minimizing the danger and impact of acute public health events of populations living across geographical regions and international boundaries.

5. Habitat security: It included housing with basic amenities.

Prioritization of different components of livelihood security based on the benefit received by the TSP beneficiaries: These five components namely (A) Food security (B) Financial security (C) Educational security (D) Health security and (E) Habitat security have been identified for the present study and it was intended to rank the five components of livelihood security on the basis of benefit received by the TSP beneficiaries. For this purpose the five components of livelihood security were presented to the respondents (TSP beneficiaries) in pairs in ten possible combinations. The respondents were requested to mark one component over the other from each pair separately from which they received more benefit in improving their livelihood security. The ten pairs are presented below:

1. (A) Food security; (B) Financial security
2. (A) Food security; (C) Educational security
3. (A) Food security; (D) Health security
4. (A) Food security; (E)Habitat security
5. (B) Financial security; (C) Educational security
6. (B) Financial security; (D) Health security
7. (B) Financial security; (E)Habitat security
8. (C) Educational security; (D) Health security
9. (C) Educational security; (E) Habitat security
10. (D) Health security; (E)Habitat security

The Method of Paired Comparisons: Thurstone developed the law of comparative judgement, which provides rationale for ordering of stimuli along a psychological continuum. It is a psychological scaling method, and makes the quantitative investigation of all kinds of values and subjective experiences (Edwards, 1969). In this method, the stimuli (items, statement or variables) are presented in pairs, in all possible combination and the respondents are asked to select one stimulus over the other from each pair separately which is judged more favorable. This method of psychological scaling also provides an estimate of the distances between each of the stimuli, in comparison to the stimulus with least preference, whose scale value is (arbitrarily) brought down to 'zero'. If there are 'n' stimuli the numbers of pairs which may be obtained are n (n-1)/2. The stimuli or items for judgement should be distinct from each other and easily understandable. To eliminate response bias, both the stimuli in each pair and the pairs themselves, are randomly arranged. The stimuli are then presented to respondents (TSP beneficiaries).

The F –Matrix: The first table shall consist of frequencies corresponding to the number of times that each stimulus is judged more favorable than the other. The cell entries correspond to the frequency with which the column stimulus is judged more favorable than the row stimulus.

The P-Matrix: The P-matrix gives the proportion of times the column stimulus is judged more favorable than the row stimulus. This is obtained by dividing each of the cell entries in the F-matrix by N i.e. total number of respondents. A rearranged P-matrix is then made with the stimulus having the smallest column sum at left and that the highest at the right.

The Z-Matrix: The Z matrix gives the normal deviates corresponding to the proportions in the table of P-matrix. These are obtained from the table of Normal deviates (Edward, 1969). In the analysis of paired comparisons the method of 'complete data' was used as there was no P_{ij} value equal to greater than 0.99 or equal to or less than 0.01.

RESULTS AND DISCUSSION

The F-matrix, P-matrix, rearranged P-matrix and the Z-matrix of the five components for the prioritization of the benefit perceived by the respondents are in Table 1, 2, 3 and 4 respectively.

Table 4 reveals that the food security is the most important component from which the TSP beneficiaries received maximum benefit and ranked first (scale value 2.045). In the initial phase of TSP project in Manipur, all

Table 1: F-matrix for the 5 components of livelihood security judged by 100 respondents

Components of livelihood security	Food security (A)	Financial security (B)	Educational security (C)	Health security (D)	Habitat security (E)
Food Security (A)	-	32	12	10	5
Financial security (B)	68*	-	3	4	10
Educational security (C)	88	97	-	27	6
Health security (D)	90	96	73	-	12
Habitat security (E)	95	90	94	88	-

*To be understood as 68 beneficiaries preferred food security to financial security and so on.

Table 2: P-matrix corresponding to the F-matrix

Components of livelihood security	Food security (A)	Financial security (B)	Educational security (C)	Health security (D)	Habitat security (E)
Food Security (A)	0.500	0.320	0.120	0.100	0.050
Financial security (B)	0.680	0.500	0.030	0.040	0.100
Educational security (C)	0.880	0.970	0.500	0.270	0.060
Health security (D)	0.900	0.960	0.730	0.500	0.120
Habitat security (E)	0.950	0.900	0.940	0.880	0.500
Sums	3.910	3.650	2.320	1.790	0.830

Table 3: Rearranged P-matrix-smallest to highest column sum

Components of livelihood security	Habitat security (E)	Health security (D)	Educational security (C)	Financial security (B)	Food security (A)
Habitat security (E)	0.500	0.880	0.940	0.900	0.950
Health security (D)	0.120	0.500	0.730	0.960	0.900
Educational security (C)	0.060	0.270	0.500	0.970	0.880
Financial security (B)	0.100	0.040	0.030	0.500	0.680
Food security (A)	0.050	0.100	0.120	0.320	0.500
Sums	0.830	1.790	2.320	3.650	3.910

Table 4: Z matrix- Hierarchy of five components of livelihood security received by the respondents (TSP beneficiaries)

Components of livelihood security	Habitat security (E)	Health security (D)	Educational security (C)	Financial security (B)	Food security (A)
Habitat security (E)	0.000	1.175	1.555	1.282	1.645
Health security (D)	-1.175	0.000	0.613	1.751	1.282
Educational security (C)	-1.555	-0.613	0.000	1.881	1.175
Financial security (B)	-1.282	-1.751	-1.881	0.000	0.468
Food Security (A)	-1.645	-1.282	-1.175	-0.468	0.000
Sums Z	-5.657	-2.471	-0.888	4.446	4.570
Mean Z (dividing by 5)	-1.131	-0.494	-0.177	0.889	0.914
Add largest negative deviation	+1.131	+1.131	+1.131	+1.131	+1.131
Rank (Scale value R)	0.0005^{th}	0.6374^{th}	0.9543^{rd}	2.0202^{nd}	2.0451^{st}

the respondents (TSP beneficiaries) are provided inputs like seeds and seedlings of various vegetables, fruits crops for cultivation, poultry, piglets, goats, fish fingerlings, cattle for rearing and many others. After the commencement of TSP, many of respondents started fish production, increased practice of poultry and livestock rearing results in enhanced nutritional diet. Receiving assistance of inputs like cereals and pulses seeds, vegetables and fruits seedlings results in increased production as well as consumption of these crops. It may be one of the reasons for increasing their food security. For this reason it has been ranked first.

The second most benefitted component of livelihood security is relating to financial security (scale value 2.020). The assistance expanded from Government in the form of various inputs helps in reducing financial burden of the TSP beneficiaries. Increasing production in agricultural and livestock sector might have enhanced the financial security. For this reason it has been ranked second.

Educational security has been ranked third (scale value 0.954) from which TSP beneficiaries' received benefit amongst the five livelihood security. It is a dream of every parent in Manipur to see their children grow up well with good education. With this hope the parents are giving more

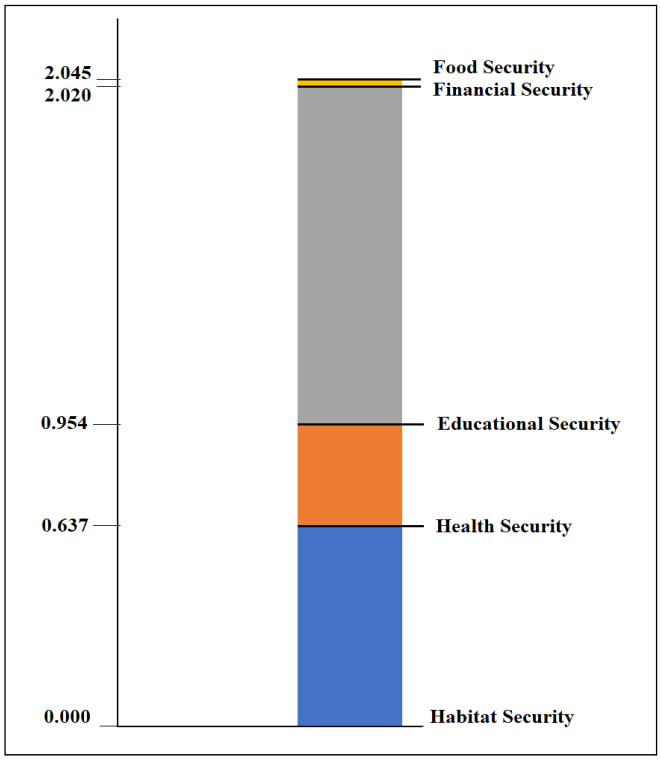

Figure 1: Bar diagram showing hierarchy of different components of livelihood security based on the benefit received

emphasis in their education investing the financial security they received from other components. However, due to lack of good quality education facilities in different districts of Manipur, Government attention is required to increase allocation of funds for the development of good quality schools, hostels scholarship in different districts of Manipur.

Health security has been considered as the fourth important component (scale value 0.637) among the components of livelihood security. Since well-equipped hospitals is far ahead till now, people of remote corner of different districts of Manipur experience extreme levels of health deprivation. Tribal women face various health issues from early childhood to motherhood life. They face numerous types of health problems due to different factors. Some of the factors are poor health care system and delivery system, lack of required funds allotted in tribal area, lack of professional health practitioner, nurse and staff and inadequate health infrastructure (hospitals, dispensaries) PHC and others, low quality medical equipment, lack of health awareness programmes cum free distribution of medicines in remote villages.

The last component among the five livelihood security from where TSP beneficiaries received very little benefit is habitat security. The scale value of habitat security has been brought down to arbitrary zero. It does not mean that people did not get any benefit relating to housing, toilet and electric facilities. Since people received least benefit in comparison to other components of livelihood security, its value has been brought down to arbitrary zero as per rules of the Method of Paired Comparisons.

CONCLUSION

It was found from the study that after commencement of Tribal Sub Plan in the study area, the beneficiaries of TSP have got maximum benefit from food security and financial security. The differences in scale value between food security and financial security is very marginal. So, the beneficiaries have got maximum benefit from food security and financial security after implementation of Tribal Sub Plan. So, it can be said that TSP achieved one of its desired goals that is enhancing livelihood security of the tribal people in terms of food security and financial security. But in case of educational security and health security which are basic components of human life not much benefit obtained in these sectors after implementation of TSP. So, efforts should be made to enhance it further especially in case of educational, health and habitat security.

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Economic Contribution of Home Makers in the Family Income through their Unpaid Household Work

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ABSTRACT

The financial value of the household work done by home makers in India always remained unnoticed and home makers continue to be treated as if they contribute nothing of value to society or the nation. Therefore, the present study was planned to find out the economic contribution of home makers in the family income through their unpaid household work by converting time into money. The design of the study was descriptive in nature. A self-structured questionnaire was constructed and the data were collected personally by the researcher. The study was conducted in Hoshiarpur and SBS Nagar which are the two major districts of Kandi region of Punjab. Time spent by the rural women for performing different household activities like cooking, taking care of children, elderly and livestock etc. were converted into money. The findings of the study revealed that majority of the respondents fall under the age category of 35-50 years, half of the respondents belonged to Schedule caste and more than one-third women respondents were illiterate. It was found that a large proportion of respondents were responsible for cooking food three times a day for their family members followed by cleaning their home and washing clothes of the entire family. Further, it was also noticed that a home maker spend maximum time on taking care of elder people and their children at home followed by fuel wood gathering and cooking for the family, whereas, minimum time was spent on activities like marketing of milk & milk products and cow dung making. The results also revealed that on an average a home maker saves approximately Rs. 14,286 per month by doing unpaid household work at her home by her own. Thus, it is concluded that the value of the people who ensure that the house is a home must be widely acknowledged.

Keywords: Home maker, Economic contribution, Family income, Unpaid work

INTRODUCTION

Women of India greatly contribute in the economy of the country through their household and agricultural work but their work has hardly been recognized (Hossian *et al.,* 2019). A report published by the United Nations Development Programme indicated that women over the world manage nearly all the unpaid household work at home and society (Human Development Report 2015). Women are epicenters of home and naturally take the responsibility of family welfare (Das *et al.,* 2021). It has been noticed that the women in rural areas of India usually start their works before dawn and continue working till dusk, sometimes even late at night in spite of any monetary return or formal recognition. They execute all household works; take care of the children and aged family members at home. As a consequence, quantification of their works has not been done; even simple appreciation has not been made. A large number of women have remained as 'invisible workers' (Ghosh and Ghosh, 2014). Since there had been concern expressed regarding the gap between women's actual economic participation and public perception of it, this study entitled "Economic contribution of home makers in the family income through their unpaid household work" has been conducted with the objective 'To find out the indirect economic contribution of a home maker in her family income.'

MATERIALS AND METHODS

The study was purposively conducted in *Kandi* area of Punjab. The *Kandi* region is spread in five districts namely; Pathankot, Hoshiarpur, SBS Nagar (Nawanshahr), Ropar and SAS Nagar (Mohali). The study was conducted in two

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major districts of Kandi region namely Hoshiarpur and SBS Nagar (Nawanshahr) of Punjab. Two blocks from these districts namely Balachaur and Garhshankar and five villages from these two blocks i.e. Achalpur, Ballowal, Mansewal, Saunkhri and Sekhowal were randomly selected for the study. Women, who had full time involvement in unpaid household works like taking care of children, elderly, livestock, preparing food for family, fuel wood gathering etc. were selected for the study. The study adopted both purposive and snowball sampling techniques. Irrespective of size of population of the selected two districts, the researcher selected 100 women for the present study.

The design of the study was descriptive in nature. The study was designed to describe the economic contribution of home makers in their family income through the unpaid household work by converting time into money. A self-structured questionnaire was constructed and the data were collected personally by the researcher by conducting a face-to-face interview from the respondents. Time spent for performing different daily activities was converted into money, although no method can provide an accurate answer of something that is uncountable by its nature. But an effort was made by the researchers and to solve the purpose of this study, a method of calculating economic value based on labor input was adopted. In this method, the cost of unpaid workers is calculated by the average of the lowest wage paid by the government to an unskilled worker, multiplied by the hours spent on each task.

According to Business Standards (2020) monthly minimum wage for unskilled workers in Punjab is Rs 9,178. A standard working day is being considered as of 8 hours. Therefore, 8 hours working was considered equivalent to Rs 306 (for an unskilled worker, as per Punjab govt.). Thus, monthly earning was calculated by multiplying it with 30 days as women work without any weekly leaves (Hossian *et al.,* 2019).

RESULTS AND DISCUSSION

The findings of the study have presented in the form of the time spent by the home makers on various unpaid activities at home. It was found that majority of them spend their whole day in taking care of their families, caring and rearing of children, elderly & livestock's and doing household chores etc. Although, many of these activities are not considered as economically active employment, but they all are critical to the well-being of rural households.

The data in the Table 1 reveals that majority of the respondents (42%) fall under the age category of 35-50 years followed by 40 per cent were below the age of 35 years. Half of the respondents belonged to Schedule caste followed by 24 per cent of General caste and 20 per cent were OBC. In case of educational qualification, it was found that more than one-third (37%) women respondents were illiterate followed by 30 per cent were educate up to matric while only eight per cent were educate upto senior secondary and above. Data also revealed that a large proportion of women respondents were married followed

Table 1: Demographic profile of the respondents (n=100)

Categories	Frequency	Percentage
Age		
Less than 35	40	40.0
35-50	42	42.0
51-65	14	14.0
65 and above	4	4.0
Caste		
General	24	24.0
SC	50	50.0
BC	6	6.0
OBC	20	20.0
Educational qualification		
Illiterate	38	38.0
Primary	14	14.0
Middle	10	10.0
Matric	30	30.0
Sen. Secondary and above	8	8.0
Marital Status		
Unmarried	10	10.0
Married	82	82.0
Widow	8	8.0
Land Holding (Acres)		
Landless	42	42.0
Less than 1 acre	20	20.0
1-2.5	16	16.0
2.5-5.0	22	22.0
Family Income (Annum)		
Less than 50000	42	42.0
50001 – 1 lakh	34	34.0
1 lakh – 1.5 lakh	12	12.0
Above 1.5 lakh	12	12.0

by 10 per cent were unmarried and 8 per cent were widow. It was also found that majority of the women (42%) were from landless families followed by 22 per cent had 2.5 to 5 acres of land of their own and 20 per cent were having less than one acre of land. Data also revealed that annual family income of 42 percent respondents was less than 50,000 followed by 34 per cent had income between 50000 to 1 lakh only.

The data in Table 2 shows the nature of participation of women in the various household activities. It reveals that a large proportion (86%) of respondents were responsible for cooking food three times a day for their family members followed by 76 per cent each clean their home and wash clothes of the entire family, 70 per cent washing utensils, 56 per cent each were fully responsible for fuel wood gathering from the fields and child rearing.

Table 2: Nature of participation of home makers in various household activities (n=100)

Type of activities	Participation		
	Doing f (%)	Supervision f (%)	No Participation f (%)
Domestic work			
Cooking	86 (86.0)	2 (2.00)	12(12.0)
Child Rearing	56(56.0)	6 (6.00)	38 (38.0)
Care of elder/older	22 (22.0)	8 (8.00)	70 (70.0)
Cleanliness	76 (76.0)	6 (6.00)	20 (20.0)
Washing clothes	7676.0)	6 (6.00)	18(18.0)
Washing utensils	70 (70.0)	4 (4.00)	28 (28.0)
Fuel wood gathering	56 (56.0)	-	44 (44.0)
Kitchen gardening	34 (34.0)	-	66 (66.0)
Livestock rearing			
Milking	48 (48.0)	-	52 (52.0)
Feeding animals	42 (42.0)	-	58 (58.0)
Fodder collection	50 (50.0)	-	50 (50.0)
Fodder chopping	40(40.0)	-	60 (60.0)
Cleaning of cattle	46 (46.0)	-	54 (54.0)
Cleaning of shed	54 (54.0)	-	46 (46.0)
Care of pregnant animal	16 (16.0)	-	84 (84.0)
Vaccination	-	-	-
Cow dung making for fuel	24 (24.0)	-	76 (76.0)
Marketing of milk and milk products	28 (28.0)	-	72 (72.0)

Livestock plays an important role in supporting women and in improving their financial situation, and women are heavily engaged in this sector. An estimated two-thirds of poor livestock keepers, totaling approximately 400 million people, are women (Thornton *et al.,* 2002). From the data in Table 2 it was observed that in case of livestock rearing 54 per cent of the respondents were cleaning the cattle shed on daily basis by their own followed by collecting fodder (50%), milking the animals (48%) and cleaning the cattle's (46%).

It is also important to mention here that women have no participation in the vaccination of animal. Further it was also found that a large majority (84%) of the respondents had very less participation in the activities like taking care of pregnant animals followed by cow dung making for fuel and marketing of milk and milk products. It is said that mostly men are responsible for the marketing of milk in the villages. Therefore the participation of women in sale of milk is low. The results of Paul *et al* (2015) are in favor with the research findings, they revealed

Table 3: Distribution of the respondents as per time spent by them on various household activities (n=100)

Type of activities	Average time spend (hours/day)	Rank
Domestic work		
Cooking	2.00	5
Child Rearing	2.82	2
Care of elder/older	2.95	1
Cleanliness	1.60	6
Washing clothes	1.29	8
Washing utensils	0.96	15
Fuel wood gathering	2.45	3
Kitchen gardening	1.48	7
Livestock rearing		
Milking	1.00	14
Feeding animals	1.11	12
Fodder collection	1.16	10
Fodder chopping	1.20	9
Cleaning of cattle	1.04	13
Cleaning of shed	1.13	11
Care of pregnant animal	2.25	4
Vaccination	-	18
Cow dung making for fuel	0.29	16
Marketing of milk and milk products	0.22	17

Table 4: Conversion of the time into money (n=100)

Activities	Avgerage time spent/day (hrs)	Avgerage time spent/ month (hrs)	General monetary payment for a worker in Rs. (as per govt. rules)	Money saved (Rs.)/ month
Domestic work (hrs)	8.63	258.90	306	9902.9
Livestock (hrs)	3.82	114.60	306	4383.4
Total			**14,286.35**	

that mostly all the activities related to livestock were performed by the women but selling of milk and animals were done by the male members of the family.

The pursuit of data presented in Table 3 evident that on an average woman spent nearly three hours a day on taking care of the elderly people in their families followed by 2.82 hours a day on child rearing and 2.45 hours a day on fuel wood gathering. It was found that on an average a woman spent more than one hour a day on the each activity related to livestock like fodder collection, cleaning of shed, feeding animals, fodder chopping, cleaning of cattle and milking etc. It was also observed that maximum time was spent on taking care of pregnant animal by the farm women i.e. 2.25 hours a day while least time was spent on cow dung making and marketing of milk and milk products. Data also shows that there was no involvement of farm women in the vaccination of the livestock.

Time spent for performing different household activities was converted into money and data has been shown in Table 4. The personal information provided by the respondents in this table revealed that on an average a woman spent more than eight hours a day on performing household work and nearly four hours a day on taking care of livestock. It can be said that on an average a housewife or a home maker spent more than twelve hours a day on performing household work and livestock activities for the betterment of their family, which is considered as an unpaid work. In addition to this, a home maker is also responsible to attend various functions at villages and at relative places. They also tend to go to their own or someone else fields to work as a laborer to earn few more pennies when they got free from their household chores.

It is evident from the data in Table 4 that the average contribution made by a home maker to her family income is Rs 9,902 and Rs. 4,383 from household work and livestock activities per month, respectively. In total, a woman indirectly contributes about Rs 14,286 (approx.) per month, which amounts Rs 1,71,432 per year to her family income

CONCLUSION

It can be concluded that on an average the value of unpaid household work performed by a home maker of India amounts to approximately Rs. 14286 per month, which amounts Rs 1,71,432 per year. Despite the magnitude of this figure, the financial value of the household work done by women without pay continues to go unnoticed, and women continue to be treated as if they contribute nothing of value to society or the nation. Whatever the cultural, economic, caste-based, religious, social, and other differences, a few factors are universal: women are seen as being responsible for the home and family. It is very difficult to raise the status of women without raising their perceived value. Since all women spend a significant amount of their time engaged in activities that have no price tag attached like cleaning home, cooking food and caring for others, the importance of these tasks must be emphasized as well as the valuable contribution of those who carry out such work without hope or expectation of economic return must be recognized. In particular, the value of the people who ensure that the house is a home must be widely acknowledged.

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Effect of Plant Growth Regulators and Chemicals on Physico-chemical Parameters of Acid Lime (*Citrus aurantifolia* Swingle). cv. Vikram

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ABSTRACT

The present investigation was carried out at Experimental area, College of Agriculture, Gwalior (M.P.) during 2018-19 and 2019-20. The experiment aimed at finding out the effect of growth regulators and chemicals on physico-chemical parameters and yield of acid lime. T_{10} ($GA_3$60 ppm + Cycocel 2000 ppm +Thiourea 2%) was found to be significantly superior to rest of the treatments under study but was reported to be at par with T_9 ($GA_3$60 ppm + Cycocel 2000 ppm + Thiourea 1%) for all the parameters like fruit volume (50.44, 50.77 and 50.61 ml), specific gravity (1.10, 1.11 and 1.10 g/cc), fruit length (5.13, 5.26 and 5.19 cm), fruit diameter (4.85, 4.91 and 4.88 cm), pulp thickness (45.27, 46.07 and 45.67 mm), minimum peel thickness (1.63, 1.50 and 1.57 mm), juice (43.85, 43.80 and 43.83%), TSS (7.69, 7.80 and 7.75%), acidity (7.81, 7.86 and 7.83%), number of seeds per fruit (6.67, 6.33 and 6.50), seed weight (1.20, 1.14 and 1.17 g) and yield per ha (410.29, 398.37 and 404.39 q) during first, second and pooled year respectively).

Keywords: Acid lime, *Citrus aurantifolia*, Physico-chemical parameters, Yield, Vikram etc.

INTRODUCTION

Acid lime (*Citrus aurantifolia*) is the 3rd important fruit crop after mango and banana. It is commonly called as *Nimbu*. It is the member of family Rutaceae and has chromosome no. 2n=18. It is a profusely branched thorny shrub, with leaves that are small with narrowly winged petioles. The flowers are small, pure white and are borne in clusters. The fruits are more or less round or oval, smooth having thin rind (papery) attached tightly. The immature fruits are dark green in colour which changes to light yellow when ripe. The colour of the pulp is light greenish-yellow, taste is acidic, aromatic, cells fine and shiny. The numbers of segments are 9-11 and numbers of seeds per fruit are 9-10. Great medicinal and nutritional values have been reported in fruits of acid lime. It is a rich source of vitamin "C".

Fruits being acidic in nature, they are largely used for garnishing and flavouring several vegetarian and non-vegetarian dishes. Besides its value-added products like pickle, juice, squash etc. Lime peel oil, peel powder are also in great demand in the soap and cosmetic industry. Raw lime contains 88 per cent water, 10 per cent carbohydrates and less than 1 per cent each of fat and protein. Only vitamin C content at 35 mg/100g of fruit. The Daily Value (DV) per 100 g serving is significant for nutrition, with other nutrients present in low DV amounts. Lime juice contains slightly less citric acid than lemon juice (about 47 g/l), nearly twice the citric acid of grapefruit juice, and about five times the amount of citric acid found in orange juice. The total area and production of Acid lime in India is about 317 MH and 3347 MT, respectively (Anonymous, 2019-20). The total area and production of acid lime in Madhya Pradesh are 0.077 MH and 0.18 MT, respectively.

Acid lime trees flower thrice a year in the months of January-February, June-July and September-October known as Ambe, Mrig and Hasta bahar, respectively. The fruits of the Ambe, Mrig and Hasta bahar flowering become available in the months of June-July, November-December and April-May months, respectively. The flowering percentage of Ambe, Mrig and Hasta bahar occurs 47, 36 and 17 per cent, respectively. The fruits of

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Hasta bahar flowering become available in the months of April-May when there is heavy demand and are sold at premium price, but Hasta bahar (Summer cropping) bear only 17 per cent flowering and fruiting is achieved in the uncontrolled condition because of the monsoon rains preceding flower initiation. Therefore, in Hasta bahar, to force the acid lime plants into profuse flowering, use of plant growth regulators and chemicals gives an effective alternative.

Use of Gibberellic acid (GA_3) during the stress period is known to reduce the intensity of flowering in the following flowering season. Cycocel (CCC) has been found very effective for imposing stress for inducing flowering. Potassium nitrate (KNO_3) chemical for sprouting has been found effective in acid lime. The water stress with hormones played an important role in regulation of flowering and there is a relationship between severity of stress and flowering response (South Wick and Davenport, 1987; Barbera and Garimi, 1988). Considering the importance of Hasta bahar fruits, it is necessary to undertake the study on stress period with some chemicals for assured flowering of Hasta bahar in acid lime. Therefore, these plant growth regulators and chemicals can be effectively used for obtaining profuse flowering and fruiting for Hasta bahar in acid lime. The present study was therefore undertaken to investigate the effect of combinations of plant growth regulators *viz*., GA_3 and Cycocel, chemicals *viz*., KNO_3 and Thiourea on flowering and fruiting patterns of acid lime.

MATERIALS AND METHODS

The experiment was conducted at agro-technology Park, Krishi Vigyan Kendra, College of Agriculture, Gwalior (M.P.). Ten-year-old Acid lime trees of uniform vigour and size were selected for the present study. All the trees were maintained under a uniform cultural schedule during the course of investigation. The experiment was conducted in Randomized Block Design (RBD) with 11 treatments replicated thrice. A total of 33 acid lime plants spaced at 3X3 m^2 were selected for the study.

GA_3 30 ppm solution: GA_3 30 mg was dissolved in a little absolute ethyl alcohol solution and then the volume was made up to 1 liter with distilled water to get 30 ppm of GA_3 solution.

GA_3 60 ppm solution: GA_3 60 mg was dissolved in a little absolute ethyl alcohol solution and then the volume was made up to 1 liter with distilled water to get 60 ppm of GA_3 solution.

Cycocel 1000 ppm solution: Cycocel 1000 mg was dissolved in a little absolute ethyl alcohol solution and then the volume was made up to 1 liter with distilled water to get 1000 ppm of Cycocel solution.

Cycocel 2000 ppm solution: Similarly, Cycocel 2000 mg was dissolved in a little absolute ethyl alcohol solution and then the volume was made up to 1 litre with distilled water to get 2000 ppm of Cycocel solution.

1% KNO_3 solution: The desired nitrate solution was prepared by dissolving 10 grams of potassium nitrate in 1litre of distilled water.

2% KNO_3 solution: The desired nitrate solution was prepared by dissolving 20 grams of potassium nitrate in 1litre of distilled water.

1% Thiourea solution: The desired solution was prepared by dissolving 10 grams of thiourea in 1litre of distilled water.

***2% Thiourea solution*:** The desired solution was prepared by dissolving 20 grams of thiourea in 1 litre of distilled water.

RESULT AND DISCUSSION

The maximum fruit volume (ml) (50.44, 50.77 and 50.61 ml during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) which was significantly superior to all the treatments under study. T10 (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) was closely followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) with a fruit volume of 47.92, 48.12 and 48.02 ml during first, second and pooled year respectively (Table 1). The minimum fruit volume (ml) (39.82, 40.00 and 39.91 ml during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. The greater fruit volume with GA_3, cycocel and thiourea treated fruits may be attributed to mobilization of photosynthates and mediating process for faster translocation from source. Similar findings have also been revealed by Debaje *et al.* (2011); Adi and Manohar (2012); Jagtap *et al.* (2013); Bhati *et al.* (2016); Debbarma and Hazarika (2016); Desai *et al.* (2017) and Tagad *et al.* (2018).

The maximum fruit length (cm) (5.13, 5.26 and 5.19 cm during first, second and pooled year respectively) was

Table 1: Effect of plant growth regulators and chemicals on fruit volume (ml), specific gravity (g/cc) and fruit length (cm) in acid lime cv. vikram

Treatments	Fruit volume (ml)			Specific gravity (g/cc)			Fruit length (cm)		
	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
T_0 = Control (water spray)	39.82	40.00	39.91	0.81	0.80	0.81	4.12	4.19	4.16
T_1 = GA_3 30 ppm + Cycocel 1000 ppm	40.64	40.97	40.81	0.84	0.85	0.85	4.22	4.20	4.21
T_2 = GA_3 60 ppm + Cycocel 2000 ppm	41.31	41.57	41.44	0.87	0.88	0.88	4.29	4.29	4.29
T_3 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 1%	41.45	41.66	41.56	0.90	0.89	0.89	4.31	4.33	4.32
T_4 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 2%	42.35	42.47	42.41	0.91	0.93	0.92	4.39	4.46	4.43
T_5 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 1%	43.28	43.29	43.29	0.91	0.94	0.93	4.49	4.51	4.50
T_6 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 2%	43.46	43.46	43.46	0.93	0.96	0.94	4.51	4.53	4.52
T_7 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 1%	43.54	43.64	43.59	1.01	1.04	1.02	4.59	4.63	4.61
T_8 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 2%	45.85	46.05	45.95	1.02	1.04	1.03	4.68	4.66	4.67
T_9 = GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%	47.92	48.12	48.02	1.05	1.07	1.06	4.70	4.70	4.70
T_{10} = GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%	50.44	50.77	50.61	1.10	1.11	1.10	5.13	5.26	5.19
SEm ±	0.410	0.414	0.292	0.023	0.023	0.016	0.059	0.078	0.049
CD 5%	1.207	1.219	0.833	0.067	0.069	0.046	0.173	0.228	0.139

recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) was closely followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) with a fruit length of 4.70 cm during first, second and pooled year. The minimum fruit length (cm) (4.12, 4.19 and 4.16 cm during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray (Table 1).

The maximum fruit diameter (cm) (4.85, 4.91 and 4.88 cm during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) was followed byT_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported fruit diameter of 4.64, 4.70 and 4.67 cm during first, second and pooled year respectively (Table 2). The minimum fruit diameter (4.08, 4.12 and 18.03% during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. Findings of the similar sort and values have also been reported by Adi and Manohar (2012); Jagtap *et al.* (2013); Manivannan *et al.* (2015); Bhati *et al.* (2016); Bagul and Masu (2017) and Chaudhary *et al.* (2018).

The maximum Pulp thickness (mm) (45.27, 46.07 and 45.67 mm during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) was followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported pulp thickness of 43.10, 43.90 and 43.50 mm during first, second and pooled year respectively (Table 2). The minimum pulp thickness (36.34, 36.81 and 36.58 mm during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray.

The minimum peel thickness (mm) (1.63, 1.50 and 1.57 mm during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) was followed by T9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported peel thickness of 1.65, 1.57 and 1.61 mm during first, second and pooled year respectively (Table 2). The maximum peel thickness (2.21, 2.20 and 2.20 mm during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. The present findings are in line with the reports of Singh and Singh (2015); Bagul and Masu (2017), Juice, TSS and acidity (%)

The maximum Juice (%) (43.85, 43.80 and 43.83% during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) which was significantly superior

Table 2: Effect of plant growth regulators and chemicals on fruit diameter (cm), pulp thickness (mm) and peel thickness (mm) in acid lime cv. Vikram

Treatments	Fruit diameter (cm)			Pulp thickness (mm)			Peel thickness (mm)		
	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
T_0 = Control (water spray)	4.08	4.12	4.10	36.35	36.81	36.58	2.21	2.20	2.20
T_1 = GA_3 30 ppm + Cycocel 1000 ppm	4.20	4.21	4.21	38.35	38.51	38.43	1.84	1.81	1.83
T_2 = GA_3 60 ppm + Cycocel 2000 ppm	4.28	4.24	4.26	39.15	38.77	38.96	1.81	1.80	1.80
T_3 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 1%	4.30	4.30	4.30	39.58	39.50	39.54	1.73	1.73	1.73
T_4 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 2%	4.38	4.39	4.39	40.34	40.49	40.41	1.71	1.72	1.72
T_5 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 1%	4.45	4.44	4.44	41.11	41.05	41.08	1.69	1.66	1.68
T_6 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 2%	4.49	4.48	4.49	41.50	41.50	41.50	1.70	1.65	1.68
T_7 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 1%	4.57	4.58	4.58	42.32	42.51	42.42	1.69	1.64	1.67
T_8 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 2%	4.66	4.67	4.66	43.29	43.49	43.39	1.66	1.59	1.62
T_9 = GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%	4.64	4.70	4.67	43.10	43.90	43.50	1.65	1.57	1.61
T_{10} = GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%	4.85	4.91	4.88	45.27	46.07	45.67	1.63	1.50	1.57
SEm ±	0.052	0.062	0.041	0.523	0.621	0.406	0.016	0.020	0.013
CD 5%	0.154	0.184	0.116	1.540	1.826	1.161	0.048	0.059	0.037

Table 3: Effect of plant growth regulators and chemicals on juice (%), TSS (%) and acidity (%) in acid lime cv. Vikram

Treatments	Juice (%)			TSS (%)			Acidity (%)		
	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
T_0 = Control (water spray)	27.18	27.10	27.14	6.35	6.42	6.39	7.19	7.20	7.20
T_1 = GA_3 30 ppm + Cycocel 1000 ppm	28.72	28.70	28.71	6.42	6.47	6.44	7.26	7.27	7.27
T_2 = GA_3 60 ppm + Cycocel 2000 ppm	30.71	30.73	30.72	6.47	6.65	6.56	7.37	7.38	7.38
T_3 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 1%	31.19	31.05	31.12	6.57	6.68	6.63	7.38	7.39	7.38
T_4 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 2%	32.70	32.58	32.64	6.63	6.72	6.68	7.39	7.40	7.40
T_5 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 1%	34.92	34.82	34.87	6.77	6.81	6.79	7.40	7.41	7.40
T_6 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 2%	36.70	36.40	36.55	6.87	6.86	6.86	7.41	7.42	7.42
T_7 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 1%	38.30	37.70	38.00	6.87	6.88	6.88	7.42	7.43	7.43
T_8 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 2%	39.33	37.80	38.57	7.37	7.00	7.18	7.48	7.47	7.48
T_9 = GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%	39.95	40.15	40.05	7.62	7.32	7.47	7.59	7.61	7.60
T_{10} = GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%	43.85	43.80	43.83	7.69	7.80	7.75	7.81	7.86	7.83
SEm ±	0.440	0.580	0.364	0.040	0.051	0.033	0.049	0.055	0.037
CD 5%	1.295	1.705	1.040	0.118	0.150	0.093	0.145	0.161	0.105

to all the treatments under study (Table 3). T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) was followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported Juice (%) of 39.95, 40.15 and 40.05% during first, second and pooled year respectively. The minimum Juice (%) (27.18, 27.10 and 27.14% during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. Debaje *et al.* (2011); Kacha *et al.* (2012); Jagtap *et al.* (2013); Jain *et al.* (2014); Arunadevi *et al.* (2019).

The maximum TSS (%) (7.69, 7.80 and 7.75% during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel

2000 ppm + Thiourea 2%) was followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported TSS (%) of 7.62, 7.32 and 7.47% during first, second and pooled year respectively. The minimum TSS (%) (6.35, 6.42 and 6.39% during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. Similar findings related to TSS have also been reported by Ghosh *et al.* (2012); Jagtap *et al.* (2013); Jain *et al.* (2014); Mukunda *et al.* (2014); Singh and Singh (2015) and Singh *et al.* (2018).

The maximum acidity (%) (7.81, 7.86 and 7.83% during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) was followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported acidity (%) of 7.59, 7.61 and 7.60% during first, second and pooled year respectively. The minimum acidity (%) (7.19, 7.20 and 7.20% during first, second and pooled year respectively) was recorded under T_0 (control) Water spray. The observations related to acidity in the present study have been supported by Rattanpal *et al.* (2008); Mahalle *et al.* (2010); Singh *et al.* (2018) and Arunadevi *et al.* (2019).

The minimum seeds per fruit (6.67, 6.33 and 6.50 during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) which was significantly superior to all the treatments under study except T_9 ($GA_3$60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported seeds per fruit of 7.33, 7.00 and 7.17 during first, second and pooled year respectively (Table 4). The maximum seeds per fruit (10.67, 11.00 and 10.83 during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. Azher Nawaz *et al.* (2011); Jagtap *et al.* (2013) and Bhatt *et al.* (2016) also found the number of seeds comparable to those in the present study.

The minimum seed weight (g) (1.20, 1.14 and 1.17 during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 2%) which was significantly superior to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) was followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported seed weight of 1.31, 1.36 and 1.34 during first, second and pooled year, respectively (Table 4). The maximum seed weight (2.03, 2.04 and 2.03 during first, second and pooled year, respectively) was recorded under T_0 (Control) Water spray. The present findings have been supported by Bhatt *et al.* (2016) and Bagul and Masu (2017).

The maximum yield per ha (410.29, 398.37 and 404.39 q during first, second and pooled year respectively) was recorded under the treatment T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) which was significantly superior

Table 4: Effect of plant growth regulators and chemicals on number of seeds per fruit, seed weight (g) and yield / ha (q) in acid lime cv. Vikram

Treatments	No. of seeds/fruit			Seed weight (g)			Yield per ha (q)		
	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled	Year 1	Year 2	Pooled
T_0 = Control (water spray)	10.67	11.00	10.83	2.03	2.04	2.03	210.29	216.35	213.32
T_1 = GA_3 30 ppm + Cycocel 1000 ppm	10.00	10.33	10.17	1.88	1.87	1.88	225.73	247.33	236.53
T_2 = GA_3 60 ppm + Cycocel 2000 ppm	9.67	10.00	9.83	1.78	1.79	1.78	254.70	259.87	257.29
T_3 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 1%	9.33	9.67	9.50	1.71	1.68	1.70	257.32	258.29	257.81
T_4 = GA_3 30 ppm + Cycocel 1000 ppm + KNO_3 2%	9.00	9.33	9.17	1.69	1.67	1.68	281.30	283.38	282.34
T_5 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 1%	8.67	9.00	8.83	1.61	1.61	1.61	269.83	278.34	274.09
T_6 = GA_3 30 ppm + Cycocel 1000 ppm + Thiourea 2%	8.33	8.67	8.50	1.52	1.55	1.54	277.21	286.69	281.95
T_7 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 1%	8.00	8.00	8.00	1.41	1.45	1.43	275.43	288.63	282.03
T_8 = GA_3 60 ppm + Cycocel 2000 ppm + KNO_3 2%	7.67	7.67	7.67	1.39	1.38	1.38	335.39	341.34	338.36
T_9 = GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%	7.33	7.00	7.17	1.31	1.36	1.34	346.98	346.58	346.78
T_{10} = GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%	6.67	6.33	6.50	1.20	1.14	1.17	410.40	398.37	404.39
SEm ±	0.489	0.480	0.343	0.032	0.043	0.027	8.620	8.102	5.915
CD 5%	1.439	1.412	0.979	0.093	0.127	0.077	25.355	23.832	16.905

to all the treatments under study. T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) was followed by T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%) that reported yield per ha of 346.98, 346.58 and 346.78 during first, second and pooled year respectively (Table 4). The minimum yield per ha (210.29, 216.35 and 213.32 during first, second and pooled year respectively) was recorded under T_0 (Control) Water spray. Effect of the similar treatments on yield parameters have also been reported by Rattanpal *et al.* (2008), Kumar *et al.* (2009); Manivannan *et al.* (2015); Bhati *et al.* (2016); Patel *et al.* (2016); Ranganna (2017); Singh *et al.* (2017); Vasure *et al.* (2018) and Arunadevi *et al.* (2019).

CONCLUSION

The treatments had a significant effect on the physio-chemical parameters viz. fruit volume, specific gravity, fruit length, fruit diameter, pulp thickness, peel thickness, juice %, TSS %, acidity %, number of seeds per fruit and seed weight. Treatment number T_{10} (GA_3 60 ppm + Cycocel 2000 ppm +Thiourea 2%) was found to be significantly superior to rest of the treatments under study but was reported to be at par with T_9 (GA_3 60 ppm + Cycocel 2000 ppm + Thiourea 1%).

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Restraining Paddy Straw Burning through FLDs on Happy Seeder in Punjab

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ABSTRACT

The study was conducted with the prime objective of motivating the farmers to shun paddy straw-burning; adopt the resource efficient technologies and evaluating the economics of wheat sown with PAU Happy Seeder. To purpose this objective, a total of 400 demonstrations were conducted on wheat sown with PAU, Happy seeder in *rabi* 2017-18 and 2018-19 in two adopted villages of Sangrur viz; Chtaha Nanhera and Taranji Khera under Farmer FIRST Project. Two varieties PBW 725 and HD 3086 were selected for FLDs and farmers' practice. The economics of the demonstration and farmers' practice have been calculated. In case of PBW 725 the B:C ratio of the demonstrated field and farmers practice was found to be 4.20 and 3.46 respectively in 2017-18 and 4.49 and 3.71 respectively in 2018-19. In this way the B:C ratio of HD 3086 in the demonstrated field and farmers practice was found to be 4.36 and 3.55 respectively during 2017-18 and 4.70 and 3.86 respectively in 2018-19. Collectively combine data over the varieties over the years shown that overall cost of cultivation was Rs 21788/ha in FLD plots and Rs 26358/ha in farmers' practice. Gross return was Rs 96823/ha in FLD plots and Rs 96263/ha in local check and BC ratio achieved in FLD plots was 4.44 as compared to 3.65 of local check.

Keywords: PAU happy seeder, Front line demonstrations, Paddy wheat, Straw burning

INTRODUCTION

Agriculture is the backbone of economy and plays a vital role in accelerating the economic development. Wheat is the second most important cereal crop after rice in India and has great role in stabilizing the national food security. Productivity of rice and wheat has begun stagnating and declining by the virtue of climate change and reduction in soil productivity that is a serious threat to the sustainability of the rice-wheat (RW) cropping. A number of problems have cropped up in the region with the spread of the RW system for the last four decades, threatening the sustainability of the system. Low levels of soil organic matter, appearance of multiple nutrient deficiencies due to their over mining from soils and poor management of crop residues (CRs), leading to their burning are some of the major reasons for declining RW productivity in the region (Ladha *et al.,* 2000). Also, the major challenge is to increase the productivity to meet the growing food demand without adverse environmental impact. With the advancement in the mechanical engineering, combine harvesters have gained ground in North-West India especially, Punjab, Haryana and western Uttar Pradesh. Therein, management of the paddy straw is a major issue. Farmers prefer burning rice residue before sowing of wheat due to economical and easy way of handling huge quantities of the residues. But burning adversely affect the organic matter and nutrients present in the soil (especially N, P, K, S and C), and induces environmental pollution with particulates and greenhouse gases (Singh and Singh, 2014). To deal with this problem, the alternative method is sowing of the wheat crop with PAU, Happy seeder. This is a novel technology to deal with the crop residues in an efficient way. It provides an alternative to burning for managing rice residues and allows direct drilling of wheat in standing as well as loose residues (Gathala *et al.,* 2009). Keeping in view, the benefits and present need of this technology, Farmer FIRST project which is aiming at giving viable alternatives to farmers which is beneficial to environment, sustainable and adding to farmers' income has taken this technology to its priority. Concerted efforts were made to popularize this technology

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thorough front line demonstrations in Sangrur district of Punjab.

MATERIALS AND METHODS

This present investigation was carried out in two adopted villages of Sangrur district viz; Chatha Nanhera and Taranji Khera, by Punjab Agricultural University, Ludhiana. The sowing of the wheat was done by PAU Happy seeder. In this pursuit, PBW 725 and HD 3086 varieties were selected and demonstrations were conducted in *rabi* 2017 and 2018. A total of 200 demonstrations comprising of 100 on PBW 725 and 100 on HD 3086 each on 0.4/ha covering a total area of 80 hectares were conducted every year. Seed and PAU happy seeder for the purpose of demonstration was provided as a critical input. The farmers were also provided with farm literature to ensure the supply of information and incline them towards following the package of practices recommended by PAU, Ludhiana. Before conducting the FLDs a benchmark survey and soil sampling was done and consequently, the necessary steps for selection of site and farmers, layout of demonstrations etc. were followed as suggested by Venkatasubramanian *et al.* (2009). The farmers were thoroughly facilitated by the research team regarding the cultivation process through various trainings and field visits, individual, group meetings for the major components such as sowings, weeding, fertilizers application, plant protection measures. Data were collected for both FLDs and control plots. The analysis was done to calculate the cost of cultivation, yield, gross returns and net returns and BC ratio.

RESULTS AND DISCUSSION

Demonstrations on PAU Happy Seeder for seeding and simultaneous in situ mulch application in wheat were carried during the month November, 2017 and 2018. The demonstrations were conducted between 200 farmers' fields covering 80 ha of land each year (400 farmers and 160 ha in total). The varieties selected for these demonstrations are PBW 725 and HD 3086. Regular visits were made and knowledge is given regarding judicious use of pesticides and fertilizers to farmers and their queries were answered in group meetings and on phone calls. Timely guidance and supervision right from the sowing to harvesting was provided through various extension methods i.e. field visits, personal meetings, group meetings, phone calls, WhatsApp etc. used for the successful cultivation and persuasion of the farmers for its adoption. It is worth to mention that with the extension efforts, non-beneficiaries have also sown the wheat crop with PAU, Happy Seeder on their own and farmers from surrounding villages have also adopted this technology.

If we compare farmers' practice and demonstration package (Table 1) it is well clear that almost all the practices and farming situation was same except the method of sowing. Conventionally after burning the paddy straw farmers do use disc harrow once, followed by planking. After this another ploughing with a cultivator is done. Then wheat is sown with seed-cum-fertilizer drill at a spacing of 15-20 cm between the rows. In demonstration package PAU Happy seeder was used. PAU Happy Seeder with press-wheel attachment is a machine which sows wheat in standing paddy stubbles. The wheels attached with the machine press the chopped straw between the furrows, and do not allow the straw to plug the furrow, which hastens/improves the emergence of crop.

Table 1: Comparison between demonstration package and farmers' practices of method of sowing of wheat

S.No.	Cultivation practices	Demonstration package	Farmers' practice
1.	Farming situation	Irrigated, sandy loam soils with medium Nitrogen, high Phosphorous and high Potassium	Irrigated, sandy loam soils with medium Nitrogen, high Phosphorous and high Potassium
2.	Variety	PBW 725, HD 3086	PBW 725, HD 3086
3.	Time of sowing	From the 4th week of October to 4th week of November	From the 4th week of October to 4th week of November
4.	Method of sowing	Happy Seeder in combine harvested paddy fields without straw burning or removal	Seed drill in fields prepared after burning straw of combine harvested paddy
5.	Seed rate	100 kg/ha	100 kg/ha
6.	Seed treatment	Raxil/Vitavax	Raxil/Vitavax /No seed treatment
7.	Fertilizers	As per recommendation after soil testing	Urea 60-65 kg/ha

Table 2: Performance of FLD on wheat sown with happy seeder

Year	Variety	Number of farmers	Area (ha)	FLD yield (q/ha)	Yield of localcheck (q/ha)	Increase in yield (%)
2017-18	PBW 725	100	40.0	51.38	50.70	1.34
	HD 3086	100	40.0	52.52	51.92	1.15
2018-19	PBW 725	100	40.0	55.00	55.10	-0.18
	HD 3086	100	40.0	57.50	57.40	0.17
	Total	400	160	54.1	53.78	0.60

Perusal of Table 2 gives the yield data both in the case of farmers' practice and FLDs. In year 2017-18 there was clearly little yield advantage in both of the varieties PBW 725 and HD 3086 (1.34% and 1.15%). But during the year yield difference was narrowed down in variety HD 3086 (0.17%) and even bit less in case of variety PBW 725 (-0.18%). If we take average of both the varieties over the years there was increase in yield to the extent of 0.60 q/ha. So we can conclude if farmers shift from conventional sowing after burning of paddy straw to the PAU Happy seeder there is no significant difference in yield of the wheat crop.

The economics of the demonstration and farmers' practice have been calculated and furnished in Table 3. Having advantage of no need for field preparation for the sowing, evades the farmers from the cost of cultivation to be incurred on field preparation. Having a glance at the total cost of cultivation, it can be observed that total cost of cultivation incurred on the PBW 725 variety sown with PAU, happy seeder was found to be Rs 21231/ha during year 2017-18 and Rs 22510/ha during year 2018-19. In comparison to this in local check it was calculated to be 25414/ha and Rs 27325 in the said years respectively. The gross returns from the demonstrated field were found to be Rs 89156/ha and conventional sowing was found to be Rs 87971/ha during year 2017-18 and Rs 101200/ha and Rs 101384/ha respectively during year 2018-19. The net returns from the demonstrated field and farmers practice were observed to be Rs 67924/ha and Rs 62557/ha respectively. The B:C ratio of the demonstrated field and farmers practice was found to be 4.20 and 3.46 respectively in 2017-18 and 4.49 and 3.71 respectively in 2018-19

Similarly in case of variety HD 3086 the cost of cultivation of the demonstrated field was found to be Rs 20905/ha and in farmers' field Rs 25369/ha during year 2017-18. In this way during year 2018-19 it was Rs 22505/ha and Rs 27325/ha respectively. Yield is an important component associated with the profitability of the crop. The gross returns and net returns were found to be Rs 91135/ha and Rs 70230/ha at the demonstrated field and Rs 90081/ha and Rs. 64712/ha at farmers practice respectively. The B:C ratio of the demonstrated field and farmers practice was found to be 4.36 and 3.55 respectively during 2017-18 and 4.70 and 3.86 respectively in 2018-19.

If we combine data over the varieties over the years then we can see overall cost of cultivation was Rs 21788/ha in FLD plots and Rs 26358/ha in farmers' practice. Gross return was Rs 96823/ha in FLD plots and Rs 96263/ha in local check. Although gross returns had not differed much but the BC ratio achieved in FLD plots was 4.44 as compared to 3.65 of local check. This is because PAU happy seeder has saved good amount by skipping cost incurred on field preparations in conventional methods.

Table 3: Economic analysis of the FLDs on wheat sown by PAU Happy Seeder

Year (variety)	Average cost of cultivation (Rs./ha)		Average gross return (Rs./ha)		Average net return (Rs./ha)		Benefit-cost ratio (GR/GC)	
	FLDs	Local tech	FLDs	Local tech	FLDs	Local tech	FLDs	Local tech
2017-18 (PBW 725)	21231	25414	89156	87971	67925	62557	4.20	3.46
2017-18 (HD 3086)	20905	25369	91135	90081	70230	64712	4.36	3.55
2018-19 (PBW 725)	22,510	27,325	101,200	101384	78,690	74059	4.49	3.71
2018-19 (HD 3086)	22,505	27,325	105,800	105,616	83,295	78291	4.70	3.86
Overall	21788	26358	96823	96263	75035	69905	4.44	3.65

Similar findings were reported by Kumar *et al.* (2015) Singh and Aggarwal (2013) and Chauhan *et al.* (2013) in crops summer moong, gram and okra, respectively.

CONCLUSION

The burning of the paddy straw is major concern to environment and an obstacle for the sustainable agriculture. There is dire need to adopt the environment friendly technologies. PAU Happy seeder not only helps to address the environmental issues but also saving money by means of reducing farm operations. At the same time there is no significant difference in yield as compared to conventional methods. Results revealed that the effective performance of the happy seeder calls for the application and adoption at farmers' field, keeping in view its benefits in terms of low cost of tillage, positive impact on the environment, soil, and biodiversity.

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Forecasting of Indian Agricultural Export Using ARIMA Model

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ABSTRACT

An attempt has been made in this paper to analyze the trend and forecast of Agricultural Export in India. Autoregressive integrated moving average (ARIMA) model by Box and Jenkins (1976) is used for the purpose. This method uses historical data of univariate time series to analyze its own trend and forecast future cycle. It was found that estimated values of Agricultural export during 2016-17 to 2018-19 were closed to the actual values as percent deviation of the estimated and observed figures were ranging between -2 to -4 and forecasted figures lie within confidence limits based on ARIMA models for the three consecutive years ahead 2019-20, 2020-21 and 2021-22.

Keywords: ARIMA, Trend, Forecast, Agricultural export, Box and Jenkins

INTRODUCTION

India, with a large and diverse agriculture, is among the world's leading producer of cereals, milk, sugar, fruits and vegetables, spices, eggs and seafood products. Indian agriculture continues to be the backbone of our society and it provides livelihood to nearly 50 per cent of our population. India is supporting 17.84 per cent of world's population, 15 per cent of livestock population with merely 2.4 per cent of world's land and 4 per cent water resources. India is currently ranked tenth amongst the major exporters globally as per WTO trade data for 2016. India's share in global exports of agriculture products has increased from merely 1 per cent a few years ago, to 2.2 per cent in 2016.

Time series (TS) data refers to observations on a variable that occurs in a time sequence. The TS movements of such chronological data can be resolved into trend, periodic (say, seasonal), cyclical and irregular variations. One or two of these components may overshadow the others in some series. A basic assumption in any TS analysis is that some aspects of the past pattern will continue to remain in the future. The most widely used technique for modeling and forecasting the TS data is Box-Jenkins' Autoregressive integrated moving average (ARIMA) methodology.

Thomas *et al.* (2011) has explored the growth performance of India's agricultural exports from 1991-92 to 2009-10, Paul *et al.* (2013) has forecast the meat export in India using SARIMA models and Ghose (2017) used ARIMA for forecasting of cotton export in India. In present study, the agricultural export of country has been projected using ARIMA. In subsequent sections, we first present the data used and methodology applied for the model building. Next, Agricultural export estimation derived from the fitted models and the related discussions are given accordingly.

MATERIALS AND METHODS

The time-series data of Agricultural Export from 1990-91 to 2018-19 were collected for the purpose from various issues of Economy Survey of India. In accordance with the objective formulated, the statistical analysis was carried out to develop the suitable relationship by ARIMA for Agricultural Export prediction in India.

The univariate ARIMA approach was first popularized by Box and Jenkins and the models developed through this approach are referred to as univariate Box-Jenkins (UBJ) models. Three stages for univariate ARIMA modelling is identification, parameter estimation, diagnostic checking and forecasting. The general functional form of ARIMA (p,d,q) model is:

$$\phi_p(B)\ \Delta^d\ y_t = c + \theta_q(B)a_t$$

where, y = Agricultural Export

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B = Lag operator

a = Error term (Y- $\hat{y}$, where $\hat{y}$ is the estimated value of Y)

t = time subscript

$\phi_p(B)$ = non-seasonal AR i.e. the autoregressive operator, represented as a polynomial in the back shift operator

Δ^d = non-seasonal difference

$\theta_q(B)$ = non-seasonal MA i.e. the moving-average operator, represented as a polynomial in the back shift operator

ϕ's and θ'_s are the parameters to be estimated

RESULTS AND DISCUSSION

The analysis was carried out on the time-series data of Agricultural Export ranging from 1990-91 to 2018-19 and same is given in Figure 1. A perusal of Figure 1 reveals an increasing trend in the Agricultural export of India over the years. The figure indicates that the export was highest in the year 2013-14. The export after reaching the highest level in 2013-14 declined in next two years 2014-15 and 2105-16. Afterward, it continuously increased.

India's exports of agriculture goods will be modeled as ARIMA process. Identification of the values of parameters p, d and q is done on basis of ACF and PACF analysis. The Agricultural Export data was found to be non-stationary and differencing of order one was sufficient for getting an appropriate stationary series. The estimated ACF are shown in Table 1. After experimenting with

Table 1: Autocorrelations : Agricultural Export

Lag	Auto-correlation	Std. error (a)	Box-Ljung Statistic		
			Value	df	Sig. (b)
1	.896	.176	25.754	1	.000
2	.780	.173	45.992	2	.000
3	.672	.170	61.610	3	.000
4	.577	.167	73.594	4	.000
5	.462	.163	81.575	5	.000
6	.316	.160	85.487	6	.000
7	.182	.156	86.840	7	.000
8	.068	.153	87.035	8	.000
9	.001	.149	87.036	9	.000
10	-.053	.145	87.169	10	.000
11	-.107	.141	87.740	11	.000
12	-.161	.138	89.105	12	.000
13	-.203	.133	91.425	13	.000
14	-.237	.129	94.795	14	.000
15	-.265	.125	99.321	15	.000
16	-.291	.120	105.159	16	.000

Table 2: Parameter estimates of ARIMA model

		Estimates	Std. error	t	Approx. sig
Non-seasonal Lags	MA1	-.526	.168	-3.128	.004
Constant		9550.654	4396.924	2.172	.039

Melard's algorithm was used for estimation.

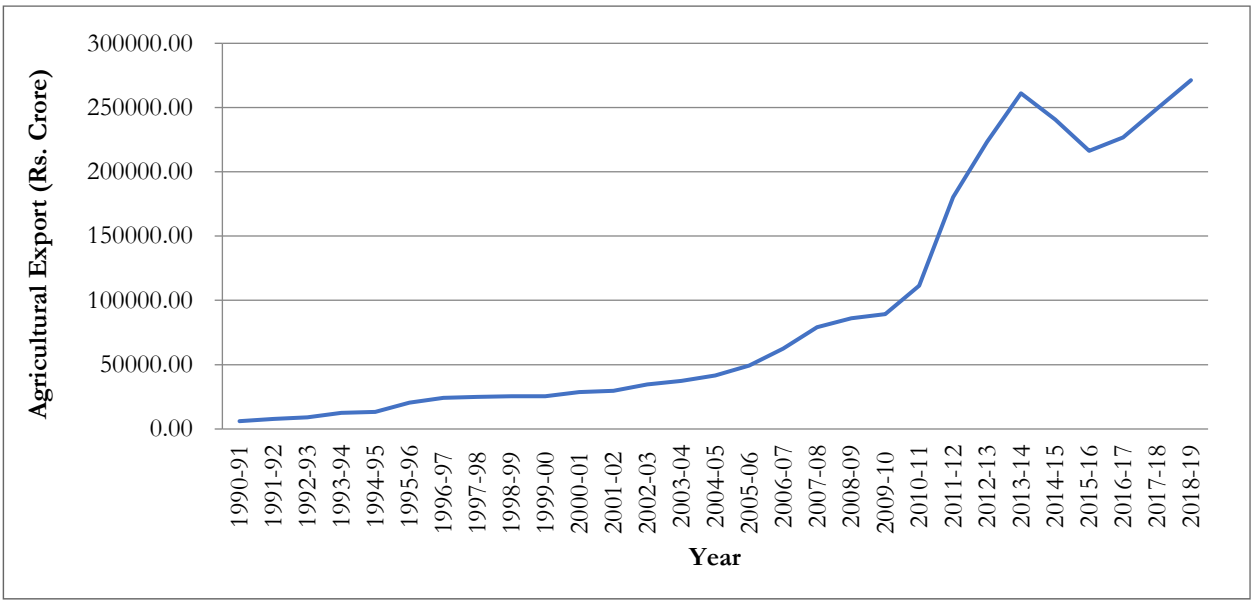

Figure 1: Agriculture exports (1990-91 to 2018-19)

Table 3: Diagnostic checking of residuals autocorrelations: Agricultural Export

Model	Number of Predictors	Model fit statistics					
		R-squared	RMSE	MAPE	Normalized BIC	Ljung-Box Q Statistics	Sig.
Agri-export (0,1,1)	0	.974	15451.77	18.25	19.53	9.86	.909

Table 4: Actual and fitted values of India's Agriculture Exports (2016-17 to 2018-19) (**RS. Crore**)

Year	Agriculture Exports Actual (Y)	Agriculture Exports Forecast (F)	Relative Deviations
2016-17	226775	220035.4	-2.97
2017-18	249182	239870.6	-3.74
2018-19	271358	263630.4	-2.85

Table 5: Forecast values of Agricultural Export of India

Models	Agricultural Export (1,1,0) (RS. Crore)		
	2019-20	2020-21	2021-22
Estimate	284973.3	294524.0	304074.7
UCL	316696.8	352402.2	379529.2
LCL	253249.8	236645.8	228620.1

UCL & LCL - Upper and lower confidence limits (95%)

different lags of the moving average and autoregressive processes, ARIMA (0,1,1) was fitted for estimating Agricultural export in India. ARIMA (0, d, q) model is also known as exponentially weighted moving average, abbreviated EWMA. EWMA model involves averaging past observations, but the weights applied for recent observations are larger than the weight applied to earlier observations. For this type of data, a forecast emphasizing the last few observations seems more sensible than a forecast emphasizing all past observation equally. Marquardt algorithm (1963) was used to minimize the sum of squared residuals. Log Likelihood, Akaike's Information Criterion, AIC (1969), Schwarz's Bayesian Criterion, SBC (1978) and residual variance decided the criteria to estimate AR and MA coefficients in the model. Parameter estimates of the fitted models are given in Table 2.

The residual ACF along with the associated 't' tests and Chi-squared test suggested by Ljung and Box (1978) were used for the checking of random shocks to be white noise (Table 3). The observed and estimated values of Agricultural Export along with their relative deviation are shown in Table 4.

ARIMA model could be used successfully for modelling as well as forecasting of yearly export of agricultural products from India. It has been found that there is a significant increasing trend in the Agricultural export from India. The estimated values of agricultural export during 2016-17 to 2018-19 are close to the actual values as relative deviation of the estimated and observed figures is in acceptable limits shown in table-4. The level of accuracy achieved by ARIMA (0,1,1) was found adequate for estimating Agricultural Export in India and residuals were white noise. Three-steps ahead (out–of-model development period i.e. 2019-20, 2020-21 and 2021-22) forecasted values of Agricultural export are shown in Table 5.

CONCLUSION

Autoregressive integrated moving average (ARIMA) model is used for the purpose. After experimenting with different lags of the moving average and autoregressive processes, ARIMA (0,1,1) was fitted for estimating Agricultural export in India. It was found that estimated values of Agricultural export during 2016-17 to 2018-19 were closed to the actual values as percent deviation of the estimated and observed figures were ranging between -2 to -4 and forecasted figures lie within confidence limits based on ARIMA models for the three consecutive years ahead 2019-20, 2020-21 and 2021-22.

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Pineapple (*Ananas comosus* L.) Cultivation- A Sustainable Livelihood Strategy in Arunachal Pradesh, India

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ABSTRACT

This paper synthesizes the sustainable performance of pineapple cultivation (*Ananas comosus* L.) in Arunachal Pradesh, India. Altogether, 100 pineapple growers were taken from a District. A pre-tested structured interview schedule was used to collect information from the respondents. To explore sustainable performance, four dimensions, namely, economic, human, social and environmental sustainability, were considered. Further, eight parameters were included against each dimension. The overall mean scores for economic, human, social and environmental sustainability were 3.458, 2.83, 3.215 and 3.476, respectively, and performance of pineapple (*Ananas comosus* L.) cultivation in terms of economic sustainability, human sustainability, social sustainability and environmental sustainability was satisfactory. It is concluded from the study that pineapple (*Ananas comosus* L.) cultivation in Arunachal Pradesh, India is a sustainable cultivation practice and a sustainable livelihood strategy.

Keywords: *Ananas comosus,* Livelihood, Pineapple cultivation, Socio-economic, Sustainable cultivation, Sustainable performance

INTRODUCTION

In rural areas of Arunachal Pradesh, North Eastern Region (NER), India, people are maintaining various activities and strategies for their livelihood and survival (Gamlin and Patra, 2020). The activities and strategies are purely based on natural, environmental and climatic conditions and the needs of the people. Various activities/strategies, viz., agricultural activities, including shifting cultivation (locally known as *jhum*), livestock, forest-based activities and small cottage industries, are commonly maintained in rural areas (benjongtoshi and Patra, 2021). Goswami and Biswas (2021) reported that crop cultivation and daily wage work were the primary and livestock rearing as ancillary livelihood activity in the Coastal zone of West Bengal, India. Similarly, French bean cultivation, livestock rearing and other crop cultivation were playing a major role in livelihood in Nagaland (Benjongtoshi and Patra, 2021). In such a way, pineapple (*Ananas comosus* L.) production and marketing is also a major livelihood activity or strategy for the survival of the people in Arunachal Pradesh, India (Gamlin and Patra, 2020). In 2018 Arunachal Pradesh, area under pineapple cultivation was 3.09,000 ha with a production of 23,11,000 tones (Govt. of India, 2018).

Pineapple (*Ananas comosus* L.) is one of the leading commercial fruit crops in the NER (it includes Assam, Tripura, Nagaland, Meghalaya, Manipur, Arunachal Pradesh, Mizoram and Sikkim), India. It is the second important fruit crop after banana, contributing to over 20 per cent of the world production of tropical fruits (Coveca, 2002). Nearly 70 per cent of the pineapple is consumed as fresh fruit in producing countries. In India, around 103,000 ha area is under this crop, with the production of 1706,000 tones/ annum and 16.6 tones/ha of productivity (Govt. of India, 2018). In pineapple cultivation, India ranks third, sixth and eighth in area, production and productivity, respectively in the world (Govt. of India, 2011). Further, the adoption of offseason pineapple cultivation has a promising role in nutrition and livelihood security (Das *et al.,* 2011).

Livelihood refers to assure and consistent supply and availability of the basic necessities of life (i.e., food, water,

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shelter and clothing). It is a set of activities and capacities for securing basic requirements of daily life. These activities may either individually or as a group be performed by using resources to meet the requirements. Further, Thangjam *et al.* (2020) viewed that livelihood security is the access to adequate basic needs, namely, food, clothing and shelter for sustaining life with consistency.

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (UN, 2021). According to Robert Chambers and Gordon Conway (1992), a livelihood is sustainable when it enables people to cope with and recover from shocks and stresses (such as natural disasters and economic or social disturbances) and enhance their well-being and that of future generations without undermining the natural environment or resource base. Sustainability is the ability or capacity of something to be maintained or to sustain itself.

Despite the consistent and high economic growth, India has frequently been experiencing poverty (Sashilila and Patra, 2018). "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture" is UN's sustainable development goal 2 (SDG2). It recognizes the interlinkages among supporting sustainable agriculture, empowering small farmers, promoting gender equality, ending rural poverty, ensuring healthy lifestyles, tackling climate change, and other issues addressed within the set of 17 Sustainable Development Goals in the Post-2015 Development Agenda. Target 2.4, under SDG2, is concerned on ensuring sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintains ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality. Govt. of India (NMSA, 2021) is emphasizing as agriculture should be more productive, sustainable, remunerative and climate-resilient.

This paper attempts to examine the sustainable performance of pineapple cultivation as a livelihood strategy in the study area. The paper is organized as follows. The following section presents the methodology adopted in the study to bring meaningful findings. Section three presents the results and discussion. Conclusion forms the last section.

MATERIALS AND METHODS

The present study was conducted in the West Siang district of Arunachal Pradesh, NER, India. In the study four villages, namely Higi Bagra, Lipu Bagra, Yamko Bagra and Angu under the Aalo-west block were selected based on the large area under pineapple cultivation. The district occupies an area of 8,325 km^2 with a population of 1,12,274 (Census, 2011) and is situated between 90°30 to 97°30 East longitude and 26°28 to 29°31 North latitude.

A purposive sampling technique was adopted, and 25 pineapple growers from each village were selected as respondents, i.e., a total of 100 respondents were selected for the present study. A pre-tested structured interview schedule was used to collect information from the respondents. To explore the sustainable performance of the pineapple, four dimensions, namely, economic, human, social and environmental, were taken into consideration. Based on the review work on various documents [namely, 'Indicators of sustainable Development: Guideline and Methodologies by (UN, 2007), sustainable Consumption and Production Indicators for The Future SDGs (UNEP, 2015), 'Sustainability Evaluation Checklist (Schroter, 2010) and Developing Methodologies for Livelihood Impact Assessment: Experience of the African Wildlife Foundation in East Africa (Ashley and Karim Hussein, 2000), eight parameters were included against each dimension. Respondents were asked to express their degree of agreement against each parameter with five options, most often, often, sometimes, rare, and very rare. The responses were converted into score values of 5, 4, 3, 2 and I, respectively.

The mean score for each parameter and overall mean with respect to each dimension were calculated. The mean score value was equal or/and greater than the midpoint (i.e., 2.5), considered as the existence of sustainability and reverse is considered unsustainable.

RESULTS AND DISCUSSION

Achieving food and nutrition security to eradicate hunger at the climate change and global warming scenario is a colossally challenging task to agriculture and the allied sector. Apart from the changing cropping pattern (Patra, 2004), the important alternatives to cope up with challenges are climate-smart agriculture and sustainable agriculture. The four dimensions, namely, economic sustainability, human sustainability, social sustainability and environmental

Table 1: Performance of pineapple cultivation in terms of economic sustainability as perceived by farmers

Statement	Maximum achievable score	Mean	SD	Range of score
Potential for steady and standard income	5	2.74	0.613	2 to 4
Income per unit area is higher compare to other crops	5	4.16	0.775	3 to 5
Supporting livelihood	5	3.39	0.79	2 to 5
Giving off season income opportunity	5	2.6	0.6	2 to 4
Cost: benefit ratio is higher	5	3.98	0.752	3 to 5
Giving income opportunity to women	5	3.36	0.79	2 to 5
Cost of cultivation is low	5	3.71	0.45	3 to 4
Round the year price of pineapple is standard	5	3.73	1.47	2 to 5
Overall mean			3.458	

sustainability, were considered to assess the sustainable performance of crop cultivation.

The 1st integral part of assessing the sustainable performance of agriculture and allied activities are economic sustainability. Under economic sustainability, issues like income from pineapple cultivation, cost of cultivation and per cent of return, supporting livelihood and gender were taken into account.

Income from cultivation has a positive and significant association with the modernization of cultivation (Patra, Moasunep and Sailo, 2020). In the case of 'potential for steady and standard income', the mean score was 2.74, which is greater than the midpoint score (i.e., midpoint score was 2.5), SD was 0.613 and scoring was ranged from 2 to 4. Similarly, in the case of 'income per unit area is higher compared to other crops', the mean score was 4.16, which was greater than the midpoint score (i.e., midpoint score is 2.5) with SD of 0.775 and scoring was ranged from 3 to 5. Concerning this, Patra and Lianzami (2021) reported from Mizoram that 60.00 per cent of 'Chow chow' growers are not satisfied in respect of income from the crop. Further, reduce the length of the marketing channel and reforms in the marketing system are the prescribed measures for augmentation of the income of farmers (Sharma and Burman, 2021).

In the case of 'supporting livelihood', 'giving off-season income opportunity' and 'cost: benefit ratio is higher, each of the mean scores as 3.39, 2.60, and 3.98, which were greater than midpoint score (i.e., 2.5) and each of the SD was 0.79, 0.6 and 0.752. In the case of 'giving off-season income opportunity', 'giving income opportunity to women', 'Cost of cultivation is low' and 'Round the year price is standard', the mean scores were 3.36, 3.71 and 3.73 (Table 1). The overall mean of the economic sustainability of pineapple cultivation was 3.458, and therefore, the performance of pineapple cultivation is sustainable in terms of economic sustainability.

The 2nd integral part of assessing the sustainable performance of agriculture and allied activities is human sustainability. Under human sustainability, issues like poverty alleviation, food and nutrition security, health, employment through pineapple cultivation, and knowledge and skill requirements for pineapple cultivation were taken into consideration.

In the case of 'reducing poverty', the mean scoring was 3.21, which was greater than the midpoint score with SD of 0.64 and the scoring was ranged from 2 to 4. Similarly, in the case of 'addressing food security', the mean scoring was 2.53 with the SD value of 0.54 and the scoring was ranged from 2 to 4 (Table 2).

In case of 'addressing the issue of nutrition', 'addressing the issue of health', 'generating employment', 'addressing the issue of taste/palatability', 'least/less knowledge reach people able to cultivate', and 'unskilled worker/people also able to perform in cultivation practices' the mean scores were 2.59, 2.8, 2.97, 2.69, 3.32 and 2.54, which were greater than the midpoint of the score (i.e., 2.5) with an SD of 0.62, 0.6, 0.69, 0.74, 0.78, and 0.65, respectively. The overall mean in respect of human sustainability by pineapple cultivation was 2.83. Therefore, the performance of pineapple cultivation is sustainable in terms of human sustainability (Table 2).

Social exclusion, untouchability and inequality are commonly persistent social issues in India (Ao and Patra, 2018). The next integral part of assessing the sustainable

Table 2: Performance of pineapple cultivation in terms of human sustainability as perceived by farmers

Statement	Maximum achievable score	Mean	SD	Range of scores
Reducing poverty	5	3.21	0.64	2 to 4
Addressing food security	5	2.53	0.54	2 to 4
Addressing issue of nutrition	5	2.59	0.62	2 to 4
Addressing issue of health	5	2.8	0.6	2 to 4
Generating employment	5	2.97	0.69	2 to 4
Addressing issue of taste/palatability	5	2.69	0.74	2 t0 4
Least/less knowledge reach people able to cultivate	5	3.32	0.78	2 t0 4
Unskilled worker/people also able to perform in cultivation practices	5	2.54	0.65	2 to 3
Overall mean			2.83	

Table 3: Performance of pineapple cultivation in terms of social sustainability as perceived by farmers

Statement	Maximum achievable score	Mean	SD	Range of score
Recognition (being engaged in something worthwhile)	5	3.25	0.642	2 to 4
Up scaling the social prestige	5	3.04	0.650	2 to 4
Maintaining happiness of the family	5	2.89	0.600	2 to 4
Compatible with food habit	5	3.33	0.473	3 to 4
Compatible with social norms and values	5	4.26	0.600	3 to 5
Compatible with Landless/Small farming	5	2.56	0.450	2 to 4
Women/gender discrimination is absent and women can complete all activities	5	3.87	0.760	3 to 5
Maintain or enhance current standard of living	5	2.52	0.610	2 to 3
Overall mean			3.215	

performance of agriculture and allied activities is social sustainability. Under social sustainability, societal issues, like recognition, up-scaling of social prestige, happiness of family, social compatibility, and compatibility with the weaker section of pineapple cultivation, were considered.

In the case of 'recognition (being engaged in something worthwhile)', the mean scoring was 3.25, which was greater than the midpoint score with SD value of 0.642. Similarly, in the case of 'upscaling the social prestige', the mean scoring was 3.04, which was greater than the midpoint score (i.e., the midpoint score was 2.5) with SD of 0.65. Whereas, in the case of 'maintaining the happiness of the family, 'compatible with food habit' and 'compatible with social norms and values each of the mean score was 2.89, 33.3 and 4.26, which were greater than the midpoint score and with the SD of 0.6, 0.473 and 0.69, respectively (Table 3). In this regard, Swangla *et al.* (2021) had also acknowledged the relationship between societal traditionalism and sustainable agriculture.

Patra and Kense (2020) reported that the Size of landholding had no influence on the level of adoption of innovations in mandarin cultivation. Similarly, in the case of 'compatible with landless/small farming' and 'women/gender discrimination are absent, women can complete all activities', and maintain or enhance the current standard of living, the mean scores were 2.56, 3.87 and 2.52, which were greater than the midpoint score (i.e., 2.5) and with the SD of 0.45, 0.76 and 0.61, respectively. The overall mean in respect of social sustainability by pineapple cultivation was 3.215. Therefore, the performance of pineapple cultivation in terms of social sustainability was highly satisfactory (Table 3).

Environment sustainability is another integral part of assessing the sustainable performance of agriculture and

Table 4: Performance of pineapple cultivation in terms of environmental sustainability as perceived by farmers

Statement	Maximum achievable score	Mean	SD	Range of scores
Restore ecological balance and biodiversity	5	3.51	0.599	3 to 4
Not deteriorating the natural resources	5	4.17	0.726	3 to 5
Favourable for organic cultivation and without chemical inputs	5	4.65	0.48	4 to 5
Control soil erosion	5	2.56	0.595	1 to 3
Can grow in less favorable climatic condition/climatic stress condition	5	2.69	0.677	1 to 4
Production/yield is consistent	5	2.52	0.56	1 t0 3
Maintained soil fertility	5	2.51	0.47	1 to 3
Suitable in mixed cropping and *jhum* field	5	3.11	0.76	2 t0 5
Overall mean			3.215	

allied activities. Under environment sustainability, issues like restoration of ecological balance, non-deterioration of natural resources, compatibility with organic farming, resilient performance, fertility maintenance and consistency in yield through pineapple cultivation were taken into consideration.

In the case of 'restore ecological balance and biodiversity, the mean score was 3.51, which was greater than the midpoint of the score (i.e., 2.5 with the SD of 0.599 and the scoring was ranged from 3 to 4. Similarly, in the case of 'not deteriorating the natural resources', the mean scoring was 4.17, greater than the midpoint of the score with an SD of 0.726 and scoring ranged from 3 to 5 (Table 4). Whereas, in case of 'favourable for organic cultivation and without chemical inputs', 'Control soil erosion', 'can grow in the less favourable climatic condition/ climatic stress condition' 'production/yield is consistent', 'Maintained Soil fertility' and 'suitable in mixed cropping and *jhum* field' the mean scores were 4.65, 2.56, 2.69, 2.52, 2.51 and 3.11, which were greater than the midpoint of the score (i.e., 2.5) and with the SD value of 0.48, 0.595, 0.677, 0.56, 0.47 and 0.76, respectively. The overall mean in respect of environmental sustainability by pineapple cultivation was 3.21. Therefore, the performance of pineapple as a livelihood strategy in terms of environmental sustainability was satisfactory (Table 4).

CONCLUSION

Sustainable performance of the crop is a prerequisite to address the issues of food security, nutrition security, global warming and climate change. Altogether, 32 parameters under four dimensions, namely, economic, human, social and environmental, were included to assess the sustainable performance of pineapple cultivation. The performance in respect of economic sustainability was significant in respect of eight economic sustainability parameters. The overall mean value on economic sustainability was 3.458.

In human sustainability, the value of all variables was greater than the midpoint. Further, the overall mean value was 2.83, and thus, the performance of pineapple cultivation from a human sustainability point of view was satisfactory. In respect of social sustainability, the value of each parameter was also greater than the midpoint. Further, the overall mean value was 3.215. The performance of pineapple cultivation from a social sustainability point of view was also satisfactory. Concerning environmental sustainability, the value of each variable was greater than the midpoint. The overall mean value was 3.215, and the performance of pineapple cultivation from an environmental sustainability point of view was also satisfactory. The overall performance of pineapple in respect of sustainability was satisfactory, and it can be concluded that pineapple is a sustainable crop in Arunachal Pradesh, India.

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Economic Feasibility of Protected Cultivation of Rose Under Polyhouse and its Supply Chain in Maharashtra

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ABSTRACT

In India, the government provides subsidies for adoption of efficient farm technology to enhance farm productivity. However, adoption rate of technologies varied significantly and some technologies negligibly adopted without subsidy support. Protected cultivation has a better input use efficiency, enabling the farmers to produce more output per unit area. Thus, this particular study assesses the role of various institutions involved in its promotion and estimates the profitability of rose cultivation under polyhouse along with its price spread in market. The cost of establishment of rose under polyhouse was very high, but offers an increased returns. Feasibility analysis shows that, rose cultivation under polyhouse are feasible under both with and without subsidy support. However, it is more profitable to farmers with subsidy support which have lesser payback period. Five types of marketing channels are being followed in Maharashtra for marketing of rose. Government subsidy support will serve as demonstration effect for higher adoption of efficient technology like polyhouse.

Keywords: Polyhouse, Subsidy, Rose, Feasibility, Institutions, Price spread, Supply chain, Maharashtra

INTRODUCTION

After the advent of green revolution in India, greater emphasis is laid on the quantity of agricultural production along with the quality of product to meet the ever growing food and nutritional requirements (Shweta *et al*., 2014). Farming as a profession is partly less remunerative and know for its drudgerious field work, does not attract educated youth towards it (Wijerathna *et al*., 2014). To motivate and attract the educated youth towards agriculture, it has to be a lucrative and competitive profession as any other industry using agro-technologies like protected cultivation (Sanwal *et al*., 2004). The main purpose of protected cultivation is to create a favorable environment for the sustained growth of crop so as to attain its maximum potential even in adverse climatic conditions (Murthy *et al*., 2009; Sabir and Singh, 2013). The protected cultivation technology is highly relevant to Indian farmers who have marginal and small land holdings (owns less than 2 hectares of land), which enables them to produce more output per unit area, particularly during the off-season which turns up an opportunity to fetch higher prices (Kallo and Singh, 2001; Sabir and Singh, 2013). However, growing high value crops under protected cultivation requires high input cost and best management practices which have direct bearing on the economic viability of the production systems. Through many schemes and programmes, Government of India is creating awareness towards the farmers and encourages them to adopt protected cultivation by subdizing its establishment cost. In India, Maharashtra is one of the leading states, when area under protected cultivation is considered. From provision of knowledge about protected cultivation to the merchandising of the produce, numerous public and individual institutions are involved, which are very active in Maharashtra. Therefore, this paper analyses the economics of cultivation of rose under polyhouse condition in Maharashtra and discusses their practical implications for the promotion of this technology. It is thus important to assess the status of protected cultivation in India, the role of various institutions involved in its promotion, to evaluate the economic feasibility of polyhouse cultivation of rose and to assess supply chain and marketing of rose in Pune and Nasik districts of Maharashtra.

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Area under protected cultivation: Numbers of schemes, both at central and state level are being implemented for promotion and development of protected cultivation. The major scheme is National Horticulture Mission (NHM) which provides 50 per cent subsidy for erecting polyhouse structure and purchasing planting materials and cultivation of flowers and vegetables under polyhouse. It is evident from the Table 1 that the area under protected cultivation promoted by NHM in India was high for plastic mulching (1.91 lakhs ha), followed by anti-bird / anti-hail nets, plastic tunnel, shade net house and naturally ventilated polyhouse. During 2005-06 to 2017-18, the total area brought under protected cultivation by NHM was 2.15 lakhs ha, of which 89 per cent under plastic mulching and 3 per cent under anti-bird / anti-hail nets.

Institutional support and linkages: For promotion of protected cultivation, a number of schemes and institutions are providing financial assistance and support to the farmers to uplift the adoption level of protected cultivation technologies. However, the protected cultivation technologies are not being fully adopted by the farmers due to high initial investment, lack of technical guidance and lack of awareness about them (Chatterjee *et al.*, 2013; Bhatnagar 2014; Punera *et al.*, 2017; Senthilkumar *et al.*, 2018). Therefore, it is critically important to promote a meaningful interface between cultivators, policy-makers, agriculture/ horticulture department officials, entrepreneurs and industry to share ideas, challenges and opportunities about protected cultivation. About 86.2 per cent of farmers are small and marginal land holders having limited capital and a little technical skill. So, intervention from the government is utmost required for promotion and development of protected cultivation among the resource poor farmer categories.

MATERIALS AND METHODS

A sample of 200 farmers comprising 120 farmers practicing protected cultivation and 80 farmers who cultivate under open field cultivations in Pune and Nasik districts of Maharashtra during 2018-19 were surveyed. Also, an informal interview was conducted among farm produce aggregators, wholesalers and retailers in both districts for value chain analysis. In our total farm household survey, 38 farmers have grown rose in their polyhouse. Further, two pre-harvest contractors, three commission agents (APMC market, Pune), two wholesalers and five retailers were involved in rose supply chain. The farmers were interviewed to collect the information on socio-economic characteristics, level of input use, price of inputs, crop yield, price of product and other aspects related to polyhouse cultivation. It was observed that, all the farmers practicing protected cultivation were literate and the main source of information was horticulture training centre (42%), followed by KVK's (22%), private agencies (17%) and fellow farmers (9%). About 90 per cent of the farmers had attended the training program organised by any one of the institution. Of these, a major proportion of the farmers (44%) had attended training program organized by the horticulture training center, succeeded by private agencies (37%), and KVKs (19%). Private agencies were the major source to purchase planting materials for majority of the farmers (91%), followed by KVKs (7%) and nearly 2 per cent of the farmers raised planting materials by themselves. The subsidy was provided at different rates

Table 1: Area under protected cultivation structure by NHM in India

Protected cultivation	Total area (ha)	Percentage share
Green house structure (fan and pad system)	299	0.1
Naturally ventilated polyhouse	4137	1.9
Shade net house	4828	2.2
Plastic tunnel	4868	2.3
Walk-in tunnel	4	0.0
Anti-bird / anti-hail nets	7000	3.2
Planting material of high-value vegetables grown in poly house	1528	0.7
Planting material for flowers for poly house/ shade net	1675	0.8
Plastic mulching	191472	88.7
Total	215810	100

Source: National horticultural mission (2005-06 to 2017-18)

under different schemes. A major proportion of the farmers (97%) were beneficiaries of the government subsidy schemes and only 3 per cent of the farmers constructed the polyhouse without subsidy. About 47 per cent of the total establishment cost was given as subsidy to construct polyhouse structures of different sizes. Out of 97 per cent of the farmers who had availed subsidy, only 29 per cent had availed loan, and the commercial banks were the major lenders to the farmers erecting protected cultivation structures.

Farm business analysis was done to estimate the costs and returns of protected cultivation of rose under polyhouse condition. The interest rate on fixed and working capital was assumed to be 12 per cent and 7 per cent per annum, respectively. Depreciation was worked out using straight line method based on their expected lifespan. The amortized cost of crop establishment was calculated using compound growth rate formula and considering the economic life of rose orchard and the equation are as follows:

$$I = B \frac{r}{1-(1+r)^{-t}} \quad \ldots (1)$$

Where, I is the annual cost (Rs.); B is the fixed cost (Rs.); r is rate of interest (12% per annum) and t is the economic life of rose orchard (in years).

The gross returns were estimated by multiplying the total quantity of rose flowers produced with respective price received. The net profits were calculated by subtracting gross revenue from the total production costs using following equation.

$$\pi = GR - TC \quad \ldots (2)$$

Where, π is the net profits; GR is the gross revenue and TC is the total production costs

To evaluate the economic viability of protected cultivation of rose under polyhouse condition, various project analysis tools were used i.e. modified Net Present Worth (MNPW) and Benefit-Cost Ratio (BCR) and Modified Internal Rate of Return (MIRR) were computed by utilizing discounted cash flow technique. The project life of the polyhouse was assumed to be 12 years. One crop of rose remains for six years in the polyhouse, so two cycles of rose cultivation in one polyhouse were taken for analysis.

Modified net present value: The standard net present value method is based on the assumption that the intermediate cash flows are reinvested at a rate of return equal to the cost of capital. When this assumption is not valid, the reinvestment rates applicable to the intermediate cash flows need to be defined for calculating the modified net present value (McClure and Girma, 2004; Chandra, 2009). To calculate the MNPV, the cash flows (B_t) are converted to future value to be assumed at the end of project life (TV).

$$TV = \sum_{t=1}^{n} B_t \, (1+r)^{n-t} \quad \ldots (3)$$

Where, TV is the terminal value of the project cash flows, B_t is the cash flow at the end of year t and r is the reinvestment rate applicable to the cash inflows of the project. The MNPV is calculated using the following equation

$$MNPV = \frac{\sum_{t=1}^{n} B_t (1+r)^{n-t}}{(1+k)^t} - \sum_{t=0}^{n} \frac{C_t}{(1+k)^t} \quad \ldots (4)$$

Where, r is the reinvestment rate; k is the cost of capital; Ct is the net cash outflow at time t. The second term in equation (4) is the present value of all net cash outflows discounted at the firm discount rate.

Modified internal rate of return: The modified IRR models were devised as an alternative measures of internal rate of return and addressed many of the shortcomings of the IRR (Cary and Dunn, 1997; Mcdaniel *et al.*, 1988; Beaves, 1998 and 1993; Mcclure and Girma, 2004; Kierulff, 2008; Satyasai, 2009; Ivanovic *et al.*, 2015). Some of them are:

- Modified IRR assumes that project cash flows are reinvested at the cost of capital whereas the regular IRR assumes that the project cash flows are reinvested at the projects own IRR. Since the reinvestment at the cost of capital is more realistic than reinvestment at IRR.
- The problem of multiple rates of IRR does not exist with modified IRR which is common in agriculture.
- The IRR method can lead to an erroneous ranking of mutually exclusive projects when compared to the net present value method of capital budgeting.
- IRR method cannot be applied in cases where during investment use (except for initial investment) the negative net cash flows appeared.

The formula (5) is based on the assumption that negative cash flow appears not only at the beginning of the investment period, but also later during investment use.

$$\sum_{t=0}^{n} \frac{C_t}{(1+r)^t} = \frac{\sum_{t=0}^{n} B_t(1+r)^{n-t}}{(1+MIRR)^n} \quad \text{... (5)}$$

Where C_t is the cash outflows; B_t is the cash inflows; r is the cost of capital; MIRR is the modified rate of return; n is the years of investment use and t is the individual year of investment use. The MIRR is calculated using the equation (5) and can be written as

$$MIRR = \sqrt[n]{\frac{\sum_{t=0}^{n} B_t(1+r)^{n-t}}{\sum_{t=0}^{n} \frac{C_t}{(1+r)^t}}} - 1 \quad \text{... (6)}$$

Benefit-cost ratio: It is given as ratio the present worth of benefit stream to present worth of cost stream determined following Gittinger (1982).

$$BCR = \frac{\sum \frac{B_t}{(1+r)^t}}{\sum \frac{C_t}{(1+r)^t}} \quad \text{... (7)}$$

A polyhouse is viable and worth taking up if the BC ratio is greater than one, then the investment of that polyhouse can be considered as economically viable. If BC ratio is greater than one then the NPW of the benefit stream is higher than that of the cost stream.

RESULTS AND DISCUSSION

The analysis of socio-economic characteristics of farmers practicing protected cultivation of rose under polyhouse in Maharashtra shows that the most of the farmers (73.68%) practicing polyhouse cultivation were between 30 to 45 years age (Table 2). About 53 per cent of the polyhouse cultivators attained intermediate education followed by graduate and above (32%) and high school (16%). However, farming experience suggest that 50 per cent of the farmers had more than 10 years of experience, followed by 5 to 10 years (34%) and very few (16%) had 2 to 5 years of experience in polyhouse cultivation. Majority of the farmers (84%) had 1 polyhouse, and 16 percent of them had 1 to 2 polyhouse structures. About 84 per cent of the farmers practicing protected cultivation were farmers, and 16 percent were businessmen. Majority of the farmers (55.26%) possess marginal and small sized landholding (owns less than 2 ha area). Regarding the area under polyhouse cultivation, about 47 per cent of the farmers had 1000 to 2000 m^2, and 34 per cent of the farmers had polyhouse structure in less than 1000 m^2 area. Whereas, about 16 per cent had polyhouse structures established in 3000 to 4000 m^2 area.

Table 2: Classification of farmers based on socio economic characteristics (N: 38)

Particulars	Classification	% of sample farmers
Age (years)	Less than 30	-
	30-45	73.68
	More than 45	26.31
Education	Illiterate	-
	Primary	-
	High school	15.78
	Intermediate	52.63
	Graduate and Above	31.57
Farming experience (years)	Less than 2	-
	2 to 5	15.79
	5 to 10	34.21
	More than 10	50.0
Number of polyhouse owned	Up to 1	84.21
	1 to 2	15.78
	More than 2	-
Occupation	Farmer	84.21
	Business/service	15.79
Landholding size (ha)	Marginal farmers (<1)	55.26
	Small farmers (1-2)	23.68
	Medium farmers (2-10)	21.05
Area under protected cultivation (m^2)	Less than 1000	34.21
	1000 to 2000	47.37
	2000 to 3000	2.63
	3000 to 4000	15.79

The polyhouses were classified into four categories based on the area of polyhouses i.e. 1000 m^2, 2000 m^2, 3000 m^2 and 4000 m^2 for this study. The total establishment cost of rose under polyhouse was Rs. 16.15 lakhs, Rs. 26.58 lakhs, Rs. 37.50 lakhs and Rs. 47.90 lakhs for the polyhouse sizes of 1000 m^2, 2000 m^2, 3000 m^2 and 4000 m^2, respectively (Table 3). Government support in the form of subsidy for polyhouse farmers are 43 to 45 per cent of the total establishment cost. A major proportion of the expenditure incurred was due to the polyhouse structure, which ranges between 79 and 80 per cent for different categories. While the cost of establishment of crops accounted for 9 to 12 per cent, irrigation system

Table 3: Establishment cost of rose under polyhouse

Particulars	1000 m^2		2000 m^2		3000 m^2		4000 m^2	
	Amount (Rs.)	% to total	Amount (Rs.)	% to total	Amount (Rs.)	% to total	Amount (Rs.)	% to total
Polyhouse structure								
Structural frame (GI pipe)	542530	33.58	1074166	40.41	1574003	41.97	2107347	43.99
Polythene sheet	107785	6.67	193894	7.29	277756	7.41	380892	7.95
Shade net	39008	2.41	74663	2.81	108298	2.89	143290	2.99
Packaging unit	450000	27.86	450000	16.93	550000	14.67	550000	11.48
Miscellaneous	157185	9.73	310569	11.68	462489	12.33	615691	12.85
Sub total	1296507	80.26	2103291	79.13	2972546	79.26	3797220	79.26
Irrigation system and equipment's								
Irrigation and Fertigation	117000	7.24	208000	7.83	282000	7.52	352000	7.35
Sprayers	6000	0.37	6000	0.23	12000	0.32	12000	0.25
Equipment's	50000	3.10	50000	1.88	50000	1.33	50000	1.04
Sub total	173000	10.71	264000	9.93	344000	9.17	414000	8.64
Crop establishment								
Planting material	102000	6.31	204000	7.67	306000	8.16	408000	8.52
Bed preparation	29750	1.84	59500	2.24	89250	2.38	119000	2.48
Organic fertilizers	5250	0.32	10500	0.40	15750	0.42	21000	0.44
Fertilizer	2702	0.17	4658	0.18	7080	0.19	8880	0.19
Chemical spray	2250	0.14	4875	0.18	6750	0.18	10125	0.21
Labour	3946	0.24	7183	0.27	9000	0.24	12517	0.26
Sub total	145898	9.03	290716	10.94	433830	11.57	579522	12.10
Total establishment cost	1615405	100	2658007	100	3750376	100	4790741	100
Subsidy	718500		1192000		1619000		2092000	
Establishment cost minus subsidy	896905		1466007		2131376		2698741	

and equipments constitute 8 to 10 per cent of the total establishment cost. Among the polyhouse structure, the proportion of the amount spent on GI pipe is the highest, sharing 34 to 44 per cent of the total establishment cost.

The cost of cultivation of rose under polyhouse condition can be categorized into fixed costs and variable costs. The average annual cost of cultivation of rose under polyhouse worked out to be Rs. 4.49 lakhs, Rs. 6.95 lakhs, Rs. 9.50 lakhs and Rs. 12.90 lakhs for the polyhouse sizes of 1000 m^2, 2000 m^2, 3000 m^2 and 4000 m^2 (Table 4). The total fixed costs accounted for 45 to 54 per cent of the total annual cost of cultivation. Among the fixed costs, interest on fixed capital accounts is the highest (24-27% of the total cost), followed by depreciation on structure and equipment's (14-17% of the total cost). The variable costs accounted for 45 to 54 per cent of the total cost of cultivation. Among the variable costs, the expenses on human labour is the highest (24-34% of the total cost), followed by packaging and transportation (8-12% of the total cost).

The total yield of rose in a year under polyhouse condition was 1.99 lakhs stems, 3.99 lakhs stems, 5.99 lakhs stems and 7.99 lakhs stems for the polyhouse sizes of 1000 m^2, 2000 m^2, 3000 m^2 and 4000 m^2 (Table 5). The average price per flower of rose received by the growers was nearly Rs. 3. Rose cultivation yields an average gross return of Rs. 6.13 lakhs, Rs. 11.75 lakhs, Rs. 17.99 lakhs and Rs. 23.99 lakhs realized for the polyhouse structures of sizes 1000 m^2, 2000 m^2, 3000 m^2 and 4000 m^2, respectively. Similarly, the net returns of Rs. 1.64 lakhs, Rs. 4.8 lakhs, Rs. 8.4 lakhs and Rs. 11.0 lakhs were realized from rose farms for the polyhouse of sizes 1000 m^2, 2000 m^2, 3000 m^2 and 4000 m^2, respectively.

Table 4: Cost# of cultivation of rose under polyhouse

Cost components	1000 m²		2000 m²		3000 m²		4000 m²	
	Amount (Rs.)	% to total	Amount (Rs.)	% to total	Amount (Rs.)	% to total	Amount (Rs.)	% to total
A. Fixed cost								
Land rent and revenue	10015	2.22	10030	2.88	10045	3.16	10060	3.10
Interest on fixed capital @ % 12 p.a.	107629	23.95	175921	25.30	255765	26.91	323849	25.09
Amortised cost of crop establishment	23079	5.13	45896	6.60	68298	7.19	91327	7.07
Depreciation	64943	14.45	112982	16.25	162075	17.05	227907	17.65
Total fixed cost	205666	45.76	354828	51.03	516183	54.31	683143	52.92
B. Variable cost								
Plant protection	11308	2.52	19056	2.74	25200	2.65	30800	2.39
Fertilizer	14512	3.23	24617	3.54	30800	3.24	38733	3.00
Labour	156615	34.84	198389	28.53	244000	25.67	315667	24.45
Irrigation charges	5425	1.21	9446	1.36	25920	2.73	22847	1.77
Packaging and transportation	40000	8.90	66667	9.59	80000	8.42	160000	12.39
Interest on working capital @ 7% p.a.	15950	3.55	22272	3.20	28414	2.99	39763	3.08
Total variable cost	243809	54.24	340446	48.97	434334	45.69	607810	47.08
Total annual cost (A+B)	449475	100	695275	100	950517	100	1290953	100

Note: #- for one year, pa-per annum

Table 5: Yield and returns from rose under polyhouse

Returns components	1000 m²	2000 m²	3000 m²	4000 m²
Number of plants in polyhouse	8500	17000	25500	34000
Number of flowers per plant /year	23.5	23.5	23.5	23.5
Total flowers produced (No)	199963	399927	599890	799854
Sale price per flower (Rs./flower)	3.1	2.9	3.0	3.0
Gross return (Rs.)	613888	1175785	1799671	2399562
Total costs (Rs.)	449475	695275	950517	1290953
Net return (Rs.)	164413	480511	849154	1108609

The feasibility analysis estimates revealed that the pay-back period for rose cultivation under polyhouse was 1.63 (with subsidy) and 2.59 (without subsidy) years for one acre area (Table 6). The modified IRR was estimated to be 32 and 24 per cent for with and without subsidy support respectively, at 12 per cent discount rate. The benefit cost ratio was worked out to be 2.17 and 1.74. With subsidy on polyhouse and planting materials, the modified IRR varies from 24 to 33 per cent at 12 per cent discount rate. Whereas, modified NPV ranged from Rs. 22 to Rs. 111 lakhs and the benefit cost ratio ranged between 1.58 and 2.23 across different sizes of polyhouse. Thus, by all the three evaluation measures the cultivation of rose under polyhouse with and without subsidy is observed to be a highly profitable enterprise and it is recommended to be promoted further.

For marketing of rose which is grown under polyhouse cultivation, five types of marketing channels are being followed in Maharashtra (Table 7). The marketing channel I was most dominant with share of 58 per cent of the total farmers under polyhouse cultivation of rose. In channel IV, 17 per cent of farmers have direct agreement with companies to supply particular quantity of flowers per day at decided price. These companies have own collection centers at floriculture park in Talegaon where farmers bring their produce. Channel V is being followed by 2 per cent of total farmers where they sell their produce directly to consumers. Through channels II

Table 6: Feasibility analysis of protected cultivation of rose under polyhouse

Size of polyhouse	Benefit-cost ratio			Modified NPV* (Lakh Rs.)			Modified IRR (%)			PBP
	7%	10%	12%	7%	10%	12%	7%	10%	12%	(years)
With subsidy on polyhouse										
1000 m^2	1.66	1.59	1.55	26.70	23.12	21.14	19.70	22.07	23.68	2.42
2000 m^2	2.09	2.00	1.95	62.77	54.54	49.99	24.55	26.99	28.64	2.03
3000 m^2	2.37	2.26	2.19	103.92	90.34	81.83	27.20	29.61	31.25	1.68
4000 m^2	2.34	2.24	2.17	136.75	119.19	109.45	27.61	30.06	31.71	1.63
With subsidy on polyhouse and planting material										
1000 m^2	1.69	1.62	1.58	27.18	23.58	21.59	20.35	22.75	24.37	2.34
2000 m^2	2.14	2.05	2.00	63.72	55.47	50.90	25.56	28.04	29.72	1.70
3000 m^2	2.43	2.32	2.25	105.35	91.74	84.19	28.46	30.90	31.56	1.60
4000 m^2	2.39	2.30	2.23	138.66	121.04	111.27	28.95	31.44	33.12	1.55
Without subsidy										
1000 m^2	1.34	1.27	1.23	19.49	16.26	14.48	13.55	15.73	17.21	4.14
2000 m^2	1.70	1.60	1.54	52.58	44.63	40.26	17.61	19.83	21.34	3.16
3000 m^2	1.93	1.81	1.74	90.22	77.02	69.74	19.76	21.98	23.50	2.65
4000 m^2	1.92	1.81	1.74	119.10	102.02	92.59	20.02	22.26	23.79	2.59

Note: * represent the reinvestment rate to be taken as 1% higher than the cost of capital

Table 7: Marketing channel followed by the polyhouse farmers for marketing of rose (Rs./100 flowers)

Marketing channels						% share	PSCR(%)
I	Farmer (PR=295; MC=38.5)	Wholesalers (MC=37; MM=68)	Other wholesaler (MC=80; MM=120)	Retailers (MC=25; MM=125)	Consumers (PP=750)	58	39
II	Farmer (PR=275; MC=30.5)	CA/traders at APMC (MC=10; MM=6.5)	Wholesaler (MC=36.5; MM=42)	Retailers (MC=22.7; MM=107.3)	Consumers (PP=500)	15	55
III	Farmer (PR=275; MC=30.5)	CA/traders at APMC (MC=10; MM=6.5)		Retailers (MC=30; MM=128.5)	Consumers (PP=450)	8	61
IV	Farmer (PR=340; MC=7.5)	Pre harvest contractors (exporter) (MC=750; MM=510)			Consumers (PP=1600)	17	21
V	Farmer (PR=300; MC=17.5)				Consumers (PP=300)	2	100

and III, 23 per cent farmers bring their produce to the APMC market and sell to the commission agents/traders. If we compare producer share in consumer rupees is highest in channel III (61%) and lowest in channel IV (21%).

CONCLUSION

The result indicated that the cumulative area under protected cultivation promoted by National Horticulture Mission in India is estimated to be 2.15 lakhs ha during 2005-06 to 2017-18. Protected cultivation of rose under polyhouse condition involves high initial investment by establishing polyhouse structures, but offers an increased returns. Feasibility analysis had shown that the rose cultivation under polyhouse with and without subsidy is observed to be highly profitable across different sizes of polyhouse. Nevertheless, government subsidy support was considered to be game changing in the establishment of polyhouse structure. Price spread in the marketing of rose shows that the producers share in consumer rupees is highest in channel III (61%) and lowest in channel IV (21%). Thus, it is suggested that protected cultivation of rose under polyhouse should be promoted among the farming community for its larger adoption as it will have a positive impact on farm income and profitability. Also, Farmers Producers Organization should be encouraged in helping farmers to look for better inputs & to access better markets.

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Economic Empowerment of Rural Women through Krishi Vigyan Kendra in Assam

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ABSTRACT

Women empowerment is a process in which women gain greater share of control over different types of resources. Exposure of women to different technology and skill development programmes such as vocational training may expedite the process of empowerment by enabling them to generate income. The present study attempts to explore impact of vocational trainings conducted by the Krishi Vigyan Kendras on economic empowerment of the women including level of income, their control over income including expenditure, savings pattern, access to credit, and improvement in the standard of living. One hundred fifty respondents who had participated in vocational trainings conducted by different KVKs were selected as participant respondents and another set of 150 respondents were selected as control group for the study. The study reveals that after the training, around 19.00 per cent participant respondents had newly started earning and their average income increased by Rs. 1630.33. The saving habit of the participant respondents improved considerably while compared to non-participant respondents. A large majority of participant respondents had bank account on their own name and became knowledgeable on operation of bank account after the selected period. Fifty two per cent participant respondents fall in the high level of economic empowerment whereas among the nonparticipant respondents highest percentage i.e. 56.00 per cent fall in medium level of economic empowerment. This reflects significant impact of KVK vocational trainings on economic empowerment of rural women.

Keywords: Economic empowerment, Rural women, KVK, Vocational training

INTRODUCTION

Empowerment is the realization of one's own capacity, power and ability to exercise it. It is the process of becoming stronger and more confident, especially in controlling one's life and claiming one's rights. Women empowerment is a process in which women gain greater share of control over different types of resources including cognitive like knowledge, information, ideas; financial resources such as access to money and control over it and there by gaining power for decision-making.

In the year 2001, United Nations Millennium Development Goal (MDG) and later in the year 2015 Sustainable Development Goals (SDG) 2030 focused on achieving gender equality and empower all women and girls with several targets. Such targets included undertaking reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources.

In India, from the Fifth Five Year Plan onwards there has been change in the approach to women's issues from welfare to development. This approach changed the women from mere beneficiary to active partners in development process. In the year 2001, National Policy for Empowerment of Women in India was formulated with a substantial dose of rights which defined the government's action on women in India. This National Women Empowerment Policy 2001 envisaged equal access to healthcare, quality education at all levels, career and vocational guidance, employment as well as equal remuneration for women.

Krishi Vigyan Kendra (KVK) is innovative science based institution at district level with the vision of 'science and technology-led growth'. The KVK serves as a light

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house for the overall development of agriculture and allied enterprises in the district. KVKs conduct different kinds of extension activities including trainings for farmers, rural women and youths as well as vocational trainings for generating diversified livelihood in the rural areas in order to achieve the objectives of solving the problem of unemployment, strengthening the allied enterprises other than crop production, disseminating new, proven and economically viable technologies in the area etc. Such vocational training may create a pool of human resources who are capable of ensuring livelihood security for themselves and for their family. These human resources in turn may become empowered in different dimensions such as economic, social and political dimensions.

At international and national level different conventions and policies advocated for skill development of women for empowering them in different spheres. Considering the necessity for skill development of women for their empowerment and provision for vocational trainings by the KVKs the present study attempts to reveal the impact of vocational trainings conducted by the KVKs on economic empowerment of the women including the change in level of income, control over income including expenditure, savings pattern, access to credit, and improvement in the standard of living. The study further explores the level of economic empowerment attained by the participant respondents after the selected period in relation to their earlier level of empowerment.

MATERIALS AND METHODS

The study was conducted in Assam where twenty three Krishi Vigyan Kendras (KVKs) are functioning under administrative control of Assam Agricultural University, Jorhat. Considering the participation of women in vocational training programmes in three areas *viz.,* 'Food processing and preservation', 'Mushroom Cultivation' and 'Vermicompost production' six KVKs were selected for selection of respondents. A list of rural women who participated in the selected vocational trainings was prepared considering their contact with respective KVK. From the prepared list, 150 respondents were selected as participant respondents and equal numbers were selected as control group who were nonparticipants of the trainings. Thus total sample size for the study was 300.

Economic empowerment is measured in terms of change in income level, control over income including expenditure, savings pattern, access to credit, and improvement in the standard of living such as expansion of house building, purchase of household assets, labour and energy saving device, agricultural assets and other assets. Respondents were asked through close ended questions. The indicators were binary, while '1' stands for empowerment and '0' for non-empowerment. Thus the aggregate empowerment score would lie between '0' and '1' for individual respondents. Based on the scores obtained on the Economic Empowerment Index, the respondents were categorized as 'Low level of empowerment', 'Medium level of empowerment' and 'High level of empowerment' by calculating the percentile.

Since the study focuses on impact of the vocational trainings on socio economic empowerment, therefore 'before' and 'after' exposure of the participant respondents were calculated in terms of change in level of empowerment. Nonparticipant respondents were asked about the earlier position and the transformation taken place in their status after the last five years. Responses for the nonparticipants were also recorded as 'before' and 'after'. Recall method was used to assess the earlier status.

RESULTS AND DISCUSSION

It is observed from the Table 1 that 69.33 per cent participant respondents and 70.67 per cent non-participant respondents belonged to medium socio economic category. Among the participant respondents, percentage of high socio economic category was slightly higher i.e. 18.00 per cent than that of non-participants (15.33 %). However, a difference in mean is observed which was 44.81 in case of participants and 40.47 for non-participants, indicating a better socio economic status among the participant respondents. This difference may be due to newly acquired better status after participating in the vocational training by the participants and the adoption of technology.

Table 1: Distribution of respondents according to socio-economic status

Category	Participant (N_1 = 150)		Non-participant (N_2 = 150)	
	Frequency	Percentage	Frequency	Percentage
Low	19	12.67	21	14.00
Medium	104	69.33	106	70.67
High	27	18.00	23	15.33
Mean	44.81		40.47	
SD	11.17		11.24	

The data presented in the Table 2 shows that 70.00 per cent participant respondents had their own income before and increased up to 89.33 per cent, which indicates that after the training around 19.00 per cent had newly started earning on their own whereas in case of nonparticipant respondents there had been increase only by 1.33 per cent i.e. from 72.00 per cent to 73.33 per cent. It shows a considerable change among the participant respondents. Regarding level of income it is seen (Table 2) that in the income level Rs. 2001-5000, the change among participant respondents is noticeable before and after training, which was only 8.00 per cent before and increased up to 29.33 per cent after. In two other income levels, i.e. Rs. 5001-10,000 and more than Rs. 10,000 there was increase of 4.00 per cent each after the training. Among the nonparticipants, very small change was observed in all the income categories. The vocational training and adoption of the technology for income generation by the participant respondents might help in increasing the percentage of earning members.

Data shows (Table 2) that the average income of participant respondents before the training was Rs. 1,368.00 and after, it raised up to Rs. 2,998.33 which is an increase by Rs. 1630.33. Among the nonparticipant respondents, earlier the income was Rs. 1,664.33 which raised up to Rs. 2,109.00 with an increase of Rs. 444.67. It may be interpreted that both participant and nonparticipant had increased level of income if compared with earlier income. However, the amount of increment had a considerable variation.

Similar findings was reported by Indoria and Balai (2018) that around 60.00 per cent of farm women belonged to medium i.e. Rs. 1,00,000 to 3,00,000 categories of income annually before the training but after receiving training their annual family income has increased by Rs. 20,000-50,000.

It is observed from the Table 3 that among the participant respondents, earlier 65.33 per cent had contributed to family income which later increased up to 82.00 per cent whereas among the nonparticipants, percentage of contributing respondent was 67.33 'before' which increased to 71.33 per cent 'after'. Regarding amount of contribution, noticeable changes were observed in two categories, i.e. more than Rs. 2000/- and no fixed amount. In more than Rs. 2000.00 category increase in percentage of contributing respondents was 18.00 per cent (i.e. from 3.33% to 21.33%) and in 'no fixed amount' category, an increase of around 7.00 per cent is observed.

Frequency of contribution reflects that highest percentage among participant and nonparticipant respondents did not contribute at a fixed interval rather they contributed as and when required.

Table 4 shows that, 84.00 per cent participant respondents saved money 'before', which increased up to 98.67 per cent later. Among the nonparticipants too, 88.67 per cent had saved money earlier, which increased up to 94.67 per cent 'after'. Percentage of respondents with saving habit increased among both the category of respondents; however among the participant respondents

Table 2: Distribution of respondents according to change in level of income

Indicators		Participant (N_1 = 150)				Non-participant (N_2 = 150)			
		Before		After		Before		After	
		F	P	F	P	F	P	F	P
Own earnings		105	70.00	134	89.33	108	72.00	110	73.33
Level of monthly income (Rs)	No income	45	30.00	16	10.67	42	28.00	40	26.67
	100-500	34	22.67	25	16.67	27	18.00	26	17.33
	501-1000	18	12.00	19	12.67	21	14.00	18	12.00
	1001-2000	35	23.33	28	18.67	32	21.33	28	18.67
	2001-5000	12	8.00	44	29.33	22	14.67	26	17.33
	5001-10000	4	2.67	10	6.67	1	0.67	4	2.67
	>10000	2	1.33	8	5.33	5	3.33	8	5.33
Average Income (Rs./month)		1,368.00		2,998.33		1,664.33		2,109.00	
Increase in average income(Rs./month)		1630.33				444.67			

F = Frequency; P = Percentage

Table 3: Distribution of respondents according to monthly contribution to family expenditure

Indicators		Participant (N_1 = 150)				Non-participant (N_2 = 150)			
		Before		After		Before		After	
		F	P	F	P	F	P	F	P
Contribution to family expenditure	Yes	98	65.33	123	82.00	101	67.33	107	71.33
	No	52	34.67	27	18.00	49	32.67	43	28.67
Amount of contribution (Rs per month)	Nil	52	34.67	27	18.00	49	32.67	43	28.67
	Up to 500	36	24.00	25	16.67	33	22.00	30	20.00
	501-1000	17	11.33	16	10.67	10	6.67	11	7.33
	1001-2000	19	12.67	18	12.00	13	8.67	18	12.00
	>2000	5	3.33	32	21.33	10	6.67	12	8.00
	No fixed amount	21	14.00	32	21.33	35	23.33	36	24.00
Frequency of contribution to family income	Never	52	34.67	27	18.00	49	32.67	43	28.67
	Daily	25	16.67	36	24.00	29	19.33	29	19.33
	Weekly	2	1.33	4	2.67	5	3.33	5	3.33
	Monthly	4	2.67	6	4.00	6	4.00	6	4.00
	Annually	2	1.33	2	1.33	5	3.33	5	3.33
	As & when needed	65	43.33	75	50.00	56	37.33	56	37.33

F = Frequency; P = Percentage

Table 4: Distribution of respondents according to saving habit

Indicators		Participant (N_1 = 150)				Non-participant (N_2 = 150)			
		Before		After		Before		After	
		F	P	F	P	F	P	F	P
Saving habit	Save money	126	84.00	148	98.67	133	88.67	142	94.67
	Do not save	24	16.00	2	1.33	17	11.33	8	5.33
Saving amount in	Nil	24	16.00	2	1.33	17	11.33	8	5.33
Rs.(monthly)	<500	59	39.33	46	30.67	63	42.00	66	44.00
	501-1000	32	21.33	52	34.67	36	24.00	42	28.00
	1001-2000	16	10.67	27	18.00	18	12.00	19	12.67
	>2000	19	12.67	23	15.33	16	10.67	15	10.00

F = Frequency; P = Percentage

it was higher. It is also observed (Table 4) in the category Rs. 501/- to Rs. 1000/- highest increase is observed i.e. 21.30 per cent to 34.67 per cent among the participant respondents after the training. Among the nonparticipants also percentage of respondents increased in each category of saving but not comparable with the participants. The savings habit improved among both the category of respondents indicates that all are becoming conscious about importance of saving for spending at the time of need without having to go to the money lenders.

Seventy eight per cent participants had their account on their own name 'before' which increased up to 95.33 per cent 'after'. Whereas 90.67 per cent nonparticipant respondents had bank account on their own name which increased up to 94.67 per cent later (Table 5). Amongst both the group of respondents, some respondents were hitherto untouched by banking sector. Data (Table 5) reflects that 68.67 per cent participant respondents had knowledge on operation of bank account which increased up to 88.67 per cent after the training. Among the

Table 5: Distribution of respondents according to holding of bank accounts and knowledge on its operation

Indicators	Participant (N_1 = 150)				Non-Participant (N_2 = 150)			
	Before		After		Before		After	
	F	P	F	P	F	P	F	P
Bank account on own name	117	78.00	143	95.33	136	90.67	142	94.67
Knowledge on operation of bank account	103	68.67	133	88.67	90	60.00	95	63.33
Knowledge of ATM	35	23.33	49	32.67	32	21.33	33	22.00

F = Frequency; P = Percentage

Table 6: Distribution of respondents according to improvement in the standard of living

Indicators	Participant (N_1 = 150)		Non-participant (N_2 = 150)	
	Frequency	Percentage	Frequency	Percentage
Improvement in the housing condition	42	28.00	30	20.00
Purchase of household assets	57	38.00	32	21.33
Purchase of labour/energy saving devices	43	28.67	25	16.67
Agricultural assets	4	2.67	2	1.33
Other assets	11	7.33	9	6.00

Multiple response

nonparticipant respondents, the corresponding percentage increased from 60.00 to 63.33 per cent only. Percentage of respondents with knowledge on ATM operation was found to be 32.67 per cent and 22.00 per cent among participant and nonparticipant respondents respectively which was considerably low.

Though the overall scenario on banking and knowledge on banking as well as ATM operation was not very satisfactory, after the training the knowledge on ATM operation increased noticeably among the participant respondents if compared with nonparticipants. At this digital era, it is a matter of concern that a noticeably large percentage of respondents cannot even withdraw money from ATM calling for popularizing digital literacy with regards to money transaction among the rural women.

More than 30.00 per cent participant respondents availed credit 'before', which increased up to 48.00 per cent 'after' (Figure 1). Among the nonparticipants, earlier it was 38.00 per cent which increased up to 44.00 per cent later. A significant increase among the participant respondents is observed. This may be because of their effort to proceed with their enterprise and support received from different agencies in availing credits for it. However, among the nonparticipant respondents also the percentage of borrowers increased which may be attributed to the fact that rural women are needy and now-a-days besides

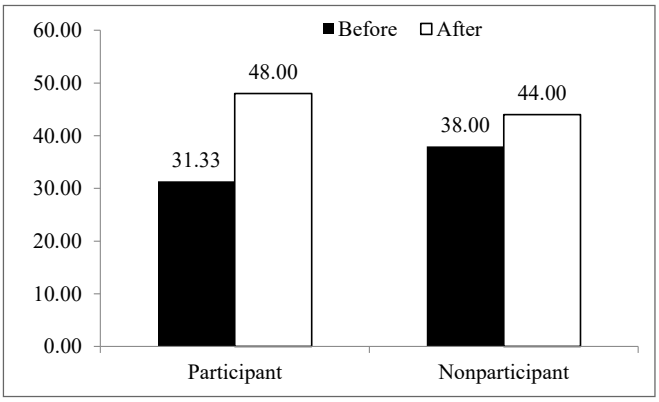

Figure 1: Distribution of respondents according to their access to credit

the nationalized banks different private financial agencies are active in the nook and corners of the country which made the borrowing process easier. Additionally, majority of the respondents were members of SHGs, which lends money without much complexity.

Data reflects (Table 6) that 38.00 participant respondents purchased different household assets which included television, radio, bicycle, motor bike, four wheeler, furniture, mobile handset, electric fan etc. whereas 21.33 per cent nonparticipants purchased such items. Around 28.00 per cent participant purchased labour and energy saving devices and almost equal percentage improved their housing condition by expansion of house building,

Table 7: Distribution of respondents according to level of empowerment

Level of empowerment	Participant (N_1 = 150)				Non-participant (N_2 = 150)			
	Before		After		Before		After	
	F	P	F	P	F	P	F	P
Low	54	36.00	19	12.67	48	32.00	39	26.00
Medium	65	43.33	53	35.33	82	54.67	84	56.00
High	31	20.67	78	52.00	20	13.33	27	18.00

F = Frequency; P = Percentage

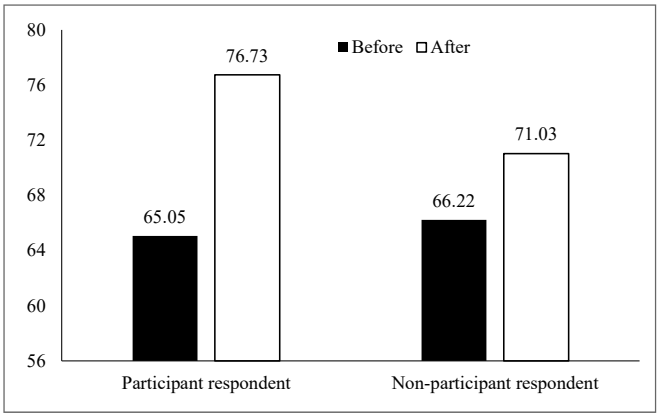

Figure 2: Difference in level of economic empowerment of participant and nonparticipant respondents 'before' and 'after'

electricity connection, provision for running water and construction of toilet. Twenty per cent nonparticipant respondents spent for improving their housing condition.

Study by Singla and Goel (2016) reported similar findings that 64.00 per cent women mushroom growers had improved in standard of living and 60.00 per cent started better saving. Gautam *et al.* (2014) also reported impact of KVK training on participants. Similar findings were reported by Deharia (2009); Nazir *et al.* (2012); Sheheli (2012); Kapila (2015). Among the participant respondents average economic empowerment was 65.03 which increased up to 76.73 'after' whereas among the nonparticipants it increased from 66.22 to 71.03 per cent (Figure 2). The data reflects that there has been considerable improvement among the participant respondents in terms of economic empowerment compared to nonparticipants.

Table 7 shows that among the participant respondents highest i.e. 43.33 per cent was in the medium level of empowerment 'before' which improved to high level of empowerment with 52.00 per cent 'after'. Among the nonparticipant respondents, 54.67 per cent were in medium level of empowerment which increased up to 56.00 per cent during the period.

CONCLUSION

The findings reflect that rural women who had participated in vocation trainings conducted by KVK had better status 'after' in all the indicators. They had better level of income, more contribution to family expenditure, better saving habit, more respondents had bank account, can operate account and can windrow money from ATM. Access to credit was more among the participant respondents. The average level of economic empowerment was also higher among participants. The study reveals better level of economic empowerment among both participant and nonparticipant respondents; however the increase in high level of empowerment among participant respondents was more which indicates the impact of vocational training on empowerment of rural women. It may be concluded that KVKs are instrumental in empowering rural women through the vocational trainings.

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A Study on the Relationship Between Selected Characteristics of the Farmers and Their Adoption

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ABSTRACT

A study was conducted to study the relationship between selected characteristics of the respondents and their adoption. Ex-post facto research design was followed. The present investigation covered three districts of the Saurashtra Region of Gujarat. A multistage sampling method was used with a sample size of 240 respondents. The statistical measures such as one sample test of kurtosis and skewness and correlation analysis were used. Twelve independent variables viz., annual income, occupation, social participation, extension agency contact, achievement motivation, frequency of internet use, Availability of ICT tools, cosmopoliteness, innovativeness, scientific orientation, risk orientation and economic motivation were found having highly significant and positive relationships with adoption of information at 0.01 level of significance. One of the most important suggestion was low cost smart phone should be made available to the farmers because farmers work in natural environment and during the rainy season and at the time irrigating the crops, many times it happened that they damaged their high costly smartphone.

Keyword: Adoption, Correlation analysis, Farmers, Information, Mobile

INTRODUCTION

Among other ICTs, mobile telephony has emerged as the technology of choice of the majority of the urban and even the rural masses (Ansari and Pandey, 2013). Mobile phones have been considered as the most broadly accessed tool among the farmers for communication and also accessing agriculture-related information mostly for the marketing of produce (Chhachar *et al.*, 2014). India is the second largest smart phone user country in the world having 220 million smart phone users base with 80 million users in rural India (Belakeri *et al.*, 2017). Kaliba *et al.* (2000) had found that smaller holder farmers tended to adopt simple technologies first before moving on to more complex ones, while cheaper technologies may be adopted before the more expensive ones in the majority of adoption studies. Finally, Aker (2011) examines the role of mobile phones in supporting access to information about agricultural technologies and extension services. Keeping this in view, an attempt has been made to study the relationship between selected characteristics of the respondents and their adoption.

MATERIALS AND METHODS

The study was conducted in Saurashtra region of Gujarat state covering, Junagadh, Rajkot and Amreli districts. A multistage sampling technique was used for selecting the districts, talukas, villages and respondents. Two villages were selected from each of the selected talukas by random sampling method. A total of twelve villages were selected for the study. Twenty respondents were selected from each village. Thus, a total of 240 respondents were selected from twelve villages. The data were collected through pre-tested interview schedule. The collected data were classified, tabulated and analyzed in order to make the findings meaningful. The statistical measures such as one sample test of kurtosis & skewness and to find out the relationship between dependent and independent variables, the correlation coefficient was computed, which provides generally accepted means for measuring the relationship were used.

General hypothesis of study: H_o: There is no relationship between the adoption of information and selected characteristics of the respondents.

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RESULTS AND DISCUSSION

The objective of the study was to examine the relationship, if any between the independent variables and their adoption of information. On the basis of operational measure developed for the variable null hypotheses were stated for testing the relationship and their significance on zero order correlation.

Age and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.1): There is no relationship between the adoption of information and age of the respondents. The calculated correlation co-efficient value r = -0.109 was non-significant at 0.01 level. Hence, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and age of the respondents. The finding is supported by the opinion of Ganesan *et al.* (2015).

Education and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.2): There is no relationship between the adoption of information and education of the respondents. The calculated correlation co-efficient value r = 0.048 was non-significant at 0.01 level. Hence, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and education of the respondents. The finding is supported by the opinion of Ganesan *et al.* (2015).

Land holding and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.3): There is no relationship between the adoption of information and land holding of the respondents. The calculated correlation co-efficient value r = 0.121 was non-significant at 0.01 level. Hence, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and land holding of the respondents. The finding is supported by the opinion of Rabari (2006) and Ganesan *et al.* (2015).

Annual income and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.4): There is no relationship between the adoption of information and annual income of the respondents. The calculated correlation co-efficient value r = 0.190 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and annual income of the respondents. It is quite natural that sound economic condition of the farmers gives courage to take risk in his farming. In such case, the sound economic condition might have directed and sustain them to adoption. The finding is not in line with the view as expressed by Rabari (2006).

Family type and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.5): There is no relationship between the adoption of information and family type of the respondents. The calculated correlation co-efficient value r = -0.009 was non-significant at 0.01 level. Hence, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and family type of the respondents. The finding is supported by the opinion of Soni and Bhimawat (2004).

Occupation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.6): There is no relationship between the adoption of information and occupation of the respondents. The calculated correlation co-efficient value r = 0.195 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and occupation of the respondents. The probable reason might be that majority of the respondents from farming as a main occupation and main income source and they are involved in farming from many years. So they need to utilize available information and sustain their farming. The finding is not in line with the view as expressed by Vankar (2000) and Dongardive (2002).

Social participation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.7): There is no relationship between the adoption of information and social participation of the respondents. The calculated correlation co-efficient value r = 0.437 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and social participation of the respondents. This indicates that social participation influence the adoption of information as it provide an opportunity to an individual to interact in an organizational way which resulted in acquisition of knowledge and are likely to receive clues from other people that would serve, as further, reinforce supporting the concept of an innovation which motivate them for adoption. The finding is in line with the view as expressed by Rabari (2006); Sharma (2008) and Rathod (2009).

Extension agency contact and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.8): There is no relationship between the adoption of information and extension agency contact of the respondents. The calculated correlation co-efficient value r = 0.170 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and extension agency contact of the respondents. The probable reason for positive and highly significant association between extension agency contact and adoption of information may be due to interaction between extension personnel pertaining to information which can have cleared their doubts about recommended information and thus helped increase its adoption. The finding is in line with the view as expressed by Suryawanshi (2009).

Farming experience and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.9): There is no relationship between the adoption of information and farming experience. The calculated correlation co-efficient value r = -0.081 was found non-significant at 0.01 level. Thus, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and farming experience of the respondents. The finding is supported by the opinion of Rabari (2006) and Rathod (2009).

Achievement motivation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.10): There is no relationship between the adoption of information and achievement motivation of the respondents. The calculated correlation co-efficient value r = 0.355 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and achievement motivation of the respondents. The probable explanation for this finding might be that small to medium size of land holding would have encouraged the respondents to take challenges and the scientific approach with farming experience and there by resulted in to success. The finding is in line with the view as expressed by Dechamma (2015).

Attitude towards social media use and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.11): There is no relationship between the adoption of information and attitude towards social media use by the respondents. The calculated correlation co-efficient value r = 0.130 was found significant at 0.05 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and significant relationship between the adoption of information and attitude towards social media use by the respondents. The probable explanation for this finding might be that majority of the respondents belong to young and middle age group with high level of education so aware about social media and positive attitude for preference of social media usage specifically for sharing agricultural information and gaining knowledge, which might reinforce them to adoption of information which in turn reflected in to this result. The finding is in line with the view as expressed by Patel (2006).

Training received and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.12): There is no relationship between the adoption of information and training received by the respondents. The calculated correlation co-efficient value r = 0.020 was non-significant at 0.01 level. Hence, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and training received by the respondents. The finding is not supported by the opinion of Singh *et al.* (2011).

Frequency of internet use and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.13): There is no relationship between the adoption of information and frequency of internet use by the respondents. The calculated correlation co-efficient value r = 0.233 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and frequency of internet use by the respondents. The probable explanation for this finding might be that positive attitude towards technology is motivating factor to make person active to implement such technology in his daily life, furthermore nowadays internet has been considered as an integral part of the life by young and middle age group farmers to know latest information about agriculture, who were highly utilizing this in their adoption. The finding is in line with the view as expressed by Rudroju (2013).

Availability of ICT tools and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.14): There is no relationship between the adoption of information and availability of ICT tools of the respondents. The calculated correlation co-efficient value

r = 0.283 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and availability of ICT tools of the respondents. It is quite natural that availability of essential tools motivate them in utilizing them for obtain information and communication. The availability of ICT tools might have directed them to adoption of information. The finding is in line with the view as expressed by Kumar (2016).

Mass media participation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.15): There is no relationship between the adoption of information and mass media participation of the respondents. The calculated correlation co-efficient value r = 0.150 was found significant at 0.05 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and significant relationship between the adoption of information and mass media participation of the respondents. The reason for the above may be that greater contact with larger society via mass media participation seemed to be association with higher adoption of information. The finding is in line with the view as expressed by Sharma (2008).

Cosmopoliteness and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.16): There is no relationship between the adoption of information and cosmopoliteness of the respondents. The calculated correlation co-efficient value r = 0.242 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and cosmopoliteness of the respondents. Concluding the findings it is well accepted that cosmopoliteness of the respondents increases his contact with outside the social system where an individual will be exposed to new idea and experience of variety of people. This interaction provides him a benefit of various experience thereby decision making ability and application of new ideas by the individual resulted into adoption of information. The finding is in line with the view as expressed by Sharma (2008).

Attitude towards ICTs and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.17): There is no relationship between the adoption of information and attitude towards ICTs. The calculated correlation co-efficient value r = -0.018 was found non-significant at 0.01 level. Thus, the null hypothesis was accepted. It can be concluded that there was non-significant relationship between the adoption of information and attitude towards ICTs of the respondents. The finding is not supported by the opinion of Patel (2006).

Information needs and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.18): There is no relationship between the adoption of information and information needs of the respondents. The calculated correlation co-efficient value r = -0.140 was found significant at 0.05 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and significant relationship between the adoption of information and information needs of the respondents. If information needed and received by respondents were in harmony with capacity to understand by respondents and without information overload than, concluding the finding it is well accepted that the access to information helps in increasing the self-esteem and self-confidence of respondents and active participation in the process of gaining new information thereby they were positively utilizing this accessed information in their decision making process by the individual resulted into adoption of information. The finding is in line with the view as expressed by Mangal (2012).

Innovativeness and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.19): There is no relationship between the adoption of information and innovativeness of the respondents. The calculated correlation co-efficient value r = 0.192 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and innovativeness of the respondents. Concluding the findings it is well accepted that majority of the respondents are quite earlier in adopting the innovations than other farmers in a social system. This might be due to their high scientific orientation coupled with high achievement motivation leading them to adoption of innovations and also trustworthiness of farmers on innovations resulted into adoption of information. The finding is in line with the view as expressed by Dechamma (2015) and Sharma *et al.* (2016).

Scientific orientation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.20): There is no relationship between the adoption of information and scientific orientation of the respondents.

The calculated correlation co-efficient value r = 0.260 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and scientific orientation of the respondents. The probable reason might be that scientific orientation opened the mental horizon which acted as a catalyst in altering actions of the respondents, which would have resulted into its significant influence on adoption of information. The finding is in line with the view as expressed by Sharma (2008) and Rathod (2009).

Risk orientation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.21): There is no relationship between the adoption of information and risk orientation of the respondents. The calculated correlation co-efficient value r = 0.468 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and risk orientation of the respondents. The probable reason for this finding might be due to that the respondents were well aware about the risk of low yield during adoption of wrong way scientific information. In spite of such awareness, they shifted to innovative nature due to importance of information in their development and get benefit in farming in future. The finding is in line with the view as expressed by Rabari (2006) and Sharma (2008).

Economic motivation and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.22): There is no relationship between the adoption of information and economic motivation of the respondents. The calculated correlation co-efficient value r = 0.305 was found significant at 0.01 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and highly significant relationship between the adoption of information and economic motivation of the respondents. It can be concluded that operating motive of earning higher income naturally activates the individuals in the direction of rational contributing with significant correlation and when one develops higher level of economic motivation and wants to achieve it, he would strive hard and get internalize himself about different part of profit maximization. The finding is in line with the view as expressed by Rabari (2006) and Sharma (2008).

Knowledge and adoption: The data presented in Table 1 were used for testing the null hypothesis (H_o.23): There is no relationship between the adoption of information and knowledge about mobile feature of the respondents. The calculated correlation co-efficient value r = 0.165 was found significant at 0.05 level. Thus, the null hypothesis was rejected. It can be concluded that there was positive and significant relationship between the adoption of information and knowledge about mobile feature of the respondents. Thus it can be concluded that awareness about available sources of agricultural information which could be accessed through the use of different mobile features which helps them to interpret the ideas in a rational thinking leads to develop all possible alternatives which in turn reflected in to favourable disposition towards rational realistic decision making resulted in to adoption. The finding is in line with the view as expressed by Sharma (2008) and Rathod (2009).

Table 1: Correlation coefficient of selected independent variables of the respondents with their adoption of information

Characteristic	Correlation coefficient(r)
Age	-0.109^{NS}
Education	0.048^{NS}
Land holding	0.121^{NS}
Annual income	0.190**
Family type	-0.009^{NS}
Occupation	0.195**
Social participation	0.437**
Extension agency contact	0.170**
Farming experience	-0.081^{NS}
Achievement motivation	0.355**
Attitude towards social media use	0.130*
Training received	0.020^{NS}
Frequency of internet use	0.233**
Availability of ICT tools	0.283**
Mass media participation	0.150*
Cosmopoliteness	0.242**
Attitude towards ICTs	-0.018^{NS}
Information needs	-0.140*
Innovativeness	0.192**
Scientific orientation	0.260**
Risk orientation	0.468**
Economic motivation	0.305**
Knowledge	0.165*

*Significant at 0.05 level of probability; **Significant at 0.01 level of probability; ^{NS} = Non significant

CONCLUSION

In this era of ICTs based communication, Mobile is the most suitable device for providing accurate, timely, relevant agricultural information to the farmers. Therefore it is very much necessary to on the relationship between selected characteristics of the farmers and their adoption, and for the same purpose correlation analysis was used. Twelve independent variables viz., annual income, occupation, social participation, extension agency contact, achievement motivation, frequency of internet use, Availability of ICT tools, cosmopoliteness, innovativeness, scientific orientation, risk orientation and economic motivation were found having highly significant and positive relationships with adoption of information at 0.01 level of significance. One of the most important suggestion was low cost smart phone should be made available to the farmers because farmers work in natural environment and during the rainy season and at the time irrigating the crops, many times it happened that they damaged their high costly smartphone. So they preferred use old modules of mobile, which are available at cheaper cost.

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Impact Study on ICT Based Extension Model : Kisan Mobile Advisory

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ABSTRACT

Information plays a critical role at every stage of this action chain. The transfer of technology to farmers is not a onetime exercise because new farm technology is being constantly evolved now the modern information communication technologies (ICTs) as mobiles and computers have created a revolution. The present study was conducted in Morena district of Madhya Pradesh state during 2008-09 to 2020-21 with the objective to evaluate the impact of KMA on farmers, extension personnel and input dealers of district. On the basis of present study it may be concluded that the use of ICT tools i.e. mobile for disseminating the information through KMA is very effective and useful to agricultural extension. This new way to disseminate the knowledge is useful to disseminate the information in real time basis as per the need of farmers. The appropriate information in form of message is the reminder for performing the different farm operation in time

Keywords: ICT, Kisan mobile advisories, Respondent, Dissemination and timeliness of information

INTRODUCTION

Rural farmers play a major role in food security equation as producers and consumer. Need is to harness productivity along with sustainability, minimize post harvest losses and getting appropriate prices for produce. For this market, research, advice, credit, infrastructure, farmer organization development and business development services (Sulaiman, 2003). Information plays a critical role at every stage of this action chain. In modern world, information transfer to and from the rural farmers hinges upon the tools of information communication Technologies (ICTs) where telecentres and mobile phone application constitute major part. Since 1990s, tele-centres have been experimented with a model to provide ICT opportunities to rural communities including farmers (Barbara and Foote, 2007). The transfer of technology to farmers is not a onetime exercise because new farm technology is being constantly evolved now the modern information communication technologies (ICTs) as mobiles and computers have created a revolution. In the 21st century, cost effective and efficient communication technologies are required to take lead in the changing agricultural scenario. Research indicates mobile access has somewhat contribute to the improvements of poor lives and supported poverty reduction (Silva and Zainudeen, 2007). Recently National Assessment survey of farmers NSSO (2005), observed that the average monthly per capita expenditure of a farm household is just rupees 503 with 27.0 per cent of farmer not liking farming while 40.00 per cent felt that if option given they prefer other carrier. Today's farmers want not only the two times bred for their family from their hard work, but also surplus food production, which can be sold in the market to get more income to fulfill their daily needs. During previous decade, it has been observed that several new concepts and theories have proposed and implemented for substituting the traditional methods of extension like personnel contact, group meeting, demonstration and so on. Introduction of Information Communication Technology (ICT) is one of them, which enable the dissemination of requisite information at right time to the needy persons at their doorsteps. This revolution in information technology has made access to the information easy and cost effective to the rural farming community also. In Madhya Pradesh, the data revealed that total 6.0 crore population having 90,00,00 mobile phone which means that every five member farming family having one mobile phone. Kisan Mobile phone had been found very effective tool for dissemination of information among different categories of respondents for making

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agriculture sustainable in the use of ICT tools (Kasana *et al.,* 2015). Kisan mobile advisory services (KMA) is one such initiative of ICT which provide location specific and crop specific farm advisory services and facilities to the farming community in a given area. The KMA services through messages have been provided to the progressive farmers with consultation of expert of different field to improve farmer's agricultural technical knowledge with decision making ability, so that they may enable to increase their production and productivity. It is observed that there is now much attention in the state MP on the aspects of disseminating the knowledge of agriculture technologies through use of ICT. Therefore these facts the present review research study was undertaken,

1. To disseminate the need based and timely information to the respondents.
2. To minimize the information losses by making direct contact to the farmers.
3. To study the impact of disseminating Kisan Mobile Advisories (KMA) in district.
4. To study the Farmers feedback on Kisan Mobile Advisories (KMA)

MATERIALS AND METHODS

The present study was conducted in Morena district of Madhya Pradesh state during 2008-09 to 2020-21. The district was selected purposively because of the working area of Subject Matter Specialist. The district consists Seven blocks i.e. Ambah, Porsa, Morena, joura, Kailarus, Pahadgarh and Sabalgarh. During the assessment period in the total 245 respondents were selected from all seven blocks personally as well as suggested by the RAEOs of the district who have mobile phone. Out of the total respondents 140, 35 and 70 were farmers, Rural Agricultural Extension officers and input supplier, respectively. Two KMA in a week have been delivered during the assessment period in Hindi language. During the assessment period total respondents were 18432. Out of which 18162, 120 and 150 were farmers, RAEOs and Input suppliers of the district. Out of which 140 (Twenty from each black), 35 (Five from each black) and 70 (Ten from each black), farmers, RAEOs and Input Suppliers were intervened for assessment of the impact of KMA service. Data were analysed by using frequency, mean and percentage.

RESULT AND DISCUSSION

Table 1 revealed that during the assessment and refinement years during total numbers of 1248 Kisan Mobile advisory information disseminated among the KMA users in the areas of plant protection (300), Animal husbandry (240), Horticulture (144), Crop production (312), Resource conservation (60) soil fertility (48) resource conservation (60), Marketing (72) weather related advisory (24) and others (48). Total 104 KMA were delivered every year during the assessment period. Nearly one half of the total KMA has been disseminated in the field of crop production and plant protection because of district having Pearlmillet, Black Gram, Gram, Mustard and wheat in field crops, while small area of vegetable has been opted by the large numbers of small land holders for their livelihood specially in Brinjal, Chilli, Tomato, Potato & Cucurbits crops.

Table 1: Distribution of KMA on the basis of area

S.No.	Areas of KMA	No of KMA delivered Per year	Total No of KMA Delivered
1	Crop Production	26	312 (25.00)
2	Horticulture	12	144 (11.53)
3	Live-Stock Production and management	20	240 (19.23)
4	Plant Protection	25	300 (24.03)
5	Soil Fertility	04	48 (03.84)
6	Resource Conservation	05	60 (04.80)
7	Marketing	06	72 (05.76)
8	Weather Related Advisories	02	24 (01.92)
9	Others	04	48 (03.84)
	Total	104	1248 (100)

Note: Data figure in parenthesis indicate percentage

The extent to the respondent to the KMA statement during the study was given in Table 2. The majority of respondent showed positive response to the KMA statement during the study. More than 95 per cent of respondent showed positivity to strong linkage with KVK (99.18), need based information (97.95) and KMA work as reminder (91.83) and appropriateness time of information (91.42). The findings were closely supported by the findings of Kumar *et al.* (2012) and Fusion (2009).

Easy to understand, save time and money and increase social contact i.e. 83.67 and 64.48 per cent respondent were showed average agreement about these statements, respectively. The findings get support from the findings of Kasana *et al.* (2017).

During the assessment period 100 per cent respondent demanded the KMA in Hindi language instead of Roman English. And Input suppliers more than two third of the respondents agreed/positive opinion about the KMA statement disseminated by the center, while, in case of their counterpart i.e. other source of information respondents had average agreement with only three statements i.e. received need based information, Appropriate time of information and easy to understand while in case of other statements respondents have low level of agreements.

On an average basis two third KMA users i.e. 80.35, 98.57 and 98.32 per cent farmers, extension personnel and input suppliers have agreed with the statements, respectively. It can be concluded from the findings that not only extension personnel but also ultimate beneficiaries i.e. farmers had agreed with the Kisan Mobile Advisory (KMA)Statement delivered by Krishi Vigyan Kendra at their doorsteps without paying a single coin by them.

Table 2: Extent of agreement of the respondents with KMA statements Showed during the assessment

S.No.	Statements asked from KMA users	KMA Respondents			
		Farmers (140)	RAEOs (35)	Agro-Input Providers (70)	Total (245)
1	Received need Based Information	135 (96.42)	35 (100)	70 (100)	240 (97.95)
2	Easy to understand	120 (85.71)	35 (100)	70 (100)	225 (91.83)
3	Appropriate time of Information	120 (85.71)	34 (97.14)	70 (100)	224 (91.42)
4	Save time and Money	60 (42.85)	33 (94.28)	65 (92.87)	158 (64.48)
5	KMA Also work as reminder	100 (71.42)	35 (100)	70(100)	205 (83.67)
6	Strong Linkage with KVK	140 (100)	35 (100)	68 (97.14)	243 (99.18)
	Total	675 (80.35)	207 (98.57)	413 (98.33)	1295 (88.09)
	Mean	112.5 (80.35)	34.5 (98.57)	68.83 (98.32)	215.8 (88.08)

Note: Data figure in parenthesis indicate percentage

Table 3: Extent of agreement of the respondents with KMA information during 2008-09 to 2020-2021

S.No.	Statements asked from KMA users	KMA Respondents			
		Farmers (140)	RAEOs (35)	Agro-Input Providers (70)	Total (245)
1	Timeliness	140 (100)	35 (100)	70 (100)	245 (100)
2	Appropriateness	135 (96.42)	35 (100)	70 (100)	240 (97.95)
3	Readability	140 (100)	35 (100)	70 (100)	245 (100)
4	Quality of content	132 (94.28)	35 (100)	70 (100)	237 (96.73)
5	Under stability of message	130 (92.85)	34 (97.14)	68 (97.14)	232 (94.69)
6	Relevance to need and time	135 (96.42)	34 (97.14)	67 (95.71)	236 (96.32)
7	Relevance to language	140 (100)	35 (100)	70 (100)	245 (100)
	Total	952 (97.14)	243 (99.18)	485 (98.97)	1680 (97.95)

Note: Data figure in parenthesis indicate percentage

The KMA has been assessed on the basis of different aspects as shown in Table 3. 100 per cent respondent farmers showed the agreement to the Timeliness of information received through KMA. However, to the some extent farmers were disagree with the quality of content (5.72%), under stability of message (7.15%) and relevance to need and time (3.58%). It may be due to the new way of dissemination of information or the farmers are un familiar to the ICT tools. However, all the respondent farmers, extension personnel's and input dealers are with agreement to the statement i.e. relevance to language. Table 3 clearly revealed that almost cent-per cent KMA user farmers agreed with the statements i.e. timeliness, appropriateness and readability.

Majority (71.42%) of the KMA user farmers were conveyed the message to the 1 to 3 other farmers among the social system, while, 17.85 per cent KMA farmers were not conveyed the message to the single farmers among the social system. Only 10.71 per cent KMA users farmers were disseminate the information 4 to 6 non users KMA farmers. Majority (57.14%) of the Rural Agriculture Extension Officers have conveyed the KMA information 10 to 15 farmers in the working area, while 28.57% percentage RAEOs disseminate/ conveyed the massage to 15 to 20 Farmers. It could be concluded that not only RAEOs but also KMA user farmers were multiplying the efficiency of message among the social system. The results in case of input suppliers were contradictory with that of KMA user farmers and input suppliers that. 78.57 and 21.424 per cent input suppliers were conveyed the KMA sometimes and rarely, respectively, while, non was found in case of regular dissemination of information to the ultimate users of information. Sandhu *et al.* (2014) were also established the facts of dissemination of information in social contact through farming community.

In all 140 progressive farmers selected from all seven blocks of Morena district were taken for getting feedback on KMA services. The most of the farmers were satisfied with the information received from the KMA. They convinced with the method and content of information given. Most of the farmers were satisfied with the timeliness and appropriateness of the information / technology and most of them were incorporated the received information in there agronomic operations. The usefulness of information was also satisfactory. However the farmers were partially satisfied with the question about the

Table 4: Distribution of KMA users according to their frequencies of message conveyed

S.No.	Category of conveyed farmers	In–servers personnel			Category of conveyed farmers	Input suppliers (n=70)
		Farmers (n=140)	Category of conveyed farmers	RAEOs (n=35)		
1	0	25 (17.85)	5-10	5 (14.28)	Regularly	0 (0)
2	1-3	100 (71.42)	10-15	20 (57.14)	Sometimes	55 (78.57)
3	4-6	15 (10.71)	15-20	10 (28.57)	Rarely	15 (21.42)

Table 5: Farmers feedback for the KMA advisory services of KVK Morena during 2008-09 to 2020-21

S.No.	Question Asked	Satisfied	Partially Satisfied	Not Satisfied
1.	Do you receive bi-weekly KMA	Satisfied	-	-
2.	If yes, regularity of bi-weekly KMA	Satisfied	-	-
3.	Do you follow Information received for your farm operation	Satisfied	-	-
4.	How relevant/useful are the KMA	Satisfied	-	-
5.	Farm operation for which KMA advisories are used	Satisfied	-	-
6.	Usefulness of technology disseminated though KMA	-	Partially Satisfied	-
7.	Your satisfaction by the KMA	Satisfied	-	-
8.	Average percentage of advantage in production though information received from KMA	Satisfied	-	-
9.	Economic benefit of KMA	Satisfied	-	-

Usefulness of technology disseminated though KMA. Siva and Zainudeen (2007) were also reported the usefulness of timely and proper available information to farmers.

CONCLUSION

On the basis of present study it may be concluded that the use of ICT tools i.e. mobile for disseminating the information through KMA is very effective and useful to agricultural extension. This new way to disseminate the knowledge is useful to disseminate the information in real time basis as per the need of farmers. The appropriate information in form of message is the reminder for performing the different farm operation in time.

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Constraints in Adoption of Polyhouse Technology Among Farmers in Jalandhar District of Punjab

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ABSTRACT

Poly-house farming is a substitute agricultural technique in rural India which shrinks the dependency on rainfall and makes the best possible use of land and water resources. Though this technology has been accepted by farmers in Jalandhar district, still the adoption rate is not impressive. Identifying the factors that encourage the farmers for adopting and declining poly-house farming has significance, because it leads to the grass root level constraints faced by them. In these circumstances, the present study was conducted to identify the constraints faced by poly-house farmers from a sample of 50 farmers through convenience sampling technique. The data on major constraints like technical constraints, socio-economic constraints, marketing constraints, infrastructural constraints, environmental constraints and labour constraints were collected from each respondent through personal interview method with the help of pre-tested structured schedule. It was observed that technical was the most important constraint as it was ranked first. This was followed by socio-economic constraints, marketing constraints, infrastructural constraints, environmental constraints and labour constraints which were ranked II, III, IV, V and VI respectively by the respondents. The present study emphasized the concerted efforts from all concerned agencies to bring this technology at par with the global standards.

Keywords: Adoption, Constraints, Polyhouse, Vegetable cultivation

INTRODUCTION

Protected cultivation is one of the interventions of plasticulture which is highly promising to provide solution to most of the burning problems faced by agriculture all over the world. In Indian context, the plasticulture was explored to enhance the productivity of different agricultural production systems and has a significantly positive impact in improving the socio-economic conditions of the farmers (Mehta *et al.,* 2020) mostly in 1980s after establishment of National Committee on use of Plastics in Agriculture (NCPA). Protected cultivation enables cultivator to produce several fold of good quality production which is difficult in normal conditions due to climatic and other constraints. If the recommended and needful package of practices is adopted skillfully with exactness, the any crop can be grown in any season, at any place using protected cultivation technique. It enables to control climate temperature, humidity, wind, light intensity, etc.), atmospheric gas composition (mainly CO_2 concentration), fertigation, watering, pest and diseases, etc. which results in better plant growth, better reproduction, minimized harmful effects of different factors (climate and agronomy) and higher production with better quality of produce. Due to the higher initial and operating cost and higher level of skill requirement, Protect Cultivation is mostly adopted by rich farmers and entrepreneurs, while it still remains far distant dream for small and marginal farmers in spite of several Governmental schemes and subsidies.

In spite of the above fact still greenhouse cultivation is not a very popular venture among farmers. The predominant reasons for the poor adoption may be due to lack of technical know-how, lack of awareness and knowledge regarding crops suitable for cultivation, non availability of superior inputs etc. Considering the significance of constrains faced by farmers it was felt essential to find out the major barriers which hinder the adoption of greenhouse technology among farmers. In

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district Jalandhar Polyhouse technology came in to existence during 2008-2009 with financial assistance from National Horticulture Board by the Department of Horticulture, Punjab. But at this time farmers did not the know technical knowhow and complete package of practices which became important reason for failure of this technology during 2012-13. With the establishment of centre of excellence for vegetable crops in 2014 in sync with the Indo-Israel agreement, farmers were shifting to polyhouse technology but the adoption rate is not impressive till date and 25 per cent of polyhouse are not working. These structures are almost dismantled and have torn out sheet. So, there is need to know the constraints faced by famers for adoption of polyhouse technology. Therefore, present study was undertaken with the objective to study the constraints faced by farmers in the adoption of Polyhouse technology.

MATERIALS AND METHODS

The present study was conducted in Jalandhar district of Punjab by Krishi Vigyan Kendra, Jalandhar during 2018. In total 50 farmers who had adopted polyhouse technology were selected from different blocks of district i.e. Jalandhar East, Jalandhar West, Phillaur, Rurka Kalan, Boghpur, Nakodar, Nurmahal and Shahkot for selection of more number of respondents from each block of district Jalandhar. The size of polyhouse varies from 1000 m^2-4000 m^2 in these selected blocks and farmers were growing high value crops like capsicum, cucumber and tomatoes. An exhaustive list of constraints was prepared which were divided into 6 categories i.e. Technical constraints, Socio-economic constraints, Marketing constraints, Infrastructural constraints, Environmental Constraints and labour constraints. The respondents' opinion in the study area on constraints was measured on a five point continuum scale of very severe, quite severe, severe, not so severe and least severe with score of 5, 4, 3, 2 and 1 respectively. Relevancy Ranking Technique was used with the following formula:

$$RCi = \frac{\text{Total score of all the respondents for } i^{th} \text{ constraint}}{\text{Maximum on the continuum} \times \text{Total No. of respondents}}$$

RCi refers to Relevancy Coefficient for the i^{th} constraint. The ranking of each constraint was made according to its relevancy coefficient such that the constraints having the highest relevancy coefficient is ranked 1st and subsequent rank given according to the scores obtained in that order.

The strategies to overcome the challenges faced by farmers in adoption of polyhouse technology were pooled based on discussions with all the respondents of the study. The strategies were tabulated and analyzed using Garrett's ranking technique.

RESULTS AND DISCUSSION

The different kinds of constraints perceived by the farmers in vegetable production are depicted in Table 1. It was observed that technical constraint was the most important constraint as it was ranked first. This was followed by input, financial, marketing and socio-cultural constraints which were ranked II, III and IV respectively by the respondents which were explained as follows.

Technical constraints: Production of crops under polyhouse conditions requires knowledge and is skill intensive. The most perceived constraint was lack of knowledge about varieties/crops suited for polyhouse cultivation (0.95) which was followed by lack of scientific knowledge about crop production under polyhouse (0.89), whereas non-availability of quality inputs like fertilizers, pesticides and insecticides in local market (0.77), Lack of Knowledge about fertigation scheduling (0.65), Lack of knowledge about training pruning of crops under polyhouse (0.58) and Lack of relevant literature in local language (0.45). Availability of quality seed and planting material of required cultivar is a severe constraint faced by farmers on account of increased dependence on formal sector especially private seed companies (Manjunatha *et al.,* 2013; Manjunatha *et al.,* 2015 and Manjunatha *et al.,* 2016). Results were in line with Kaur *et al.* (2017) and reported that majority of capsicum and tomato growers in district Jalandhar did not know about the recommended practices of cultivation right from selection of variety to harvesting.

Socio-economic constraints: The socio- economic constraints of the farmers in adoption of polyhouse presented in Table 1 revealed that the initial cost required for the construction of a polyhouse is still very high (7-8 lac per 500 m^2) which is beyond the reach of small and medium farmers with highest frequency (0.89) in present study, Singh and Sirohi (2006) also reported that the basic cost of fabrication and the operational cost of the climate-controlled greenhouses are very high. High cost of planting material was ranked second with relevancy coefficient of 0.76 which was followed by high cost of fertilizers and plant protection chemicals (0.68), Lack of adequate and

Table 1: Different constraints perceived by farmers in adoption of polyhouse technology

S.No	Constraints	Relevancy coefficient	Rank
1	**Technical constraints**		
1.1	Lack of knowledge about varieties/crops suited for polyhouse cultivation	0.95	I
1.2	Lack of scientific knowledge about crop production technologies under polyhouse	0.89	II
1.3	Non-availability of required quantity and quality planting material at right time	0.81	III
1.4	Non-availability of quality inputs like fertilizers and pesticides in local market	0.77	IV
1.5	Lack of Knowledge about fertigation scheduling	0.65	V
1.6	Lack of knowledge about training pruning of crops under polyhouse	0.58	VI
1.7	Lack of relevant literature in local language	0.45	VII
2	**Socio-economic constraints**		
2.1	High initial investment in construction of poly house	0.89	I
2.2	High cost of planting material	0.76	II
2.3	High cost of fertilizers and plant protection chemicals	0.68	III
2.4	Lack of adequate and timely disbursement of loan from financial institutions	0.61	IV
2.5	Non availability of credit in time.	0.56	V
2.7	Lack of crop insurance scheme for greenhouse crops	0.51	VI
2.8	High cost of replacement of torn-out sheet	0.45	VIII
3	**Marketing constraints**		
3.1	Lack of exclusive markets for flowers/ vegetable grown under polyhouse	0.91	I
3.1	Fluctuation in market prices	0.85	II
3.2	Lack of marketing facilities at local place (block/district headquarters)	0.77	III
3.4	Existence of middle men malpractices	0.65	IV
3.5	Lack of specialized supply chain management including cold chain	0.55	V
4.	**Infrastructural constraints**		
4.1	Design for different agro climatic region is not standardized.	0.83	I
4.2	Non-availability of quality material for establishment of poly house in local market	0.74	II
4.3	Non availability of inputs needed for polyhouse plants	0.67	III
4.4	Non availability of skilled person for repair of polyhose	0.58	IV
5.	**Environmental Constraints**		
5.1	Torn out of polysheet during heavy wind storm	0.76	I
5.2	Relatively higher perishability of flowers/ vegetables	0.66	II
5.3	No occupancy of polyhouse during hot summer months	0.54	III
6	**Labour constraints**		
6.1	High cost of skilled labour	0.68	I
6.2	Scarcity of labour during peak seasons	0.57	II
6.3	Lack of availability of skilled labour	0.54	III

timely disbursement of loan from financial institutions (0.61), Non availability of credit in time (0.56), Lack of crop insurance scheme for greenhouse crops (0.51) and high cost of replacement of torn-out sheet (0.45).The poor accessibility to subsidy and absence of pricing policy including crop insurance has further increased the risk of polyhouse cultivation. Smitha *et al.* (2017) reported that high initial establishment cost, lack of separate market facility and reasonable prices, non availability of inputs needed for greenhouse plants, non availability of credit in time are major constraints faced by farmers for adoption of polyhouse technology. Lack of finance and credit

facilities have been identified as the major constraints for non adoption of precision farming was also reported by Maheswari (2008)

Marketing constraints: The marketing constraints faced by the farmers have been presented in Table 1. Indian farmer is a price taker and not a price fixer. It is more in crops where price policy is completely absent as in case of flowers and vegetables. Hence, unfavorable market prices may cause huge financial losses. It was observed in present study that lack of exclusive markets for vegetable grown under polyhouse exhibited highest relevancy coefficient (0.91) followed by fluctuation in market prices (0.85), lack of marketing facilities at local place mainly block/district headquarters (0.77), existence of middle men malpractices (0.65) and lack of specialized supply chain management including cold chain (0.55). Similar results were also reported by Parbakar *et al.* (2017) and reported that the deficiencies in the infrastructure such as poor grading and transport facilities and cold chain management combined with market malpractices add to the risk component of farmers in India.

Infrastructural constraints: Most important infrastructural constraints perceived by farmers were design of structure for different agro-climatic region and is not standardized with relevancy coefficient (0.83) followed by Non-availability of quality material for establishment of poly house in local market (0.74). Non availability of inputs needed for polyhouse plants (0.67) and non-availability of skilled person for repair of polyhouse (0.54).

Environmental constraints*:* Environmental constraints was found fifth most important constraints. In central Punjab heavy wind storm occurs during April to May with moderate to heavy rainfall. During this period heavy wind storm leads to torn out polyhouse sheet which leads to economic loose of Rs 50,000-70,000 on repair of polyhouse. Under this survey torn out of polysheet during heavy wind storm (0.76) was found major environmental constraint faced by farmers followed by relatively higher perishability of vegetables (0.66) and non-use of polyhouse during hot summer months (0.54). Climatic changes, less availability of inputs and lack of financial inputs are the other problems faced by the farmers observed by Hena (2017).

Labour constraints: Polyhouse cultivation is labour intensive and demands skilled labour throughout the year. Not surprisingly, availability of skilled labour is a critical issue for farmers in district Jalandhar. The most perceived constraint was high cost of skilled labour (0.68). It was further followed by scarcity of labour during peak seasons (0.57) and Lack of availability of skilled labour (0.54). As rural youth in central Punjab with specific context of district Jalandhar who are lured by foreign countries for study and other employment opportunities regardless of farming and non-farming family which leads to no interest in adoption of these type technologies like protected cultivation.

CONCLUSION

Technological constraints were most serious followed by input, financial, marketing and socio-cultural constraints. The study highlighted the non-availability and lack of knowledge about improved varieties, seed rate and sowing time, high cost of pesticides, lack of technical knowhow right from sowing to harvesting, high cost of cultivation right from cost of planting material to harvesting as the major constraints faced by the vegetable growers. The study also exhibited that inadequate marketing facilities, lack of awareness on improved technologies, poor sources of information and lack of adoption of vegetable cultivation as enterprise had been contributing to low production. Thus there was a need to organize awareness and training programmes to encourage the farmers for adoption of polyhouse technology. It was further concluded that polyhouse technology is still in its preliminary stage in district and concerted efforts are required from all concerned agencies to bring it at par with the global standards.

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Economic Analysis of Losses at Different Stages of Harvest and Post-Harvest Operation in Wheat Production in Gwalior District of Madhya Pradesh

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ABSTRACT

The overall wastage of wheat production at different harvest and post-harvest stages was estimated at 6.58 per cent. It was 8.07 per cent in the case of small farms, 7.05 per cent in medium farms and 6.27 per cent in large farms. The maximum loss of grains occurred at the time of harvesting of crop (2.18%) followed by storage losses (1.92%) due to rats, high atmospheric moisture, insect pests, etc. Nearly 0.38 per cent grain was wasted during transportation. The quantity of feed unconsumed by (animal) livestock was estimated at 0.20 per cent. The survey showed that the storage loss was highest (2.98%) on small farms, followed by medium farms (2.09%) and large farms (1.73%). Wastage during home consumption was estimated at 1.02 per cent in the case of small farms followed by medium farms (0.51%) and large farms (0.27%). Considering heavy amounts of wheat grain handled at different stages, the wheat grains lost were found to be in very large quantities.

Keywords: Harvest losses, Post-harvest losses, Wheat wastages

INTRODUCTION

Agriculture sector in India is playing an important role in overall economic development and employment creation. Agriculture sector contributes around 15.4 per cent to the gross domestic product, it contributes to about 53 per cent of the total employment and its share in total India's exports is about 9.9 per cent (GOI, 2018). India is one of the largest producers of food grains in the world, and its wheat production in the year 2016 was 93.82 million tons and it exported about 5 million tonnes. Wheat is mostly used as food for human consumption, some may be also use as cattle feed, and some is going as waste during harvest and post-harvest stages. Increasing food grain losses, before and after harvest has its significance to the national food availability. There are few studies which examined wheat production and marketing in India (Lal *et al.*, 2003; Kumar *et al.*, 2013; Sharma, 2016; Kajale, 2013), but there is no study dealt with losses (post-harvest). So, this study was undertaken to assess food losses with special reference to wheat in Madhya Pradesh through intensive field study. The specific objective of the study is to assess the economic analysis of losses at different stages of harvest and post-harvest operation in wheat production in Gwalior district of Madhya Pradesh.

MATERIALS AND METHODS

The study was undertaken in Gwalior district, which was purposively selected from Pearl-Millet-Wheat zone of Madhya Pradesh. Three-stage-stratified random sampling was used. At first stage Morar block was selected having highest area (1150 ha) under wheat crop in the district. At second stage, five villages, *viz.,* Badegaon, Padampur-kheria, Bilheti, Berja and Mohanpur were selected randomly the selected block. A list of farmers of each selected village was prepared separately and further categorized into three groups of farmers, according to their land holdings size *viz.,* small (up to 2.00 ha), medium (2.01-4.00 ha) and large (more than 4.00 ha). At third stage, six farmers from each land-size-group were selected at random from each selected village. Thus, the total sample included 90 farmers from five villages of Morar block of Gwalior district of Madhya Pradesh. At third stage in same number of six farmers from each size group from each selected village were selected at random i.e. six in all total sample of 90

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farmers for detail investigation was selected. Data were collected using a pre-tested interview schedule and the collected data were classified and tabulated as per the objectives of the study. Simple average and percentage were used for the estimation of losses of wheat production at stages like transportation, storage, threshing, picking by birds, market yard, etc. The primary data related to the general characteristics of sample farmers, management practices of wheat production, total requirements of wheat and total wastage of wheat during home consumption, storages and at different harvest and post-harvest stages were collected through personal interview with the help pre-tested interview schedule.

RESULTS AND DISCUSSION

The total production of wheat of 30 sample of small size group was 504.64 quintal. Nearly 1.87 per cent loss of grain was observed during harvesting of crop. Wastage of grains due to rats, dampness and insect pests was 2.98 per cent of the total produce. During home consumption, the loss was 1.02 per cent. Nearly 0.36 per cent feed left as unconsumed by animals during feeding. The total loss was observed in small group was 8.07 per cent. Mostly the ratio of losses during harvesting, threshing, grain left in straw and transportation are similar in all size groups.

The loss during storage was highest in small group (2.98%) and lowest in large size group (1.73%). In medium group the losses during storage was 2.09 per cent. Similar trend in losses of grains was observed during home consumption and animal feed. The total wastage of wheat grain in small, medium, large groups came to 8.07, 7.05, 6.27 and overall 6.58 per cent respectively. The loss was highest in small group and lowest in large group (Table 1).

Factors that contribute to food loss range from mechanization of practices such as harvesting to handling, processing and others, to weather conditions, production practices, management decisions, transportation facilities, grading issues, infrastructure, consumer preferences/ attitudes, and availability of financial markets. A typical post-harvest chain comprises of a number of stages for the movement of harvested output from the field to the final retail market. The losses incurred at each step vary depending upon the organization and technologies used in the food supply chain. For example, in less developed countries where the supply chain is less mechanized, larger losses are incurred during drying, storage, processing and in transportation (Figure 1).

The magnitude and pattern of post-harvest losses (PHLs) therefore vary across countries based on their stage of economic development. In high and middle-income countries, significant losses occur in the early stages of the food supply chains and at the consumer level (United Nations, 2011). Field losses at early stages may reflect economic decision by the farmer to forgo harvesting due to market conditions or grading perfections demanded by the consumers. Minor losses may also occur at other stages of the supply chain. Food losses are relatively high across many commodities for the developed countries. This could be a reflection that food wastes at the consumer level tend to predominate food losses in the developed countries. Key factors which are responsible for the food waste in the developed countries are growing consumer intolerance of substandard foods or cosmetic defects such as blemishes and misshapen produce, as well as consumer purchases of more food than they consume. The problem faced by wheat growers in reducing the harvest and post

Table 1: Wastage of wheat at different harvest and post-harvest stages

Size of Holding	Total production (Qtls.)	Wastage (Quintal)									
		Harvesting	Threshing and shattered	Straw	Loading	Unloading	Transportation	Storage	Home consumption	Left by animal in feed	Total wastage
Small	504.64	9.46	6.72	0.48	0.21	0.14	1.72	15.02	5.15	1.82	40.72
	(100.00)	(1.87)	(1.33)	(0.10)	(0.04)	(0.03)	(0.34)	(2.98)	(1.02)	(0.36)	(8.07)
Medium	928.65	20.41	13.71	0.90	0.45	0.31	3.21	19.45	4.71	2.31	65.46
	(100.00)	(2.20)	(1.48)	(0.09)	(0.05)	(0.03)	(0.35)	(2.09)	(0.51)	(0.25)	(7.05)
Large	3779.57	83.61	54.81	1.87	1.25	0.78	12.65	65.47	10.26	6.42	237.12
	(100.00)	(2.21)	(1.45)	(0.05)	(0.03)	(0.02)	(0.34)	(1.73)	(0.27)	(0.17)	(6.27)
Overall	5212.86	113.48	75.24	3.25	1.91	1.23	17.58	99.94	20.12	10.55	343.3
	(100.00)	(2.18)	(1.44)	(0.06)	(0.04)	(0.02)	(0.34)	(1.92)	(0.38)	(0.20)	(6.58)

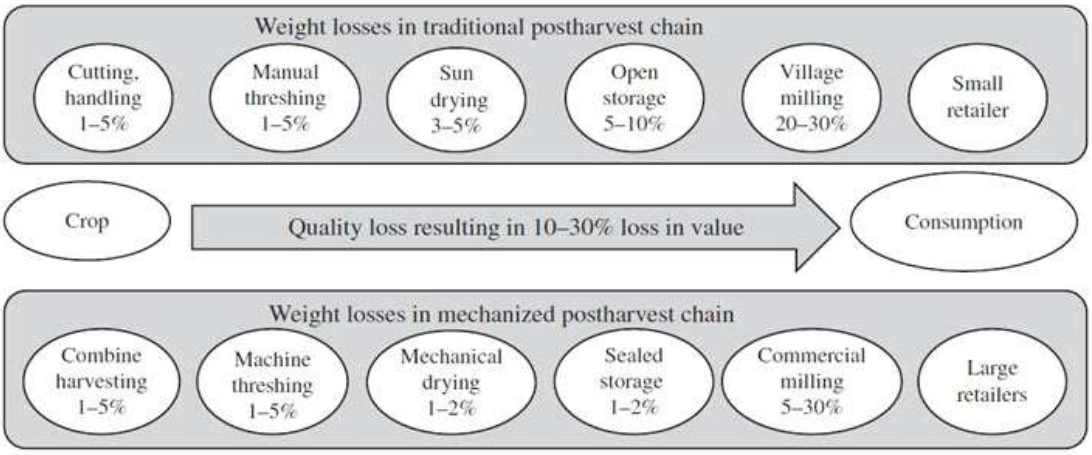

Figure 1: Traditional versus mechanized postharvest chain (Hodges *et al.*, 2011)

harvest losses revealed that huge loss of grain by rodents from sowing to storage reported about 88 per cent of the sample farmers says across the farm size. Loss of grain occurs during transportation of wheat due to leaking of carry bags result to grain leaking while storage. Heavy losses of grains are found in threshing floor by birds, animals and loss due to spreading by wind. Considerable loss of wheat grain ear heads, during the time of harvesting through sickles and high chances of ear heads losses/fall into the field while harvesting through combine harvester. Due to combine harvester, there are more chances of ear heads loss, left in the harvester itself. Storage pests have because severe loss in wheat grain storage sometimes there is heavy loss of grain due to fire hazard and theft by thieves (Table 2).

The results in the table reveal some interesting aspects. First, a comparison of the three categories of farmers is attempted. Among small farmers (n_1=30) out of their total production estimate of 504.64 q (aggregates for all sample of 30 small farmers) the total losses were about 40.24 quintal and the losses in value amount to Rs. 44,264.00. And as the farm size of the farmers is increasing their total wheat grain have also been increasing: about 64.56 q (aggregates amount of all 30 farmers) amounting to a value of Rs. 71,016.00 thousand 235.25 q (aggregates amount of wheat lost by 30 large farmers) amounting to nearly Rs. 2,58,775.00 lakhs.

Grain losses were found to occur in several stages: harvesting, threshing, loading, unloading, transporting, storage, and consumption stages. A cursory look at the

Table 2: The problems faced by wheat grower in reducing the harvest and post-harvest losses:

S.No.	Problems	Small	Medium	Large	Overall
1.	Considerable loss of wheat grain ear heads, during the time of harvesting through sickles and high chances of ear heads losses/fall into the field while harvesting through combine harvester. Due to combine harvester, there are more chances of ear heads loss, left in the harvester itself.	30(65)	30(70)	30(75)	90(70)
2.	There is huge loss from rodents from sowing to storage.	30(85)	30(90)	30(90)	90(88)
3.	Storage pests cause severe loss in wheat grain storage.	30(75)	30(80)	30(75)	90(77)
4.	Sometimes there is a huge loss of wheat and grain breaking occur during threshing because of malfunctioning or mis-operation of thresher, probability of grain loss with wheat straw contribute more to post harvest losses.	30(50)	30(70)	30(75)	90(77)
5.	Loss of grain occurs during transport of wheat due to leakage of carry bags. There is more proving to damage of carry bags result to grain leaking while storage.	30(75)	30(80)	30(80)	90(78)
6.	Heavy loss of grain in threshing floor by birds and animals and wind.	30(75)	30(80)	30(80)	90 (77)
7.	Loss of grain due to scalping and test samples in market sheds.	30(70)	30(80)	30(80)	90(77)
8.	Some time there is heavy loss of grain due to fire hazard and theft.	30(60)	30(75)	30(90)	90(75)

(Figure in parenthesis indicate percentage)

wheat grain losses at the various stages in harvesting and post-harvesting stages is done here.

Harvesting stage: At harvesting stage the wheat grain losses for small farmers was 9.46 q (23.51%) amounting to a value of Rs. 10,406.00 for medium farmers it was 20.41 q (31.61%) amounting to Rs. 22, 451.00 and for large farmers the losses were up to 83.61 q (35.54%) amounting to Rs. 91,971.00. Thus, at harvesting stage all the 90 farmers were found to lose 113.48 q of wheat grain amounting to huge losses of Rs. 1,24, 828. The losses of wheat ranged from 24 to 36% which were very huge. Thus, it can be concluded that wheat growers were incurring huge losses right at the harvesting stage, which may be avoided if proper care is taken can of while harvesting, ear heads (broken) may be collected manually.

Threshing stage: Threshing is one stage, where loss of wheat grain may result. Here small farmers were incurring losses of wheat grain to the have of 6.72 q (16.70%) amounting to value of Rs. 7,392.00 medium farmers were losing 13.71 q (21.24%) amounting to a value of Rs. 15,081.00 and large farmers were losing heaving at 54.81 q (23.30%) amounting to Rs. 60,291.00. During threshing, using a tapeline sheet under the thresher to not to let any grain wastes can be a good solution and care is also required to fill the bags properly. Total losses of wheat grain for all 90 samples of farmers were 75.24 q amounting to Rs. 82,764.00.

Loading, unloading and transporting stages: At this stage, the losses were also estimated from sample farmers. Among small farmers the losses during transportation were 1.72 q (4.27%) for medium farmers it was 3.21 q (4.97%) and for large farmers it was 12.65 q (5.38%). The total losses are value during transportation of wheat grain incurred by the small, medium and large farmers were 2.07q (5.14%), 3.97 q (6.15%) and 14.68 q (6.24%). Aggregate losses for all so farmers amounted to Rs. 22,792.

Storage: This is the most crucial stage where farmers were found to incur great losses due to lack of proper storage facilities at farm or household level; poor storage condition, high dampness, high temperature, incidence of storage grain pests including weevils, insects and rats.

The losses of wheat grains were recorded at 15.02 q (37.33%) for small farmers and amounting to Rs. 16,522.00, 19.45 q (30.13%) for medium amounting to Rs. 21, 395.00 and 65.47 q (27.83%) for large farmers amounting to Rs. 72,017.00. Total losses for all 90 samples farmers was up to 340.05 q amounting to Rs. 37,4055.

The losses of wheat during storage ranged from 27.83 per cent to 37.33 per cent of total losses of wheat grain in different harvesting and post-harvesting stages of wheat production. Huge losses during storage can easily be avoided if only farmers adhere to the standards of safe storage practices. Rat menace coupled with insect damage

Table 3: Losses of wheat in harvesting and post-harvesting stages

	Losses in wastage (Quintal)								
Categories of farmers	**Total losses**	**Harvest-ing**	**Threshing and shattered**	**Loading**	**Unloading**	**Trans-portation**	**Storage**	**Home consumption**	**Left by animal in feed**
Small farmers (n_1=30)	40.24 (100.00)	9.46 (23.51)	6.72 (16.70)	0.21 (0.52)	0.14 (0.35)	1.72 (4.27)	15.02 (37.33)	5.15 (12.80)	1.82 (4.52)
Value of losses in Rs. (X1200)	44,264.00	10,406.00	7,392.00	231.00	154.00	1,892.00	16,522.00	5,665.00	2,002.00
Medium farmers (n_2=30)	64.56 (100.00)	20.41 (31.61)	13.71 (21.24)	0.45 (0.70)	0.31 (0.48)	3.21 (4.97)	19.45 (30.13)	4.71 (7.29)	2.31 (3.58)
Value of losses in Rs. (X1200)	71,016.00	22,451.00	15,081.00	495.00	341.00	3,531.00	21,395.00	5,181.00	2,541.00
Largefarmers (n_3=30)	235.25 (100.00)	83.61 (35.54)	54.81 (23.30)	1.25 (0.53)	0.78 (0.33)	12.65 (5.38)	65.47 (27.83)	10.26 (4.36)	6.42 (2.73)
Value of losses in Rs. (X1200)	2,58,775.00	91,971.00	60,291.00	1,375.00	858.00	13,915.00	72,017.00	11,286.00	7,062.00

Note: Total amounts were calculated based on the minimum support price of wheat in 2010-11. The minimum support price (MSP) for wheat, paddy and coarse grain (fixed by the Department of agriculture & cooperation on the recommendation of the CACP in 2010-11 for wheat is Rs. 1100/- per quintal.

Note: agricoop.nic.in/minimum support prices data accessed on 26 May 2017.

was found to reduce the food safety and value of wheat grain, thereby causing severe losses in revenue, when the rat-infested wheat grain is sold in the market. Food safety standards need be adhered while using harmful hazard own chemicals to save wheat grain from insect and rat infestation. All the storage losses are still avoidable and measure to safe storage need to be promoted.

i. Calculate per hectare losses - for three groups of farms.

ii. Make a diagram -line diagram/Bar diagram.

Other losses: Even during home consumption and during feeding cattle, some losses were observed. Losses during home consumption were higher than in the cattle shed.

Home consumption stage: Small farmers were losing 5.15 q (12.80%) amounting to Rs. 5,665.00, medium farmers were losing 4.71 q (7.29%) amounting to Rs. 5181.00 and large farmers were losing 10.26 q (4.36%) amounting to Rs. 11,286.00. Total losses in value during home consumption were up to Rs. 22,132.00.

Thus, it can be concluded that the losses of wheat grain were maximum for small farmers even though their total productive by is lower, the losses being higher was found to jeopardize their wheat production system. With low production levels and heavy losses small farmers were found to be on the wrong side of losing proposition as far as wheat production & storage is concerned (Table 3).

CONCLUSION

It is concluded that the overall wastage of wheat production at different harvest and post-harvest stages was estimated at 6.58 per cent. It was 8.07 per cent in the case of small farms, 7.05 per cent in medium farms and 6.27 per cent in large farms. The maximum loss of grains was occurred at the time of harvesting of crop (2.18%) followed by storage losses (1.92%) due to rat, moisture, insect pest etc. Nearly 0.38 per cent grain was wastage during transportation. The quantity of feed unconsumed by (animal) livestock was estimated at 0.20 per cent. The survey showed that the storage loss was highest (2.98%) on small farms, followed by medium farms (2.09%) and large farms (1.73%). Wastage during home consumption was estimated at 1.02 per cent in the case of small farms followed by medium farms (0.51%) and large farms (0.27%). Proper planning and management of short, medium and long duration varieties may result in minimum harvesting losses. The maximum harvest and post-harvest losses (broken grains) occurred when farmer used machine. Thus, it is recommended that specialized wheat machine be evolved and popularized among the wheat producers. At present the common machine are used by the wheat producers after some adjustment, which are also used for Bajra, Mustard etc. The problem faced by wheat growers in reducing the harvest and post-harvest losses revealed that huge loss of grain by rodents from sowing to storage reported about 88 per cent of the sample farmers says across the farm size. Loss of grain occurs during transportation of wheat due to leaking of carry bags result to grain leaking while storage. Heavy loss of grain on threshing floor by birds, animals and loss due to wind. Considerable loss of wheat grain ear heads, during the time of harvesting through sickles and high chances of ear heads losses/fall into the field while harvesting through combine harvester. Due to combine harvester, there are more chances of ear heads loss, left in the harvester itself. Storage pests cause severe loss in wheat grain storage sometimes there is heavy loss of grain due to fire and theft by thieves.

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Mobile Based Agro Advisory Service and Farmer's Willingness to Pay: A Case Study in Bageshwar District of Uttarakhand

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ABSTRACT

The study was conducted on randomly selected 64 farmers using Reuters Market Light's (RML) short message service (SMS) for agro-advisories in Bageshwar District of Uttarakhand. The objectives of the study were to analyse socio-economic characteristics of the users, their major sources of information agriculture, willingness to pay for the SMS service, their distribution as per the amount they were willing to pay per annum, their preference for the specific SMS for which they wanted to pay and the factors which determined their willingness to pay behaviour for the SMS services. A Probit Regression Model was used to estimate the impact of socioeconomic and other variables on the willingness to pay (WTP) behaviour of the farmers. Results showed that majority of the farmer users were middle aged (40.60%) followed by young (37.50%). Most of the respondents had their education up to middle school (43.75%) followed by inter college (31.2%) Majority of the farmers had 0.026-0.53 ha of land (87.50%), were both members and office bearers in the social organization (59.40%) and did not have any training experience regarding agriculture (54.70%). 'RML', 'progressive farmers', 'SHGs/NGOs/Famers' clubs' and input retailer were found to be 1st, 2nd, 3rd and 4th source of getting information by the respondents. It was found that 70.31 per cent of the beneficiaries were willing to pay for accessing RML's SMS and among them majority of the farmers (42.22%) were willing to pay Rs. 201-300 per annum for this service. The most preferred SMS advisories were found to be on pest and disease management followed by improved vegetable production technology. The willingness to pay behaviour was found to have significant and positive relationship with age, education, and training experience of the farmers.

Keywords: Behaviour, Extension approach, ICT, Mobile based agro advisory, RML, Willingness to pay

INTRODUCTION

Access to information is an important input for making decisions in production, marketing, and finance in agriculture which is an important sector with a majority of the rural population in developing countries depending on it. The success of agricultural development programmes in developing countries depends on the nature and extent of effective use of mass media to mobilize people and to disseminate newly evolved agricultural technologies (Birkenholtz and Maricle, 1991). In last two decades, ICT has revolutionized the mass media. ICT is an umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers. In several developing countries, more people have access to mobile phones than to older technologies like telephone landlines, newspapers, and radio (Aker, 2011), although significant spatial disparity is observed (Buys *et al.,* 2009). The world data show that in developing countries peoples are subscribing mobile-cellular telephone in very faster rate which has been recorded four times increase in last ten years with 40% annual growth rate (Figure 1). The gap in possession of mobile-cellular telephone between the developed and developing country has been narrowed down over the decade (2005-2019). The reasons behind are technological innovations, attractive payment options for poor people and improved regulatory environments, all of which have enabled the rapid uptake of mobile phones (Haward and Mazaheri, 2009; Donovan, 2011).

As a result mobile phone coverage is widely expanding in developing countries like India. As per TRAI data, 2020;

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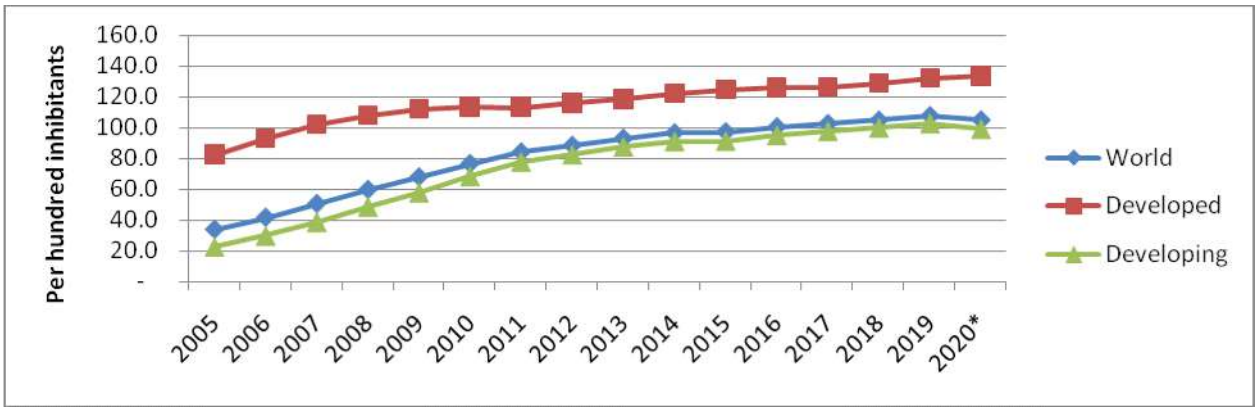

Figure 1: Trends of Mobile-cellular telephone subscription in developing and developed country (*Data Source:* ITU, 2021)

though there are about 52.43 crore mobile telephone connections in rural areas (44.87% rural subscriber) with teledensity 58.96 per cent, mobile messaging is the most effective tool so far having pervasive outreach to nearly 8.93 crore farm families. In India the mobile penetration was 10.37 per cent in 2001 which has increased to 145.48 per cent in 2019 (TRAI, 2020). It has shown 10.40 per cent annual growth rate. It is estimated that ~323 number of people are taking mobile phone connection in a minute and out of that 31 are from rural areas. The increases in their affordability, accessibility and adaptability have resulted in their use even within rural homesteads relying on agriculture. Small devices (such as mobile phones), infrastructure (such as mobile telecommunications networks and cloud computing facilities), and applications have been proliferated (Mcnamara *et al.*, 2011).

It is believed that ICT-based agricultural extension brings opportunities and has the potential for enabling the empowerment of farming communities and hence, extension practitioners are interested in experimenting with innovative e-agriculture initiatives in India (Saravanan, 2010). Several studies, with few exceptions, have established that mobile phones are indeed improving farmers' production practices and adoption of new practices. Lio and Liu (2006) found that the adoption of new ICTs increases overall agricultural productivity, perhaps because ICT infrastructure facilitates the adoption of modern agricultural inputs. Mittal *et al.* (2010) interviewed Indian farmers and fisherman who stated that information delivered via mobile phone allowed them to increase yields. Mobile phone exposure has also enhanced market efficiency and abridged consumer prices for certain commodities (Jensen, 2007; Minten *et al.*, 2012; Aker and Fafchamps, 2012).

E-agriculture, or ICTs in agriculture, is designing, evolving and applying ICT applications in innovative ways to the rural domain, with a major focus on agriculture. E-agriculture offers a basket of solutions option to some agricultural challenges. It is an emerging field converging on the enhancement of agricultural and rural development through better information and communication processes. Now a days e-Agriculture have gone beyond technology, to promote the assimilation of technology with multimedia, knowledge and culture, with the objective of triggering and refining communication and learning processes between various stakeholders in agriculture locally, regionally and worldwide. The key components of e-Agriculture are facilitation, support of standards and norms, technical assistance, capacity building, education, and extension. There are quite a lot of activities related to e-agriculture applications that are extensively recognized around the world today. The delivery of agricultural information and knowledge services (i.e. market prices, weather information, disease surveillance and other extension services etc.) using the Internet and related technologies falls under the definition of e-Agriculture. Saravanan (2012) has classified e-agriculture initiatives implemented in four major categories. They are: (1) web portals, (2) knowledge centres/tele-centres, (3) telephony/ mobile telephony (m-agriculture initiatives) like IFFCO Kisan Sanchar Limited (IKSL), Fisher Friend, Reuters Market Light (RML) and (4) hybrid projects.

In India the mobile based agro advisory services came into focus in late nineties with sporadic and local based applications. Although, the successful models were replicated regionally and country wide and are still working for the development of farmers (Table 1).

Table 1: Category of few mobile based agro-advisory services working in India

Mobile services	Year	Service provider	Mode of service	Content	Business model	Service area
Hello Uttam	2000	Pvt	2	A,B	Free	Regional
Via SMS	2000	Pvt	1	A,B	Free	Regional
Kisan Call Centre	2004	PPP	2	A	Free	Country wide
Lifelines of India	2006	Pvt	2,5	A	Free	Regional
Warana Unwired	2006	Pvt	1	A,C	Free	Regional
Fisher Friend	2007	Pvt	6	B,C	Paid	Regional
IFFCO Kisan Sanchar Limited (IKSL)	2007	Pvt	1,2	D	Free	Regional
Reuters Market Light	2007	Pvt	1	A,B,C	Paid	Regional
DMI (Dynamic Market Information)	2008	Ppc	1,5	A,D	Free	Regional
Fasal	2008	Pvt	1	D	Free	Regional
KHETI	2008	Prvt	1,2,5	A	Free	Regional
Kisan Sanchar	2008	Ppc	1	A	Free	Regional
Nano Ganesh	2008	Pvt	6	D	Paid	Regional
SMS Broadcast Service	2008	Pub	1	D	Paid	Country wide
Avaaj Otalo (Voikiosk/ Spokenweb)	2009	Pvt	2,5	D	Free	Regional
Kissan Kerala	2009	Pub	1,2	D	Free	Regional
mKRISHI	2009	Pvt	1,2,5	D	Free	Regional
Mandi Bhav	2009	Ppc	1	A	Free	Regional
MAHAAGRI SMS	2009	Pub	1	D	Free	Regional
Life Tools	2009	Pvt	1	D	Paid	Regional
Mobile Multimedia Agriculture Advisory System (MAAS)	2009	PPP	1,2	A	Free	Regional
Awaaz De (Give your voice)	2010	Pvt	1,2,5	A	Free	Regional
Kisan Mobile Advisory Service (KMAS)	2010	PPP	1	D	Free	Regional
Market Price on Mobile	2010	Pub	1	A	Paid	Country wide
v-KVK	2010	Pub	1,2,5	C	Free	Regional
Mandi on Mobile/ Digital Mandi	2011	Pub	1	C,D	Free	Regional
mKisan	2011	Pvt	1,2,4	C,D	Free	Regional
SMS Service	2011	Pub	1	C,D	Free	Regional
Annapurna Krishi Prasaar Seva	2012	Pub	6	C,D	Free	Regional
Behtar Zindagi (Better life)	2012	Pvt	1	D	Free	Regional
Kisan Help Line	2012	Pub		A	Free	Regional
m4agriNEI	2012	Pub	6	C,D	Free	Regional
mFMS	2012	Pub	1	C	Free	Country wide
SMS Weather Alert	2012	Pub	1	C	Paid	Country wide
Intelligent Advisory System for Farmers (IASF)	2013	Pub	1,2	D	Free	Regional
Kissan SMS Portal	2013	Pub	1	D	Paid	Country wide
aAqua mini (redesigned for mobile browser)	2005	Pvt	1,5	D	Free	Country wide
ISAP-QRS	2001	Pvt	2	D	Free	Regional
Vedio Kheti	2009	Pvt	6	D	Free	Regional

Note: 1= Interactive Video Response Service; 2= Pictures, 3=Videos, 4=Website, 5=software/mobile app, 6= All and A=market, B=Weather, C=Holistic, D=Other services like disease and pest management, agronomic practices etc.
Source: Sarvanan and Bhattacharjee (2014)

From the above evidences it is clear that ICT through the widely adopted mobile phone has established several benefits. Several studies have shown the impact of mobile phone in agriculture through mobile based agro advisory services in India and across the world. But a very few study has been conducted on farmers willingness to pay for the service.

Hill area in any country has not been developed as compared to the planes due to the geography and topography. In some country hilly areas are far behind in infrastructural development pathway. The poor logistics, road connectivity and market due to difficult hilly terrain are serious constraints hindering commercial farming. Our interest was to inquire how much hill farmers are interested in mobile based agro advisory services. The objective of this paper is to examine the effect of mobile based agro advisory services in rural hilly areas of North Western Himalaya. It is aimed at providing farm-level evidence to translate technological opportunities into economic benefits. Specifically, the paper responds to the following research questions: (1) which kind of farmers' access mobile based agricultural advisory service? (2) How much money they are willing to pay for the service? (3) Which factors are influencing the farmers' willingness to pay for the advisory service? By addressing these questions, the paper contributes to the growing literature on mobile based agro advisory services and farmers' willingness to pay. It also presents new insights into farmer's willingness to pay for mobile based agro advisory services.

MATERIALS AND METHODS

Theoretical framework: As far as dissemination of information is concerned personal face to face contact with farmers is quite expensive in terms of time and money especially in hilly terrains where topography hinders the rapid communication. A number of studies (Aker, 2008; Aker, 2010; Aker and Fafchamp, 2010; Mittal *et al.,* 2010; World Bank, 2011) have established the potential of mobile phones in improving the capacity of farmers to cope with agricultural risks. A wide range of mobile based agro-advisory services are delivered but how farmers are accepting this technology for their own development is a kind of concern particular to hill farming condition.

North West Himalaya (NWH) is comprised of three states *viz.*, Jammu and Kashmir (J&K), Uttarakhand (UK) and Himachal Pradesh (HP) and plays a very important role in ecology and economy of Indian agriculture. Due to the geography and topography, the area is far behind in infrastructural development pathway. Poor logistics, connectivity and market due to difficult hilly terrain are serious constraints hindering commercial farming. In spite of that agriculture has been a key economic source of this region as lion share of states GDP comes from agriculture. As far as dissemination of information is concerned the best way is use of ICT instead of personal face to face contact with farmers which is quite expensive in terms of time and money.

The present study was planned in Uttarakhand and RML mobile service was selected. RML, the ICT based agricultural extension approach which was implemented in Uttarakhand after successful implementation in several other states like Maharashtra, Punjab etc. (*http://mkisan.gov.in/*).

The Indian branch of Thompson-Reuters recently started an innovative service to disseminate agricultural information to farmers in India. This service is called RML (Reuters Market Light). Subscribers are provided with SMS messages (75-100/ month), in English or local languages, sent directly to their personal cell phone. They are offered a menu of information types i.e. various agricultural markets, various crops etc. from which they can choose as per their need. Initially RML has started its services from 2010 in five districts of Uttarakhand namely Almora, Bageshwar, Chamoli, Tehri and Uttarakashi. It sends SMS to farmers with information on prices, weather forecasts, crop advice, and general news items. RML allowed farmers to choose two crops and customized the information with each farmer received. It also supplied weather information at the *taluka* level. RML delivered information *via* text message enabling farmers to access information more conveniently. Very little research has been conducted in home and abroad regarding the use of mobile in agricultural development (Rashid and Elder, 2009). However, it is much needed to know the relevance, quality and timeliness of such information. It is also important to know the frequency of such services and study whether and how such information is helping the farmers to improve their livelihood. Keeping this in mind, the present study aims at analyzing the efficacy of mobile advisory services through short message service (SMS) provided by Reuters Market Light (RML) in Bageshwar district of Uttarakhand. Initially RML provided one year SMS service free of cost, for continuing with the service after the one year, one needs to pay Rs. 300/- and Rs. 500/- for six months and one

year services, respectively. So, there is a need to study the farmers' willingness to pay (WTP) behaviour. Hence, this study was undertaken to ascertain farmers' willingness to pay behavior for ICT based extension approach in Uttarakhand.

Present study was completed in different villages of Kapkot and Bageshwar blocks of Bageshwar District, Uttarakhand (Figure 2) in the year 2014-15. Bulk messages were sent related to various aspects of crop advisory, weather, market price and news on their registered mobiles.

Willingness to pay: Willingness to pay (WTP) is the price which a consumer determines to pay depending upon his need and ability. Although in microeconomic term it is the maximum price at or below which a consumer will certainly buy one unit of the product (Hal, 1992). This resembles to the standard economic view of consumer reservation price. According to the constructive preference view, consumer willingness to pay is a context sensitive construct, that is, a consumer´s maximum WTP for a product depends on the concrete decision context (Cole and Fernando, 2012). The WTP can be estimated directly or indirectly. Indirect methods try to judge consumers WTP by observing their behaviour in related markets whereas direct methods determine WTP by means of surveys (Parry *et al.*, 2007). In order to do the latter, researchers employ the Contingent Valuation Method (CVM). A well-designed contingent valuation survey describes both the problem a farmer is facing and the support an advisory service offers to address that problem (Carson, 2012).

During the telephonic interviews, the farmers were confronted by the questionnaire with two hypothetical scenarios (Figure 3). First, respondents were inquired about their general interest in agricultural advisory services. If the respondents were interested, they were asked to specify these services. Subsequently the question was asked of whether they would be willing to pay for these services (stated WTP) and they were probed to quantify that willingness. If respondents were not interested, not sure, or were interested but unable to quantify their WTP, they were asked for their WTP assuming that the advice would result in a 10-20 per cent yield increase or minimize 10-20 per cent loss (in case of crop protection advisory). If the respondent specified a percentage of the increase rather than a value, the WTP was calculated using the gross income from crop production.

Data and statistical methods: Out of ~2100 farmers registered, 621 were found active during the survey period. To minimize the cost and time involved in complete survey, proportionate random sampling method was adopted to select about 10 per cent as sample *i.e.* 64 farmers who were registered for receiving the SMS more than a year. The respondents were interviewed following a structured interview schedule through telephone by calling on their

Figure 2: Study area

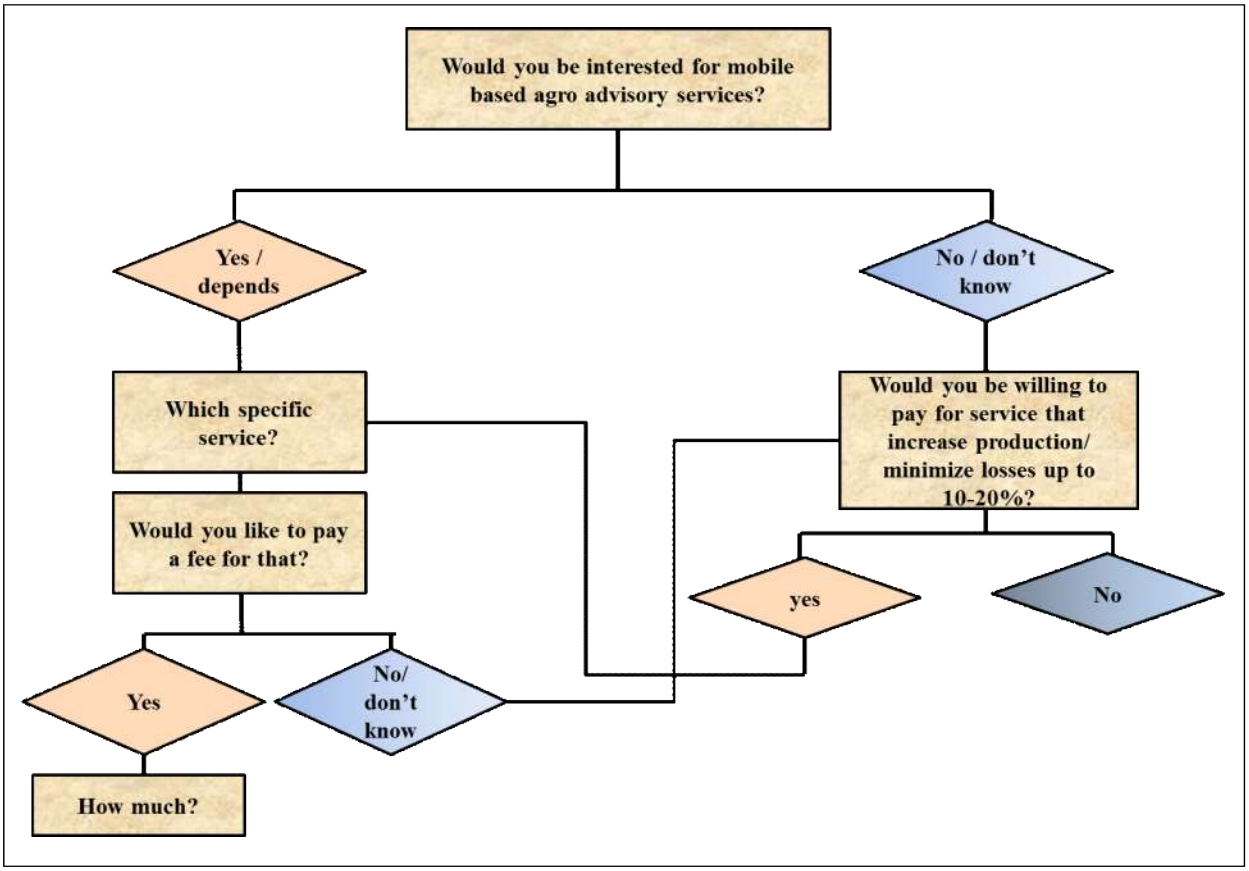

Figure 3: Flow chart of CVM scenario applied to measure WTP

respective mobile number. Here an open-ended question format has been used for asking consumers directly to state their WTP. A Probit Regression Model was used in order to determine the impact of socio-economic and other factors on the farmer's willingness to pay for the SMS services. The estimated results were extracted with the help of econometric software "STATA" version 12.0.

RESULTS AND DISCUSSIONS

Socio-economic characteristics of farmers: Results in the Table 2, revealed that majority of farmers were middle aged (40.60%) followed by young (37.50%) and old age (21.90 %). The farmers of middle and young age group had more participation in the SMS service program due to their involvement in agriculture and the cosmopolitan contacts. The reason attributed for less involvement of old age might be due to less cosmopolitan nature, practicing traditional agricultural practices. It could be concluded that majority (40.60%) of the respondents were of middle aged and they had shown great interest towards getting technical advices from reliable sources namely RML. Majority of the members were female (92.20%), this showed the involvement of women in agriculture in hills and their aspiration for gaining knowledge and information seeking behavior.

More than one-third of the respondents had their education up to middle school (43.75%), 31.25 per cent of the people had their education up to inter college, 14.06 per cent are functionally literate, 9.38 per cent of people had their education up to primary school and 1.56 per cent were illiterate. From the above findings it could be seen that majority of the respondents were educated. This implies that majority of the farmers in the study area were literate and can easily adopt new technologies to improve their farm production. This finding is to some extent similar to that of Abu *et al.* (2011) who had reported that majority of the respondents were educated up to secondary level.

Majority of the farmers (87.50%) had 0.026-0.53 ha of land and 12.50 per cent of the respondents had more than 0.53 ha of land. Small farmers had relatively lesser holdings, so they were interested in adopting new technologies to improve their farm production. This finding was similar to that of Ajayi (2007). Only 40.60 per cent of respondents were found members of the social

Table 2: Farmer's socio-economic characteristics

Variables	Frequency	Percentage
Age (Years)		
Young (up to 35 years)	24	37.50
Middle (36-45 years)	26	40.60
Old (>45 years)	14	21.90
Gender		
Male	05	7.80
Female	59	92.20
Educational Status		
Illiterate	01	1.56
Functionally literate	09	14.06
Primary	06	9.38
Middle	28	43.75
Intercollege	20	31.25
Graduation	0	0.00
Land Holding		
Low (<0.026 ha)	0	0.00
Middle (0.026-0.53 ha)	56	87.50
High (>0.53 ha)	8	12.50
Social participation		
Member	26	40.60
Both members and office bearer	38	59.40
Neither member nor office bearer	0	00.00
Training Experience in agriculture		
No training	35	54.70
1-3 days	18	28.10
>3 days	11	17.20

Source: Author's estimation based on survey data

organization and about 59.40 per cent of them were both members and office bearers in the social organization.

It was also found that most of the respondents (54.70%) did not have any training experience regarding agriculture, 28.10 per cent and 17.20 per cent had more than three days and one to three days of training experience, respectively.

Various information sources through which farmers get required agricultural information: From Table 3, It can be observed that 'RML', 'progressive farmers', 'SHGs/NGOs/Famers' clubs' and input retailer were ranked as 1st, 2nd, 3rd and 4th respectively as sources of getting information by the respondents. The results reported by Mittal *et al.* (2010) are more or less in conformity with the findings of the present study. Though RML SMS service is gaining importance, but progressive farmers still play an important source of information for the rural poor farmers.

Farmer's willingness to pay for the SMS service: Willingness to pay is the maximum amount a person would be willing to pay, in order to access scientific advices in agriculture through RML's SMS agro advisory services. The willingness to pay behavior of the farmers to avail extension services from RML were analysed and given in the Table 4. It clearly shows that 70.31 per cent of the beneficiaries were willing to pay and 29.69 per cent of the farmers were not willing to pay annually for accessing extension service offered by RML. Some of the farmers had low income and not felt the need of it, so they were not willing to pay for RMLs mobile advisory services. This result is similar to that of Abu *et al.* (2011) and Ozor *et al.* (2011) who also reported that more than three-fourth of the farmers were willing to pay for soil management information services in Nigeria.

Distribution of farmers according to the amount they were willing to pay per annum: Out of 64 farmers, 45 were ready to pay, thus the willingness to pay behavior of 45 RML beneficiaries in future were analysed and given in the Table 4. It showed that about (28.89%) of the farmers were willing to pay Rs.100-200 for accessing RMLs SMS services, followed by Rs.201-300 (42.22%), Rs.301-400 (15.56%), Rs.401-500 (11.11%), more than 500 (2.22%). From the findings it can be stated that most of the farmers were willing to pay for accessing the extension services through one of ICT based extension method *i.e.* RML's SMS service. Through this service, farmers were able to access advices at their farm gate which not only enabled them to make sound decisions and but also reduced risk besides their time and money. The results reported by Shanthinichandra *et al.* (2013) are more or less in conformity with the findings of the present study.

Though the SMS service was provided in the areas of crop advisory, weather, market price and news, an attempt was made here to know the most preferred information for which respondents were ready to pay for the RML's SMS services in future. A perusal of Table 6. clearly shows that the farmers' most preferred areas which they used to rate more were: Pest and disease management and improved vegetable production technologies with 68.8 per cent and 65.6 per cent showing desire, followed by market price (56.3%) and information about new varieties (51.6%),

Table 3: Sources of information used by the respondents to meet agri-based value added services

S.No.	Source of Information	Often		Seldom		Never		Score	Rank
		F	%	F	%	F	%		
1.	RML	27	42.18	36	56.25	1	1.56	2.41	I
2.	Progressive farmers	25	39.06	24	37.50	15	23.43	2.16	II
3.	SHGs/NGO/Farmers' club	17	26.53	15	23.43	32	50.00	1.77	III
4.	Input retailer	10	15.62	20	31.25	34	53.12	1.63	IV
5.	Extension worker, AAO, BDO etc.	12	18.75	11	17.18	41	64.06	1.55	V
6.	TV	5	7.83	14	21.87	45	70.31	1.38	VI
7.	Training	3	4.68	15	23.43	46	71.87	1.33	VII
8.	Radio	3	4.68	8	12.50	53	82.81	1.22	VIII
9.	Toll free services like kisan helpline etc.	1	1.56	12	18.75	51	79.68	1.22	VIII
10.	Farm publications	0	0.00	13	20.31	51	79.68	1.20	IX
11.	News Paper	0	0.00	12	18.75	52	81.25	1.19	X
12.	Relatives	2	3.12	6	9.37	56	87.50	1.16	XI
13.	Demonstrations	0	0.00	7	10.93	57	89.06	1.11	XII
14.	Exposure visits	0	0.00	7	10.93	57	89.06	1.11	XII

(Often-3; Seldom-2, Never-1); *Source:* Author's estimation based on survey data

Table 4: Distribution of respondents according to their willingness to pay for the SMS service

Willingness to pay	Frequency	Percentage
Not willing to pay	19	29.69
Willing to pay	45	70.31

Source: Authors estimation based on survey data

Table 5: Distribution of respondents according to the amount they were willing to pay per annum (n=45)

Amount willing to pay per annum	Frequency	Percentage
Rs. 100-200	13	28.89
Rs. 201-300	19	42.22
Rs. 301-400	7	15.56
Rs. 401-500	5	11.11
More than 500	1	2.22

Source: Author's estimation based on survey data

which ranked III and IV, respectively. This infers there is an information need on pest and disease management, vegetable production technologies, market prices and information on new varieties.

A Probit Regression Model was used in order to determine the impact of socio-economic and other factors on the farmer's willingness to pay for the SMS services. The estimated results were extracted with the help of econometric software "STATA" version 12.0 and the results were shown in Table 7. The probit model was used because the dependent variable (willingness to pay) "Y" has two outcomes (i.e. 1= not willingness, 2=willingness to pay). The other explanatory variables which determine the impact on "Y" are : X1= age in years, X2= dummy variable for gender (Male=0, Female = 1), X3= education level (1= illiterate, 2= if the farmer had primary education level, 3=if the farmer had high school education, 4= if the farmer had high school education, and 5= collegiate), X4= Social participation and X5= Training experience in days. The expression is follows as:

$$Y = -1.47 + 0.56X1 - 1.105X2 + 0.767X3 - 0.423X4 + 0.912X5$$

From the findings of the probit function analysis, it could be observed that three out of five variables were found significantly associated with the Willingness to Pay. The significant attributes that have contributed to the farmers' behavior of willingness to pay for RML's SMS were age, education level and training experience. The coefficient of "Education" has positive sign and is significant at 1% level. This implies that with the increase in schooling years, the WTP increases by 0.767 units. Education is considered as the robust determinant of WTP. This result is in line with many other studies [see for example, Shantinichandra *et al.* (2013)].

Table 6: Distribution of respondents those willing to pay for the specific SMS

S.No.	Category	Frequency	Percentage	Rank
1.	Pest and disease management	44	68.8	I
2.	Information about new varieties	33	51.6	IV
3.	Organic fertilizer and manure	20	31.3	V
4.	Seed treatment	17	26.6	VII
5.	Mushroom cultivation	14	21.9	VIII
6.	Improved fruit production technologies	14	21.9	VIII
7.	Improved vegetable production technologies	42	65.6	II
8.	Improved cereal production technologies	18	28.1	VI
9.	Market price	36	56.3	III

Source: Author's estimation based on survey data

Table 7: Factors influencing farmers' willingness to pay for the SMS services [Probit Regression Model (Dependent Variable=WTP)]

Variable	Coefficient	Std. Error	z	P>z
Age	0.0567883	.0310336	1.83	0.067*
Sex	-1.105037	.9477048	-1.17	0.224
Education	0.7674976	.3634057	2.11	0.035**
Social participation	-0.4235806	.6987526	-0.61	0.544
Training Experience	0.9129801	.4990662	1.83	0.067*
Constant	-1.470378	1.758141	-0.84	0.403
Summary Statistics				
No. of Observations	64			
LR $chi^2(6)$	43.89			
Prob> chi^2	0.000			
Log likelihood	-18.5588			
Pseudo R^2	0.5418			

Source: Author's estimation based on survey data; ** and * are Significant at 1 percent level, and 5 percent level respectively.

The sign of the variable 'age' is positive and significant at 5% level. It means that older respondents are willing to pay more than young respondents. With the one year increase in age, the WTP for SMS services increases by 0.56 units. Similarly variable training experience is also having positive association with WTP at 1 per cent level of significance. It implies that with one unit increase in training experience, WTP increases by 0.91 units. The direction of the variable documented that farmers having high training experience were willing to pay more for SMS services. The results of the "age" and "training experience" lead in the same direction to the results of Shantinichandra *et al.* (2013) in their study.

The other variables in the model analysed were found insignificant in nature; however their coefficients were expected in direction. For example "sex" variable is dummy which attains the value of '1' if the respondent is female and '0' if he is male. This variable was found insignificant but showing negative sign follows the same results of Shantinichandra *et al.* (2013). The variable "farm size" is also found insignificant and this variable has been dropped from the analysis even though having expected sign due to its multicollinearity with other variables. This connoted that as the farm size increases, the opportunity to generate more income is possible and the farmers tend to be willing to pay in order to avert the possible risk in agriculture. Similarly, the "social participation" variable is also found insignificant and having negative coefficient.

The summary of the regression model suggested that the model is quite robust and significantly better with Chi-

square of about 43. The Log Likelihood value was worked out as -18.55, which indicates that the model is fit. The pseudo R-Square were found to be about 0.54, which is also reasonable for model fit. The variable findings are quite in line with the studies like Shantinichandra *et al.* (2013); Abu *et al.* (2011) and Ozor *et al.* (2011) among others. About 67.2 per cent occurrences are correctly predicted by the model, which is quite high compared to Shantinichandra *et al.* (2013). The Probit Regression Model fitness and test statistics are shown in Table 7.

CONCLUSION

The present study attempted to determine the farmers' willingness to pay for agricultural extension service through RML's SMS service. The study showed that majority of respondents were medium aged, female, educated at different levels, possessing medium sized land holdings, members and office bearers in social organization. Nearly three-fourth of farmers were found to be willing to pay for the extension service attempted through RML's SMS service. The most preferred SMSs were found to be on pest and disease management followed by improved vegetable production technology, market price and information about new varieties. The willingness to pay was found to have significant and positive relationship with age, education, and training experience of the farmers.

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An Economic Analysis of Production and it's Constraints of Marigold Flower in Madhya Pradesh

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ABSTRACT

This study was carried out in Ratlam and Indore districts of Madhya Pradesh as they covered highest i.e. 40 % area of production of marigold flower. The primary data were collected from 120 selected responded of the study area. For the calculation of cost and returns, scientific cost concept was used. The study shows that the total cost of cultivation was found highest in large size group i.e. 132711.513 per hectare followed by 123733.75 in medium size and 116228.34 in large size group. The cost of production was observed less in small size (847.9 Rs./qt) then medium size (863.15 Rs./qt) and large size group (906.31 Rs./qt) respectively. The overall benefit cost ratio was found 1.52 and it was found highest in small (1.57) size group. Garrett's Ranking test was used for analysis constraints which are faced by sample responded. The most important production constraints faced by marigold flower grower was unavailability of sufficient number of labour during sowing and plucking of flower as reported rank first.

Keywords: B:C ratio, Constraints, Cost of cultivation, Marigold flower

INTRODUCTION

Flowers have been associated with ancient Indian Culture. However, the social and economic aspects of flower growing were recognized only later. It is only in the last three decades with changing life styles and under increased urban affluence (Verma *et al.*, 2019). Marigold flower is a high value and labour intensive crop and it is cultivated by most of the farmers on a small scale. It is an immensely popular loose flower crop widely grown throughout the world. Marigold flower has a high market demand as loose flower crop and is widely used for making garlands and for decorative purposes. It is grown in flower beds, borders and also even as potted plants. It has gained popularity on account of its easy cultivation; wide adaptability and its alternative quality have attracted the attention of flower growers. It has a huge market and is widely used for its natural colours in food and animal industry. As the richest source of natural carotenoid pigment (Kolambkar *et al.*, 2014) it is a quite popular organic pigment, as it is responsible for the pigmentation in a large number of plants. Marigold Flowers are very intimately associated with social and religious activities in India. Due to enhanced demand of the loose flower, bouquet, garland and wreaths, the cultivation of flowers now-a-days is a big concern in the Indian economy. By taking into consideration all important aspects of the marigold flower, it is necessary to know cost of production, profitability of marigold flowers and constrains faced by marigold flower growers.

Patel (2017) conducted a study on economic analysis of commercial flower cultivation in Madhya Pradesh. The study was undertaken to estimate the cost of cultivation of commercial (marigold) flower in Khandwa district of Madhya Pradesh. The data portrayed that on an average cost of cultivation per hectare of marigold crop was found to Rs. 26031 (Cost A1), Rs. 27163 (Cost B1), Rs.32163 (Cost B2), Rs. 57363 (Cost C1), Rs. 62363 (Cost C2) and Rs. 68599 (Cost C3) respectively. The data depicted that the marigold growers reaped 195 quintal of flower on per unit of area. The data also shows that the overall average gross income per hectare of this crop was found to Rs. 136443. The average net income realized from cultivation of marigold per hectare was found to Rs. 67844. On the other hand, the B:C. ratio has been determined by the return from per rupee investment and the study depicted that it was 1.98 in marigold cultivation.

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Sai *et al.* (2018) the present study was carried out in Surajpur district of Chhattisgarh, with the objective to find out the cost and returns analysis of Marigold cultivation as well as major constraints of marigold cultivation. Agriculture was the main occupation with 77.68 per cent with overall total cultivated area at 1.12 ha/farm. Cost of cultivation showed an increasing trend from marginal to small farms for marigold crop. The overall cost of cultivation for marigold worked out as Rs. 84594 per ha and it ranges from marginal farms Rs. 82344 per ha to Rs. 85588 per ha at small farms. The overall input-out ratio and B.C. Ratio was 1:2.18 and 1:1.19 for marigold crop. Overall, family labour income was Rs. 105317 per ha. Family labour income and farm business income was higher at small farms Rs. 105317 per ha and Rs. 113377 per ha respectively. Overall, farm investment income was found to be Rs. 108618 per ha.

MATERIALS AND METHODS

Ratlam and Indore districts were selected for the study as they cover the maximum area i.e.40 per cent of marigold flower to total area in the state (Ratlam district covers 5150 hectares with the production of 47635 MT and Indore district covers 3550 hectares with the production of 36000 MT during 2016-17). Ratlam district consist of six blocks and Indore district consist of five blocks. Out of which one block from each district was selected on the basis of maximum area of marigold flower. Ratlam block from Ratlam district and Indore block from Indore district was selected. After selection of blocks, a list of marigold flower growing villages were prepared from selected block and from each selected block, 10 villages were selected on the basis of maximum area of marigold flower. After selection of villages, a list of marigold flower growers were prepared and further categorised into three size groups on the basis of size of land holding i.e. Small (<2.0 ha), Medium (2.1 to 4.0 ha) and Large size (>4.0 ha). From each size group of marigold flower growers, 20 farmers were selected randomly for the study purpose. Thus, total 60 sample marigold growers were considered for detail investigation to fulfill the stated objectives. The primary data were collected from sample respondent through survey with the help of pre-tested interview schedule by the personal contact during agricultural year 2017-18.

Analytical tools

(A) For estimation of cost and returns of marigold flower, following Cost concepts and Profitability aspect were used

(a) Cost concepts:

Cost A_1 = All actual expenses incurred in the production of marigold flower by producer

Cost A_2 = Cost A_1 + Rent paid for leased in land

Cost B_1=Cost A_2 + Interest on fixed capital excluding land

Cost B_2 =Cost B_1 + Rental value of owned land

Cost C_1 = Cost B_1 + Imputed value of family labor

Cost C_2 = Cost B_2 + Imputed value of family labor

Cost C_3 = Cost C_2 + 10% of Cost C_2 as managerial cost

(b) Profitability aspect

(i) Gross income: Quantity of marigold flower * price/ unit

(ii) Farm business income: Gross income – Cost 'A_1'

(iii) Family labour income: Gross income- Cost 'B_2'

(iv) Net farm income: Gross income – Cost 'C_3'

(v) Net income over Cost A2: Gross income – (Cost 'A2' + Imputed value of family labor)

(vi) *Benefit cost ratio:* Gross income / Total expenses (Cost C_3)

(B) For estimate the production constrains, Garrett's Ranking Technique was used

Garrett's Ranking Technique was employed in the present study to examine the various constraints in the order of their importance. The respondents were asked to rank the problems in marigold flower production. In the Garrett's ranking technique these ranks were converted into percent position by using the formula,

$$\text{Percent position} = \frac{100^* (0.5\text{-Rij})}{\text{Nj}}$$

Where, Rij = Ranking given to the i_{th} attribute by the j_{th} individual

Nj = Number of attributes ranked by the j_{th} individual.

RESULTS AND DISCUSSION

The scientific cost concept was used for estimation of cost of cultivation of marigold flower. The actual expenses incurred during production of marigold i.e. cost A1 was estimated to be Rs. 54958.4, 55643.03 and 61591.33 for small, medium and large size groups respectively. The total cost (C3) was estimated to be Rs. 116228.34, 123733.75 and 132711.513 for small, medium and large size groups respectively (Table 1). The percentage of cost A1 to cost

Table 1: Cost of cultivation of marigold flower based on cost concept (Unit: Rs/ha)

Cost Concepts	Size Groups		
	Small	Medium	Large
Cost A1 : It includes			
Value of hired human labour	3581	3233	3849
Value of hired and owned bullock labour	247	353	454
Value of machinery labour	620	1235	1362
Value of owned and purchased seed	6913	5293	6019
Value of manure and fertilizer	4444	4235	4543
Value of insecticide and pesticide	12346	11764	13628
Expenditure on irrigation	6914	6588	7950
Land revenue and taxes	126	171	190
Depreciation	18063	20615.58	21527.55
Interest on working capital	1704.8	1856.45	2068.78
Cost A1	54958.4(47.28)	55643.03(44.96)	61591.33(46.40)
Cost A2 (CostA1 + rent paid for leased land)	54958.4	55643.03	61591.33
Cost B1 (Cost A2 +interest on fixed capital excluding land)	75028.4	78549.23	85510.83
Cost B2 (CostB1 + rental value of owned land)	106395.4	110278.23	118105.83
Cost C1(CostB1 + imputed value of family labour)	77022.4	80756.23	88051.83
Cost C2 (Cost B2 + imputed value of family labour)	108389.4	112485.23	120646.83
Cost C3 (Cost C2 +10% of Cost C2 as managerial cost)	116228.34(100)	123733.75(100)	132711.51(100)

Figure in brackets shows the percentage to total cost i.e. C3.

C3 was covered was 47.28, 44.96 and 46.40 per cent under small, medium and large size groups respectively.

Table 2 shows that, the net income was estimated Rs. 68971.76 per hectare in small size group, Rs. 66641.25 per hectare in medium size group and Rs. 857.49 per hectare for large size group respectively. The percentage of net income from total income was found 36.64, 34.84 and 32.14 percent in small, medium and large size group respectively. Family labour income (Rs. per hectare) was found more in small size group followed by large and medium size groups. Regarding farm business income, it was observed highest in medium size group followed by large and small size groups. Net income over the cost A2 was estimate Rs. 131247.6, 132524.97 and 131436.67 per hectare in small, medium and large size group respectively. Cost of production was found more in large size group i.e. Rs. 906.31 quintal than the medium Rs. 863.15 and large Rs. 847.9 per quintal. It is clear from the Table 2 that the benefit-cost ratio was calculated 1.57, 1.53 and 1.47 in small medium and large size groups respectively.

Production constraints: In the study area, the common problems were identifying which was faced by marigold growers and details of production constrain has been provided in Table 3. The most important production constraints faced by marigold flower grower was unavailability of sufficient number of labour during sowing

Table 2: Profitability of marigold flower

Size group	Gross income (Rs/ha)	Gross expenses (Rs/ha)	Net income (Rs/ha)	Family labour income (Rs/ha)	Farm business income (Rs/ha)	Net income over the cost A2	Cost of production (Rs/qt)	B:C ratio
Small	188200(100)	116228.24	68971.76(36.64)	81804.6	133241.6	131247.6	847.9	1.57
Medium	190375(100)	123733.75	66641.25(34.84)	80098.77	134731.97	132524.97	863.15	1.53
Large	195569(100)	132711.51	62857.49(32.14)	77463.17	134004.67	131436.67	906.31	1.47

Figure in brackets shows the percentage to gross income

Table 3: Production constraints of marigold faced by selected respondents

S.No.	Particulars	Mean value	Garrett' rank
1.	Quality seed or plant is not available in proper time	52.00	2nd
2.	Problem in raising nursery bed	42.77	3rd
3.	Unavailability of sufficient number of labour during sowing and plucking of flower	67.08	1st
4.	lack of knowledge about plant protection measures	31.11	4th
5.	Protection from theft (more expenses require for extra labour)	18.13	5th

and plucking of flower. The second major production constrain ranked by marigold flower grower was quality seed or plant is not available on proper time. Problem in raising nursery bed was ranked as third, lack of knowledge about plant protection measures was ranked as fourth production constrain and Protection from theft (more expenses require for extra labour) was ranked as fifth in the marigold flower production constraints.

CONCLUSION

The total cost i.e. total cost (C3) was estimated to be Rs. 116228.34, 123733.75 and 132711.513 for small, medium and large size groups respectively. The net return was found more in small size group. The return over the cost was high in small size group flowed by medium and large size groups. Regarding production constraint of marigold flower, unavailability of sufficient number of labours during different operations and unavailability of seed/plant on proper time are the major constraints faced by marigold grower in the study area.

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Purpose of Utilization of ICT tools by the Teachers of Agricultural Universities of Rajasthan

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ABSTRACT

Information and Communication Technologies are explained as electronic and digital technologies for storing, processing, transferring the information for communication ICT has the ability to prepare learners for a rapidly changing world scenario. They may use ICT as a tool to identify, analyze, exchange and present information as per their need. study was conducted in three purposively selected agricultural universities in Rajasthan; namely, Sri Karan Narendra Agriculture University, Jobner, Maharana Pratap University of Agriculture and Technology, Udaipur and Swami Keshwanand Rajasthan Agricultural University, Bikaner. The most important purpose of using ICT tools perceived by the teachers of SKNAU, Jobner and SKRAU, Bikaner was for gaining knowledge but for the teachers of MPUAT, Udaipur the most important purpose of using ICT tools was for sending and receiving e-mail. There was no significant difference between teachers of SKNAU, Jobner, SKRAU, Bikaner and MPUAT, Udaipur with regard to their perception regarding the purpose of utilization of different ICT tools

Keywords: ICT tools, Purpose, Teachers and Agriculture University

INTRODUCTION

Information and Communications Technology (ICT) is a comprehensive term that includes all technologies for the processing and communication of information encompassing: computers, internet, mobile phones, and network hardware and software, satellite systems and so on, as well as the different services and applications associated with them. ICTs in fact include any medium for recording and broadcasting information like magnetic disk, optical disk, CD/ DVD, flash memory etc. Information and Communication Technologies are explained as electronic and digital technologies for storing, processing, transferring of information and communication. Information and Communication Technology (ICT) in education is the method of education that use information and communications technology to support, improve, and optimize the delivery of information.

Information and Communication Technology can lead to improved student learning and superior teaching methods. ICT is often link with sophisticated technologies. But ICT also includes the ordinary technologies, such as, radio, television and telephone. In today's networked society, the technology used is often integrated, and we use multiple technologies together. We use internet, satellite and tale-conferencing facilities to connect with people who may be beyond different geographical locations. Through the application of ICT, one can overcome the impact of space, time and distance. The results of this study in total will act as a guideline to the educationists, policymakers, planners, administrators, agricultural universities, their academic institutions and other people who are engaged in the application of information and communication technology in one way or the other (Kumar *et al.,* 2019).

MATERIALS AND METHODS

The study was conducted in three purposively selected agricultural universities in Rajasthan; namely, Sri Karan Narendra Agriculture University, Jobner, Maharana Pratap University of Agriculture and Technology, Udaipur and Swami Keshwanand Rajasthan Agricultural University, Bikaner. These agricultural universities are well established and their constituent colleges are regularly teaching the

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agriculture students from more than last 30 years and these agricultural universities have more number of constituent colleges as compared to other agricultural universities in Rajasthan. From the selected agricultural university separate lists of all the constituent colleges were procured, out of which three constituent colleges from each agriculture university were selected purposely on the basis of having maximum number of teachers. In this way a total nine constituent colleges were selected from these three agricultural universities for study purpose. The selection of teachers was made by using stratified Random sampling technique. For this purpose from the selected constituent colleges separate lists of all the teachers were prepared and out of these 60 per cent of teachers were selected from every college by using simple Random sampling technique. The data were collected by getting the responses filled from the respondents with the help of a questionnaire. The extent of utilization of ICT tools by the agricultural universities teachers was measured on three point continuum as most aware, aware and less aware with a score of 3, 2 and 1 respectively. The maximum attainable score was 90 and minimum attainable score was 30. Based on the total attainable score, the respondents were classified into three categories namely low, medium and high utilization by using arbitrary method. To determine the extent of utilization of respondents about each ICT tool mean per cent score was worked out and ranked accordingly. To analyze the collected information several statistical tools were used. The following statistical measures were used for interpreting the data and testing the hypotheses.

RESULTS AND DISCUSSION

The data presented in Table 1 depicted that the most important purpose of utilization of ICT tools by the agricultural universities teachers combindly was "for gaining Knowledge" (98.38 MPS) which was ranked first followed by for sending and receiving e-mail (97.79 MPS), Printing

Table 1: Purpose of utilization of ICT tools by agriculture university teachers

S.No.	Statements	SKNAU, Jobner (n_1=65)		SKRAU, Bikaner (n_2=28)		MPUAT, Udaipur (n_3=73)		Overall (n=166)	
		MPS	Rank	MPS	Rank	MPS	Rank	MPS	Rank
1.	For gaining knowledge	97.43	I	100.00	I	97.71	II	98.38	I
2.	For getting reviews	88.71	VII	91.66	VI	89.04	IX	89.80	IX
3.	For specific topics/research Information	92.82	III	90.47	VII	91.78	VII	91.69	VI
4.	For making presentation	85.12	IX	90.47	VII	86.30	XII	87.29	X
5.	For data analysis	82.05	XI	84.52	X	81.73	XIII	82.77	XI
6.	Sending and receiving e-mail	96.41	II	98.80	II	98.17	I	97.79	II
7.	Data storage	87.17	VIII	92.85	V	89.49	VIII	89.84	VIII
8.	Typing	91.79	V	95.23	IV	93.60	V	93.54	V
9.	Printing	91.79	V	98.80	II	96.80	III	95.80	III
10.	Report writing	89.74	VI	91.66	VI	92.23	VI	91.21	VII
11.	Social media	75.89	XII	75.00	XII	77.62	XV	76.17	XV
12.	Teaching	92.30	IV	96.42	III	94.97	IV	94.56	IV
13.	Scanning	82.05	XI	85.71	IX	86.75	XI	84.84	XIII
14.	Organizational plans for exhibition	71.79	XIII	70.23	XIII	71.23	XVI	71.08	XVI
15.	Publication	84.10	X	88.09	VIII	87.21	X	86.47	XII
16.	Production of video films/ multimedia	59.48	XVI	61.90	XV	61.18	XVIII	60.85	XIX
17.	To participate in web/ video conferencing	58.97	XVII	63.09	XIV	60.73	XIX	60.93	XVIII
18.	Organizational plans for teaching	70.76	XIV	83.33	XI	78.53	XIV	77.54	XIV
19.	Image processing	62.05	XV	70.23	XIII	68.49	XVII	66.92	XVII
	Overall MPS	**82.13**		**85.71**		**84.40**		**84.08**	

MPS= Mean per cent score

Table 2: Distribution of frequency of purpose of utilization of ICT tools by agriculture university teachers

S. No.	Purpose	SKNAU, Jobner (n_1=65)			SKRAU, Bikaner (n_2=28)			MPUAT, Udaipur (n_3=73)			Overall (n= 166)		
		Mostly	Some-times	Never	Mostly	Some-times	Never	Mostly	Some-times	Never	Mostly	Some-times	Never
1.	For gaining knowledge	60(92.31)	5(7.69)	00(00.00)	28(100.00)	00(00.00)	00(00.00)	68(93.15)	5(6.85)	00(00.00)	156(93.98)	10(6.02)	00(00.00)
2.	For getting reviews	43(66.15)	22(33.85)	00(00.00)	21(75.00)	7(25.00)	00(00.00)	49(67.12)	24(32.88)	00(00.00)	113(68.07)	53(31.93)	00(00.00)
3.	For specific topics/research information	51(78.46)	14(21.54)	00(00.00)	20(71.43)	08(28.57)	00(00.00)	55(75.34)	18(24.66)	00(00.00)	126(75.90)	40(24.10)	00(00.00)
4.	For making Presentation	36(55.38)	29(44.62)	0000.00	20(71.43)	08(28.57)	0000.00	43(58.90)	30(41.10)	00(00.00)	99(59.64)	67(40.36)	00(00.00)
5.	For data analysis	30(46.15)	35(53.85)	00(00.00)	16(57.14)	11(39.29)	1(3.57)	34(46.58)	38(52.05)	1(1.37)	80(48.20)	84(50.60)	2(1.20)
6.	Sending and receiving e-mail	58(89.23)	7(10.77)	00(00.00)	27(96.43)	1(3.57)	00(00.00)	69(94.52)	4(5.48)	00(00.00)	154(92.77)	12(7.23)	00(00.00)
7.	Data storage	42(64.61)	21(32.31)	02(3.08)	22(78.57)	6(21.43)	00(00.00)	52(71.23)	19(26.03)	2(2.74)	116(69.88)	46(27.71)	4(2.41)
8.	Typing	49(75.38)	16(24.62)	00(00.00)	24(85.71)	4(14.29)	00(00.00)	59(80.82)	14(19.18)	00(00.00)	132(79.52)	34(20.48)	00(00.00)
9.	Printing	49(75.38)	16(24.62)	00(00.00)	27(96.43)	1(3.57)	00(00.00)	66(90.41)	7(9.59)	00(00.00)	142(85.54)	24(14.46)	00(00.00)
10.	Report writing	45(69.23)	20(30.77)	00(00.00)	21(75.00)	7(25.00)	00(00.00)	56(76.71)	17(23.28)	00(00.00)	122(73.49)	44(26.51)	00(00.00)
11.	Social media	27(41.54)	31(47.69)	7(10.77)	15(53.57)	8(28.57)	5(17.86)	37(50.68)	23(31.51)	13(17.81)	79(47.59)	62(37.35)	25(15.06)
12.	Teaching	50(76.92)	15(23.08)	00(00.00)	25(89.29)	3(10.71)	00(00.00)	62(84.93)	11(15.07)	00(00.00)	137(82.53)	29(17.47)	00(00.00)
13.	Scanning	32(49.23)	31(47.69)	2(3.08)	16(57.14)	12(42.86)	00(00.00)	46(63.01)	25(34.25)	2(2.74)	94(56.63)	68(40.96)	4(2.41)
14.	Organizational plans for exhibition	20(30.77)	35(53.85)	10(15.38)	10(35.71)	11(39.29)	7(25.00)	28(38.36)	27(36.98)	18(24.66)	58(34.94)	73(43.98)	35(21.08)
15.	Publication	35(53.85)	29(44.61)	1(1.54)	18(64.29)	10(35.71)	00(00.00)	47(64.38)	24(32.88)	2(2.74)	100(60.24)	63(37.95)	3(1.81)
16.	Production of video films/ multimedia	14(21.54)	23(35.38)	28(43.08)	7(25.00)	10(35.71)	11(39.29)	19(26.03)	23(31.50)	31(42.47)	40(24.10)	56(33.73)	70(42.17)
17.	To participate in web/ video conferencing	7(10.77)	36(55.38)	22(33.85)	7(25.00)	11(39.29)	10(35.71)	13(17.81)	34(46.57)	26(35.62)	27(16.27)	81(48.79)	58(34.94)
18.	Organizational plans for teaching	17(26.15)	39(60.00)	9(13.85)	15(53.57)	12(42.86)	1(3.57)	34(46.57)	31(42.47)	8(10.96)	66(39.76)	82(49.40)	18(10.84)
19.	Image processing	8(12.31)	40(61.54)	17(26.15)	7(25.00)	17(60.71)	4(14.29)	23(31.51)	31(42.47)	19(26.02)	38(22.89)	88(53.01)	40(24.10)

Figures in parentheses indicate percentage

(95.80 MPS) and teaching (94.56 MPS) which were ranked second, third, and fourth, respectively. The least important purpose of using ICT tools was "production of video films/ multimedia" (60.85 MPS), which was ranked last by agricultural university teachers combindly.

As far as the university wise analysis of the purposes of the utilization of ICT tools was concerned the data presented in Table 1 revealed that the most important purpose of using ICT tools by the teachers of SKNAU, Jobner were for gaining knowledge (97.43 MPS), for sending and receiving e-mail (96.41 MPS) and for specific topics/ research information (92.82) which were ranked first, second and third, respectively, whereas the teachers of SKRAU, Bikaner were using ICT tools for the purpose of gaining knowledge (100.00 MPS) which was rank first, followed by for sending and receiving e-mail and printing (98.80 MPS) which were both jointly ranked second. For the teachers of MPUAT, Udaipur the most important purpose of using ICT tools were for sending and receiving e-mail (98.17 MPS), for gaining knowledge (97.71 MPS) and for printing (96.80 MPS) which were ranked first, second and third respectively

The least important purpose of utilization of ICT tools by the teachers was to participate in web/ video conferencing in SKNAU, Jobner (58.97 MPS) and MPUAT, Udaipur (60.73), whereas for the teachers of SKRAU, Bikaner the least important purpose of utilization of ICT tools was for production of video films/ multimedia (61.90 MPS) which were ranked last.

Table 2 presents an analysis of that the frequency of purpose of utilization of ICT tools and conclude that the most important purpose of utilization of ICT tools by agricultural university teachers was for gaining knowledge as for this 93.98 per cent teachers mostly used ICT tools and remaining 6.02 per cent sometime used ICT tools whereas for the purpose of sending and receiving e-mail, 92.77 per cent teachers mostly used ICT tools and remaining 7.23 per cent sometime used ICT tools. The least important purpose of utilization of ICT tools was for production of video films/ multimedia, for which 42.17 per cent teachers never used ICT tools, 37.73 per cent were sometime used and only 24.10 per cent mostly used ICT tools.

Table 2 further indicate that as far as the university wise frequency of purpose of utilization of ICT tools was concerned, for gaining knowledge 100.00 per cent teachers of SKRAU, Bikaner mostly used ICT tools whereas 93.15 per cent teachers of MPUAT, Udaipur and 92.31 per cent teachers of SKNAU, Jobner mostly used ICT tools for this. For sending and receiving e-mail 96.43 per cent teachers of SKRAU, Bikaner, 94.52 per cent teachers of MPUAT, Udaipur and 89.23 per cent teachers of SKNAU, Jobner mostly used ICT tools. Whereas for the least important purpose of utilization of ICT tools i.e. for production of video films/ multimedia for which 43.08 per cent teacher of SKNAU, Jobner, 42.47 per cent teachers of MPUAT and 39.29 per cent teachers of SKRAU, Bikaner never used ICT tools.

CONCLUSION

The most important purpose of using ICT tools perceived by the teachers of SKNAU, Jobner and SKRAU, Bikaner was for gaining knowledge but for the teachers of MPUAT, Udaipur the most important purpose of using ICT tools was for sending and receiving e-mail.

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Enhancement of Productivity of Maize (*Zea mays* L.) by Adoption of Scientific Method of Cultivation

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ABSTRACT

Maize is the second most important cereal crop in Assam. Considering its significant role in ensuring food security and direct consumption and as well as for second cycle produce in piggery and poultry farming, the study was carried out during *rabi* season of 2016-17 and 2017-18 at Morigaon district of Assam in three different locations for enhancement of productivity under Front Line Demonstration. Prevailing farmer's practices were treated as control for comparison with recommended practices. All the demonstrations have been carried out with an objective to demonstrate how farmer's income can be enhanced and doubled by adopting all the recommended package of practices. Determination of the effects of recommended packages of practice on plant population, plant height, number of cob, cob length, no of grains/cob, test weight, corn grain yield and economic yield were also under the objective of study as important yield attributes for measuring the productivity of maize. The adopted improved technologies consisted of hybrid variety, line sowing, irrigation at three different growth stages, recommended fertilizer doses, weeding as required and insect pest management at proper time. The results of present investigation revealed that maximum morpho-physiological characters, yield components and yield was obtained with better quality by adoption of improved package and practices to ensuring the highest plant population (15 plant/sqm), plant height (220 cm), number of cob/ plant (1.45), cob length without husk (20.12 cm), number of grain/ cob (448), test weight (245.2 gm) and maximum grain yield (8.5 t/ha) compared to farmer's practices. The demonstration plot recorded the highest average yield of 8.5 t/ha compared to 6.3 t/ha at farmer's practice in both the years with an average percentage increase of 34.92 per cent over farmer's practice. The demonstration plot recorded the highest average net return (Rs. 65300/-) compared to Farmer's practice (Rs 36000/-) with 81.39 per cent increase over Farmer's practice. Higher benefit cost ratio of Demo (3.32) obtained as compared to farmer's practices (2.33) considering the market price of Rs. 11000/t on quality hybrid variety NMH830 compared to Rs. 10000/t on lower quality of farmer's variety.

Keywords: Benefit cost ratio, Hybrid, Morpho-physiological, Net return, Productivity, Yield attributes

INTRODUCTION

Maize (*Zea mays* L) is one of the most important cereals having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals. In India, maize occupies third position both in area and production after rice and wheat (Swaroopa *et al.,* 2016). Maize in India, contributes nearly 9 per cent in the national food basket and more than Rs. 100 billion to the agricultural GDP at current prices apart from the generating employment to over 100 million man-days at the farm and downstream agricultural and industrial sectors. In Assam, maize is the second most important crop, next to rice. In this region, maize production plays a significant role in ensuring food security and is used both for direct consumption and as well as for second cycle produce in piggery and poultry farming. The crop acreage in the state is growing year wise in the present scenario. The area increased by 52 per cent production by a massive 600 per cent and the yield by 360 per cent in 7-8 years from 2007-2008 to 2014-15 in the state. Maize being a crop of high potential can give a boost to the economy of the state. Presently the crop has state acreage of 31000ha and production of 91000 tonnes with a productivity of 2911 kg/ha during 2017-18 (Kalita *et al*., 2019). Maize is relatively

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a short duration crop, capable of utilizing inputs more efficiently and producing large quantity of food grains per unit area (Farhad *et al.,* 2009). Maize has greater nutritional value as it contains about starch (72%), proteins (10%), oil (4.8%), fibre (8.5%), sugar (3%) and ash (1.7%) (Chaudhary, 1993). Maize being a C4 plant is having high genetic potential and is photosynthesis explorative crop (Rowan and Xin, 2011). In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc. (Swaroopa *et al.,* 2016).

It is therefore important to note that this crop, though classified as a food grain in official classifications, is actually going into poultry and animal feed mostly. In that context, arguments that maize is to be promoted for food security of this country also need to be firmly re-visited (Taipodia and Sukla, 2013). It is reported that today in the country, 42 per cent of the country's maize produce comes from hybrid seeds. All the demonstrations have been carried out with an objective to demonstrate how farmer's income can be enhanced and doubled by adopting all the recommended package of practices and to determine the effects of recommended packages of practice on plant population, plant height, number of cob, cob length, corn grain yield, test weight and economic yield. The demonstrations of scientific technologies in different crops had yielded better results as compared to the existing practices (Sharma and Parkash, 2015; Singh *et al.,* 2016; Singh *et al.,* 2016 and Rana *et al.,* 2017).

MATERIALS AND METHODS

The study was carried in three locations in Morigaon district situated in central Brahmaputra zone (92° E to 95.5° E longitude and 26.15°N to 26.5°N latitude) during 2016-17 and 2017-18 of Assam. under Krishi Vigyan Kendra, Morigaon covering total 3 villages namely Jhargaon, Borsola and Dungabori in two hectare area. For conducting the trials seven farmers were selected based on land situation. The required inputs were supplied and regular visits to the demonstration fields by the KVK scientists ensured proper guidance to the farmers. Field days and group meetings were also organized to provide the opportunities for other farmers to witness the benefits of demonstrated technologies.

The sowing of maize was done during January in *rabi* season and harvested during May in both the season (Table 1). Using the recommended package of practices, total seven (7) demonstrations were conducted covering total area of 2.0 ha in both the years. Seeds were sown in rows with proper spacing. The soil was acidic and medium land situation. The demonstration (Demo) yield was compared with farmer's practice (FP). At maturity, ten plants were randomly selected to measure yield attributes (Excluding the border plants). Number of cobs were counted and one cob per plant were randomly selected for measuring the length, number of seeds and length. The maize cobs were harvested and dried and yield was measured. The economics were calculated as per below considering market price of Rs. 11000/ton in Demo variety and Rs. 10000/ton in FP variety.

Table 1: Comparison between demonstrated package and existing farmer's practice of maize production

Practices	Demonstration	Farmer's practice
Variety	Hybrid var. NMH 803	Hybrid variety
Time of sowing	25.01.2017 & 29.01.2018	February, 2017 & February, 2018
Method of sowing line	Spacing 20 x 25 cm seed to seed 65 x 75 cm row to row	No proper spacing maintained
Seed rate	22.5 kg/ha	25-30 kg/ha
Seed treatment	Seed treated with thiram 75% WP @ 3g/kg	Nil
Fertilizer	Urea 140 kg/ha, SSP 250 kg/ha, MOP 65 kg/ha	No recommended dose Lower fertilizer dose
Plant protection	Need based	
Interculture	Weeding Atrazine @ 2.5 kg/ha as pre-emergence,	one hand weeding at 30 days after sowing
	Paraquat 2.5l/ha as post-emergence followed by	
Irrigation	Grand growth period, Tasseling, Grain setting stage	Nil
Date of harvesting	27.05.2017 & 30.05.2018	June, 2017 & June, 2018

Table 2: Yield and yield attributes obtained under demonstration v/s farmer's practice in maize

Treatments	Yield (t/ha)	Plant height (cm)	No. of plants/ sqm(nos)	No. of cobs/ sqm(nos)	Cob length without husk (cm)	No. of grain/ cob(nos)	No of cob/ plant(nos)	Test weight (g)
Demo	8.5	220	15	15	20.12	448	1.45	245.2
FP	6.3	200	12	13	17.45	398	1.0	200.5
CD	0.041	0.943	1.089	0.828	01.017	0.206	0.964	15.804
SE(m)	0.012	0.267	0.309	0.235	0.288	0.058	0.273	4.480
SE(d)	0.017	0.378	0.436	0.332	0.408	0.082	0.386	6.335

Table 3: Economics of maize cultivation under FLD and farmer's practice (Average of two years)

Year	Cost of production (Rs/ha)		Gross return (Rs/ha)		Net return (Rs/ha)		B:C ratio	
	Demo	FP	Demo	FP	Demo	FP	Demo	FM
2016	28100	26900	92400	62000	64300	35100	3.29	2.30
2017	28300	27100	94600	64000	66300	36900	3.34	2.36
Average	28200	27000	93500	63000	65300	36000	3.32	2.33

Gross return: The total monetary returns of the economic produce obtained from the crop included in the system were calculated based on the local market prices. The total return was expressed in terms of unit area, usually one hectare

Net return: This has been calculated by subtracting the total cost of cultivation from the returns. This value gives the actual profit obtained by the farmer.

Return per rupee invested: This is befit-cost ratio or input-output ratio (Gross return/Cost of cultivation)

RESULTS AND DISCUSSION

This has been observed that as per Table 1, the maize variety NMH 803 (Surya) was grown under the complete recommended packages and practices as compared to the Farmer' practice where no any particular practices were followed. Likewise, time of sowing was also different and no proper weeding only one hand weeding was followed by the farmers. The data (Table 2) revealed that the average number of cobs under the demonstration were more (1.25 cobs/plant) compared to farmer's practice (1 cob/plant). Similarly, average 1000 grain weight was also high (245.2 g) under demonstration compared to the farmer's practice (200.5g) which ultimately resulted in higher average grain yield of 7.5 t/ha. On an average, maize grain yield under demonstration was higher by 19 per cent as compared to farmer's practices (6.3t/ha) (Table 3). Similar result was also observed by Swaroopa *et al.* (2016) where maize yield was recorded as 8.5 t/ha in Demo plot compared to 6.4 t/ha in framer's practice. The results indicated that the demonstration has given good impact in terms of yield and income generation. The higher productivity of maize under improved technologies was due to the sowing of hybrid variety and adoption of improved techniques. Similar results have been reported earlier by Arora *et al.* (2019); Jeengar *et al.* (2006); Taipodia *et al.* (2013) and Dhaka *et al.* (2010) Economic study revealed that demonstrations on new technologies help the farmers in increasing the farm income than before. The net returns under the demonstration plots (Rs. 54,300 /ha) increased by 50.8 per cent over the farmer's practice (Rs. 36,000/ ha). This may be due to higher yield and higher price due to quality and size of the grains. The result had similarity with the result of Swaroopa *et al.* (2016) of the net returns under the FLD plots (Rs. 67,925 /ha) increased by 6.8 per cent over the farmer's practice (Rs. 63,543/ha). During the years, 2016-17 and 2017-18, the average benefit cost ratios of demonstrated plot and farmer's practice were recorded as 2.93 and 2.33, respectively.

CONCLUSION

The farmers in all the three villages never ever received such a return from the maize they used to cultivate normally They expressed their satisfaction in maize cultivation during the season. With proper adoption of the technologies as advised by the scientists. The production under demonstration created awareness and motivated the other

farmers to adopt cultivation of maize during *Rabi* season particularly in Morigaon district of Assam. The farm women willingly came to dehusk the cobs for selling to get better market price. The new market linkages also were established with the help of KVK scientist from where a new trade link had been opened for the farmers.

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A Scale to Measure the Attitude of Beneficiaries and Non-beneficiaries of ARYA Project Towards Goat Farming

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ABSTRACT

Krishi Vigyan Kendra, Banswara will be the locale of the study because initially Attracting and Retaining Youth in Agriculture (ARYA) project was implemented through KVKs in 25 states of the country. In Rajasthan, Banswara is the only district in which this project was initiated. Under, ARYA project Goat farming is one of the major aspects chosen for the present study. With this context, the present study has been carried out to know the attitude of beneficiaries and non-beneficiaries of ARYA project towards goat farming. For measuring attitude, a scale was developed in Likert method with 28 statements. 14 positive and 14 negative statements were selected from goat farming technologies and framed accordingly. The statements were pretested and selected based on the 't' values from the item analysis. The attitude scale may be useful for policy makers and researcher working in the field of goat farming.

Keywords: ARYA project, Attitude, Beneficiaries, Non-beneficiaries, Rural youth

INTRODUCTION

In livelihood sector, goat farming plays an important role in the food and nutritional security of the rural poor. Goat rearing has distinct economic and managerial advantages over other livestock because of its less initial investment, low input requirement, higher prolificacy, early sexual maturity, and ease in marketing. Goat rearing, which is one of the most widely adopted livestock activities in the country, has the potential to emerge as a very good source of income and employment for the rural people.

On the other hand, Krishi Vigyan Kendra is a noble concept developed by ICAR to impart skills and need based vocational training to farmers, farm women, and rural youth for self- employment and entrepreneurship development. Among all, youth are the primary productive human resource of socio-economic development. There is a continuous increase in migration of rural youth to urban areas. Skill development of rural youth through training will help in improving their confidence levels and encourage them to pursue farming as a profession, generate additional employment opportunities to mitigate under-employment and unemployment in rural areas. For this, ICAR has selected KVK Banswara as one of the district among 25 districts for implementing ARYA project for providing vocational training in all areas of agriculture and allied sector. Goat farming is also one of the major. The productivity of goats under the prevailing traditional extensive production system is quite low. Low productivity is seen mainly because of feed scarcity and lack of adoption of improved technologies and management practices of goat farming. One of the main reasons for low adoption is that attitude possessed by the farmers towards goat farming practices. Prior research studies Patel (2015); Bharwad (2016); Ranjan *et al.* (2017) have found mixed feelings as positive and negative attitude towards goat farming as well as other livestock production technologies. Looking into the above facts, it was quiet important to know the attitude of beneficiaries and non-beneficiaries towards goat farming under ARYA project.

MATERIALS AND METHODS

Attitude is an organized predisposition to think, feel, perceive and behave towards a referent or cognitive object (Kerlinger, 1995). Attitude in the present study is defined as "the degree of positive or negative feeling, opinion, belief and action associated with goat farming technologies by the beneficiary and non-beneficiary farmers in Banswara

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district in which attitude of people can differ in varying degrees. For measuring the feeling, a scale has been developed. For constructing attitude scale, there are several techniques like summated rating scales, equal appearing scales and cumulative scales. While looking into the requirement of the study, Likert summated rating scale was selected as it requires less number of items and judges to start with. Comparatively it requires less time than the other techniques. It is a scale construction technique in which statements which can clearly distinguish favourable and unfavourable response of the individual about a particular object (Likert, 1932). The steps followed for scale construction are as follows Item collection from literature, relevancy tests, selection of items, Item analysis, Reliability test and Validity test. Relevant statistical tools and techniques such as mean, median, variance and t-test was used for item analysis. The critical ratio (t-value) for each item was worked out by the formula given by Edwards (1957).

Table 1: Attitude statement of item analysis with 't' values

S.No.	Statements	t- value (Critical ratio)
1.	Goat farming is a profitable venture in the area	8.70
2	Receiving credit for goat farming is difficult	4.47
3	Goat is known as cow of low income group tribal family	5.25
4	Goat milk is not suitable for preparation of various milk products	2.07
5	Goat farming is an insurance against crop failure	4.22
6	Initial investment requirement for goat farming is high	1.94
7	Goat farming is economically low risk oriented business	4.03
8.	Religious taboo against goat farming is present in the area	**-8.16**
9.	Goat farming is best suited to drought prone areas	3.07
10.	Improved breeding bucks are not easily available in rural areas	2.23
11.	Goat farming is best option for income generation in rural areas	2.08
12.	Goat farming does not give more production per unit of investment	1.78
13.	Goat keepers should posses improved goat rearing practices for higher yield and more economic production	4.39
14.	Market for goat meat is not well established in the area	3.29
15.	Goat rearing can improve economy of small, marginal and landless farmers in the area	2.16
16.	Balanced diet is not essential in goat farming	**-6.34**
17.	Adequate veterinary services should be provided timely	**-2.16**
18.	Adoption of goat farming is less due to high price of nutritional food and costly medical facilities,	3.29
19.	Establishment of goat farming enterprise is an easy task for the people	4.61
20.	Importance of mineral mixture is not popularized yet in gat farming	1.87
21.	Good planning can minimize the consequences of risk in goat farming	2.04
22.	There is limited scope of goat farming as compared to other livestock farming	3.01
23.	Decreased grazing area/ pastures is one of major constraints of goat farming	2.33
24.	Training period of ARYA is not sufficient to cover all information about selected vocations	2.73
25.	Majority of youth are selected for training programme as per their needs regarding goat farming under ARYA project	2.80
26.	Non-availability of good demonstration units at KVK under ARYA project	**-2.71**
27	Knowledge about modern goat rearing practices are provided by KVK under ARYA project	2.14
28.	There is no adequate follow-up of the training programme at KVK under ARYA project	2.32
29.	Course content of training programme on goat farming is well designed under ARYA project	**0.65**
30	Many youth are not getting benefits of ARYA due to lack of proper publicity	2.23
31.	ARYA project helps in empowering youth and making them productive	**-1.51**
32.	Training approach followed by ARYA is not innovative	3.63
33.	Skill development trainings provided by ARYA can improve the efficiency of youth in starting new enterprise	4.83
34.	Deworming practice at regular intervals is not essential in goat farming	4.22

RESULT AND DISCUSSION

The initial step was to collect as many statements related with the goat farming technologies. Hence, items were collected based on the review of literature, discussions with experts and informal interviews with the goat farmers. A tentative list of 45 statements was drafted keeping in view the applicability of statements to the area of study.

The statements were carefully edited based on the criteria given by Likert (1932) and Edward (1957). Ambiguous, irrelevant and statements not conforming to the suggested criteria were deleted. At this stage, statements were reduced to 34. Again the statements were rewritten in the light of comments of experts and arranged in positive and negative statements, alternatively. Hence, after editing 34 statements were retained for the study. The statements were selected in such a way that they expressed the positive or negative attitude. In order to get a five point continuum, five alternative response category ranging from strongly agree to strongly disagree were assigned to each statement. For item analysis, the items were first administered to a random sample of 40 farmers of study area. The responses from then were elicited on a five point continuum *viz.* Strongly agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly disagree (SDA). The numerical values assigned for each was 5, 4, 3, 2 and 1 respectively for positive statements. The score for each individual on the scale was computed by summing the response of individuals' item response.

Considering the total score obtained by each individual, these were arranged in the descending order. Then 25 per

Table 2: Attitude of beneficiaries and non-beneficiaries towards goat farming practices (Final scale)

S.No.	Statements	Degree of statement
1.	Goat farming is a profitable venture in the area	+
2	Receiving credit for goat farming is difficult	-
3	Goat is known as cow of low income group tribal family	+
4	Goat milk is not suitable for preparation of various milk products	-
5	Goat farming is an insurance against crop failure	+
6	Initial investment requirement for goat farming is high	-
7	Goat farming is economically low risk oriented business	+
8.	Deworming practice at regular intervals is not essential in goat farming	-
9.	Goat farming is best suited to drought prone areas	+
10.	Improved breeding bucks are not easily available in rural areas	-
11.	Goat farming is best option for income generation in rural areas	+
12.	Goat farming does not give more production per unit of investment	-
13.	Goat keepers should posses improved goat rearing practices for higher yield and more economic production	+
14.	Market for goat meat is not well established in the area	-
15.	Goat rearing can improve economy of small, marginal and landless farmers in the area	+
16.	Adoption of goat farming is less due to high price of nutritional food and costly medical facilities,	-
17.	Establishment of goat farming enterprise is an easy task for the people	+
18.	Importance of mineral mixture is not popularized yet in goat farming	-
19.	Good planning can minimize the consequences of risk in goat farming	+
20.	There is limited scope of goat farming as compared to other livestock farming	-
21.	Decreased grazing area/ pastures is one of major constraints of goat farming	+
22.	Training period of ARYA is not sufficient to cover all information about selected vocations	-
23.	Majority of youth are selected for training programme as per their needs regarding goat farming under ARYA project	+
24.	There is no adequate follow-up of the training programme at KVK under ARYA project	-
25.	Knowledge about modern goat rearing practices are provided by KVK under ARYA project	+
26.	Many youth are not getting benefits of ARYA due to lack of proper publicity	-
27.	Skill development trainings provided by ARYA can improve the efficiency of youth in starting new enterprise	+
28	Training approach followed by ARYA is not innovative	

cent of the subjects with the highest total score and also 25 per cent of the subjects with the lowest total score were selected. These two groups provided the criterion groups as "high" and "low" groups to evaluate the individual item. The critical ratio (t-value) for each item was worked out (Table 1).

The item having 't' value greater than and equal to 1.75 were selected for the final format of the scale. By this procedure, 28 items retained and included in final format of attitude scale. The final format of 28 statements was split into two halves on the basis of odd and even number of items and it was administered to 30 randomly selected farmers. The responses were rated on five point continuum *viz.* Strongly agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly disagree (SDA) having scores 5, 4, 3, 2 and 1 respectively. Two sets of scores were obtained and these scores were correlated with each other. The correlation coefficient for two sets of score was 0.80. Thus, the product moment correlation coefficient produces reliability coefficient of the test. The correlation factor was applied to get the full reliability of the test.

Validity of an instrument refers to how well it measures what it is to be measured. It is an important thing in the descriptive research. There are three types of validity i.e. criterion validity, content validity and construct validity. To test the validity of the scale, content validity of the attitude scale was done. Content validity is basically a judgmental where items of the test are being studied and each item being weighed for its presumed representativeness of the universe (Kerlinger, 1995). Content validity was assessed by asking 20 experts from concerned discipline of Animal production. After the discussion with the panel, the questionnaire was reviewed and changes were made in line with the suggestions (Table 2). The attitude scale was incorporated in the final format of the interview schedule for administration to the sampled farmers. The scale consists of 14 positive and 14 negative statements. The scale for administration was provided with five response categories viz. "Strongly agree, Agree, Undecided, Disagree and Strongly disagree" with scores 5, 4, 3, 2 and 1 for the positive statement and vice-versa for negative statements.

CONCLUSION

Scale developed will be useful to the researcher for measuring the attitude of beneficiaries and non-beneficiaries farmers of ARYA project towards goat farming technologies. Equal number of positive and negative statements were selected and framed on the basis of expert opinions, literatures and after statistical analysis. This also helps in identifying preferences and rankings of both beneficiaries and non-beneficiaries of goat farming.

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Socio Economic Profile of the Almond Growers in Pampore Area of Kashmir Valley

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ABSTRACT

A study on socio economic profile of the almond growers in district Pulwama was carried out in 2017-18. A sample of 120 almond growers by proportionate allocation method was taken from 5 villages of Pampore block for collecting the primary data with the help of a well-structured interview schedule. The study revealed that majority of the respondents were literate with middle age (16-30 years) having family size of 6-10 members, possessing a land holding of above 2 hectares. Majority of the respondents were dependent on agriculture for their livelihood with farming experience of 16-30 years, annual income upto Rs 2 lakhs, medium sources of information and scientific orientation and majority of the respondents had medium extension contacts.

Keywords: Agriculture, Almond growers, Farm experience, Interview schedule, Scientific orientation

INTRODUCTION

Almonds (*Prunus amygdalus*) are native to Mediterranean region and considered as one of the oldest tree nut in the world. Almond belongs to family Rosaceae a drupe, consisting of an outer hull and a hard shell with the seed, which is not a true nut. There are two main types of almonds. One variety (*Prunus amygdalus var. dulcis*) produces sweet almonds, which are edible, and may be eaten raw or roasted or pressed for the almond oil (Bender and Bender. 2005). The other variety (*Prunus amygdalus var. amara*) produces bitter almonds, which are used for almond oil.

The world almond production for the year 2017 stands at 2,239 thousand metric tonnes, with United States being the leading producer. In united states the production amounted to approximately 10 lakh tonnes with area 4 lakh hectares (Anonymous, 2017a).

The India's almond production for the year 2016-17 stands at 7.94 thousand metric tonnes. Out of this, 7 thousand metric tonnes are being produced alone in Kashmir valley, which accounts for 88 per cent of the total almond production in India and rest 0.94 metric tonnes are being produced in Himachal Pradesh, accounting for 11 per cent of the total almond production in India. In Jammu and Kashmir, almond is cultivated over an area of 5.11 thousand hectares with production of 7 thousand metric tonnes. Pulwama is the leading producer of almonds and is having maximum area 4688 hectares under almond in the state of Jammu and Kashmir with a production of 4180 metric tonnes. In district Pulwama block Pampore has the maximum area under almond 1435 hectares with production 574 metric tonnes. The area and production of Himachal Pradesh for the year 2017 stands at 6.58 thousand hectares and 7 thousand metric tonnes respectively (Anonymous, 2017b).

MATERIALS AND METHODS

Pulwama district in Jammu and Kashmir was selected purposively on the basis of having maximum area and production of almond crop. In district Pulwama, almond is cultivated in 5 blocks and block Pampore has been purposively selected having maximum area under almond. Five villages namely Chandharoo, Maij, Dusoo, Konibal, Ludhoo got selected randomly from Pampore block. A comprehensive list of farmers engaged in almond cultivation from each village was framed in consultation with the office of Horticulture Development Officer of the concerned Horticulture Block. Respondents were

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selected using proportionate sampling technique (taking area as auxiliary information) and ultimate unit of sampling (farmer) were selected randomly taking the total sample size of 120 respondents.

RESULTS AND DISCUSSION

The data presented in the Table 1 revealed that more than half of the respondents i.e. 50.83 per cent belonged to middle age category, whereas 36.67 per cent belonged to old age category and only 12.50 per cent belonged to young age category. Most of them were middle aged, with more experience, but younger farmers being more innovative counteract it. It might be because of the reason that farmers of middle age are enthusiastic having more responsibility and are more efficient than the younger and older ones. These results are in line with Ashok (2011).

With regard to education, it is evident from the Table 1 that 26.67 per cent of the respondents studied upto middle level, while 25.00 per cent and 25.83 per cent of respondents have education upto high school and graduation and above level respectively followed by illiterate 20.83 per cent and primary level of education 1.67 per cent. The possible reasons for more educated sample from the total sample could be the importance of education in one's life, easy availability and access to education facilities in the area. The findings also get support from Moulasab (2004).

The data presented in the Table 1 and revealed that majority 45.00 per cent of the respondents had agriculture as their main occupation followed by 30.84 per cent who were involved in agriculture as well as Govt. services and rest of the sample size 24.16 per cent were having agriculture as well as business as their occupation. Hence, the agriculture was seen as an important occupation in the study area. The results are in line with the findings of Raghuprasad (2018).

Table 1 revealed that majority 37.50 per cent of the respondents were having annual income upto 2 lakhs, 33.33 per cent had annual income of 2-4 lakhs and 29.17 per cent of the respondents were having annual income of above 4 lakhs per anum. The data in Table 1 significant relation with the results from Table 1 and Fig. 4.4 which reveals why majority of the farmers had low annual income upto (2 lakhs) as majority of farmers had only agriculture as their main occupation. The findings are similar to the findings reported by Raja *et al.* (2018).

A close look at Table 1 shows that majority 58.33 per cent of the respondents belonged to family group of 6-10 members followed by 25.84 per cent which belong to family group of above 10 members and only 15.83 per cent of the respondent were having upto 5 members of family. The reason for falling majority of respondents in medium category is due to the fact that in modern days people prefer to live with families having medium and nuclear family size to maintain their economic status and livelihood, also the emergence of government policies which emphasizes on having small families also might be one of the reasons. This is in conformity with the findings of earlier studies by Khalache and Khaire (2014).

The data pertaining to experience in almond cultivation in the Table 1 and showed that majority 45.00 per cent of the respondents had an experience of 16-30 years, 30.83 per cent had above 30 years and 24.17 per cent had experience upto 15 years. This might be due to the reason that farming experience mainly depends upon age of the farmer. Since majority of the respondents belonged to middle age category, having medium level of farming experience. The results are in line with the findings of Din (2011).

From the Table 1, it was revealed that 35.00 per cent of the respondents were having land holding of 2 hectares, 34.16 per cent had holdings of more than 2 hectares and 30.83 per cent had holding of 1 hectare of land. The study area greatly has the plain land and in such lands large land holdings are common. Similar findings were reported by Sidram (2008).

The data presented in the Table 1 revealed that majority of the respondents 45.84 per cent belonged to medium level of information sources category followed by 33.33 per cent who had low level of sources of information and 20.83 per cent of respondents had high level of sources of information. Thus, it may be concluded that majority of the farmers had medium information source utilization followed by low and high. The reason behind this fact may be that majority of respondents belonged to middle level of education, which affects the overall information seeking behaviour of almond growers. The results of this finding are in line with the previous study conducted by Motiwale (2017).

With regard to scientific orientation the data presented in the Table 1 showed that, 42.50 per cent of the respondents had low level of scientific orientation.

Table 1: Socio-economic profile of almond growers (N=120)

S.No	Variable	Category	Respondents	
			Frequency	Percentage
1.	Age	Young (23-44 years)	15	12.50
		Middle (45-66 years)	61	50.83
		Old (above 66 years)	44	36.67
2.	Education	Illiterate	25	20.83
		Primary level	02	01.67
		Middle level	32	26.67
		High level	30	25.00
		Graduate and above	31	25.83
3.	Occupation	Only Agriculture	54	45.00
		Agriculture + Business	29	24.16
		Agriculture + Services	37	30.84
4.	Annual income	Annual income group I (up to 2 lakhs)	45	37.50
		Annual income group II (2-4 lakhs)	40	33.33
		Annual income group III (above 4 lakhs)	35	29.17
5.	Family size	(up to 5 members)	19	15.83
		(6-10 members)	70	58.33
		(Above 10 members)	31	25.84
6.	Experience in Almond cultivation	Up to 15 years	29	24.17
		16-30 years	54	45.00
		Above 30 years	37	30.83
7.	Land holding	Small (up to 1 hectare)	37	30.83
		Medium (2 hectares)	41	34.17
		Large (more than 2 hectares)	42	35.00
8.	Source of information	Low (below mean- S.D)	40	33.33
		Medium (btwn mean ± S.D)	55	45.84
		High (above mean + S.D)	25	20.83
9.	Scientific orientation	Low (below mean - S.D)	51	42.50
		Medium (btwn mean ± S.D)	47	39.50
		High (above mean + S.D)	12	10.00
10.	Extension contacts	Low (below mean- S.D)	33	27.50
		Medium (btwn mean ± S.D)	64	53.33
		High (above mean + S.D)	23	19.17

Whereas, 39.50 per cent and 10.00 per cent had medium and high level of scientific orientation respectively. This might be due to that majority of respondents were middle aged with medium level of education. The results are in accordance with the findings of Sriramana (2014).

It is evident from data given in Table 1 that more than half of the respondents 53.33 per cent belonged to medium level extension contacts, whereas 27.50 per cent of the respondents had low level extension contact and 19.17 per cent had high level of extension contact. This might be due to reason that majority of respondents might have medium extension participation as the Agriculture/ Horticulture departments, KVK'S were not far from the villages resulting in medium extension contacts. The above findings were in accordance with the findings of study conducted by Raja (2018).

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Extent of Knowledge Level of Farmers About Improved Maize Production Technology in Saharsa District of Bihar

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ABSTRACT

Knowledge is one of the most vital inputs for development because everything we do depends upon knowledge. Keeping the importance in assessing knowledge of clietele in the field of Extension Education, an attempt has been made to build up a knowledge test for measuring knowledge level of maize growers about improved maize production technology in Saharsa district of Bihar state. Maize (*Zea mays*) is one of the most important cereal crops in the world grown over in area of 132 m.ha. with a production of 570 mt. It is the crop with the highest per day productivity. In India, maize is next in important crop after rice and has acreage around 6 m.ha with a production of 10.5m.t. Maize is the third most important cereal crop of the country after rice and wheat. Maize is a non-tiller plant. It is valued as food, feed, fodder and industrial raw material. In view of maize being produced under very diverse ecology in our country, development of high yielding hybrids with in-built resistance and tolerance to diseases, pests and various climatic stresses; and development and fine-tuning of production ecology are our top priorities. During last 10 years, more than 120 hybrids have been developed and released in addition to development of various production technologies. Classification of maize on the basis of endosperm characteristics. It is classified in to seven groups. They are Dent corn, Flint corn, Sweet corn, Flour corn, Popcorn, Waxy corn, and Pod corn. The developed knowledge test was administered to the selected 220 respondents selected for the study. With the using of this test it was found that majority of the respondents had medium level of knowledge (52.27%) followed by low (28.18%) and high (19.55%) about improved maize production Technology.

Keywords: High yielding variety, Maize, Production

INTRODUCTION

Agriculture has always occupied a pride place in Indian economy on 2.4 per cent of world land; India is managing 17.5 per cent of world population. At the time of independence, more than half of the national income was contributed by agriculture along with more than 70 per cent of total population depending on agriculture (Pandey, 2013). But the scenario has changed and the rural population is migrating towards urban areas for the purpose of employment (NSS 64th Round, 2007-08) and the proportion of rural population has declined from 72.19 per cent in 2001 to 68.84 per cent in 2011 (Census of India, 2011). The great significance of Agriculture in the country's economy is well understood by the fact that it is the mainstay of the people. India is predominantly an agricultural country, as more than 72.2 per cent of its population is living in villages and majority of them are engaged in agricultural enterprise. In 2004, around 55.96 crore population was found engaged in agriculture which accounts for 51.76 per cent of country's total population. Among economically active population of 67.88 crores, 57.8 per cent were active in agriculture (Data Book, ICAR, 2016).

India is the home of the food grains, pulses and few oilseed crops like cotton, castor, groundnut etc. Maize possesses the highest yield potential among the cereals that is why known as "queen of cereals" is one of the most ancient and important commercial crop. Therefore, the present study was conducted to see the Knowledge level of improved maize production technology.

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MATERIALS AND METHODS

The Bihar state is one of the prominent Rabi maize growing states in India. This is the reason for selecting the Bihar for this study. Winter maize is a natural gift provided to Bihar with very high yield potential i.e. 8.0 to 9.0 ton per ha. The researcher is well acquainted with the culture, tradition, social customs and situations, prevailed and language of the area. The study was conducted in Saharsa district of Bihar. Saharsa district of Bihar is having the highest area and production of the maize as compared to other districts of the state. The other resourceful institutions like, KVK & Agriculture College are also located in this district. Saharsa district comprises 10 blocks. Out of these, two blocks i.e. Kahra and Nauhatta were selected randomly for the study.

A complete list of all the major maize growing villages were prepared in consultation with the personnel of revenue and agriculture department from the identified blocks. From the list so prepared, three villages from each identified block were selected on the basis of random selection technique. Thus, in all six villages were selected for the present investigation. The villages are Amarpuri, Mohanpur, Rhova, Barahi, Deoka, and Kasimpur. All the maize growers were taken as the population of the study. From the population a sample of total 220 were selected through proportionate random sampling technique. Numbers of respondents were found to be in proportion to the total population of the maize growers in the concerned village. Total 5% of sample size is selected from entire maize grower population of concerned village. The data was analysed with suitable statistical tools frequency, percentage and mean percent score and ranking. It can be defined as procedure and methodology followed in the research study. The research design adopted for the study was ex-post facto, since the phenomena has already taken place. To determine the extent of knowledge level of respondents about each major aspect, Knowledge index was worked out and ranked accordingly.

RESULT

This chapter deals with the existing status of knowledge level of farmers about improved maize cultivation technology. Knowledge, as a body of information possessed by individual, is one of the important components of behavioural aspects and plays an important role in the adoption of an innovation. On this ground, it is imperative to know the extent of knowledge of farmers about improved maize cultivation technology. Hence, keeping this in view, efforts have been made in this section to report the existing knowledge of respondents towards different aspects of maize production technology.

Table 1: Knowledge level of farmers under different knowledge of recommended maize cultivation practices (N=220)

Knowledge level	Frequency	Percentage
Low knowledge (score below 20.00)	062	28.18
Medium knowledge (score from 21 to 46)	115	52.27
High knowledge (score above 46)	043	19.55
Total	220	100.00

Mean =33.3, SD=13.01

To knowledge level of the farmers on the basis of their existing knowledge about maize production technology, three categories viz. low, medium and high level of knowledge were made by using mean score and standard deviation of the obtained knowledge score by the respondents (Table 1).

It is clear from Table that out of 220 respondents, 52.27 per cent respondents had medium level of knowledge about improved maize production technology followed by 28.18 per cent farmers having low knowledge level regarding maize production technology and only 19.55 per cent respondents were observed in high knowledge level. The knowledge level of large farmers was higher due to big size of land holding, more income level, active social participation, and more prone to change than small and marginal farmers. The findings of the study are similar to the findings reported by Jha and Singh (1970) and Yadav *et al.* (2003).

The data presented in Table 2 show that maize growers possessed maximum knowledge level about soil and field preparation practices for maize cultivation with the extent of 80.25 per cent and ranked first by the farmers. The majority of the respondents knew the type of soil required for maize cultivation, quantity of FYM/ha added to the soil, number of ploughing to be done for field preparation. The extent of knowledge about time and method of sowing was 76.90 per cent among maize growers and this aspect was accorded second by the respondents. The extent of knowledge of this practice was very good because almost all the respondents possessed complete knowledge about appropriate time and method of sowing and advantages of timely sowing of maize. The knowledge

about ear thing up for maize cultivation was 70.41 per cent among the respondents. Most of the maize growers were acquainted with appropriate time of sowing in seeds, recommended doses of fertilizers.

Regarding knowledge level of fertilizer application, it was found that the extent of knowledge was 69.79 per cent among all of farmers. It was observed that some of the respondents were not aware of the recommended dose of nitrogen, phosphorus, and potash for maize crop. The extent of knowledge level of maize growers about irrigation management was 59.51 per cent and ranked fifth by all respondents. Majority of the maize growers had full knowledge about most critical stages of irrigation in maize crop. Further analysis of Table 2 reveals that Knowledge level of maize growers possessing knowledge about recommended seed rate and spacing was 56.07. It was noted that most of the farmers knew about recommended seed rate and spacing of maize crop. The extent of knowledge level about seed treatment was 52.37 per cent. Majority of the maize growers were not fully acquainted with name and quantity of chemicals which can be used for treatment of maize seed before sowing.

Regarding knowledge of high yielding varieties, it was found that the extent of knowledge level was 48.67 per cent. The analysis of data clearly shows that most of the respondents were not fully acquainted with high yielding varieties of maize namely Shaktiman, Rattan, Ganga-7.

Table 2: Extent of knowledge level of farmers regarding improved rice cultivation practices (N=220)

S. No.	Improved Practices	Total	
		Knowledge index	Rank
1.	High yielding varieties	48.67	IX
2.	Soil and field preparation	80.25	I
3.	Soil treatment	34.73	XII
4.	Seed treatment	52.37	VII
5.	Time and method of sowing	76.90	II
6.	Seed rate and recommended spacing	56.07	VI
7.	Fertilizer application	69.48	IV
8.	Irrigation management	59.60	V
9.	Earthlings up	69.79	III
10.	Weed management	39.68	XI
11.	Plant protection measures	43.18	X
12.	Harvesting and storage	49.07	VIII

However, the average yield of these varieties was more than 55 quintals per hectare and most suitable in the study area. The knowledge level of maize growers about plant protection measures was recorded as 43.18 per cent. Most of the farmers were not awarded about quantity of chemicals used for controlling insect-pests and diseases. The knowledge level of weed management by chemicals and soil treatment was 39.68 and 34.73 per cent respectively. It means that farmers had poor knowledge about use of chemicals for controlling of weed and soil borne diseases & insects present in the soil.

The knowledge level about harvesting and storage was 49.07 among the respondents. Majority of the maize grower had complete knowledge about chemicals used during storage of maize. The present finding are supported by the findings of Thyagarajan and Ramanathan (2006) who reported that majority of the respondents (39.16%) possessed medium level of awareness, followed by low (31.67%) and high (29.17%) level of awareness about bio-fertilizer practices in maize cultivation.

CONCLUSION

It was found that out of 220 respondents, 52.27 per cent respondents had medium level of knowledge about improved maize production technology, followed by 28.18 per cent farmers having low knowledge level regarding maize production technology and only 19.55 per cent respondents were observed in the high knowledge level. The study revealed that the extent of knowledge level about soil and field preparation, time and method of sowing, earthing up, fertilizer application and irrigation management was 80.25, 76.90, 69.79, 69.48 and 59.60 per cent respectively among the farmers. While the knowledge about soil treatment was very low having higher knowledge gap 34.73 per cent among the maize growers. It was further observed that large farmers possessed more knowledge about almost all the practices than small and marginal farmers. It was found that there was significant variation in possession of knowledge level among all maize growers with regard to improved maize cultivation practices.

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Estimation of Post-harvest losses of Onion in Maharashtra and Potato in Uttar Pradesh

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ABSTRACT

The present study was undertaken in 2020 in Pune, Maharashtra and Agra, Uttar Pradesh to estimate the quantum of post-harvest losses in onion and potato respectively at various stages of the supply chain. The sample size was 170 including 60 onion farmers, 60 potato farmers, 10 wholesalers and 15 retailers for each crop, all selected through the process of random sampling from the purposively selected blocks of Junnar and Khandauli respectively. The maximum post-harvest loss in onion was observed at farm level, which was estimated to be 26.65 q/ha. At the farm level, the maximum amount of post-harvest losses was observed at the storage level (27.9%) followed by the harvesting stage (23.48%). The storage losses in onion at the wholesaler level were 3.8 kg/q. The storage losses at the retailer level were observed at 1.73 kg/q from a total figure of 1.83 kg/q. In case of potato, the maximum amount of post-harvest losses was observed at the farm level. However, at the farm level, the highest losses were observed at the harvesting level with 27.09 per cent followed by the on-farm storage level (24.38%). The estimated post-harvest loss of potato at farm level was calculated to be 39.32 q/ha. At the wholesaler and retailer levels, major losses were observed in the storage stage.

Keywords: Harvesting, Onion, Post-harvest losses, Potato, Retailer, Storage, Wholesaler

INTRODUCTION

Agricultural sector provides employment to 54.6 per cent Indian population and contributes to 13.7 per cent of the GDP and thus is regarded as the backbone of Indian economy (DAC & FW, 2018-19). The presence of diverse climatic conditions enables production of different varieties of fruits and vegetables, which makes India as the second leading producer of fruits and vegetables in the world, after China. Apart from nutritional benefits, the production of fruits and vegetables have the potential to improve the economy of a country as these are very good sources of income and employment. Despite having achieved such accolades in production front, India continues to grapple with the issue of malnutrition. With nearly 195 million undernourished people, India is home to one-fourth of the world's hungry people (IIPS & ICF, 2017).

Massive quantities of food are lost due to spoilage and infestations each year on a global level (FAO, 2011; Stuart, 2009). Almost around a third of the world's food production is wasted each year, which accounts for approximately 1.3 billion tons and US 990$ dollars (FAO–World Bank, 2010; Prusky, 2011; Gustavsson *et al.,* 2011 and Bond *et al.,* 2013). In India too, a huge amount of the produce goes wasted in form of post-harvest losses. The issues of continuously growing population and the impact of unconstrained food losses on the planet have been major areas of concern, as represented by the Sustainable Development Goals (United Nations, 2011). The persistent challenge of feeding the hungry mouths can be addressed by reducing the post-harvest losses, along with increasing production and improving distribution system. Consequently, there is a need for an integrated and innovative approach for ensuring sustainable food production and consumption (Nellemann *et al.,* 2009; FAO, 2011 and Foresight, 2011). Keeping the above factors in mind, the present study was undertaken in 2020 in Maharashtra and Uttar Pradesh to assess the amount of post-harvest losses occurring at the various stages of the supply chain in two major crops- onion and potato.

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MATERIALS AND METHODS

The research design adopted for the present study was ex-post facto research design. The districts Agra in Uttar Pradesh, and Pune district in Maharashtra were purposely selected as they were the major potato, and onion producing belts respectively. The production of onion was recorded at 1077.71 million tonnes from an area of 48.99 million ha in Pune. The potato production was 1664.10 million tonnes from an area of 64.81 million ha in Agra district (NHB, 2018). The blocks Khandauli and Junnar were purposively selected for the study. The villages Hasanpur and Semra of Khandauli block, and villages Agar and Narayangaon from Junnar block were selected by the process of random selection. From each village, thirty farmers were selected randomly. Additionally, ten wholesalers and fifteen retailers were selected randomly for each crop. Thus, 170 respondents comprised the study sample. The data were collected through a well-structured and pre-tested interview schedule. The statistical tools used in data analysis were frequency, percentage, measures of the central tendency, standard deviation.

RESULTS AND DISCUSSION

The post-harvest losses were estimated at farmer level in different stages like harvesting; grading and packaging; storage; handling and transportation. The losses at wholesaler level have been estimated at (a) handling and transportation and (b) storage stages. At the retailer level, the losses were estimated at (a) handling and transportation; (b) grading and (c) storage. The quantum of post-harvest losses was estimated on per quintal of output produce and then figures were worked out on per hectare basis.

Total onion bulbs produced by all the sample of sixty onion growers were 20340 quintals from an area of 306 acres (122.4 ha). Out of the total bulb yield, 497 q of onion bulbs was kept by the sample onion growers for own consumption or for use in onion seed production programme for the next crop season or for giving gifts to friends or relatives or for paying wages in kind. So, the marketable surplus was the remaining 19842.9 q bulbs (Table 1). The total losses amounted to 3218 q due to various losses at field levels like doubles, bolters, rotten bulbs, drying, bulb injuries, de-topping, sprouting, transportation losses, marketing losses etc. So, the total marketed surplus was 16624.48 q. Results further showed that out of the total available marketable produce (37924.2 q), almost around 76.7 per cent of the respondents sold the produce (11100 q) immediately and only 23.3 per cent of the respondents stored the produce (9240 q) for a later period.

At the farm level, the post-harvest losses of onion at the different stages, namely harvesting; grading and packaging; storage; handling and transportation were estimated at 5.1, 3.9, 6.06 and 0.98 kg/q respectively (Table 2). This denotes that the maximum amount of post-harvest losses was observed at the storage level on farm, i.e. 27.9 per cent followed by the harvesting phase with 23.48 percent losses.

The resultant losses observed at the farm level were due to numerous reasons like injury at the time of harvesting, de-topping, doubles, bolters, rotted bulbs, splitting, drying, sun-scalding, greening, shrinkage, discoloration, malformed and under-sized bulbs, faulty storage and transportation, and improper handling of the produce at the time of marketing. Many of the problems arise in field or later at storage, due to not harvesting the bulbs at optimum maturity, lack of proper nutrient and irrigation regime, not following the recommended planting and bed preparation, lack of crop rotation, abiotic stress, adverse weather conditions, unscientific way of transplanting, attack by insects and diseases, lack of proper curing, etc. A common phenomenon followed by the farmers was the excessive use of sulphate for faster bulb development, to benefit from high market prices. But the adverse effect of this is that the size increases but the layers are not developed from inside. The most common insect

Table 1: Overall average quantity of onion bulbs produced, marketable surplus, marketed surplus and stored quantity of onion in the study location (n= 60 farmers)

Total onion production by selected farmers (q)	Onion kept for own consumption or seed purpose (q)	Total marketable surplus (q)	Losses in total production at farm level (q)	Total marketed surplus (q)	Quantity sold immediately (q)	Share of bulbs sold immediately (%)	Quantity stored for later period (q)	Share of bulbs stored (%)
20340	497.1	19842.9	3218	16624.48	11100	54.57	9240	45.42

pests observed in onion were thrips and *Eriophyid* mite. Diseases like Seedling blight, Stemphylium blight, Basal rot, Bulb rot, Purple blotch, Damping off (seedling rot), Downy mildew (Bulbs don't attain full size, remain soft and immature), Purple blotch (sunken lesions on bulbs), Bacterial stalk rot (dried inflorescence and formation of hollow bulbs), Smut (unattractive bulbs with black lesions) were common at the field level.

Inappropriate packaging and rough handling during weeding, harvesting, de-topping of the bulbs, grading, storage, transit may lead to compression bruising in the produce. It was observed that the farmers were using the local varieties with poor storability against the recommended varieties like Bhima Kiran, Bhima Shakti, Arka Niketan, Agrifound light red. The farmers were not using the recommended season specific (for example, N-53, Agrifound dark red, Baswant 780, Arka Kalyan are some of the *kharif* season varieties) or disease resistant varieties but were using the locally self- produced seeds of unknown parentage and poor variety, due to which they were not realising the maximum obtainable yield and facing losses at harvest and storage.

At sorting and grading stage, the spoiled, rotten, thick-necked, bolted, split, doubles, misshapen small bulbs were discarded which were directly contributing to the losses. The losses at storage were seemingly high, because most of them followed the traditional methods of storage. The storage losses are common in form of sprouting, rooting, rotting, desiccation and physiological loss in weight (PLW). Absence of proper balance of temperature and relative humidity in the storage place leads to such problems. The optimum range of humidity should be 65-75 per cent RH and temperature should be either between 25-30°C or 0-5°C. Rotting is caused due to the fungal and microbial infection, is promoted in high humidity along with warm temperature, and is common at the initial months of storage. Sprouting usually occurs at the end of the storage period. Temperature between 10-25°C increases sprouting. Presence of high temperature (> 35°C) and low humidity conditions in the storage house leads to the PLW, which indicates loss of moisture and shrinkage of the bulbs. Rooting was prevalent in case of high humidity. These storage losses become more prevalent in case of immature/over-mature bulbs or if the bulbs are not properly cured or in absence of proper sorting and grading, use of poor varieties with low storability, or incidence of rains during and after harvest, leaking of water and poor ventilation in storage. Bacterial soft rot (inner bulb scales are water soaked and emit a foul odour), black mould (black powdery mass of spores on exterior and inner scales), fusarium bulb rot, neck rot or grey rot, smudge were common diseases observed in storage.

The post-harvest losses at the wholesaler level arise at the handling, transportation and storage levels, amounting to 3.85 kg/q. Sprouting, rooting, rotting and physiological weight loss were rampant at the wholesaler storage level. High temperatures of around 30-35°C in storage caused bulb rot by *Aspergillus niger* while low temperatures favoured bulb rot by *Botrytis alli*. It can be observed that during the stage of transportation, there is almost negligible loss, varying from 0.03- 0.05 kg/q at the retailer and wholesaler level respectively. The storage losses at the retailer level have also decreased to 1.73 kg/q and losses during grading have been calculated to be 0.07 kg/q. The total post-harvest losses at the retailer level amounts to 1.83 kg/q (Table 2).

The post-harvest loss occurring at field and market was added up to 21.72 kg/q. Maximum post-harvest loss was observed at the farm level (16.04 kg/q) accounting

Table 2: Post harvest losses in onion at different stages

Stages	Onion	
	Loss (kg/quintal)	Loss (%)
Farm level losses		
Harvesting	5.10	23.48
Grading & Packaging	3.90	17.96
Storage	6.06	27.90
Handling & Transportation	0.98	4.51
Total losses at farm level	16.04	73.84
Wholesaler level losses		
Handling and transport	0.05	0.23
Storage	3.80	17.49
Total losses at wholesaler level	3.85	17.72
Retailer level losses		
Handling and transport	0.03	0.14
Grading	0.07	0.32
Storage	1.73	7.96
Total losses at retailer level	1.83	8.42
Total post-harvest losses	21.72	100

*Total number of respondents= 60 farmers; 10 wholesalers and 15 retailers

for 73.85 per cent of the total loss (Table 2). Further 3.85 kg/q of the produce losses were observed at the wholesale level, accounting for 17.72 per cent. The loss at retail level was to the tune of 1.83 kg/q (8.42%). Results of the study further revealed that post-harvest losses at the wholesale level were observed relatively more as compared to that at the retailer level during marketing of onion in the study location.

On an average, the yield of onion bulbs for each sample farmer in the study area was 166.18 q/ha (Table 3) and the post-harvest loss of onion was 16.04 percent at the farm level. So, the per hectare post-harvest loss at farm level was estimated to be 26.65 q (Table 3).

Total potato tubers produced by all the sampled farmers (sixty potato growers were 33136 quintals from an area of 140.3 hectares. The household farm retention has been recorded at 801.3 quintals in total by farmers for home consumption, seed and feed purpose, gift to friends and relatives, wages and other payments in kind. It was observed that the small farmers retained comparatively more, i.e. 3 per cent of the total produce as compared to the semi-medium and medium farmers, who reserved 2 and 1.5 per cent of the total produce for own consumption (Table 4). So, the total marketable surplus was 32334.7 quintals. The total farm losses amounted to 5434.04 q due to various reasons at field levels like greening, sprouting, rotting, cutting and cracking arising out of poor handling and storage conditions etc. So, the total marketed surplus was 26900.7 q (Table 4). Results further showed that almost around 85 percent of the respondents sold the produce (22997.8 q) immediately and around 15 percent of the respondents stored the produce (9336.92 q) for a later period.

The total losses at the farm level summed up to 16.65 kg/q (Table 5). The maximum amount of post-harvest losses at the farm level was observed at the harvesting level with 27.09 per cent followed by the on-farm storage level with 24.38 per cent losses. At harvesting, the losses arise out of the injuries or cuts caused during rough handling, which further lead to fungal and bacterial infections causing rotting and decay. The common pests and diseases are cut worms, blight and common scab. It was also observed that some of the tubers are left under soil, due to difficulty in harvesting and contribute to the final losses.

At sorting phase, farmers looked out for tubers with common disorders which include growth cracks, secondary growth (knobs, dumbbells, and malformed), heat sprouts, enlarged lenticels and greening. A major contributor of loss at the sorting stage is the greening of the tubers, due to over-exposure to extreme high temperature or sunlight. At sorting stage, mostly the tubers with mechanical and insect damage are separated. Also, the already rotten tubers are removed and disposed of. The study found that 14.67 per cent of the produce to be wasted at the grading and packaging stage.

Mostly, the farmers followed traditional storage methods like heap storage. In this method, the potato tubers are heaped under the shade of the trees, preferably in the orchards on a raised platform of 20-25 cm. The heaps are covered with a layer of paddy or wheat straw of 30-45 cm thickness. But, this method of storage was not very efficient and caused losses due to unexpected rains and hailstorms. Likelihood of the produce being affected by insects, pests like tuber moth (larvae bores tunnels within the tubers and result in weight loss, affecting

Table 3: Average per hectare post-harvest loss at farm level (n= 60 farmers)

Total production of sample farmers (q)	Total area under onion cultivation (ha)	Average yield (q/ha)	Post-harvest loss at farm level (kg/q)	Post- harvest losses (q/ha)
20340	122.4	166.18	16.04	26.65

Table 4: Overall average quantity of potato tubers produced, marketable surplus, marketed surplus and stored quantity of potato in the study location (n= 60 farmers)

Total potato production by selected farmers (q)	Potato kept for own consumption (q)	Total marketable surplus (q)	Losses in total production at farm level (q)	Total marketed surplus (q)	Quantity sold immediately (q)	Share of tubers sold immediately (%)	Quantity stored for later period (q)	Share of tubers stored (%)
33136	801.3	32334.7	5434.04	26900.7	22997.8	71.12	9336.92	28.88

Table 5: Post harvest losses in potato at different stages

Stages	Potato	
	Loss (kg/quintal)	Loss (%)
Farm level losses		
Harvesting	6.00	27.09
Grading & Packaging	3.25	14.67
Storage	5.40	24.38
Handling & Transportation	2.00	9.03
Total losses at farm level	16.65	75.17
Wholesaler level losses		
Handling and transport	0.80	3.62
Storage	2.90	13.09
Total losses at wholesaler level	3.70	16.70
Retailer level losses		
Handling and transport	0.30	1.35
Grading	0.50	2.26
Storage	1.00	4.51
Total losses at retailer level	1.80	8.13
Total post-harvest losses	22.15	100

*Total number of respondents= 60 farmers; 10 wholesalers and 15 retailers

the market value of the potato), etc. increases manifold when the produce is left in open. A few farmers falling under semi-medium and medium category of adopters were going for wooden storage structures for the purpose of off-season marketing at a later period. Such farmers too had to bear storage losses due to incidence of pathological diseases like charcoal rot disease, soft rot and late blight. At transit stage, rough handling practices while loading and unloading can cause bruises and tear of the potato tubers, which can induce fungal infection. Also, inadequate transportation facilities (trucks), poor and slow distribution services lead to wastages during the transit. Approximately 9 per cent of the total losses were reported at handling and transportation stage.

At the wholesaler and retailer levels, more losses were observed in the storage stage. The tubers underwent physiological weight loss, rotting and sprouting in storage. Black heart (blackening of tissues in the centre) occurred in storage due to higher temperature, poor ventilation and excessive moisture, which affected the appearance of the tuber and marketability. It was also observed that the storage pests like tuber moth and diseases like late blight, soft rot, charcoal rot, etc. were very common. The total loss at wholesaler level was 3.7 kg/q, which is equal to 16.7 percent of the total losses. Losses at retailer level accounts for 8.12 percent of the total losses. During handling and transit, the losses recorded at the wholesaler and retailer stage is 0.8 and 0.3 kg/q respectively (Table 5).

The post-harvest losses at field and market level summed up to 22.15 kg/q. The highest quantum of post-harvest losses was observed at the farm level (16.65 kg/q), which constituted almost three-fourth (75.17%) of the total losses. The remaining one-fourth quantity of estimated post-harvest losses was observed at the wholesaler level (16%) and the retailer level (8%). It is to note that the post-harvest losses observed at the wholesale level were relatively more as compared to that at the retail marketing of potato. This may be due to the bulk handling of the potato tubers at the wholesaler level as compared to the retailer level and careless management of the same.

On an average, the yield of potato tubers for each sample farmer in the study area was 236.18 q/ha (Table 6). The estimated farm level post-harvest loss of potato was 16.65 percent. So, the per hectare post-harvest loss at farm level was calculated to be 39.32 q.

The results are in confirmation with the findings of Sharma *et al.* (2013), who reported that the various factors that contribute to food loss range from mechanization of practices such as harvesting to handling, processing and others, to climate change, unfavourable production environments, production practices, management decisions, transportation facilities, grading issues, infrastructure, consumer preferences/attitudes, poor institutional support and poor access to post harvest technology and resources as consequence of poor governance systems and availability of functional markets. It has been rightly pointed out by Daniel Runde *et al.* (2013) that Market-driven solutions can effectively transform post-harvest losses from

Table 6: Average post-harvest loss (per hectare) at Farm Level (n= 60 farmers)

Total production of sample farmers (q)	Total area under cultivation (ha)	Average yield (q/ha)	Post-harvest losses at farm level (kg/q)	Post- harvest losses (q/ha)
33136	140.3	236.18	16.65	39.32

an enormous problem into a potential and synergistic opportunity for various stakeholders that would significantly increase the quantity and quality of food supplies at a time of growing demand and need, grow local economies and create new family and national wealth, and provide new and expanding sources of supply for buyers and end-users.

CONCLUSION

The present study revealed that the maximum amount of post-harvest losses in onion and potato both were observed at the farm level as compared to the wholesaler and retailer level. In onion, the losses were highest at storage level followed by the harvesting stage at the field level. Sprouting, rooting, rotting and physiological weight loss in onion were rampant at the storage level. In case of potato, the maximum amount of post-harvest losses at the farm level was observed at the harvesting level followed by the on-farm storage level. Thus, we need to focus on how to minimise the field level losses by proper handling and developing efficient on-farm storage infrastructure. There should be frequent capacity building programmes, demonstrations and training sessions for the farmers, wholesalers and retailers to impart skills and know-how regarding the improved pre and post-harvest handling practices.

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Distance Mobility of Migration in Rural India: The Social Ecology and Interpretation

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ABSTRACT

Migration is an integral part of human civilization. It can be occurring due to perceived benefits or it can be a result and consequence which is inhabitable. The present study aims at delineating the social ecology of migration, perceived benefits of migration and ecological factors of migration. The rural areas of Chakdah and Haringhata C.D. blocks in Nadia district in West Bengal was selected for the study. For the selection of state, district, block and villages, purposive sampling techniques were adopted. 100 respondents have been interviewed for more than six months with well-constructed table to elucidate the comprehensive information about the social ecology of migration. The present study reveals that from the social ecology of agriculture, people are quitting their own land and settlements just to find a better livelihood option elsewhere. The variables age at survey, age at migration, marital age, reasons of migration, source of help at destination, amount received by household in last one year, duration of stay at home, destination of migration, pattern of migration, frequency of visiting home, deciding authority in migration, communication with out-migrant's and utilization of additional benefits have been found extremely relevant to impact on the social ecology of migration.

Keywords: Migration, Distance, Age, Income

INTRODUCTION

Migration means to move from one place to another. Human migration is a universal social phenomenon. Mobility being an inherent character of all living things, various human races from pre-historic time onwards had started moving from their places of origin in search of food or from one region to another as part of a process of adaptation to their social, economic, cultural and ecological environment. The word 'Migration' is derived from the Latin word 'migrare' which means "physical movement by humans from one place in the world to another for the purpose of taking up permanent or semi permanent residence, usually across a political boundary" (Joshi, 1994).

According to Britannica Dictionary, permanent change of residence by an individual or group, excluding such movements as NOMADISM and MIGRANT LABOURER (Britannica Dictionary, 2013), migrations are classing internal or international and as voluntary or forced. Voluntary migration is usually undertaken in search of a better life; forced migrations include expulsions during war and the transportation of slaves or prisoner (Migration Terms). War-related forced migrations and refugee flows continue to be very large, as are voluntary migrations from developing nations to industrialized ones. Internal migrations have tended to be from rural areas to urban centers.

The early study of Indian population movement was conducted by Davis (1951). His work focused primarily on the population of India and Pakistan from 1889 to 1941. The discussion on migration was part of his whole work. In another work (Davis, 1954) he has considered internal migration in respect of urbanization, which helped a lot to the researchers in studying migration problem. In one view, population mobility in India is more or less low (Davis, 1951; Kundu and Gupta, 1996). Migration statistics to the early 1990s also suggest a decline in mobility. In the 1991 census, using the change in residence concept, 27.4 per cent of the population is considered to have migrated (that is, 232 million of the total 838 million persons), which

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shows a considerable decline from 30.6 per cent in 1971 and 31.2 per cent in 1981. This is true for male and female migrants. In the case of males, it declined from 18.1 per cent in 1971 to 14.7 per cent in 1991. In the case of females, it declined from 43.1 per cent in 1971 to 41.6 per cent in 1991. However, recent evidence based on NSS figures for 1992–1993 and 1999–2000, and indirectly supported by the census, suggests an increase in migration rates from 24.7 per cent to 26.6 per cent over that period. This evidence suggests the proportion of migrants of both sexes, in both rural and urban areas, increased during the last decade of the 20th century.

Lee observed that the migrant faces both economic and non-economic difficulties, which have a positive relation with distance. This observation of Lee is more relevant for international migration including travel cost and psychic cost along with legal barriers make the movement more difficult (Lee, 1966 & 1996). In this work for Kenya, Rempel (1970) observed distance as a significant factor acting as a preventive force on migration (Rempel, 1970). Also Sahota's (1986) empirical study of regional movement of Brazil supported the same. But the studies by Connell *et al.* (1976) showed that people living in place very near to towns can enjoy many benefits and avoid the inconveniences of actually migrating, but after a certain point is reached further distance does deter migration (Dasgupta, 1984 and Lipton, 1980). Also some regional studies, showing that distance prevents migration by Caldwell (1969); Essang and Mabawanku (1974) and Riddell (1970) are worth mentioning.

One of the major factors influencing the process of migration is the cost of transportation. Analyses of the data on region basis find that people are interested in migrating a short distance than a long distance because it is not only less costly but also easy for them to get more information about culture, language and opportunities in nearby places. Working on developed and developing countries, Richey (1976) and Gardner (1981) found that especially the tendency of short distance migration is true for low income and less well educated group of migrants. Analyzing the Colombia data, Schultz (1971) showed that the distance of migration which reflects the cost of the migration process, sometime may prevent certain types of migration. For example, international migration requires heavy costs. These international emigrants according to Schultz tend to be better-educated, higher income earner, with greater risk-bearing capacity and have more valuable job skills than internal migrants (Schultz, 1971). Greenwood (1971) found that people are reluctant to make long-distance movement because it widens the cultural gap between the migrant's home and his place of destination. According to Mangalam (1968) it is preferable to a migrant to go to a destination where the social organization is as similar as possible to that of their place of origin. These psychic, non-monetary costs of migration along with the monetary costs also play a role in migration process.

The objectives of the study are to elaborate the concept and function of migration in rural social ecology, to estimate the distance of migration in terms of a score of socio-ecological variables and to isolate dominant factors impacting on distance of migration having micro-sociological policy implications.

MATERIALS AND METHODS

The rural areas of Chakdah and Haringhata C.D. Blocks in Nadia district in West Bengal was selected for the study. For the selection of state, district, block and villages, purposive sampling techniques were adopted because the area was ideal with respect to the problem, convenient for researcher and having the infrastructural facilities and in case of selection of respondents simple random sampling technique was taken up. From the each two blocks ten villages namely Simurali, Majher Char, Saguna, Ghoragachha, Kata Belia from Chakdah C.D. Block and Hatikanda, Jaguli, Birohi, Balindi, Fatepur from Haringhata C.D. Block were selected by purposive sampling. From each village 10 numbers of respondents were selected by simple random sampling. For participatory rural appraisal a heterogeneous group was formed with including some aged respondent. The area had been selected for the study because of the availability of appropriate respondents, people as well as the local language. Both the C.D. blocks have been substantial rural population which is significant for this study.

Before taking up actual fieldwork a pilot study was conducted to understand the area, its people, institution, the programme's activities related to migration process in the research area. Basis of situational and background information of the respondents were collected during the period of pilot study. An outline of the socio-economic background of the farmers of the concerned villages, their opinion towards different types of technologies, socialization process, natural resources, ecology, migration issues, gender discrimination, conflict and confusion helped

in the construction of reformative working tools. Respondents were personally interviewed during puja vacation of 2017 and 2018 (especially in the time of Mahalaya and Eid festival when the maximum migrants return to their homes) and summer vacation. The questions were asked in local language so that the respondent can easily understand the queries.

Several researchers pointed out that the behavior of an individual could be understood more in depth if one has the knowledge of some variables, which comprised the constructed world of reality within which an individual received the stimuli and acts. The socio personal, agro economic, socio-psychological and communication variables are such type of variables, which determine the behavior of an individual. Appropriate operation and measurement of the variables help the researcher to land upon the accurate conclusion. Therefore, the selected variables for this study had been operated and measured in following manner. Variables in the present study have been categorized into two main categories.

(i) Independent variable; (ii) Dependent variable

Independent Variables

The independent variables and their empirical measurements are as follows.

1. Gender (X_1): Gender is the social construction of "male" and "female". The judgments on the independent variable gender were given on a scoring pattern in which 1-value is considered for female respondents and 2-value is considered for male respondents.

2. Community (X_2): It has been found that the locale of research is constituted of two communities i.e. Hindu and Muslim. The judgments on the independent variable community were given on a scoring pattern in which 1-value is considered for Muslim respondents and 2-value is considered for Hindu respondents.

3. Marital status of the migrant (X_3): It is the distinct option that describes a person's relationship with a significant other. Married, unmarried, divorced and widowed are examples of civil status. It is categorized into four categories on the basis of mean and standard deviation. The judgments on the independent variable marital status of the migrant were given on a scoring pattern in which 1-value is considered for married respondents, 2-value is considered for unmarried respondents, 3-value is considered for divorced respondents and 4-value is considered for widowed respondents.

4. Age of the migrant at the time of survey (X_4): It refers to the chronological years of the respondent at the time of data collection. Age is measured as the number of calendar years completed by the respondent at the time of survey.

5. Age of the migrant at the time of migration (X_5): In all societies, it is one of the most important determinants of social status and social role of the individual. In the present study, age of the respondent is measured on the basis of their chronological age. Age is measured as the number of calendar years completed by the respondent at the time of migration.

6. Marital age of the migrant (X_6): It refers to the chronological years of the respondent at the time of his/her marriage. Age is measured as the number of calendar years completed by the respondent at the time of his/her marriage.

7. Family type (X_7): The attribute family type had been operationalised as the family type of our rural system. The family type had been divided into two categories of the social system that is nuclear family and joint family. The judgments on the independent variable family type of the migrant were given on a scoring system suggested by Trivedi (1963) with some modification in which 1-value is considered for nuclear family and 2-value is considered for joint family.

8. Family size (X_8): The family size had been divided into categories of the social system that is up to 5 members and above 5 members. The judgments on the independent variable family size of the migrant were given on a scoring system suggested by Trivedi (1963) with some modification in which 1-value is considered for family up to 5 members and 2-value is considered for family above 5 members.

9. Educational status of the migrant (X_9): It refers to the respondents' level of literacy and academic qualification acquired through formal schooling. The judgments on the independent variable family size of the migrant were given on a scoring system suggested by Trivedi (1963) with some modification in which 1-value is considered for illiterate, 2-value is considered for up to primary education, 3-value is considered for up to secondary education, 4-value is considered for up to higher secondary education, 5-value

is considered for up to graduation and 6-value is considered for up to post graduation.

10. Family land holding (X_{10}): The respondents were asked the amount of land holding they had. The judgments on the independent variable family size of the migrant were given on a scoring system suggested by Trivedi (1963) with some modification in which 1-value is considered for migrants whose family have land holding of more than 10 bigha, 2-value is considered for migrants whose family have land holding of 5-10 bigha, 3-value is considered for migrants whose family have land holding of 2-5 bigha, 4-value is considered for migrants whose family have land holding of less than 2 bigha and 5-value is considered for migrants whose family have no land holding of more than 10 bigha1-value is considered for migrant whose family have land holding.

11. House type (X_{11}): It had been measured with the scale developed by Trivedi (1963) and weightages as the no house, hut, kachha house, mixed house, pucca house, mansion etc. The judgments on the independent variable house type of the migrant were given on a scoring pattern in which 1-value is considered for mansion, 2-value is considered for pucca house, 3-value is considered for mixed house, 4-value is considered for kaccha house, 5-value is considered for hut, 6-value is considered for no house.

12. Social participation (X_{12}): It refers to the participation of the respondents in the activities of one or more organization. The judgments on the independent variable social participation of the migrant were given on a scoring system suggested by Trivedi (1963) with some modification in which 0-value is considered for migrants who are member of no organization, 1-value is considered for migrants who are member of one organization, 2-value is considered for migrants who are member of more than one organization, 3-value is considered for migrants who are office holder and 4-value is considered for migrants who are public leader.

13. Material possession (X_{13}): It refers to the various materials possessed by the migrant and his/her family.

14. Family cosmopoliteness (X_{14}): Family cosmopoliteness refers to the exposure of that family to ex-situ situation and having an initial idea or experience about faraway places or ex-situ places where in they can have their occupation better.

15. Mass media exposure (X_{15}): It refers to the access of migrants to the different mass media like newspaper, radio, TV etc.

16. Source of information for migration (X_{16}): The respondents were asked to indicate the source of information for migration. The judgments on the independent variable source of information for migration were given on a scoring pattern in which 7-value is considered for friends, 6-value is considered for relatives, 5-value is considered for any other person of village or community, 4-value is considered for agents or brokers, 3-value is considered for travel agencies, 2-value is considered for internet and 1-value is considered for others.

17. Source of help at destination (X_{17}): The respondents were asked to indicate the source of help at where the migrant persons were migrated and the judgments on the independent variable source of help at destination were given on a scoring pattern in which 7-value is considered for agents or representatives, 6-value is considered for employers representative, 5-value is considered for friends, 4-value is considered for relatives, 3-value is considered for any other person of the village or community, 2-value is considered for self and 1-value is considered for others.

18. Principal source of income (X_{18}): The respondents were asked to indicate the principal source of income and judgments were given on a scoring pattern in which 4-value is considered for cultivation, 3-value is considered for farm labour, 2-value is considered for non-farm labour and 1-value is considered for others.

19. Divergent sources of income (X_{19}): The respondents were asked to indicate the divergent sources of income and the scoring pattern are 3-value is considered for income from one source, 2-value is considered for income from two sources and 1-value is considered for income from more than two sources.

20. Source of money for migration (X_{20}): The respondents were asked to indicate source of money required for the migration process and the scoring pattern are 5-value is considered for no money required, 4-value is considered for own saving, 3-value is considered for family saving, 2-value is considered for private money lender and 1-value is considered for selling property.

21. Communication with out-migrant (X_{21}): The respondents were asked to indicate the frequency of communication with his or her family and the judgments

were given on a scoring pattern in which 6-value is considered for daily, 5-value is considered for alternative days, 4-value is considered for weekly, 3-value is considered for fortnightly, 2-value is considered for monthly and 1-value is considered for yearly.

22. Mode of communication (X_{22}): The respondents were asked to indicate the mode of communication to the family and the judgments were given on a scoring pattern in which 7-value is considered for telephone, 6-value is considered for SMS, 5-value is considered for facebook or WhatsApp, 4-value is considered for email, 3-value is considered for online chats, 2-value is considered for online video communication and 1-value is considered for letter.

23. Frequency of visiting home (X_{23}): The respondents were asked to indicate the frequency of visiting home and the scoring pattern are 7-value is considered for once in less than three months, 6-value is considered for once in three months, 5-value is considered for once in six months, 4-value is considered for once in a year, 3-value is considered for once in two year, 2-value is considered for once in more than two year and 1-value is considered for never.

24. Duration of stay at home (X_{24}): The respondents were asked to indicate duration of stay in the native place and the judgments were given on a scoring pattern in which 7-value is considered for less than one week, 6-value is considered for one to two weeks, 5-value is considered for two to three weeks, 4-value is considered for three to four weeks, 3-value is considered for one to two months, 2-value is considered for more than two months, and 1-value is considered for migrated for the first time.

25. Amount received by household in last one year (X_{25}): The respondents were asked to indicate the amount received by the household in last one year after the migration process. The judgments were given on a scoring pattern in which 5-value is considered for Rs. 0 to 20,000, 4-value is considered for Rs. 20,000 to 50,000, 3-value is considered for Rs. 50,000 to 100,000, 2-value is considered for Rs. 100,000 to 200,000 and 1-value is considered for more than Rs. 200,000.

26. Reasons of migration (X_{26}): The respondents were asked to indicate the reasons for the migration process and the judgments on the independent variable reasons of migration process were given on a scoring pattern in which 5-value is considered for poverty, 4-value is considered for large emergency expenditure, 3-value is considered for better wage, 2-value is considered for better working condition and 1-value is considered for others.

27. Deciding authority for migration process (X_{27}): The respondents were asked to indicate the deciding authority for the migration process and the judgments on the independent variable deciding authority for the migration process were given on a scoring pattern in which 4-value is considered for own will, 3-value is considered for spouse, 2-value is considered for relatives and 1-value is considered for others.

28. Destination of migration (X_{28}): The respondents were asked to indicate where the migrant or migrant's family migrated. The judgments on the independent variable destination of migration were given on a scoring pattern in which 4-value is considered for inter-district migration, 3-value is considered for intra-state migration, 2-value is considered for inter-state migration and 1-value is considered for international migration.

29. Pattern of migration (X_{29}): By the pattern of migration the judgments on the independent variable pattern of migration were given on a scoring pattern in which 4-value is considered for migration with whole family, 3-value is considered for migration with wife and children, 2-value is considered for migration with wife only and 1-value is considered for migration alone.

30. Types of migration (X_{30}): There are so many types of migration. But for the study the types and scores are as follows: 3-value is considered seasonal migration, 2-value is considered for temporary migration and 1-value is considered for permanent migration.

31. Place of stay (X_{31}): The respondents were asked to indicate where they stayed after the migration process. The judgments on the independent variable place of stay were given on a scoring pattern in which 4-value is considered for own house, 3-value is considered for friends' house, 2-value is considered for rented house and 1-value is considered for others.

32. Utilization of additional benefit (X_{32}): The respondents were asked to indicate after the migration process what he or she does with the additional benefit from the current job. The judgments on the independent variable utilization of additional benefit were given on a scoring pattern in which 1-value is considered for investment, 2-value is considered for improving social participation, 3-value is considered for consumption.

Dependent Variables

Considering the objective of the study, distance of migration has been taken as dependent variable. It denotes the geographical distance covered by the migrant due to migration and it is calculated in kilometer.

RESULTS

The qualitative data is quantified by using specific numerical procedure. Then the quantified data were put under four statistical analysis i.e. correlation analysis, multiple regression analysis, step-down regression analysis, path analysis and canonical covariate analysis. The findings are as follows-

Correlation analysis: The co-efficient of correlation was calculated to assess the linear relationship between Distance of migration from home (y) and 32 independent variables.

Table 1 represents coefficient of correlation between distance of migration from home (y) and 32 causal variables (X_1-X_{32}). It has been found that the gender (X_1), family cosmopoliteness (X_{14}), source of information for migration (X_{16}), source of help at destination (X_{17}), types of migration (X_{30}) has recorded significant positive correlation and family land holding (X_{10}), communication with out-migrant's (X_{21}), frequency of visiting home (X_{23}), duration of stay at home (X_{24}), destination of migration (X_{28}), pattern of migration (X_{29}) has recorded significant but negative correlation with distance of migration from home (y). Duration of stay at home (X_{24}) has been recorded to have the highest r-value in association with distance of migration from home (y).

Multiple regression analysis: Table 2 presents the multiple regression analysis where in 32 causal variables have been regressed against the consequent variable distance of migration from home (y) to estimate the functional impact of 32 causal variables on the consequent variable distance of migration from home (y).

It has been found that with the combination of all these 32 causal variables 84.50 per cent of variance can be explained in the consequent variable i.e. Distance of migration from home (y). So, a substantive amount of variance has been explained with the combination of the 32 consequent variables (X_1-X_{32}). So that justifies the selection of the causal variable. In other side, per unit change in gender (X_1), family land holding (X_{10}), family cosmopoliteness (X_{14}), source of information for migration (X_{16}), source of help at destination (X_{17}), communication with out-migrant's (X_{21}), frequency of visiting home (X_{23}), duration of stay at home (X_{24}), destination of migration (X_{28}), pattern of migration (X_{29}) and types of migration (X_{30}), positively or negatively, have a reciprocal impact of (+215.742), (-165.277), (-290.070),

Table 1: Coefficient of correlation (r) among distance of migration from home (y) and 32 independent variables (X_1-X_{32})

Independent Variables	'r' Value	Remarks
Gender (X_1)	.392	**
Community (X_2)	-.058	
Marital status (X_3)	-.123	
Age at survey (X_4)	-.193	
Age at migration (X_5)	.186	
Marital age (X_6)	-.172	
Family type (X_7)	-.038	
Family size (X_8)	-.054	
Education status of migrant (X_9)	-.177	
Family land holding (X_{10})	-.207	*
House type (X_{11})	.039	
Family social participation (X_{12})	-.134	
Material possession (X_{13})	-.107	
Family cosmopoliteness (X_{14})	.303	**
Mass media exposure (X_{15})	.003	
Source of information for migration (X_{16})	.236	*
Source of help at destination (X_{17})	.268	**
Principal source of income (X_{18})	.090	
Divergent sources of income (X_{19})	.089	
Source of money for migration (X_{20})	-.144	
Communication with out-migrant's (X_{21})	-.279	**
Mode of communication (X_{22})	-.192	
Frequency of visiting home (X_{23})	-.531	**
Duration of stay at home (X_{24})	-.790	**
Amount received by household in last one year (X_{25})	.102	
Reasons of migration (X_{26})	.048	
Deciding authority in migration (X_{27})	-.043	
Destination of migration (X_{28})	-.660	**
Pattern of migration (X_{29})	-.353	**
Types of migration (X_{30})	.261	**
Place of stay (X_{31})	-.092	
Utilization of additional benefit (X_{32})	.134	

***Correlation is significant at the 0.01 level*
**Correlation is significant at the 0.05 level*

Table 2: Multiple regression analysis among distance of migration from home (y) and 32 causal variables (X_1-X_{32})

Variables	Reg. Coef. B	S.E. B	Beta	t Value
Gender (X_1)	215.742	258.458	.080	.835
Community (X_2)	-111.885	165.788	-.047	-.675
Marital status (X_3)	-25.392	115.816	-.018	-.219
Age at survey (X_4)	-73.468	29.470	-.737	-2.493
Age at migration (X_5)	27.919	14.604	.120	1.912
Marital age (X_6)	72.091	28.080	.731	2.567
Family type (X_7)	-431.551	199.944	-.188	-2.158
Family size (X_8)	104.785	98.126	.091	1.068
Education status of migrant (X_9)	-30.294	26.139	-.158	-1.159
Family land holding (X_{10})	-165.277	105.173	-.114	-1.571
House type (X_{11})	-249.098	139.666	-.155	-1.784
Family social participation (X_{12})	-101.690	126.535	-.056	-.804
Material possession (X_{13})	212.678	184.536	.117	1.153
Family cosmopoliteness (X_{14})	-290.070	260.353	-.086	-1.114
Mass media exposure (X_{15})	70.961	357.688	.019	.198
Source of information for migration (X_{16})	-2.531	42.890	-.005	-.059
Source of help at destination (X_{17})	48.061	40.185	.073	1.196
Principal source of income (X_{18})	35.466	136.488	.026	.260
Divergent sources of income (X_{19})	260.587	146.407	.144	1.780
Source of money for migration (X_{20})	94.337	75.422	.088	1.251
Communication with out-migrant's (X_{21})	59.896	106.055	.072	.565
Mode of communication (X_{22})	-8.090	31.545	-.015	-.256
Frequency of visiting home (X_{23})	-237.092	98.667	-.326	-2.403
Duration of stay at home (X_{24})	-380.061	80.888	-.456	-4.699
Amount received by household in last one year (X_{25})	-186.961	122.629	-.201	-1.525
Reasons of migration (X_{26})	118.482	77.373	.122	1.531
Deciding authority in migration (X_{27})	47.659	55.127	.055	.865
Destination of migration (X_{28})	-242.620	128.532	-.188	-1.888
Pattern of migration (X_{29})	-337.730	112.843	-.298	-2.993
Types of migration (X_{30})	77.976	172.044	.038	.453
Place of stay (X_{31})	-.472	2.648	-.010	-.178
Utilization of additional benefit (X_{32})	-39.822	88.021	-.047	-.452

R square: 84.50 per cent; The standard error of the estimate: 549.846

(-2.531), (+48.061), (+59.896), (-237.092), (-380.061), (-242.620), (-337.730) and (+77.976) unit of change in distance of migration from home (y).

Stepwise regression analysis: Table 3 presents the stepwise regression analysis to isolate the variables from 32 causal variables, having dominance of effect on consequent variable, distance of migration from home (y). It has been found that the following variables i.e. Duration of stay at home (X_{24}), destination of migration (X_{28}), pattern of migration (X_{29}), frequency of visiting home (X_{23}), deciding authority in migration (X_{27}), these 5 consequent variables have been retained in the last step of regression and these five variables together have explained 75.50 per cent of variance embedded with the consequent variant explained. 32 causal variables together have explained 84.50 per cent but these 5 variables together

Table 3: Stepwise regression analysis among distance of migration from home (y) and 5 causal variables (X_{24}, X_{28}, X_{29}, X_{23}, X_{27})

Variables	Reg. coef. B	S.E. B	Beta	t value
Duration of stay at home (X_{24})	-403.781	58.259	-.485	-6.931
Destination of migration (X_{28})	-325.997	87.789	-.252	-3.713
Pattern of migration (X_{29})	-315.454	64.848	-.278	-4.865
Frequency of visiting home (X_{23})	-155.652	49.578	-.214	-3.140
Deciding authority in migration (X_{27})	116.530	46.506	.134	2.506

R square: 75.50 per cent; The standard error of the estimate: 583.876

explained 75.50 per cent, so, 27 variables have explained only 9 per cent variant. So, these 5 variables are extremely significant in terms of their contribution.

Path analysis: Table 4 presents the path analysis where in co-efficient of correlation (r) of distance of migration from home (y) vs. 32 independent variables is being decomposed into the direct, indirect and residual effect. it has been found that the variable age at survey (X_4) has recorded highest direct effect and marital age (X_6) has recorded highest indirect effect. so, the functional and operational contribution of age at survey (X_4) and marital age (X_6) have been the highest on distance of migration from home (y). the residual effect being 15.34 per cent, it is to conclude that even with a combination of 32 exogenous variables, 15.34 per cent of variance in consequent variable distance of migration from home (y) could not be explained.

DISCUSSION

Gender is the social construct of "male" and "female", and gender norms shape roles, expectations, and behaviors associated with masculinity and femininity. Gender norms can both empower and constrain rights and opportunities. A gendered analysis offers a perspective on gender relations; how gender affects access to resources; and differences in power and equality in economic, social, and legal structures. Gender has recorded a positive and significant correlation that implies that the migration is dominated by the male respondents or male worker. It is obvious that male respondents or male worker are more prone to migration. Hill (1972) found that poorer and landless have a greater propensity of migration than richer and big landowners. On the other hand, Sekhar (1993) found that out-migration is higher for the small and medium land-owning families and lower for either landless or big landowners. Family land holding has recorded significant but a negative correlation that indicates that those who are having less size of holding they are more prone to migration. It is quite obvious that those who are having less size of holding or smaller size of holding (it is not only small, it may be fragmented) and those who don't have income backup from land, they are more concerned to go for any alternative occupation and that's why they are migrating. Family cosmopoliteness is that family having higher cosmopoliteness between higher exposure to ex-situ situation and they are more prone to migrate elsewhere because they have got an initial idea or experience about faraway places or ex-situ places where in they can have their occupation better.

Source of information for migration has got significant and positive correlation quite logically, which means more people are exposing to information of migration more people are getting psychologically and socially ready to migrate to quit their in-situ society and it is obvious that they have already collected some positive information about the migrant places and that's why they are ready to quit their home places or home villages to move elsewhere. Source of help at destination, it is quite logical that most of the migrations are happening being supported by some accomplished persons who are helping them to develop a better attitude or positive attitude in favor of migration.

Communication with out-migrants has been found having negative correlation with distance of migration from home which means those who are having long distance from home, are having less communication or less information about out-migration. For this set of respondents this type of communication does not help them to quit their home place in favor of out- migration. Some of the information collected by them for the source persons is not good enough for the out-migration. Frequency of visiting home, it is obvious that those who are migrant they do not have mass scope to visit their home place frequently because it is tenurial, it is time framed and sometimes it is negotiable how many times they can visit their home places. Duration of stay at home, it is also

Table 4: Path analysis among distance of migration from home (y) and 32 exogenous variables (X_1-X_{32})

Variables	Total effect	Direct effect	Indirect effect	Highest indirect effect
Gender (X_1)	0.392	0.087	0.305	-0.175 (X_4)
Community (X_2)	-0.058	-0.049	-0.009	0.153 (X_6)
Marital status (X_3)	-0.123	-0.020	-0.103	0.065 (X_7)
Age at survey (X_4)	-0.193	-0.776	0.583	0.739 (X_6)
Age at migration (X_5)	0.186	0.119	0.067	-0.134 (X_4)
Marital age (X_6)	-0.172	0.771	-0.943	-0.744 (X_4)
Family type (X_7)	-0.038	-0.189	0.151	0.062 (X_8)
Family size (X_8)	-0.054	0.090	-0.144	-0.130 (X_7)
Education status of migrant (X_9)	-0.177	-0.162	-0.015	-0.164 (X_6)
Family land holding (X_{10})	-0.207	-0.115	-0.092	-0.144 (X_4)
House type (X_{11})	0.039	-0.158	0.197	0.115 (X_6)
Family social participation (X_{12})	-0.134	-0.057	-0.077	-0.076 (X_9)
Material possession (X_{13})	-0.107	0.124	-0.231	0.124 (X_{25})
Family cosmopoliteness (X_{14})	0.303	-0.086	0.389	-0.247 (X_6)
Mass media exposure (X_{15})	0.003	0.017	-0.014	-0.116 (X_6)
Source of information for migration (X_{16})	0.236	-0.006	0.242	0.140 (X_{24})
Source of help at destination (X_{17})	0.268	0.074	0.194	-0.156 (X_6)
Principal source of income (X_{18})	0.090	0.022	0.068	0.205 (X_6)
Divergent sources of income (X_{19})	0.089	0.144	-0.055	0.221 (X_6)
Source of money for migration (X_{20})	-0.144	0.087	-0.231	-0.114 (X_{24})
Communication with out-migrant's (X_{21})	-0.279	0.074	-0.353	-0.266 (X_{23})
Mode of communication (X_{22})	-0.192	-0.016	-0.176	0.200 (X_6)
Frequency of visiting home (X_{23})	-0.531	-0.324	-0.207	-0.244 (X_{24})
Duration of stay at home (X_{24})	-0.790	-0.457	-0.333	-0.239 (X_4)
Amount received by household in last one year (X_{25})	0.102	-0.200	0.302	0.125 (X_{24})
Reasons of migration (X_{26})	0.048	0.124	-0.076	-0.095 (X_{25})
Deciding authority in migration (X_{27})	-0.043	0.052	-0.095	0.117 (X_6)
Destination of migration (X_{28})	-0.660	-0.187	-0.473	-0.270 (X_{24})
Pattern of migration (X_{29})	-0.353	-0.292	-0.061	0.258 (X_6)
Types of migration (X_{30})	0.261	0.038	0.223	0.231 (X_4)
Place of stay (X_{31})	-0.092	-0.012	-0.080	0.062 (X_6)
Utilization of additional benefit (X_{32})	0.134	-0.046	0.180	-0.143 (X_6)

Residual effect: 15.34 per cent

negative, whenever a migrant worker is away from the home it is quite logical that they will leave the home and that's why most stay outside means they are missing the home more. Destination of migration is significant but negative correlation which means the distance of migration and the destination they have an inverse correlation that is they have a clear choice for migrating place which has a lesser distance. Pattern of migration, it is also negatively correlated with distance of migration, means lesser the distance the pattern of migration is been set up. Those who are obtaining for faraway places through migration they are not developing any kind of pattern. It is exactly happening for the migrant agricultural labourer. For example, in West Bengal there is clear pattern that migrant worker from Purulia, they are very much frequent to go Bardhaman and other districts. The same thing is happening

when Murshidabad massionaries are having pattern of migration to other places, in Kolkata especially there is clear demand for massionaries from Murshidabad. Distance of migration is closely predicted by the Deciding authority in the migration. So, it is quite discernable because the observation seeks that the respondent who are younger are more prone to migration, but migration is being indirectly influenced by the stand of year he or she pass through after marriage. Marriage is not only an institutional or family relationship, but it involves immense emotive bondage between husband and wife. So, whenever one young if he is unmarried easily migrate to other places but if he recently married to then it is exceedingly difficult to quit the family. That is why when age is retaining the highest direct effect then numbers of year since marriage is retaining the highest indirect effect. So age at the same time the duration of marriage and number of years since marriage are coming up as important determinants for migration. The residual effect being 0.15340, it implies that, with the combination of 32 variables, there is 15.34 per cent variance embedded with the consequent variable variant remain unexplained.

CONCLUSION

The present study reveals that from the social ecology of agriculture, people are quitting their own land and settlements just to find a better livelihood option elsewhere. The variables like age at survey, age at migration, marital age, reasons of migration, source of help at destination, amount received by household in last one year, duration of stay at home, destination of migration, pattern of migration, frequency of visiting home, deciding authority in migration, communication with out-migrant's and utilisation of additional benefits have been found extremely relevant to impact on the social ecology of migration. Canonical covariate analysis has been carried out to elucidate two set of migration variables, how they are impact by another set of heterogeneous variables. Here factor analysis has been applied to extract what are the dominant factors. Migration by becoming an overly complex socio ecology tools, it is not possible to deals with all these thirty-two exogenous variables, so factor analysis has offer us with an opportunity to deal with the problem of migration. The cluster analysis again has help us to go for grouping of migrant respondents and grouping will help to take a micro economic intervention at the grassroot level.

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Study of Different Concentrations of Sodium Para-Nitrophenolate on Growth, Sex Ratio and Yield of Cucumber (*Cucumis sativus* L.) *cv.* – Pusa Barkha

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ABSTRACT

The field experiment was conducted during 2018 and 2019 at Krishi Vigyan Kendra, College of Agriculture, Gwalior. Study the effect of different concentrations of Sodium para – Nitrophenolate on growth, sex ratio and yield of cucumber (*Cucumis sativus* L.) *cv.* – Pusa Barkha". The trail was laid out in randomized block design with eight treatments and three replications. The treatments consist of different concentrations of Sodium para – Nitrophenolate and a control. Results divulge that the application of Sodium para – Nitrophenolate @ 5000 ppm significantly increased growth, sex ratio and yield parameters *viz.,* number of branches per plant, days taken to first male, female and 50% flowering, fruit yield per ha (q/ha) etc. as compared to control.

Keywords: Sodium para – Nitrophenolate, Sex ratio, Yield, Pusa Barkha

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a commonly cultivated plant that belongs to the cucurbitaceae family and has 2n = 14 chromosomes. Cucumber is known as '*khira*'. It is consider as Indian endemic vegetable. Cucumber is a monoecious, annual, climbing or consecutive vine with triangular ovate leaves and a hirsute stem (Baily, 1969). Cucumber shows a desirable spectrum of floral morphology, including staminate, pistillate and hermaphrodite blooms that occur in a variety of arrangements and produce a variety of sexual expression (Kadi *et al.*, 2018). Which have the properties of anticancer. A 100 g of nutritious cucumber contains 96.3 g of water, 2.5 g of carbohydrates, 0.4 g of protein, 0.1 g of fat, 0.3 g of minerals, 10 mg of calcium, 0.4 g of fiber and trace amount of vitamin C, manganese and iron.

Cucumber yield has increased from recent years as a result of growth control factors that alter sex expression. Growth regulators have significantly impact on sex ratio and flowering in different cucurbits leading to either reduction the number of male flowers or an increase in the number of female flowers (Al-Masoum and Al-Masri, 1999) without dignified any negative impact on the environment and human health. Among plant growth regulators, GA_3 and NAA are particularly important in the transformation of sex ratio in various cucurbitaceous plants (Hilli *et al.*, 2010) External use of plant growth regulators may change sex ratio and series, if included in 2 and 4 stage, which is a critical stage when sexual suppression or promotions occur (Hossain *et al.*, 2006).

Sodium para–Nitrophenolate a plant phytohormone that affects various stages of plant growth, improves germination and root growth. It also accelerates pollination and tube growth and thus improves flower fertilization and fruit set. It reduces the negative impact of stress and improves plant health. It works to improve quality, increase yield and profitability.

MATERIALS AND METHODS

The present investigation was conducted in Krishi Vigyan Kendra, College of Agriculture, Gwalior (M.P.) during the year 2018 and 2019. With the help of tractor-drawn equipment, ploughing and harrowing practices were done in experimental fields. The land was levelled with the use of wooden planks and preparing the plots manually. In addition to incorporation of farmyard manure 10 t/ha, the fertilizers were applied at the rate of 150:75:75 N, P_2O_5, K_2O kg/ha, respectively. The sowing was performed on

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10 July 2018 and 11th July 2019 by dibbling at least three seeds/hill at a depth of 2 to 3 cm by keeping 1 meter inter-row spacing and 1 meter intra-row Spacing. All necessary intercultural practices, including as weeding, irrigation, and plant protection, were implemented as needed. The experiment was laid out in randomized block design (RBD) with three replications and consisted of 8 treatments, namely different concentrations of Sodium para Nitrophenolate viz. 1000 ppm, 2000 ppm, 3000 ppm, 4000 ppm, 5000 ppm, 6000 ppm, 10000 ppm and control (Distil water At this study, five cucumber vines were chosen at random in the beginning and tagged with labels from each plot to record the following observations on growth, sex expression, and yield characters during the crop's growth phase.

RESULTS AND DISCUSSION

Different concentration of Sodium para – Nitrophenolate had significantly effect on number of primary branches per plant at 40 and 50 DAS (Table 1). At 40 and 50 DAS minimum number of primary branches were recorded in Sodium para – Nitrophenolate @ 10,000 ppm and maximum number of primary branches were recorded by Sodium para – Nitrophenolate @ 5,000 ppm. The mean data also showed that Sodium para – Nitrophenolate @ 10000 ppm was produced minimum number of primary branches closely followed by control (distil water). This could be allocated to the plant growth regulators stimulatory impact on cell division and cell enlargement, which lead to effect on growth and development (Geeta *et al*., 2010). The difference in number of branches per plant may have been expected to its PGRs effect and also due to vine length, inter-nodal length and environmental factor that confirming to reports of Mangave *et al.* (2017); Kaur *et al.* (2016) and also the discoveries are in concurrence with the outcomes of Kadi *et al.* (2018); Nanaware *et al.* (2012); Mahida *et al.* (2015); Murthy *et al.* (2007); Chovatia *et al.* (2010).

Different concentration of Sodium para – Nitrophenolate had significantly effect on days taken to first male and female flower (Table 1). minimum days taken to first male flower was recorded in Sodium para – Nitrophenolate @ 5,000 ppm (26.93 and 26.79 in 2018 and 2019, respectively) and maximum days taken to first male flower was recorded in by control (Distilled water) (35.20 and 34.82 in 2018 and 2019, respectively). Minimum days taken to first female flower was recorded in Sodium para – Nitrophenolate @ 2,000 ppm (28.47 and 28.56 in 2018 and 2019, respectively) and maximum days taken to first female flower was recorded by control (Distilled water) (37.33 and 37.22 in 2018 and 2019, respectively). The variation in the days taken to first flowering might be due to effect of Sodium para – Nitrophenolate on different treatments. It is the desired character for early maturity and marketing of a crop. Application of Sodium para – Nitrophenolate, might be greater concentration or activity of auxins. This finding also support by Khatoon *et al.* (2019) observed that NAA 150 ppm minimum days take for the appearance of first female flower. These results are in line with Dinesh *et al.* (2019) observed that ethrel exhibited the best results for the minimum number of days taken for first female flower appearance. These discoveries are additionally in concurrence with Kadi *et al.* (2018) in cucumber.

Different concentration of Sodium para – Nitrophenolate had significant effect on days taken to 50% flowering (Table 1). minimum days taken to 50% flowering was recorded in Sodium para – Nitrophenolate @ 4,000 ppm (27.50 in 2018) and minimum days taken to 50% flowering was recorded in Sodium para – Nitrophenolate @ 5,000 ppm (29.19 in 2019) and maximum days taken to 50% flowering was recorded by control (Distilled water) (40.37 and 40.31 in 2018 and 2019, respectively). The mean data also showed that minimum days taken to 50% flowering were recorded in Sodium para – Nitrophenolate @ 4,000 ppm followed by Sodium para – Nitrophenolate @ 5,000 ppm. This is in agreement with the result reported by Kadi *et al.* (2018) in cucumbers for traits plant growth, Number of Branches, first male and female flowers and 50% flowers.

Different concentration of Sodium para – Nitrophenolate had significant effect male and female flower ratio (Table 1). Minimum male and female flower ratio was recorded in Sodium para – Nitrophenolate @ 5,000 ppm (1.97 in 2018 and 1.93 in 2019, respectively) maximum male and female flower ratio was recorded in Sodium para – Nitrophenolate @ 10,000 ppm (6.51 in 2019 and 6.63 in 2020, respectively). This is in agreement with the result reported by the principle in sex modification in cucurbits lies in altering the sequence of flowering and sex ratio. The sex ratio and flowering sequence are determined by environmental condition at the time and place of ontogeny (Leopold and Kriedemann, 1975). In the present investigation, growth regulators increased the female flowers, which might be due to increase in auxin

Table 1: Effect of Sodium para – Nitrophenolate on growth and sex ratio of cucumber *cv.* (Pusa Barkha)

Treatment	No. of primary branches at 40 DAS			No. of primary branches at 50 DAS			Days taken to first male flower			Days taken to first female flower			Days taken to 50% flowering		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled
Sodium para-Nitrophenolate @ 1,000 ppm	4.00	4.33	4.17	6.67	6.33	6.50	28.17	27.24	27.71	29.43	29.45	29.44	27.77	31.02	29.40
Sodium para-Nitrophenolate @ 2,000 ppm	5.67	5.00	5.33	6.33	6.67	6.50	27.37	27.31	27.34	28.47	28.56	28.51	30.27	30.17	30.22
Sodium para-Nitrophenolate @ 3,000 ppm	4.67	5.33	5.00	8.67	8.33	8.50	28.07	27.57	27.82	30.00	29.96	29.98	30.17	30.11	30.14
Sodium para-Nitrophenolate @ 4,000 ppm	5.67	5.67	5.67	7.33	7.33	7.33	27.37	27.05	27.21	29.17	29.06	29.12	27.50	30.75	29.12
Sodium para-Nitrophenolate @ 5,000 ppm	7.00	6.67	6.83	10.6	10.00	10.33	26.93	26.79	26.86	29.37	29.27	29.32	29.50	29.19	29.35
Sodium para-Nitrophenolate @ 6,000 ppm	4.33	4.33	4.33	7.00	7.00	7.00	28.60	28.45	28.52	30.90	31.05	30.98	31.50	31.50	31.50
Sodium para-Nitrophenolate @ 10,000 ppm	3.33	3.67	3.50	6.33	6.33	6.33	30.67	30.54	30.60	32.81	32.80	32.80	34.97	34.87	34.92
Control (Distilled water)	3.67	4.33	4.00	6.33	6.33	6.33	35.20	34.82	35.01	37.33	37.22	37.28	40.37	40.31	40.34
SEm±	0.63	0.35	0.36	0.58	0.49	0.38	0.41	0.45	0.31	0.57	0.57	0.40	1.46	0.39	0.76
CD	1.86	1.02	1.04	1.71	1.42	1.09	1.21	1.32	0.87	1.66	1.68	1.15	4.27	1.15	2.16

Table 1 contd....

Treatment	Male/Female flower ratio			Number of fruit per plant			Fruit length (cm) at harvesting stage			Fruit dimeter (mm) at harvesting stage			Fruit yield (q/ha)		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled	1st year	2nd year	Pooled
Sodium para-Nitrophenolate @ 1,000 ppm	2.71	2.71	2.71	4.07	3.33	3.70	17.10	16.27	16.68	68.50	68.66	68.58	86.73	85.39	86.06
Sodium para-Nitrophenolate @ 2,000 ppm	2.36	2.39	2.37	4.33	3.50	3.92	17.20	16.83	17.02	67.57	67.49	67.53	83.97	83.12	83.54
Sodium para-Nitrophenolate @ 3,000 ppm	2.36	2.20	2.29	5.33	5.00	5.17	19.13	18.70	18.92	68.00	67.37	67.69	136.63	133.52	135.08
Sodium para-Nitrophenolate @ 4,000 ppm	1.97	2.11	2.04	6.83	6.67	6.75	20.00	19.90	19.95	70.10	69.21	69.66	124.63	149.84	137.24
Sodium para-Nitrophenolate @ 5,000 ppm	1.97	1.93	1.95	8.83	8.00	8.42	18.50	17.80	18.15	73.23	72.53	72.88	191.57	179.04	185.30
Sodium para-Nitrophenolate @ 6,000 ppm	3.44	3.57	3.51	5.00	5.00	5.00	18.73	18.50	18.62	69.43	69.48	69.46	107.60	101.83	104.71
Sodium para-Nitrophenolate @ 10,000 ppm	6.51	6.63	6.57	5.00	4.50	4.75	18.07	17.27	17.67	66.77	67.38	67.07	71.87	63.53	67.70
Control @ (Distilled water)	6.41	6.47	6.44	3.00	3.33	3.17	18.33	17.83	18.08	66.80	66.76	66.78	92.80	94.11	93.45
SEm±	0.51	0.50	0.36	0.37	0.46	0.30	0.44	0.49	0.33	0.86	0.92	0.63	12.11	18.58	11.09
CD	1.49	1.45	1.02	1.09	1.35	0.85	1.28	1.43	0.94	2.53	2.68	1.80	35.45	54.38	31.75

substances mobilization in plants as well as reduction of sugar thereby resulting in a change in membrane permeability. Mia *et al.* (2014) GA_3 has maximum male and female ratio were recorded, Khan and Chaudhry (2006) Application of 400 ppm GA_3 stimulated the number of both staminate and pistillate flowers, Sure *et al.* (2013) and Baruah and sarma (2015).

Different concentration of Sodium para – Nitrophenolate had significant effect Number of fruit per plant (Table 1). Minimum number of fruit per plant were recorded in Sodium para – Nitrophenolate @ 10,000 ppm (3.00 and 3.33 in 2018 and 2019, respectively) as well as mean value (3.17) and maximum Number of fruit per plant were recorded by Sodium para – Nitrophenolate @ 5,000 ppm (8.83 and 8.00 in 2018 and 2019) as well as mean value (8.42) followed by Sodium para – Nitrophenolate 0.3% SL @ 4,000 ppm. The present study clearly indicates that application of Sodium para - Nitrophenolate at fruit set stage significantly increased the antioxidant enzymes and decreased auxin catabolic enzymes, which favor the internal auxin content. The plants treated with Nitrophenols show low abscission of flowers due to increased levels of auxin and antioxidant enzymes resulting increased fruit set and yield confirmed by Djanaguiraman *et al.* (2004) in tomato.

Different concentration of Sodium para – Nitrophenolate had significant effect Fruit length (cm) at harvesting stage (Table 1). Minimum number of fruit length (cm) at harvesting stage per plant were recorded in Sodium para – Nitrophenolate @ 1,000 ppm (17.10 and 16.27 in 2018 and 2019, respectively) as well as mean value (16.48) and maximum fruit length (cm) at harvesting stage were recorded by Sodium para – Nitrophenolate @ 4,000 ppm (20.00 and 19.90 in 2018 and 2019) as well as mean value (19.95). These findings are also confirmed by Dalai *et al.* (2016).

Different concentration of Sodium para – Nitrophenolate had significant effect fruit diameter (mm) at harvesting stage (Table 1). Minimum number of fruit dimeter (mm) at harvesting stage per plant were recorded in Sodium para – Nitrophenolate @ 10,000 ppm (66.77 and 67.38 in 2018 and 2019, respectively) as well as mean value (67.07) and maximum fruit diameter (mm) at harvesting stage were recorded by Sodium para – Nitrophenolate @ 5,000 ppm (73.23 and 72.53 in 2018 and 2019) as well as mean value (72.88) followed by Sodium para – Nitrophenolate @ 4,000 ppm. Due to effect of PGR refers to increase cell division and cell elongation. These findings agreement with Ansari *et al.* (2018) reported that among the fruit characters ex., fruit length, fruit maturity, fruit diameter, average fruit weight, yield/plant and yield/ha were found initiate significant effect of PGR. This finding also confirmed by Thappa *et al.* (2011); Chovatia *et al.* (2010); Kumar *et al.* (2006).

Different concentration of Sodium para – Nitrophenolate had significant effect Fruit yield (q/ha) (Table 1). Minimum fruit yield was observed (q/ha) in Sodium para – Nitrophenolate @ 10,000 ppm and maximum fruit yield (q/ha) were recorded by Sodium para – Nitrophenolate @ 5,000 ppm followed by Sodium para – Nitrophenolate @ 3,000 ppm. The increased concentration or activity of auxins might support the use of sodium para – Nitrophenolate. Plants treated with bio-stimulants have a stronger inhibition of IAA oxidase, which ensures that naturally synthesized auxin is more active. (Stutte and Clark, 1990). Present experiment results also support the findings of Marbhal *et al.* (2005) the application of NAA @ 50 ppm as compared to control, the fruit yield in bitter gourd was increased. The reports of Dalai *et al.* (2016) are also in agreement these findings It was showed initiate significantly best superior in terms of growth, blooming and yield attributing optimal parameters, Khaton *et al.* (2019), Dhakal *et al.* (2019); Ansari *et al.* (2018); Das *et al.* (2001).

CONCLUSION

The overall results of present research work, we observed that Sodium para-Nitrophenolate @ 5,000 ppm is suitable for increasing the number of female flowers as a result number of fruit per plant also improve and production respectively increased.

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Socio-economic Conditions and Constraints Faced by Goat farmers: A Study in Uttarakhand

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ABSTRACT

Present research investigation was conducted to assess the constraints faced by the goat farmers in Pithoragadh district of Uttarakhand, India. A well designed questionnaire was administered to 50 goat farmers purposively selected from *Geethigada* and *Vid* District Pithoragadh of Uttarakhand. The aim of this study was to study the socio-economic condition of goat farmers and to identify critical constraints faced by goat farmers. Data revealed that majority of goat farmers were middle age group, literate and were female. They have less than 1 year experience. They were facing various problems related to breeding, feeding, health management, marketing etc.

Keywords: Constraints, Goat farmers, Socio-economic condition

INTRODUCTION

India is contributing 11.6 per cent of total livestock in World and 17.93 per cent of which is contributed by goats. The share of goats to the total milk yield and meat production of India was recorded 3.5 per cent and 14.22 per cent respectively 2016-17 (Government of India, 2017).

Goats play a very important role in the food and nutritional security of the rural people. Goat rearing needs low investment, high profit and ease in marketing. Goats can also stay alive on available bushes and leaves in adverse surroundings. This is one of the sources of income. In recent years, goat enterprise has also shown promise of its successful intensification and commercialization (Kumar, 2007). Goats are rich sources of animal protein.

About 70 per cent of the landless agricultural laborers, marginal and small farmers in the country are associated with goat husbandry. They are not only an important source of income and employment for them, but also a vital source of animal protein for the family Sabapara (2016).

Goat farmers were facing many problems as poor income level, lack of knowledge and information on goat rearing etc. Goat rearing is extensively adopted livestock activities in the country and a good source of income. Goat milk is healthy, easily palatable and has therapeutic properties. They are universally considered the "poor man's cow" and are the major source of animal protein like milk and meat for many subsistence farmers in tropical regions. Because of these fast socio-economic changes in the recent past, a rapid shift has taken place in the dietary habits in favour of non-vegetarian diet. As a result, the demand for goat meat has swiftly increased and the domestic market price (Kumar, 2007).

Gamit *et al.* (2020) reported that goat farmers of Saurashtra region faced major problem in demand of raw milk for consumption and whatever milk they are selling they don't get sufficient price followed by limited grazing land availability, high kid mortality and Predator/ wild animal attack. No agency helping for marketing to the goat keepers which forced them to migrate from one place to another for better market. High percentage of road accident, Theft/ robbery problems and long distance market reduce the economic loss to goat farmers. Lack of knowledge on importance of vaccination, deworming, awareness of common disease leads high mortality in flock was also major constrain faced by study are farmers. Amended extension services with awareness plan will leads to improvement of socio-economic status, which ultimately lead to animal husbandry development. In present situation goat farmers are facing many problems due to lack of knowledge, information and education on many

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aspects. Present research study was conducted with following objectives: [1] To study the socio-economic condition of goat farmers. [2] To ascertain the constraints faced by goat farmers.

MATERIALS AND METHODS

The present study was conducted in Pithoragadh District of Uttarakhand. Data was collected from two villages *Geethigada* and *Vid* of District Pithoragadh. Total 50 goat farmers were selected. The goats were provided by Animal Department to the farmers. Data was collected through questionnaire. The collected data were compiled, tabulated and analyzed to interpret the results. The descriptive statistics like frequency and percentage were used for the investigation. An attempt was made to identify the constraints faced by the goat farmers to seek out suggestions of farmers to overcome the difficulties faced by them. Many constraints faced by the farmers hinder the production and hence, desired production could not be achieved.

The data about profile parameters of *Sirohi* goat keepers are presented in Table 1.

Age: It revealed that majority of respondents were in middle age category (50%) and involvement of youths was 36 per cent followed by old age 14 per cent was very less. Similar result was also reported by Gamit *et al.* (2020).

Education: Majority of respondents (90%) were literate followed by illiterate (5%). Similar result was also reported by Nandi *et al.* (2011).

Table 1: Socio-economic condition of goat farmers

Parameter	Respondents	Percentage
Age		
Young <30	18	36
Middle 30-50	25	50
Old >50	7	14
Education		
Literate	45	90
Illiterate	5	10
Sex		
Male	11	22
Female	39	78
Goat farming experience		
>1 year	35	70
1-2 year	15	30

Sex: Majority of goat farmers were female (78%) followed by 22 per cent female.

Goat farming experience: Total 70 per cent respondents have less than 1 year experience of goat farming followed by 1-2 year experience (30%).

Table 2: Constraints faced by Goat farmers

Parameters	Respondents	Percentage
Feeding constraints		
Lack of knowledge about balance feeding	49	98
Problem of green fodder	45	90
Problem of dry fodder	47	94
High feed and fodder cost	35	70
Lack of knowledge on concentrate feeding	29	58
Reduction of grazing land	39	78
Unaware about mineral mixture feeding	34	68
Humiliation by forest people	38	76
Water problem	37	74
Breeding constraints		
Breeding buck problem	41	82
Indiscriminate breeding	39	78
Lack of knowledge on breeding practices	47	94
Repeat breeding problem	38	76
Lack of knowledge on breeding buck selection	46	92
Health care/ disease control constraints		
Lack of availability of health service in village	49	98
High treatment cost	39	78
Vaccination program not carried out by any agency	36	72
Lack of knowledge on importance of deworming	47	94
Lack of knowledge on common disease	32	64
Lack of knowledge on importance of vaccination	31	62
High kid mortality	28	56
Marketing constraint		
Lack of market infrastructure availability	26	52
Long distance market	46	92
No agency help in marketing	43	86
Middle man problem	32	64
Low price of goat milk	49	98
Less demand of goat milk	45	90
Miscellaneous constraints		
Road accident/ injurier	49	98
Predator/ wild animal attack	45	90

Feeding constraints: Feeding management is very important factors in the livestock farming. Feeding is also one of the major reasons for the cost creation in livestock farming. Thus, feeding constrain is directly affecting economics of goat farming. The feeding constraints practices are presented in Table 2. Majority of respondents were facing the constraints Lack of knowledge about balance feeding (98%) followed by Problem of dry fodder (94%) and Problem of green fodder (90 per cent). Total 78 per cent respondents were facing the problem of reduction of grazing land followed by Humiliation by forest people (76%) and water problem (74%). Present finding were nearer to Sone *et al.* (2015).

Breeding constraints: Breeding is also very important process in goat farming. A large portion of the India's goat population is maintained under free ranging conditions in which controlled mating are not possible. Good breeding objectives are needed for the genetic improvement of goat breed. The constraints associated with breeding are presented in Table 2.

Majority of farmers (94%) were facing the constraint lack of knowledge on breeding practices followed by Lack of knowledge on breeding buck selection (92%) and Breeding buck problem (82%). Total 78 per cent respondents were facing the constraint indiscriminate breeding and Repeat breeding problem (76%). Present finding were nearer to Kumawat *et al.* (2017).

Health care/ disease control constraints: Majority of respondents (98%) were facing the constraint lack of availability of health service in village followed by Lack of knowledge on importance of deworming (94%) and High treatment cost (78%). Total 64 per cent respondents were facing the constraint lack of knowledge on common disease followed by Lack of knowledge on importance of vaccination (62%) and High kid mortality (56%).

Marketing constraint: Majority of respondents (98%) were facing the constraint low price of goat milk followed by Long distance market (92%) and less demand of goat milk (90%). Total 86 per cent respondents were facing the constraints No agency help in marketing followed by Middle man problem (64%). Present finding were nearer to Singh *et al.* (2018).

Miscellaneous constraints: Total 98 per cent respondents were facing the constraint Road accident/injurier followed by Predator/ wild animal attack (90%).

CONCLUSION

Present research paper showed that goat farming is also a good source of occupation in hills of Uttarakhand. In Uttarakhand, Goat farmers were facing many constraints related to feeding, breeding, health care etc. The study has also enriched our understanding on the socio-economics of status of goat farmers. Goats play an important role in the livelihood security of the hill people. It is also a useful income generating option for the hill people.

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A Study on Electric-cum-solar Fencing as a Tool for Facilitating Multiple-cropping in Area with Open-grazing by Stray-cattle

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ABSTRACT

The present study was conducted to see the efficacy of electric-fencing as a tool for facilitating multiple-cropping in a chronically flood-prone village, *viz.,* Panimirigaon of Dibrugarh district, where 2nd crop cannot be grown at all after winter rice due to open grazing by stray-cattle. Crop production interventions were taken up for three consecutive years in the study area within the electrical-fencing in sequence mode (Rice-toria-Rice) based on soil-nutrient analysis. By the use of electric-fencing, cropping intensity of the study area was enhanced by 2-3 folds from existing cropping intensity of 108 per cent of the village. On comparison, it is found that the cost of the electric-fencing is less than the bamboo-fencing in long run; in bamboo-fencing the cost per hectare per year is more to a tune of Rs. 3,300.00 than electric fencing. With the intervention the gross-income increased by 321.02 per cent in 2014-15, 339.77 per cent in 2015-16 and 359.09 per cent in 2016-17. This fencing may help farmers in doubling his income through multiple-cropping.

Keyword: Assam, Cropping intensity, Electric-cum-solar fencing

INTRODUCTION

The cropping intensity of our country and Dibrugarh district is 136 per cent (ICAR website) and 148 per cent (C-DAP, Dibrugarh), respectively. In Dibrugarh, tea and winter rice are the only crops with universal acceptability. Out of many obstacles that hinder multiple cropping in the district, stray-cattle ranks top in entire district. This is a man-made problem which can be solved by bringing an attitudinal change in farmers which requires many decades. This problem is much severe in district like Dibrugarh where "the letting the cattle free after winter rice" has attained traditional status. Practically, it is next to impossible to ban the stray animal after harvesting the winter rice. Electric-cum-solar fencing may prove to be a practical solution to combat the stray-cattle. In the present study, effort has been made to highlight this fencing as a tool to facilitate multiple cropping for doubling farmers' income.

MATERIAL AND METHOD

The study was conducted at Panimirigaon under Barbaruah ADO circle of Dibrugarh district. The study area was at a global position of 27°17´575´´E and 94°47´960´´N where an electric-cum-solar fencing has been installed in the crop-field by the farmer. Cropping intensity of the village was 108%. Subsequent agricultural interventions in the study area were taken up under the guidance of KVK, Dibrugarh, Assam.

Flood, stray cattle and wild elephants are the major threats of the locality. The area is chronically flood-prone and suffers from regular recurrent floods due to inundation by the mighty Brahmaputra and two of its tributaries viz., Burhidihing and Sessa. Flood being a regular event farmers of this area cultivate deep water rice in low lying zone where severity of flood is relatively higher with prolong water stagnation; but rest of the area remain uncultivated after winter rice. The fields remain fallow for about 6-7 months with no productive output. Having the individual irrigation facility also, the progressive farmers can not adopt double cropping due to damage caused by stray cattle. Bamboo fencing is not cost-effective to raise the 2nd crop in large crop-field and has the inherent demerit of less durability. Moreover, the crop in this village is also damaged by herds of wild elephants destroying the traditional bamboo fencing.

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This is run by an electrically operated machine (Make: NEMTEK Energizer), which can effectively pass electric current through iron-wire used as fencing to protect the crop from livestock. The machine can be operated by battery also during power-cut up to 10-12 hours. The uniqueness of the fencing is that electricity does not pass continuously because of which animals that come in contact with the wire, get intermittent shocks and do not get killed. Animals once getting such shock do not usually come again to it. The machine has both electric and electric-cum-solar versions; the later one is much more useful in crop-field with no electric-power supply nearby. No death of stray-cattle has been reported so far from the study area.

The potential fencing area of the machine costing Rs. 60,000.00 is 4 ha and average life span of the machine is 6 years with one time replacement of the battery. Hence, a comparative study on cost of electric and bamboo fencing of 4 ha for 6 years has been made here (Table 1).

It is seen that traditional bamboo-fencing is costlier than the electric-fencing (Table 1) in long run. Even though the initial cost involvement is higher in electric-fencing due to high cost in machine component, the total cost involvement in higher in bamboo-fencing. As per estimation an additional cost of Rs. 79,300.00 is required in bamboo-fencing than electrical one for 4 ha fencing area in 6years; *i.e.* 86.48 per cent higher monetary involvement is required in traditional fencing. In other words, the cost of fencing per hectare per year is more to a tune of Rs. 3,300.00 in bamboo-fencing than electric fencing. The difference will be more in case of BPL famers due to less electric cost. Cost of the machine may not be affordable for an individual farmer but it can be purchased by a group of farmers.

Soil Health Card (SHC) being a tool of farmers' doubling income 166 SHCs have been distributed among the farmers of the village including the farmer under study i.e. soil-samples from crop-area of the study unit has also been considered for SHC preparation. Mridaparikshak (Mini Soil Kit) developed by Indian Institute of Soil Science, Bhopal has been used for the analysis. The nutritional status of the village and the study unit (area inside electric-fencing) is good for crop except for few elements (Table 2).

The variation in NPK status between the village and study unit may be attributed to many reasons including the variation in *in-situ* application of fertilizer. The variation, except in available K, is not prominent. High organic matter is an indication of healthy soil for sustainable crop production. From the fertility point of view, it is observed that multiple-cropping can be practiced in the village with external supplement of nutrients as per the need of the crop. Selection of crop, variety, sequence of cropping etc. was taken up as demonstration suitable for the agro-ecological conditions of the village in order to showcase it to the nearby farmers.

Within the electric-fencing, two high yielding submergence tolerant rice varieties viz., Jalashree & Jalkunwari as winter rice, high yielding normal sown toria varieties viz., TS-36 & TS-38 and late sown toria variety (TS-67) and short duration Ahu (Autumn rice) varieties

Table 1: Comparative cost of electric and bamboo-fencing.

S.No.	Item	Cost electric fencing (Rs.)		Cost bamboo fencing (Rs.)
		Up to 3 yrs	Up to 6 years	Up to 6 years*
Fencing Area= 4 ha; Duration considered = 6 years				
1.	Electric machine	60,000.00	-	-
2.	Battery	8,000.00	8,000.00	-
3.	Wire	2,000.00	500.00	-
4.	Bamboo	1,000.00	1,000.00	81,000.00
5.	Labour cost	1,000.00	1,000.00	90,000.00
6.	Electric cost **	3,600.00	3,600.00	-
Total cost		77,600.00	14,100.00	1,71,000.00
Grand total (up to 6 years)		91,700.00	1,71,000.00	
Cost of fencing/ha/year		3,820.00 ~3,800.00	7,125.00~7,100.00	
			Difference in Cost of fencing/ha/year =	3,300.00

*Needs two replacements after every two years; **Electric cost of BPL farmer will be less.

Table 2: Soil status of the study area

Locality	Non-elemental parameter			Available Nutrient (kg ha^{-1})				Available micronutrient (ppm)	
	pH	EC (dsm^{-1})	OC (%)	N	P	K	S	Zn	B
*Village	5.21	0.05	0.95	463.19	27.87	109.28	31.47	1.78	0.40
Status	SA	N	H	M	M	L	VH	S	D
Study unit	5.34	0.05	0.85	546.87	21.07	276.54	22.09	1.72	0.33
Status	SA	N	H	H	L	M	VH	S	D

*Village data is the mean of SHCs of 166 farmers; EC: Electrical conductivity; OC: Organic carbon; SA: Slightly acidic; N: Normal; H: High; M: Medium; L: Low; VH: Very High; S: Sufficient; D: Deficient.

Table 3: Impact of electric-fencing in terms of monetary gross-return.

Crop	Pre-intervention return (Rs.)	Post intervention return (Rs.)		
		2014-15	2015-16	2016-17
Winter/Sali rice	1,05,600.00 (Bao rice)	2,25,600.00 (Jalashree, Jalkuwari)	2,30,400.00 (Jalashree, Jalkuwari)	2,40,000.00 (Jalashree, Jalkuwari)
Toria #		79,800.00 (TS-36, 38)	90,000.00 (TS-67)	96,000.00 (TS-67)
Autumn/Ahu rice		1,39,200.00 (Dishang & Kolong)	1,44,000.00 (Dishang & Kolong)	1,48,800.00 (Dishang & Kolong)
Total	1,05,600.00	4,44,600.00	4,64,400.00	4,84,800.00
% increase (over pre-intervention)		321.02	339.77	359.09

*Pre-intervention is before using electric-fencing. #Toria is under natural pollination system.

(*i.e.* Dishang and Kolong) in rice-toria-rice sequence were grown in different years (Table 3). Thus three crops (winter rice-toria-autumn rice) were grown in proper sequence and thereby enhanced cropping intensity by 200%. However, the cropping intensity could never been enhanced without the use of electric-fencing to protect the crops from stray-animals.

It is very clear from the Table 3 that the gross-income of the study area increased many folds after intervention of scientific crop production within electric-fencing. With the intervention the gross-income increased by 321.02 per cent in 2014-15, 339.77 per cent in 2015-16 and 359.09 per cent in 2016-17. The electric-cum-solar fencing may be used as tool for increasing cropping intensity for doubling income in monocropped area such as Upper Brahmaputra Valley Zone of Assam where stray-cattle hinders the growing of 2nd crop after winter rice.

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Use of Manure and Fertilizers in Capsicum Crop Under Protected Cultivation

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ABSTRACT

In the present study an attempt has been made to study the use of manure and fertilizers in capsicum crop in six district of Punjab. In main season, glut of vegetable arises in the market which lowers down the price. Due to shortage of processing industry and storage infrastructure, off season vegetable is the viable option to enhance the income and quality of produce. The findings of the study revealed that 58.93 per cent of respondents applied farm yard manure to capsicum crop in protected cultivation out of which 36.36 per cent applied its recommended dose and 63.64 per cent of respondents applied more than recommended dose of farm yard manure to capsicum crop while 41.07 per cent of respondents did not applied farm yard manure to the crop. The study further revealed that in case of urea, 35.71 per cent of the respondents applied urea to crop while 64.29 per cent of them did not applied urea to capsicum crop in protected cultivation. All respondents who had applied urea to capsicum crop applied less than recommended dose of urea. All the respondents had applied Di-Ammonium Phosphate (DAP) to capsicum crop out of which 53.57 per cent applied more than recommended dose and 39.29 per cent of respondents applied the DAP dose at less than recommended rate and about seven per cent of respondents applied DAP at the recommended dose to the capsicum crop under protected structures.

Keywords: Capsicum crop, Fertilizers, Manure, Protected cultivation

INTRODUCTION

In main season, glut of vegetable arises in the market which lowers down the price. Due to shortage of processing industry and storage infrastructure, off season vegetable is the viable option to enhance the income and quality of produce. In off season, vegetables can be cultivated under protected structures like net house, poly house, green house, low tunnel, shade house and row covers etc. (Sirohi and Bahera, 2000). In the 21st century, for off season production of vegetables to avoid glut in main season and for superior quality of vegetables with high production, protected cultivation is the best choice for efficient utilization of natural resources (Chandra *et al.,* 2000). Tomato, capsicum, brinjal and cucumber are the major vegetable crops that can be grown under protected conditions in Punjab with high productivity and yield as compare to open field conditions. Bitter gourd and some other cucurbits can also be grown under these protected structures. Throughout year cultivation of these vegetables is possible through these technologies. To study the manure and fertilizer use behaviour of farmers in cultivation of capsicum crop under protected vegetable cultivation technologies, this study has been planned.

MATERIALS AND METHODS

The present study was conducted in six districts i.e. Amritsar, Gurdaspur, Sangrur, Moga, Jalandhar and Kapurthala of Punjab state in year 2016-17. A list of total vegetable growers in selected districts was prepared with the help of department of horticulture. From this list 150 farmers who have adopted protected vegetable cultivation were selected according to probability proportion of number of farmers doing protected vegetable cultivation in different districts. An interview schedule was designed by consulting relevant literature for data collection. It dealt with the statements to know the manures and fertilizers used for capsicum crop under protected structures. The data were collected personally by the researcher by visiting the study area and interviewing the respondents. For

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receiving the response of respondents, the investigator contacted them personally in their villages. The data were analyzed with the help of statistical tools such as frequencies, percentage methods.

RESULTS AND DISCUSSION

Data given in Table 1 indicate that 58.93 per cent of respondents applied farm yard manure to capsicum crop in protected cultivation out of which 36.36 per cent applied its recommended dose and 63.64 per cent of respondents applied more than recommended dose of farm yard manure to capsicum crop while 41.07 per cent of respondents did not applied farm yard manure to the crop. Data in Table 1 also revealed that in case of urea, 35.71 per cent of the respondents applied urea to crop while 64.29 per cent of them did not applied urea to capsicum crop in protected cultivation. All respondents who had applied urea to capsicum crop applied less than recommended dose of urea. All the respondents had applied Di-Ammonium Phosphate (DAP) to capsicum crop out of which 53.57 per cent applied more than recommended dose and 39.29 per cent of respondents applied the DAP dose at less than recommended rate and about seven per cent of respondents applied DAP at the recommended dose to the capsicum crop under protected structures (Table 1). Data further depicted that Muriate of Potash (MOP) was applied by 64.29 per cent of the respondents out of them, 66.67 per cent applied more than recommended dose while, 25 per cent of respondents applied less than recommended rate of MOP. More than 35.71 per cent of respondent did not applied MOP to the capsicum crop in protected cultivation technologies (Table 1).

It can be concluded from Table 1 that majority of respondents did not applied recommended fertilizers and manures practices under protected structures in capsicum. Similar results were observed by Sharma (2002) in chilli and by Dhillon and Kumar (2004) in mentha cultivation under open field conditions.

Data given in Table 2 revealed that maximum number of respondents (94.64%) applied Nitrogen: Phosphorus:

Table 2: Distribution of respondents according to NPK formulations and other micronutrients applied under protected cultivation of vegetables

S.No.	NPK Formulations and micronutrients	Capsicum (n=56)* Frequency (%)
1	NPK formulation (19:19:19)	53 (94.64)
2	NPK Formulation (12:61:0)	33 (58.90)
3	NPK Formulation (13:40:13)	24 (42.86)
4	NPK Formulation (13:5:26)	27 (48.21)
5	$CaNO_3$	41 (73.21)
6	$MgNO_3$	29 (51.79)
7	$FeSO_4$	31 (55.36)
8	$MgSO_4$	35 (62.50)

*Multiple Response

Table 1: Distribution of respondents according to manures and fertilizers used for capsicum crop under protected cultivation (n=56)

S.No.	Manures and fertilizers		Frequency (%)	Category	Frequency (%)
1	FYM	Applied	33 (58.93)	Recommended (20 t/acre)	12 (36.36)
				More than recommended (25-28 t/acre)	21 (63.64)
		Not applied	23 (41.07)	_	_
2	Urea	Applied	20 (35.71)	Less than recommended (50-75 kg/acre)	20 (100.00)
				Recommended (110 kg/acre in 3 split dose)	-
		Not applied	36 (64.29)	_	_
3	DAP	Applied	56 (100)	Less than recommended (25-35 kg/acre)	22 (39.29)
				Recommended (50 kg/acre)	4 (7.14)
				More than recommended (55-75 kg/acre)	30 (53.57)
4	MOP	Applied	36 (64.29)	Less than recommended (30-40 kg/acre)	9 (25.00)
				Recommended (50 kg/acre)	3 (8.33)
				More than recommended (60-75 kg/acre)	24 (66.67)
		Not applied	20 (35.71)	_	_

Table 3: Distribution of respondents according to method of application of fertilizers under protected cultivation of vegetables

S.No.	Method of application of fertilizers	Capsicum (n=56)* Frequency (%)
1	Fertigation	3 (5.36)
2	Broadcasting	13 (23.21)
3	Fertigation + broadcasting	40 (71.43)
4	Spray	32 (57.14)

*Multiple Response

Table 4: Distribution of respondents according to application of growth regulators under protected cultivation of vegetables

S.No.	Application of growth regulators	Capsicum (n=56) Frequency (%)
1	Applied	14 (25.00)
2	Not applied	42 (75.00)

Table 5: Distribution of respondents according to growth regulators used under protected cultivation of vegetables

Crop	Growth regulators	F	%
Capsicum (n=14)	Humic acid @ 1.5-2 g per kg of seed, Cytozyme @ 2 ml/L 15 days after transplanting, CCC @ 3 g/L and NAA @ 0.25 g/L of water	8	57.14
	Biozyme @ 200 ml/acre	6	42.86

Potash (NPK) formulation 19:19:19 in capsicum crop under protected cultivation. NPK formulation 12:61:0 was applied by 58.90 per cent of respondents in capsicum crop. Data further revealed that NPK formulation 13:40:13 was applied by 42.86 per cent of respondents in capsicum crop. NPK formulation 13:5:26 was applied by 48.21 per cent of the respondents in capsicum (Table 2). In case of micro nutrients, calcium nitrate was applied by 73.21 per cent of respondents in capsicum crop while magnesium nitrate was applied by 51.79 per cent of the respondents in capsicum crop. Iron sulphate was applied by 55.36 per cent of respondents in capsicum crop. Magnesium sulphate was applied by 62.50 per cent of respondents in capsicum crop (Table 2). It was observed from Table 2 that majority of respondents applied NPK formulation of 19:19:19 and calcium nitrate as micronutrient to capsicum crop under protected cultivation.

Respondents were asked about method of application of fertilizers in the protected vegetable cultivation and it was found that majority of respondents (71.43%) followed both fertigation and broadcasting method for fertilizer application in capsicum crops. While fertigation method was followed by more than five per cent of respondents in capsicum crop under protected structures. Data further revealed that 23.21 per cent of respondents applied fertilizers by broadcasting method in capsicum crop under protected structures. Spraying of fertilizers method was followed by 57.14 per cent of respondents in capsicum crop under protected structures (Table 3). It was observed that combination of fertigation and broadcasting methods was mostly followed by respondents in capsicum crop under protected structures.

Data given in Table 4 indicate that in the capsicum crop majority of the respondents i.e. 75 per cent did not applied any growth regulator and only one fourth of them applied growth regulator to capsicum crop under protected structures.

Data in Table 5 indicate that majority of respondents i.e. 57.14 per cent in capsicum crop applied Humic acid @ 1.5-2 g per Kg of seed, Cytozyme @ 2 ml/L after 15 days of transplanting in capsicum. About 43 per cent respondents in capsicum applied Biozyme @ 200 ml/acre growth regulator.

CONCLUSION

It can be concluded from Table 1 that majority of respondents did not applied recommended fertilizers and manures practices under protected structures in capsicum and majority of the respondents did not applied any growth regulator.

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FPO: Harvest the Profits of Collectivisation

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ABSTRACT

Farmer Producers Organization performs an essential function in moulding the states economy, agriculture and helps farmers to conquer numerous hurdles in agrarian production. At the point, when unrecognized farmers become capable authorities and proprietors of a FPO, they engage and help to raise more farmers and make an amazing social change towards their empowerment. So, to improve the scenario of farmers at farm and market level and provide arrangements on how farmers in agribusiness can get their due share and be perceived as important part, the FPO may lend a hand to the farmers who have a an extraordinary contribution in Indian farming.

Keywords: Agribusiness, Agricultural market, Empowerment, Farmer producers organization, Farmers

Farmer Producers Organization (FPO)

Agriculture in India is overwhelmingly positioned in huge number of separated little farm possessions and plays a significant role in the Indian economy. It gives work to around 56 per cent of the Indian workforce which adds to development of the economy and provides livelihood by giving work and ensures food security.

India is reinforcing its hold in worldwide agricultural market while major part (82%) of its farmers have small or marginal holdings of farm land and hold around 44 per cent of the land under cultivation and keep on working with drudgery in farm operations and surface from poor economic conditions. The inadequate production quantities, limited reach to public assets, misleading information sources, lack of access to modern technologies, frequent crop failures, lack of assured market, income in security and poor supply chain management has brought about high reliance of farmers on the exploitative mediators. The key identified concerns with small farm holders comprise of:

- Low level of adoption of technological advancement
- Lack of availability of adequate information
- Inadequate farming and extension services
- Lack of resources
- Poor marketing skills
- Low profit

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These circumstances give rise to the need for major structural reforms of Indian agribusiness for profitability improvement. In these unique circumstances, a manageable arrangement lies in collectivization of farming produce by accomplishing the economy of value chains with support of agri business farmers on the impartial terms. Farmers Producer organizations are the farmers associations meeting up on the principle of membership, to seek after basic interests of the members and creating specialized monetary and technical facilities that benefit their members. The FPOs are financially and technically supported by the Government, NGOs, aid agencies at national and international level, NABARD and SFAC.

The Department of Agriculture and Cooperation under Ministry of Agriculture Govt. of India started farmer producer organizations to support the state government in the formation of the FPO. The goal is to streamline the consolidation of land as well as coordination of smallholders into rural agricultural value chain. FPOs deals with market actions related to the agricultural production and it works for the welfare of the member producers. FPOs are member based farmers' institutions imperative to feed the growing population of the world where resources are limited. FPOs were shaped under different initiatives of the Govt. of India, State Governments, NABARD and different associations in the course of the last 8-10 years, directly numbering around 5000 FPOs. These FPOs require specialized handholding

support as well as sufficient capital and framework offices including market linkages for continuing their business tasks. The Cabinet Committee on Economic Affairs has given its endorsement for 10,000 FPOs to be developed in five years time span from 2019-20 to 2023-24. The report of "Doubling of Farmer's Income (DFI)' has suggested the development of 7,000 FPOs by 2022 towards union of endeavors for multiplying the farmers income.

Another new Central Sector Scheme named "Formation and Promotion of Farmer Produce Organizations (FPOs)" to frame and promote 10,000 new FPOs with a complete budgetary support of nearly Rs. 4500 crore by 2024 as part of its efforts to cut production cost and boost income of farming community. Indian Council of Food and Agriculture accepts the open door to examine the working of these FPOs and procedures to address other difficulties so as to establish a steady climate for farmers and FPOs for making profitable farm production and practically make possible the recognition of Indian farm production in worldwide farming. The Farmer Producers Organization helps farmers to accomplish beyond what they could independently do and help in aggregate farm production and promoting at their produce bringing best possible cost.

Need of FPOs

Almost 86 per cent of farmers in India are small and marginal farmers with very less land holding being less than 1.1 hectares. They face various difficulties during farming, for example, access to information and new innovation, modern technology, quality seed, composts and capital. They additionally face enormous difficulties in marketing because of absence of monetary quality chain. FPOs help in the collectivization of farmers so as to strengthen them as a group to manage such issues. The agricultural marketing has a long chain of mediators so farmers are not able to get the best price for their produce. The principle point of FPO is to make sure the better pay for the produce (Figure 1).

Significance of FPOs

FPOs helps the farmers by providing knowledge of better farm practices, marketing strategies, storage and transportation, linkage with business sectors and markets, and best price for the farm produce as they help to get rid of the mediators. The provision of direct selling provided to the farmers can lessen the expense of marketing by

Figure 1: The essential features of a FPO

interconnecting farmers and all the more linkage with the supply chain and consumers. Technical and marketing help, farmer's welfare, quality assurance, imparting knowledge to farmers, increasing efficiency through better sources of information, collective marketing and farm input purchase are the interest areas of the FPOs. FPOs help farmers to make outstanding accomplishments in crop production and improving quality through best farm practices, explore the market area, excluding the mediators and increase the farmer's income.

Services provided by FPO

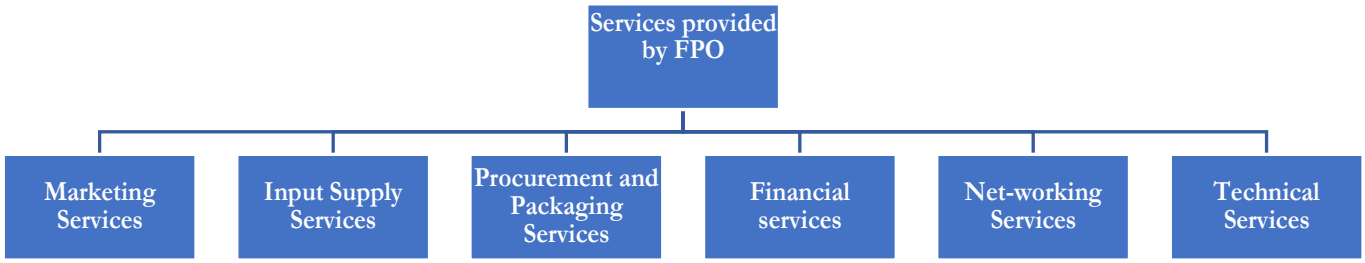
Marketing Services: The direct marketing service avoids the mediators and helps farmers to get best price for their farm produce and also saves the time.

Input supply services: The FPO can supply quality production inputs like seed fertilizer pesticides at reasonably lower whole sale rates.

Procurement and packaging services: The FPO facilities procurement of the farm produce and provides help in packaging and storage of the farm production.

Financial services: The FPO provides credit for different farm operations and for the acquisition of farm machinery.

Networking services: The FPO creates the linkage between producers and market, financial organizations, consumers, traders and government departments.



Technical services: FPO provides technical support for the various farm practices. The information regarding innovations, procedures and technologies, skill to enhance the farm production and value addition may improve the condition of farmers.

The FPOs requires support of adequate ecosystem to prosper. A congenial ecosystem is an absolute necessity for advancement of farmer producer organizations. A typical ecosystem comprises help during the financial emergency, production and marketing. The farmer association can develop linkage with the banks and line divisions for guaranteeing the foundation access for the agribusiness. The environmental change, serious dry seasons and floods and other situations are also very challenging to deal with. Financing and value chain are the associated difficulties for farmers thus to help the farmers, FPOs could be valuable. Small and marginal farmers have zero influential power in indirect selling. The achievement of FPO's will likewise rely upon different factors which are associated with the banks, retailers and corporate sector.

CONCLUSION

All the way through development of FPOs, farmers can have better collective strength for more access to quality information, quality input, innovative, technologies, finance and improves direct marketing access. The success of farmer producer organization is significant for making sure the success of small and marginal farm holders and FPOs may remain a helping hand for the millions of farmers in the country.

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Agri-entrepreneurial Innovations Impacting Livelihood Security in Indo-Gangetic Plains: Case Studies of Innovative Farmers from Uttar Pradesh and Haryana

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ABSTRACT

Agricultural development in India is in a mystifying situation while talking about the financial benefits it offers to the farmers in the context of reducing resource bases. However, there are farmers who, through tireless efforts and inventiveness, have made significant contributions to the economic uplift of their livelihoods as well as the food security of others. Because of the magnitude of its contributions to the nation's economic and social development, agriculture is referred to as an entrepreneurship entity. This study attempted to understand farmers' complex entrepreneurial behaviour and traits in a real-life context through a naturalistic design. According to the findings of the study, the entrepreneurial traits that aided the farmers in remaining innovative and adaptable in their field of work are scientific orientation, inquisitive nature, calculated risk-taking, critical thinking, adaptive mindset toward innovations, and so on.

Keywords: Agri-engineering, Diversification, Entrepreneurial behaviour, Food processing

INTRODUCTION

Entrepreneurship has been identified as a strategic tool for any nation's economic development. Policymakers all over the world, particularly agricultural policymakers, have recognised agribusiness as the engine of economic development and prosperity in the sector (Ayat, 2020). In India, where more than 60 per cent of the population is still finding livelihood from agriculture which is relatively termed as sluggish in the technological adaptation, creates a perplexing situation while talking about economic development in this sector. Though the country has achieved a substantial leap in food sufficiency and affordability in the recent past, the agriculture sector is still hampered by low productivity and economic insecurity in many areas. In rural India, farmers are forced to migrate to cities for a living due to lower remuneration or unfathomable crop losses due to volatile market dynamics and production constraints. However, the government of India has initiated many programmes to inculcate the entrepreneurial culture and climate among the farmers for better economic realisation (Sharma *et al.*, 2021); the trickle-down effect of the government schemes are in an enigmatic manner (Bornali *et al.,* 2020). The Indo-Gangetic Plains (IGP), which include the Indian states of Punjab, Haryana, Uttar Pradesh, Bihar, and West Bengal, are one of the country's primary food-producing regions. Even though the region mirrored the green revolution in the 1960s, with a series of dramatic transformations in conventional agricultural practices, it is now constrained by diminishing resource bases. Nonetheless, there are farmers who have made significant contributions to the economic uplift of their livelihoods as well as the food security of others through tireless efforts and ingenuity. When a common cause of production distress exists in a region, if some of them are able to overcome it and demonstrate a successful case to others, it is almost certainly due to intrinsic traits they have acquired over time rather than external supports. Since agriculture is considered a business entity, we hypothesised the intrinsic factors as the entrepreneurial traits of the framers in this study. As a result, we conceptualised the study and attempted to define entrepreneurial characteristics by interviewing farmers who have developed agri-entrepreneurial innovations that have impacted livelihood security in the Indo-Gangetic plains.

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MATERIALS AND METHODS

We used the case study method in a naturalistic design rather than an experimental design with controlled variables to document, study, and create a multifaceted understanding of complex entrepreneurial behaviour and innovativeness in the real-life context of farmers. Among the three different approaches of the case study (Stake, 1995), we used the collective approach with multiple cases simultaneously to generate a broader appreciation of the impact of Agri-entrepreneurial innovations on the livelihood security of farmers in Indo-Gangetic plains. The successful innovative farmers purposively selected from the Haryana and Uttar Pradesh states were included in the study. To examine the broad spectrum of agricultural aspects in relation to farmers' entrepreneurial behaviour, we included farmers who excelled in food processing, agricultural engineering, and diversified agriculture. Personal interviews conducted in an interrogative mode were used to elicit qualitative and contextual information from each case. Both the deductive and inductive reasoning logic (Sternberg, 2009) was used to reach the results and reflections of the study.

RESULT AND DISCUSSION

This session's first section provides an in-depth case analysis of selected innovative farmers in a holistic manner. The second part of this session analyse the entrepreneurial traits that support an innovation-sustaining climate based on the cases.

Case 1: Ms. Pooja Sharma - Journey of a village woman in search of self-reliance

A decade ago, Ms. Pooja Sharma was not recognised among Chandu Village, Haryana, though she possessed an igniting aspiration for self-sufficiency. Ms. Sharma's family had no place to live or a steady source of income in 2005. Though they could build a house with a family member's help, the family of five struggled to make ends meet. Ms. Sharma looked for a way to supplement her family income and began doing odd jobs to help support her family. She got a temporary job in a primary school in nearby Iqbalpur village in 2008. She used to walk 5 kilometres to school and claimed to be the first woman in Chandu village to work and leave the house. Despite the fact that she had not received any encouraging words from the villagers, she had remained firm in her decision to work to support her family and three children. As she was on a contract, the job she got wasn't lasting for long. By 2010, she was under intense pressure to find a new job. Rearing cows was an idea that came to her while she was on the job search. But the space for keeping and rearing the cows was another hurdle. Ms. Pooja's family (her father in law) had owned a 250-year-old haveli (mansion) in the village, which was believed to be 'haunted'. Ms. Pooja took a brave decision to step inside it and turn it into a cowshed. Thus the loan she got from her family member, she bought a cow and cleaned a portion of the haveli to turn it into the cowshed. Though the villagers at first treated her as a rebel she could prove that anything is possible with a strong will and determination. She out scaled the cow rearing unit, and it reached five in number.

Ms. Pooja and 29 other village women joined the Shikohpur Krishi Vigyan Kendra's, sewing centre in 2013. She realised that she should support her husband to meet the livelihood more intensely as her husbands' earnings are insufficient to meet their house needs. She soon realised that her tailoring ability would not help her financially support the family. She asked the KVK Shikohpur to teach her a skill that would help her earn a living. Thus, at KVK Shikoupur, she learned food processing skills, specifically how to process soybeans and other cereals into ready-to-eat culinary items. She turned a portion of the haveli (mansion) into a kitchen to make the food products. Despite the fact that she could gradually increase her financial base in the business, she did not stop there. She encouraged other women in the village to join the venture by providing food processing training. 'I try to let other women enjoy the freedom and self-reliance I could earn through this venture,' she says. Ms. Pooja formed a self-help group called Kshitij, which means "horizon," with 10 village women. She also proposed a corpus fund for the SHG, which she established by collecting Rs.200 from each woman in the SHG. During the crisis, the corpus fund provided financial assistance to women. It also enabled members to conduct mutual transactions and provide credit to low-income families. Ms. Sharma has now formed nine self-help groups with 150 village women to receive financial assistance from each other. First, the group purchased a processing machine to establish the bakery unit. Later, with the money collected from the members, they bought seven other pieces of machinery to expand the unit.

Reaching such heights was not an easy task for the group. Product production and processing are not merely contributors to success. The assured market is the driving

force behind any business unit's financial stability and feasibility. In this case, women who were considered farm labourers rather than asset owners made *dalia, laddoo, walnut, flaxseed, and oatmeal cookies*, among other things. Though their title has changed from farm labourers to bakers, they have ensured their sustenance by finding markets for their products. Initially, they sold their wares at farmer's markets or exhibitions. They later approached the Haryana State Government Department and the Rural Livelihood Mission to sell their products. They supplied snacks and drinks to government offices, international trade fairs organised by the state, and other exhibitions held by various departments using this link. The fundamental transformation occurred when an NGO that supports livelihoods approached Ms. Pooja in 2017 with a proposal for a project involving women in food processing. The NGO assisted the women in receiving training from a Mumbai chef. Over 150 village women were taught how to bake. The NGO also assisted in packing the products, marketing the products, and fostering their culinary skills.

At the moment, five different types of cookies that they manufacture are in the high-value market chain. Under the brand name Zingn Zest, they supply products to supermarket chains such as 24Seven, Le Marche, Reliance, and Mumbai's Hyatt Hotel and Home Ministry functions. This is an initiative incubated as a social enterprise owned and managed by these rural women entrepreneurs, with the support of Citi Foundation. The women in this group now earn around Rs 5,000-7,000 per month. A portion of the haveli (mansion) is now outfitted with cutting-edge kitchen sets and utensils. Small machines have been set up in the homes of the female members to do the work in their spare time. Ms. Pooja is not only an innovator but also an effective manager. She used the division of labour management principle to create small production value chains within the unit by distributing work, i.e., some women do the drying of beans, others clean them, and still others roast and pack them. The tenacity and dedication of one woman have clearly resulted in Chandu being more than just an incredible production unit, but also a place where many women from the village can be themselves feel empowered.

Ms. Pooja Sharma not only assists village women in learning food processing skills, but she also teaches them to sew and facilitates their training in farming practises based on their interests. She is a recipient of many laurels too. She is a recipient of appreciation from Governor-Kaptan Singh Solanki, for her contribution to producing nutrient-rich food items and snacks and is recognised as a member of ATMA. She was awarded Pandit Deendayal Upadhyaya Krishi Puraskar from Zone II, comprising Rajasthan, Haryana, and Delhi states. Her contributions to society were also recognised by the ICAR-IARI in New Delhi.

Case 2: Sh. Dharam Veer Sigh Kamboj - From A Delhi based rickshaw-puller to an honoured innovator

Sh. Dharam Veer Sigh Kamboj was born in Damla Village, Haryana, in 1963, and is the youngest of five siblings. He completed his education up to the tenth grade. He assisted his father in agriculture during his childhood and ran an *aata chakki* (flour mill) and *gur bhatti* (jaggery processing plant). Dharam Veer, the curious young man, had always been fascinated by nature. His mother's knowledge of nature and herbal plants nourished it. Being very close to his mother, he assisted her in plucking and caring for Kesuda flowers, which she used as Holi colours. He was very interested in the plant's natural colouring characteristics, which motivated him to learn more enthusiastically about the plants around him. A holy man who had visited the village deepened his knowledge of herbs by providing various information about Ayurvedic medicines and herbal ingredients in them. Through his conversation with the saint, he was also able to comprehend the potential of the herbs in earning a higher income.

In 1986, 23-year-old young Dharam Veer had a verbal altercation with his father and decided to leave his native village of Yamuna Nagar in Haryana. The journey brought him to Delhi, where he found work as a rickshaw puller ferrying traders in the Khari Baoli area of old Delhi. He learned much more about the same through those ferry passengers dealing in herbs. Being an innovator in every thought, he decided to start small scale farming, and he was the first farmer in the area to cultivate hybrid tomatoes and keep a record of his produce. He is an inventor too. According to him, he was never good in school, but he was always fascinated by machines. He developed a battery-operated spraying machine using an old tape recorder motor in 1990 for his small field, thanks to his scientific curiosity. He also experimented with various aspects of crop production and cultivation practices. He invented an insect trap out of adhesive tapes, a special plough for the sugarcane crop and practised intercropping in his field to maximise profits-Department of Horticulture guided him

in mushroom cultivation, and he started growing mushrooms in 1991. The true turning point in his life was when he decided to become an organic farmer (more suitably called a farmer scientist). He underwent training in organic farming with the help of the village development society in organic farming, and he interacted with various farmers and subject matter specialists from various agricultural universities. Mr. Dharam Veer even converted a half-acre plot of land into an organic farming laboratory.

Some remarkable examples showed his social responsibility, care for workers, and empathetic attitude. Though he used to see sweepers cleaning the street or public places till 1995, they seem as just workers with a working instrument for him. But when he keenly observed a sweeper cleaning the platform at the Saharanpur Railway Station in Uttar Pradesh, his analytical theorist had a conflict in thought about the pen and broom. Why hasn't the broom been upgraded like the pen, which evolved into a typewriter, printing press, and then a computer? Seeing the struggle of the job, he set out to create a machine that would make the sweepers' jobs easier. He developed a prototype and created a sweeping machine with an old auto engine and scrap materials a month later.

Due to the motivation provided by a forward-thinking new bank manager assigned to Yamuna Nagar in 2002, Dharamveer visited various Aloe vera and Amla processing units for various products in Rajasthan in 2004. Mr. Dharamveer was enthralled by the lucrative opportunity provided by the Aloe vera gel extractor. However, the exorbitant cost of the unit was a deterrent to getting started. Instead of abandoning the project, he decided to create his own machine because he had a good understanding of the processing methodology by this point. He began working on the development and, by April 2006, had completed the first prototype of the machine, which he primarily used for Aloe vera juice extraction. Later he converted it into a device that can be used as a processing unit for several herbs. After finalising the prototype of this machine, he took it to a nearby mechanic. With a cost of Rs 35,000 rupees finally he brought out the Multi-Purpose Machine. This machine is inimitable that it can process a wide range of products without damaging the fruit or vegetable seed.

Mr. Dharamveer received support from various organisations and units (NIF-India and GIAN North) to commercialise this machinery. Dharamveer has vended his machine in various states across the country. His multi-purpose machine and products are even exported to Japan, South America, Kenya, Nepal, and Nigeria. Besides the multi-purpose machine, he sells rosewater, tulsi oil, soybean milk, and fruit jam. His products are sold under the prince brand name all over the world. He has employed over a dozen women in the village who produce and sell processed amla and aloe vera products made with the multi-purpose machine. Dharmaveer has gone from a rickshaw puller to a successful impresario with an annual turnover of 40- 65 lakhs through sheer hard work and fortitude. In 2009, he had honoured with an award from the National Innovation Foundation (NIF) for his innovation in agro-based food processing machinery. In 2014, President Pranab Mukherjee invited him to be a guest at the Rashtrapati Bhavan for 20 days, along with five other innovators who had made significant contributions in their fields. The BBC aired a documentary based on his story.

Case 3: Sh. Raghupat Singh – the proponent of diversified agriculture

Sh. Raghupat Singh belongs to Samathal, Dist. Moradabad, U.P. He is a staunch supporter of innovative approaches to diversified farming. This farmer-owned only 1.5 ha of land under traditional farming about ten years ago, making it difficult for the family to meet both ends. The keen observer and enthusiastic experimenter in him transformed his fate from one of desperation to one of profit. He worked as a plant breeder on his farm, where he developed approximately 23 varieties of Rajma through selection and combinations. His breeding experiments on his farm allow him to develop improved varieties of various vegetables such as bitter gourd, brinjal, okra, lemon, gramme, etc. The refinement process he implements for seed production results in better and higher-quality plants. It is worth noting that he has developed a bottle gourd variety that bears 1.5-metre long fruit. He has also created two Lobia varieties, one with a one-meter pod length and the other with a 60-cm pod length.

Organic farming practices, he believes, are the best way to ensure long-term farm production. He experimented with the integration of various innovative farming methods such as organic farming, integrated farming, and the exclusive use of indigenous seeds to produce a bumper harvest from his field. While considering farming in his field as a business venture, the organic production procedures he followed allowed him to reduce input costs on one hand while also allowing him to obtain a better marketplace for the products due to the 'organic'

branding. He claims that farmers can increase their income many times over rather than just doubling their income through innovative farming practices. Aside from the farming practises he employs on his farm, he is an excellent preserver of the germplasm of local Colocasia varieties. The scientific zeal he possessed compelled him to validate the scientific rationales of the various traditional cultivational methods and techniques practised by his forefathers rather than blindly adopting the same. He is an entrepreneur who has implemented new technologies on his farm. Improved techniques include vegetable seed production (lobia, rajma, etc.), the use of improved varieties released by the Pusa Institute, medicinal plant cultivation, and vegetable pot cultivation. He has also been involved in the modification of technologies such as crop mulching, seed production technologies, intercropping practices, different patterns of nursery preparation, and so on. As an advocate for organic farming practices, he uses biological and biopesticide control of pests and diseases on his farm. He received a lot of praise and awards for the innovativeness he implemented. In the initial years, he has been honoured by various people in exhibitions and fairs. He also received the prestigious N.G. Ranga Farmer Award for Diversified Agriculture (2019), the Pandit Deendayal Upadhyay Antyodaya Krishi Puruskar (2016-17), and the Jagjivan Ram Abhinav Kisan Puruskar/ Jagjivan Ram Innovative Farmer Award (2018).

Echoes of the cases documented

There is a new push to promote farming as a business worldwide. Given the magnitude of contributions agriculture makes to the nation's economic and social development, it is referred to as an entrepreneurship entity rather than a business firm. Like in any other economic sector, innovations and innovative actors are the driving forces for its shove. Since the innovations made by the farmers in this study had proved their acceptance and superiority in real-life situations, we paid particular attention to analysing the entrepreneurial traits of the farmers in this study.

All the three cases studied here had a common eccentric stage in their life as they started the innovative journey from a point that intensely demanded financial independence and stability for their family. Though the farmers' financial status is considered an extrinsic factor, it acted as a propeller for the intense achievement motivation among them. Ms. Pooja's case study demonstrated that even someone from such a disadvantaged background can excel in life with determination and hard work. Her success was built on perseverance and bravery. We can see that she is a good situational analyst if we look closely. Initially, she was trained to sew, but she quickly realised that the sewing job would not make her self-sufficient. She did not come to a halt at that realisation. She summoned the courage to ask the KVK scientist to teach her something that could truly change her life. She is knowledgeable enough to conduct market research in order to finalise the product that can be made from crop produce available in their village. It indirectly raises the demand for and price of farm produce. She and her group's journey to the global value chains is an example of a strategic market decision. She is both a leader and a motivator. Her vision to make other women in the village financially independent and self-sufficient demonstrates her leadership ability. Similarly, the establishment and development of SHGs for the socio-economic empowerment of disadvantaged women demonstrates how she envisions the developmental changes it can bring to the village. She is a person who has the thrive to achieve the goals set by herself as she was competing with herself for excellence. Even she converted the haunted house into a well modular kitchen and office of the group. She is facilitating the empowerment of the women in the village to get skilled in their interested domain. It shows her consideration, care and empathetic ability towards the felt needs of other persons.

Sh. Dharam Veer Sigh Kamboj is more of a farmer-scientist and engineer by nature. It points to the adaptability he showed and his openness towards knowledge. The Dharam Veer's inquisitive and curious nature drew him to experiment with many things he saw around him. Though financial circumstances always pushed him to do something lucrative, his scientific orientation won out, and he attempted to create prototypes of machinery that could benefit many farmers by lowering costs. He consistently exhibited a critical thinking ability and realised that traditional farming practices wouldn't make a remarkable change in his livelihood if it was not innovative in many dimensions. As a result, he was constantly experimenting with new farming methods. His scientific bent compelled him to keep a portion of his land as an experimental laboratory. He is always eager to experiment and invent new machines that are both cost-effective to build and productive to operate. Rather than approaching his actions from a business standpoint, he approached them with passion and dedication.

Sh. Raghupat Singh's case demonstrates how nature nurtures an innovator who values the natural way of protecting and improving the environment. Innovative approaches have always cherished his attitude towards farming. He is a knowledge seeker and always showed an openness to developments in science. He exhibits a very good observation skill combined with the scientific knowledge to select a superior line of progenies for different crops. This carving for ability and desire to be unique helped him earn much more for the products by giving the Organic brand. His scientific orientation has motivated him to experiment with various aspects of the knowledge he has gained. He has a strong desire to work hard in order to achieve the goals and standards he has set for himself. The calculated risk-taking, proactiveness and intentions he had motivated him to experiment the organic farming practices in his field. He could also sense the market value that innovative farming practices could provide for his produce.

CONCLUSION

Farmers' entrepreneurial traits and characteristics are the fundamental building blocks for agribusiness development in any region. The experimentation and innovativeness demonstrated by humans at various stages of development resulted in an agrarian settlement from the nomadic hunter-gatherer pattern. Agriculture's depleted resource base necessitates the creation of a more entrepreneurial climate that can inculcate innovations to provide a better living. Many farmers could reap befefits from the farming practices through judicious exhibition of the entreprunurial traits they have in various crises. In the present study, we tried to identify such qualitative entrepreneurial traits, which helped the achiever framers to excel in their field by critically examining their cases. Though the selected innovative farmers' fields of work varied, all of them shared some characteristics such as scientific orientation, inquisitive nature, calculated risk taking, critical thinking, adaptive mindset toward innovations, and so on. According to the study's findings, those entrepreneurial traits aided them in remaining innovative and adaptive in their field of work.

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