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All correspondence may be made at the following address:

Chief Editor

Journal of Community Mobilization and Sustainable Development

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

E-mail: journalmobilization@yahoo.com

Website: www.mobilization.co.in

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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 1400 Life Members. The recognition of the Society in the efforts for strengthening the forum for scientific communication is growing among the related professionals and concerned agricultural stakeholders rapidly. The Society works on following objectives-

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

ABOUT THE JOURNAL

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

The aim and scope of the journal are:

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

Editorial

The declining trend of agriculture sectors' contribution to GDP implies a significant efficiency gap in agri-value chains due to persistent structural and operational challenges. A dynamic shift in agricultural operations from heirloom structures to technology-driven solutions is desperately needed. Fostering entrepreneurship, which will bring vitality, new thinking, and jobs to the farm sector is critical to the country's economic destiny. 'Startup India' is a flagship programme launched in 2016 with three basic action items, i.e. "simplification and handholding," "financial assistance and incentives," and "industry-academia cooperation and incubation" to leverage the potential of India's entrepreneurial ecosystem in all sectors. The technological advancement and increasing production pressure-demand the fusion of traditional knowledge practices and cutting-edge technologies in the agriculture value chain to devise disruptive strategies to tap the potential of entrepreneurial ecosystem benefits. At this point, start up initiatives in agriculture is approaching the fourth phase of disruptive innovation, known as Agriculture 4.0. It calls for the re-scripting of the contemptible agriculture value chains to an efficient system through the infusion of smart technologies like artificial Intelligence (AI), data analytics, software as a service (SaaS), Internet of Things (IoT) etc. Being a committed professional society for the social system mobilization through its scientific contribution and dedicated actions, the Society for Community Mobilization for Sustainable Development (MOBILIZATION Society) is always keen on pioneering efforts to showcase techno-cognitive advancement in the agriculture sector. In this regard, the organization has announced its 10th National Seminar on "Agriculture and More: Beyond 4.0," in partnership with SKUAST-Kashmir and SKUAST-Jammu which will be held during 26th -28th May 2022.

I am pleased to deliver to our esteemed readers the current issues of the MOBILIZATION journal (January-April, 2022). The current issue covered a wide range of topics from various perspectives. A few among them include improvements in the framing system through technological adaptation, COVID-19-induced social system changes and mitigation practices, frontline technology demonstrations and their impact, perception studies on nutrition and community health aspects, prospects of agricultural education as perceived by students and occupational stress among teachers, utilization and impact of innovative and ICT-based technologies, spiritual intelligence among rural youth, market-led and market-oriented extensions like price forecasting, incubation etc., and crop genetic divergence studies. I am confident that this issue will provide you with a fascinating intellectual experience, as it contains a diverse collection of strategic and action-oriented research findings from various sectors.

Dr(s). Souvik Ghosh, S. K. Dubey, R. Roy Burman, Nishi Sharma, S.R.K. Singh, Reshma Gills, Sudipta Paul, and Sujit Sarkar of the editorial team deserve my heartfelt thanks and appreciation. Their consistent and dedicated efforts and an efficient editorial process aided in the timely publication of the journal without compromising its quality, norms, and publication standards. My heartfelt gratitude goes to Dr. Subhashree Sahu and Dr. Hema Baliwada for their consistant supervision and assistance in shaping this issue of the journal as on-line editors. Most importantly, I would like to thank our valued readers and authors for their scientific contributions and intellectual support, which have enabled our journal to achieve a respectable and appreciable position among other scientific publications.

J.P. Sharma
Chief Editor

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ICT Tools Use Pattern of Farmers: A Review

Abhishek Mishra, O.P. Yadav[1], Swatantra Pratap Singh, Rajeev Singh, Nikhil Vikram Singh and S.K. Dubey*
ICAR-ATARI, Zone III, Kanpur, Uttar Pradesh
[1]CSAUA&T, Kanpur, Uttar Pradesh

ABSTRACT

The present review aims to highlight the agricultural scenario with the emergence of the new communication technology especially ICTs. ICT can effectively be applied in agriculture field directed for the socio-economic development of the farming community. Timely dissemination of improved technologies, size of land holding, soil type, type of crops and related pests/diseases is the real issue to brazen out ahead for the agricultural scientists/experts. The timely availability of accurate information and its proper utilization is indispensable for agriculture. ICT can be helpful to farmers in way that, transfer of technology, procurement of inputs and selling of outputs can be facilitated using it. The timely and relevant information and practical solutions of the agricultural problems helps the farmers to adopt good agricultural practices, make better choices of inputs and to plan the cultivation properly.

Keyword: ICTs, Farming, Socio-economic development and Farm productivity

Information and Communication Technology (ICT) includes communication device or application, encompassing cellular phones, computer, internet and network, hardware & software, satellite systems & videoconferencing or distance learning (Pandey, 2017). ICTs are often used in different areas i.e. education, agriculture, healthcare or libraries. ICT offers the ability to timely availability of information provided to farmers and minimize the risk of uncertainty in agriculture sector (FAO, 2017). Knowledge of ICT and its use in agriculture will enable the development of strategies to promote ICT adoption and increase the effectiveness and efficiency of information used in agriculture (FAO, 2017). It is a fact that access to information holds the key for agriculture development. Improved communications and information access is directly related to socio-economic development of country. Study by Kale *et al.* (2016a) reported that experts of the KVKs had positive perception towards ICTs for the extension work. Experiences of integration of ICTs in the agricultural institutes have been showing encouraging results and also complementing conventional communication methods (Bisht *et al.,* 2010; Kale *et al.,* 2015a). At the same time, it is also a challenge to place rural ICT infrastructure, developing appropriate content, ensuring sustainability and scaling- up (Sawant, 2010). There are many authors or experts studied the role of ICT in the rural areas for agriculture development. In the present article, authors have attempted to make detailed review of the role of Information and Communication Technology in agriculture and rural areas under the following subheads.

Extent of use of ICT by farmers

Since last decades many researches have been conducted on use of ICT and its initiatives in agriculture and rural areas specially for accessing the information. Lokhande (2004) reported that use of internet and computers for different purpose is increasing rapidly. E-governance will be fruitful for the farmers as they would be able to get information regarding prices of commodities in different markets, new varieties of seeds, new techniques and methods of cultivation, crop protection guidance. Singh *et al.* (2007) studied that 9.5 per cent of radio users and 11.5 per cent of television viewers maintained a diary for preservation of information received through radio and TV farm programmes. Sen (2008) concluded that majority of the respondents (46.67%) had medium level of usefulness regarding to ITC in agriculture, 36.67 per cent low and 16.66 per cent of them high level of usefulness of ITC in agriculture. Mabe and Oladele (2012) revealed

*Corresponding author email id: skumar710@gmail.com

that information communication technologies should be made available to extension officers, so that they will become more aware of the use of ICT in extension work as tools that can gather and disseminate agricultural information. Sivabalan *et al.* (2013) studied that assesses the extent of use of ICT Tools such as internet and mobile based technology dissemination system, community radio and *kisan* call centres by the rural people and the major constraints for using ICT based tools. Access to ICT among farmers the awareness about KCC was highest (75%) followed by telephonic services (65%) and SMS based service was least aware (10%). But the usage was very narrow as only 18 per cent had actually used the services of KCC. The usage of telephonic services was highest with 45 per cent and none of the respondents reported to have used SMS based technology services. Similarly study revealed that majority of respondents (56.25%) had medium level of ICT application in agriculture. The extent of use of computer, internet, mobile phone, kisan call center and information kiosk in agriculture was noted to be 43.71, 39.31, 46.08, 36.40 and 27.52 per cent respectively by the extension personnel (Verma, 2013). It was also found that 54.17 per cent of the respondents had access to mobile phones, followed by radio (33.33%) and television (31.67%). Only 20 per cent respondents had access to computer and 19.17 per cent had access to internet facility (Williams and Agbo, 2013). ICT was used by 31.67 per cent respondents to get information on new varieties, followed by respondents to search for places where farm products are highly needed (25.83%), exchange knowledge and ideas with fallow farmers (25%), get information on market situation (24.17%) and searching for recent information or innovation in agriculture (22.50%).The use of ICTs was limited by technical, infrastructural, financial and institutional constraints Jayade (2014) concluded that farmers need information on six stages of crops through the agricultural cycle: (i) crop planning (ii) buying seeds (iii) planting (iv) growing (v) harvesting, packing and storing (vi) selling. The application of ICT in agriculture is increasingly important at all six stages of agriculture. E-Agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. More specifically, e-Agriculture involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture. Sireesha *et al.* (2014) revealed that among all ICT services TV was utilized by the most of the animal husbandry oraganizations followed by Video Conferencing, Tele conferencing and Multimedia CDs. The other ICT tools utilized by the different organizations were wireless set conferencing by limited number of animal husbandry organizations. Like above all studies Reena Deora in 2014 concluded that for "gaining knowledge / or getting information" the tools used by Subject Matter Specialists were computer and mobile (100%), internet (80%), CD/VCD (30%), for "transfer of technology"- mobile/ telephone (80%), internet (70%), computer (60%), CD/VCD (50%), still / video camera (40%), for "training and teaching"- computer (70%), internet (60%), CD/VCD (44%), still/video camera (30%), for making/sending reports- computer (100%), E-mail (80%), internet (64%) and still/video camera (20%). It was reported that maximum respondents (60%) get their information from TV and cinema, 16 per cent of the respondents got it from print media, 14 per cent of respondents got it from computer and 10 per cent respondents got their information from radio (Saurabh, 2014). Singh (2016) also revealed that higher percentage 38.33 per cent of the information communication technology services users found sometime users regarding overall information communication technology services followed by 36.67 per cent information communication technology services users found always users and 25.00 per cent found never users of overall information communication technology services in agricultural development. Tomar *et al.* (2016) found the association between socio-demographic profile and communication characteristics of farmers with their extent of use of ICTs, it was found that education, total family income, mass media exposure, cosmopoliteness, information seeking behavior, extension contact had positive and significant relationship with the extent of use of ICTs. On the other hand, age, landholding and social participation had non-significant relationship with the extent of use of ICTs.

In the same manner Sabir Hussain Awan *et al.* (2019) also studied and found that source of information of the farmers is fellow farmers (37.39%) following by Radio (29.13%), Major barriers to access modern information systems is high illiteracy (39.43%) and non-availability of local information centers (36.08%).

Benefits of use of ICT as Perceived by Farmers

There were many studied have conducted to found the advantage of use of ICT at farmer's level. Michaili (2005) evaluated the adoption of computers and internet among

farmers and determined the importance of computers in their business which was creating real benefits in the areas of financial management, budgeting and word processing in the region of northern grace. Ahmed and Abdel (2006) observed that e-mail is highly utilizable ICT services in agriculture for transferring the information and advisory services to farmers. The information is provided in variety of ways such as SMS, email, newsletters, call centers etc. They further observed that mobile telephones can have economic implications on their users become they can save time and money especially for those who do not prefer to leave their worksites and travel into nearby towns and cities to make their own purchases of agricultural inputs, prices and other needs. Duflo *et al.* (2007) concluded that simple mobile phones can be used as a means of collecting both farmers and agent level data, thereby improving the accountability of extension service voice and SMS can be used to collect data on farmer's adoption, costs and yields on a more frequent basis, rather than waiting for annual agricultural surveys, where recall data on costs and production are often subject to measurement error. Mobile phones have been spreading fast among farmers and they are exchanging their marketing, weather and business information among each other. Rahman (2007) reported that telephones allowed farmers in Gezira state to be better informed about new agricultural information, buying agriculture inputs, market information and solving agricultural problems. Adamides and Stylianou (2013) reported that the mobile phone is more accessible and less expensive among another ICT technology. So that, these studies found that mobile phone usages appear to be an effective and low cost mean of providing information, and it was considered to be an effective tool for poverty reduction for poor rural households. Egwu *et al.* (2013) revealed that out of 45 per cent of the respondents who were farmers, 41.7 per cent were mainly crop farmers. 54.17 per cent of the respondents had access to mobile phones whereas 57.50 per cent had no access to computer. ICTs was used by 31.67 per cent of the respondents to get information on new varieties, ICT was effective in information delivery in determining the quantity of farm inputs.

Manfre and Nordehn (2013) told that, mobile phones were used to call extension experts and inquire about general information on new technologies. Farmers also use mobile phones to gain specific information, such as how to treat a plant disease. The farmer will call the extension agent and describe the symptoms and receive advice over the phone. Rahman *et al.* (2015) found that (37.3%) of the farmers were use mobile phones for acquiring agricultural information, while 21.3 per cent used internet facilities provided by Agricultural Information and Communication Centers (AICC), a community based ICT hub established by the Ministry of Agriculture. Only 2 per cent farmers were found having use of smart phone. Farmers' characteristics such as education, training received on ICT, knowledge on ICT had a significant positive relationship with the extent of use of ICT based media by the farmers, while age and constraints in using ICT had a negative relationship with their extent of ICT based media use. Diksha (2015) observed the respondents in use of ICTs were knowledge of developmental programmes for women and children, saves time, getting latest information, information within no time, increase education, to know credit sources, get answer to each and every query and reduce face to face meetings. Joshi and Dhaliwal (2015) observed that extent of use of cell phones in the area of extension followed by computers and landlines but negligible use of internet in all components. The major area of use was the information regarding the local extension services, development projects and expert advice. In governance, health services and payment of bills are major activities used by the landlines and cell phones respectively. They showed negligible interest in the area of research. Among the non progressive farmers, there reliability was more on landlines and used it mainly for expert advice and local extension services. They also used cell phones appreciably to gather the information on sustainable practices while subsidiary information, banking and health services were major services among the e-governance. The uses of computers were meager but internet use was almost none among both the groups of farmers. Kafura *et al.* (2016) revealed that most use of different ICT tools was found low among the respondents in the study area. Television as ICT tool was found more popular among the farmers in securing agricultural information. CD/DVD and *Grameen* phone Community Information service were the least popular ICT tools in dissemination of agricultural information. Level of education, annual income, innovativeness, and cosmopoliteness and ICT knowledge had positive significant relationship with the extent of use of different ICT tools by the farmers while age and farming experience showed negative significant relationship.

Suggest Strategies for Making Effectiveness of ICT for Farmers

As updating of new technology in agriculture, significant improvement in the crop productivity was also noticed. However, proper resource mix and appropriate culture practices become a pre-requisite for the adoption and success of new farm technology, which are often beyond the reach of majority of the farmers (Gaddi *et al*., 2002). Soni (2002) found the perceptions of improved technologies users need to be under-stood and ensure viable potential of modern technology use on their own end. In other side it is very essential both for the farmers and execution of programme designed both raising agricultural production that they would know whether investment in modern inputs like high yielding variety, fertilizer, plant protection, chemicals and irrigation etc. the present study is examine the comparative economics of gram production of the existing and improved technology adopted by the farmers and adoption gap influence the productivity. The result indicated that with the adoption of modern technology the yield of gram increased on an average 3.35 quintal per hectare. This we can say that there exist a vast yield potential in the area. In economics point of view the improved technology was found to be highly remunerative also. It is resulting in encouraging additional net returns Rs. 910.50/hectare. Vasanthi and Hema (2003) revealed that computers are acting as a support system to improve the teaching learning process as it helps in teaching new skills or concepts, give remedial teaching, providing for enrichment of learning, creative thinking and problem solving along with its capability to provide instant response and its flexibility to suit the learner's needs and requirements through tutorial interaction and dialogue. Anderson and Feder (2004) observed that agricultural extension services include transferring knowledge of farmers, advising and educating farmers in their decision making, enabling farmers to clarify their own goals and possibilities and stimulating desirable agricultural developments. Traditional public sector extension services use a variety of extension programmers to overcome barriers to technological adoption without much success. It was suggested that more research and development in the ICTs will not only help in the development and information area but will also help people to get skill, knowledge etc. easily if the gadgets are in affordable limits. The information and communication technology has got a very high stake for development of various combinations, which can be adopted in the traditional market and society (Mishra, 2008). Franklyn and Tukur (2012) focused attempt to contribute to a better understanding of adoption success factors and adoption problems of ICT in agriculture. It also highlights e-Agriculture as an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes. The paper concludes that "End Users" are the key factor in defining the needs and critical success factors for ICT development and implementation. It was also reported that ICTs for agricultural extension projects need to be compared and evaluated objectively. Low cost ICT tools such as mobile phones having lot of promise for agricultural extension. At the same time, experiences are indicating that ICT are going to play greater role in private sector agribusiness, market information and market intelligence. Further, certain type of farm information (*e.g.* informing government schemes) and online monitoring of the progress of the governmental schemes are proved successful. Hence, it is high time to find out appropriate information to provide through ICTs. As indicated earlier, formulating National and State level e-Agriculture policy, human resource development, strengthening ICT infrastructure, localization and customization of appropriate content are to be taken-up to harvest the benefits of ICTs for agricultural extension services provision and agricultural development (Saravanan, 2013). Islam *et al.* (2016) found that most of the farmers are not familiar with the online agricultural information sources due to lack of technological facilities, such as a computer and Internet connection. Farmers are not concerned about using ICTs or online information sources; rather, they are worried about the low prices of their products and high prices of seeds, fertilizers, pesticides, fuel and transportation. Their primary sources of information are television, radio, newspaper, fellow farmers and agriculture extension service providers.

Singh (2016) revealed that "information by the authorities must be received on time" (M.S. 2.25) followed by "time to time information about information communication technology services given by authorities" (M.S. 2.24), "proper management of network and electricity" (M.S. 2.18) and "promotion facility given by Gram Panchayat" (M.S. 2.14) respectively. Constraints and Suggestions Perceived by KVK Scientists in Utilization of ICT for Agricultural Extension that the lack of expertise to use ICT, slow functioning of internet, lack of trainings related to ICT use, lack of awareness among the farmers regarding ICT use. These constraints minimize the

implementing suggestions by respondents like; proper and improved infrastructural facilities at KVKs as well as village level, skill development and updating with trainings, creating awareness regarding use of ICTs for educational and agricultural purpose (Kale *et al.,* 2017) and one another research identified the general problems faced by the MSDA extension personnel were 'internet connection is poor/slow' (59.09%), 'lack of proper training facility' (38.18%), lack of knowledge (30.90%), insufficient power supply' (30.00%) and 'inadequate computer facility' (22.73%)'. Physiological problems faced by the MSDA extension personnel were; 'eye pain' (36.36%), 'hand pain' (34.55%), 'back pain' (22.13%). Social Problems encountered by MSDA extension personnel were decrease in frequency of 'time spent with children's (63.63%), 'conversation with parents' (59.09%), 'time spent in social events or gathering outside home'(39.09%). Economical Problems faced by MSDA extension personnel like 'low income' (79.09%), 'high cost' (70.00%) and 'cost of data pack' (66.36%). Technological Problems faced by MSDA extension personnel like insufficient information to use (69.09%) and age factor (36.36%) (Patil *et al.,* 2017). Study revealed the significance of New ICT in agriculture, discuss their opportunities in agriculture and examine their challenges as well. ICT can help a farmer to get relevant information regarding agro-inputs, crop production technologies, agro processing, market support, agro-finance and management of farm Agri-business. Agriculture sector faces major challenges of enhancing production in a situation of falling natural resource necessary for production. The growing demand for agriculture products, however, also offers opportunities for farmers to sustain and improve their livelihood (Parmar *et al.,* 2015).

CONCLUSION

ICT enable the farmers and agricultural experts for disseminating the agricultural information and its proper utilization. ICT projects are making breakthrough in agricultural information dissemination and acts as a bridge between farmers and experts. The application of ICT tools in agriculture has emerged as an important pillar of extension education to support the agriculture and rural development by improved information and communication access. ICT tools have potential to make the rural communities prosperous as it enables the dissemination of timely and relevant information, easy to access, cost-effective ways at the right time. ICT presented various opportunities to empower small land holder farmers by strengthening their capabilities in marketing their products and all agricultural related works. ICT can turn agriculture into more diversified, knowledge intensive sector of the economy and thus become more effective in meeting farmer's aspirations. From these results, it is important to encourage the use of ICT tools in rural level, by some measures such as: ICT infrastructure development, training on ICT tools use towards farmers, especially smallholder for setting market information. Transforming agriculture sector into the modern digital agriculture to further improve social and economic benefits. Improving the digital access by farmers with technological advances and skills improvement.

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Assessment of Knowledge and Attitude of Peri-urban Farmers Towards COVID-19

Jagriti Rohit[1]*, G. Nirmala[2], K. Nagasree[3], G. Sriker Reddy[4], S. Vijaykumar[5], Vidhyadhari[5] and V.K. Singh[6]
[1]Scientist, [2]Head and Principal Scientist, [3]Principal Scientist, [4]Research Assistant, Transfer of Technology Section, ICAR-CRIDA, Hyderabad
[5]ACTO, CRIDA-KVK, Hyderabad; [6]Director, ICAR-CRIDA, Hyderabad

ABSTRACT

The COVID-19 outbreak affects all segments of the population and is particularly detrimental to members of those social groups in the most vulnerable situations. The restrictions imposed as a measure to contain the spread of the virus has led to disruption in farming activities and agricultural supply chain. Farmers, already stressed by numerous factors have to face an unprecedented crisis that may last for a long time. The present study attempts to investigate the farmers' knowledge and attitude towards COVID-19 during the second wave of the pandemic. The study also examines farmer's attitude towards agriculture and its association with various demographic variables. The study was conducted in Rangareddy and Vikarabad districts which are surrounding Hyderabad. Following random sampling, two mandal from each districts were selected. Further, from each mandal two villages and 30 farmers from each village were selected randomly. Hence, the total sample size for the study was 240 farmers. The results of the study showed that the majority of farmers had the good knowledge about the symptoms and transmission of the disease but the knowledge about the asymptomatic transmission was less. They also had positive attitude toward the control of the pandemic. Farmer had faith in the control measures taken by the government. The findings also indicated that pandemic had decreased the confidence of the farmers in agriculture and led to the Distress sale of agricultural products. Education showed positive relation with knowledge and attitude of the farmers towards the pandemic. The study provides critical and timely insights into the farmers knowledge and attitude towards the pandemic. The results of the study will government and public health organizations establish and implement appropriate policies and interventions towards educating the farmers towards better management of the pandemic like situations.

Keywords: Attitude, COVID-19, Distress, Knowledge pandemic

INTRODUCTION

The coronavirus disease (COVID-19), which has been characterized as a pandemic by the World Health Organization (WHO), is attacking societies at their core. The COVID-19 outbreak affects all segments of the population and is particularly detrimental to members of those social groups in the most vulnerable situations. For several years, farmers have faced increasingly high levels of stress as markets tanked, weather destroyed their crops, and hard work and long hours proved inadequate to bring any profits. Now, COVID-19 adds one more burden to that already heavy load. In this crosshair, the farming sector in India is one of the most vulnerable sectors to bear the brunt of the pandemic. The restrictions imposed as a measure to contain the spread of the virus has led to disruption in farming activities and agricultural supply chain. Farmers, already stressed by numerous factors have to face an unprecedented crisis that may last for a long time. This can lead to an increase in Farmer's distress. During the lockdown Prices received by farmers fell as a result of the supply disruption and fall in demand. The decline was marked in certain food grain like wheat, perishables like vegetables and fruit, eggs and poultry chicken (Ramakumar, 2020). The vulnerabilities in agricultural supply chains and depleted workforces caused by the COVID-19 crisis have hurt farms of all sizes in India, especially high-value farm enterprises. Most affected have been dairy farming, floriculture, fruit production, fisheries, and poultry farms. The implementation of nationwide lockdown due to corona virus pandemic (COVID-19) brought havoc into the lives and livelihood of these migrant workers living in

*Corresponding author email id: jags.rohit@gmail.com

the cities who were primarily depending upon daily wage earning and surviving through contribution of labour to the informal sector (Kumar *et al.*, 2020).

A lack of awareness of how diseases spread could undermine preventive efforts and behaviours (Bandura, 1998). Lessons learned from the severe acute respiratory syndrome (SARS) epidemic point out that high knowledge, attitudes, and practices (KAP) toward different epidemics decrease stress and panic and pave the way toward their prevention and control (Person *et al.,* 2004). Also, high public awareness toward Ebola and the Middle East respiratory syndrome (MERS) provided the background to control them (Almutairi et al., 2015). Several researches have established that study of knowledge and attitude helps in understanding the adoption of practices and preventive measures by the people (Papagiannis *et al.,* 2020). Till date, various studies have been conducted to assess knowledge and attitude of the various section of the society towards the pandemic. But there is dearth of literature regarding farmer's knowledge and attitude towards COVID-19.

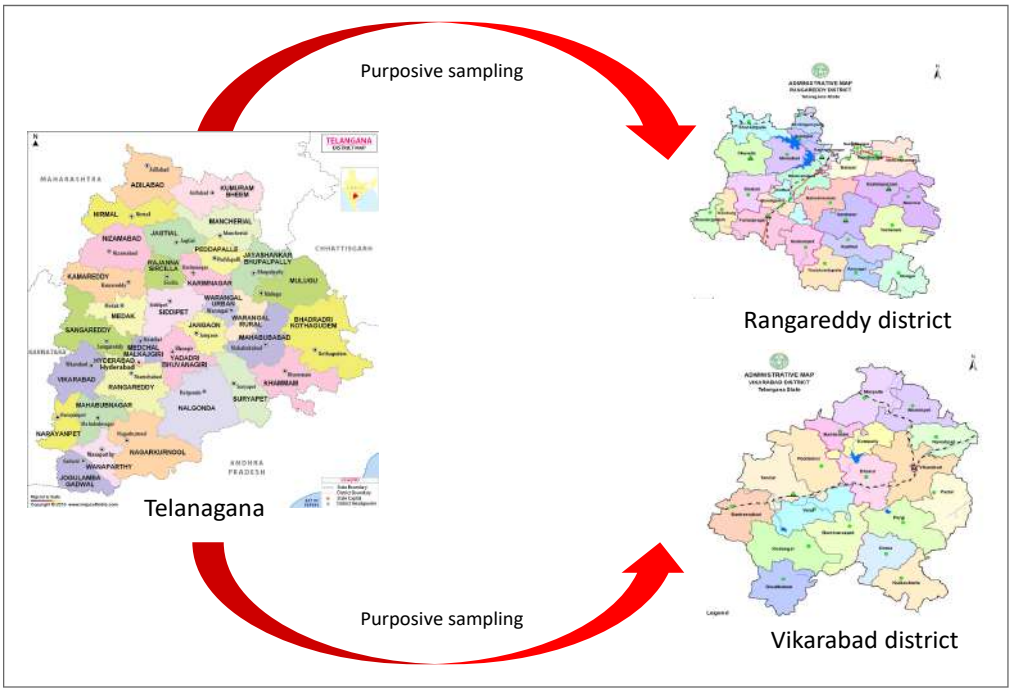
The present study attempts to investigate the farmers' knowledge and attitude towards COVID-19 during the second wave of the pandemic. The study also examines farmers attitude towards agriculture and its association with various demographic variables. The findings will help the government and public health authorities to design targeted intervention for better management of such extreme events.

MATERIALS AND METHODS

The study was conducted in Rangareddy and Vikrabad districts which are surrounding Hyderabad. These districts supplies vegetables, fruits, flowers (Horticultural products) and dairy products to Hyderabad in large quantities. During the pandemic and subsequent lockdown, the livelihoods of farmers were severely affected. Floriculture sector was particularly affected from these regions. (Hindu, April, 2020). These farmers are dependent on the Hyderabad market for the sale of their products. Hence, the farmers from these areas will constitute the respondents of the study. A multistage sampling technique was used for the study. Purposive sampling was done for the selection of the districts. Rangareddy and Vikrabad districts were selected as study area. Two Mandals from each district was selected randomly. Subsequently, two villages from each Mandals were selected using random sampling. Thirty farmers from each village were selected randomly hence constituting a sample size of 240 farmers (Figure 1).

The questionnaire was prepared after extensive literature reviews and taking inputs for the experts. The questionnaire primarily consisted of four sections. The first section gathered information on respondents' sociodemographic characteristics. The second section assessed participants' knowledge of COVID-19. This section included 23 items on modes of transmission, clinical symptoms, treatment, isolation, prevention and control. The respondents could respond as true, false and not sure.

Figure 1: Selection of locale



The third section assessed participants' attitudes toward COVID-19, using a three-point Likert scale. For each of seven statements, respondents were asked to state their level of agreement, from "disagree," "undecided," "agree," The final section of the questionnaire assessed the respondents' attitude towards agriculture during the pandemic. A five point likert scale ranging from "strongly disagree" to strongly was used to take response of the participants (Table 1).

Table 1: Reliability values

Variables	No. of Items	Cronbach Alpha
Knowledge	13	0.851
Attitude towards COVID-19	7	0.813
Attitude towards Agriculture during COVID-19	15	0.780

RESULTS AND DISCUSSION

Knowledge about the symptoms, mode of transmission and prevention is important in dealing with effective management of spread of the disease. The results of the study (Table 2) indicated that the farmers had good knowledge about the symptomatic COVID-19 infection but they had less knowledge about the spread of disease from asymptomatic transmission. About 93 per cent of the farmers had knowledge about the main symptoms of COVID-19 were fever, fatigue, dry cough, and body aches. Al-Hanawi *et al.* (2020) in their study also indicated that the respondents had a mean of 81.64 per cent in the knowledge questionnaire. About 48 per cent of the farmers responded that Persons with COVID-19 cannot infect the virus to others if they do not have a fever as true. This reflects that observable symptoms of COVID-19 were recognized by the farmers. This can lead to spread

Table 2: Knowledge of the participants towards COVID-19 (n=240)

S. No.	Knowledge Statements	True		False		Not Sure	
		f	%	f	%	f	%
1	The main clinical symptoms of COVID-19 are fever, fatigue, dry cough, and body aches.	223	92.9	4	1.7	13	5.4
2	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus.	199	82.9	13	5.4	28	11.7
3	There is currently no effective cure for COVID-19, but early symptomatic and supportive treatment can help most patients recover from the infection.	203	84.6	16	6.7	21	8.8
4	Not all persons with COVID-19 will develop to severe cases. Only those who are elderly and have chronic illnesses are more likely to be severe cases.	180	75.0	17	7.1	43	17.9
5	Eating or touching wild animals would result in infection by the COVID-19 virus.	15	6.3	158	65.8	67	27.9
6	Persons with COVID-19 cannot infect the virus to others if they do not have a fever.	115	47.9	40	16.7	85	35.4
7	The COVID-19 virus spreads via respiratory droplets of infected individuals	203	84.6	9	3.8	28	11.7
8	The COVID-19 virus is airborne	143	59.6	21	8.8	76	31.7
9	Ordinary residents can wear face masks to prevent the infection by the COVID-19 virus.	217	90.4	6	2.5	17	7.1
10	It is not necessary for children and young adults to take measures to prevent the infection by the COVID-19 virus	7	2.9	202	84.2	31	12.9
11	To prevent the infection by COVID-19, individuals should avoid going to crowded places and avoid taking public transportations	212	88.3	9	3.8	19	7.9
12	Isolation and treatment of people who are infected with the COVID-19 virus are effective ways to reduce the spread of the virus	192	80.0	16	6.7	32	13.3
13	People who have contact with someone infected with the COVID-19 virus should be immediately isolated in a proper place. In general, the isolation period is 14 days.	197	82.1	8	3.3	35	14.6

of disease due to less knowledge of the respondents. Efforts should be made people aware about the asymptomatic spread of COVID-19. Around 90 per cent of the farmers responded that wearing face mask can help in prevention of infection of COVID-19. Regarding prevention of infection of COVID-19 by avoiding crowded places and not taking public transport was considered as true by about 88 per cent of the respondents. About 87% of the farmers knew that COVID-19 virus spread through respiratory droplets of infected individuals.

The results of the attitude of farmers toward COVID-19 Pandemic shows that about 75 per cent of the farmers were of the opinion that COVID-19 situation would be successfully controlled while only 61 per cent of the farmers agreed that Government and the health care system handled the health crisis well (Table 3). About 90 per cent of the farmers felt worried or scared after knowing the information on the number of cases of COVID-19. Majority (89%) of the participants agreed that People with COVID-19 should not be given a negative stigma in society. When the farmers were asked about isolation, about 86 percent were of the opinion that People with COVID-19 who isolate themselves show that they have a responsibility in preventing the transmission of COVID-19.

The findings of the attitude of farmers towards agriculture during COVID-19 pandemic have been depicted in Table 4. Majority of the farmers (57%) strongly agreed that COVID-19 pandemic had decreased their confidence levels in farming while 48 per cent of the farmers expressed that Distress sale of agricultural products has increased due to the wake of the covid-19 pandemic. This might be due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hinder the proper distribution. Mastronardi *et al.* (2020) in their study on "Diversified Farms Facing the COVID-19 Pandemic: First Signals from Italian Case Studies" found that farmers had registered a sharp contraction in agricultural production activities throughout the quarantine period. Disruption of farming activities due to lockdown and quarantine decreases the farmer's confidence as it results in loss of income and livelihood. About 57 per cent of the farmers strongly agreed that Due to COVID-19, there was a shortage of Labor and hike in their Cost. Singh *et al.* (2020) also found that 80 per cent of the farmers agreed that regular farm labour unavailability has increased the labour cost and cost of cultivation of crops. Fifty three percent of the farmers said that doing all the regular farming activities along with preventive and protective measures (masks, sanitizers and social distance) of the COVID-19 was problematic. Only 5 per cent of the farmers were of the opinion that the preventive and protective measures of COVID-19 and implementation of lockdown were well managed by Government. Majority (58%) of the respondents had the attitude that farming during COVID-19 pandemic had become stressful. Around 65 per cent of the farmers experienced negative income shock during the lockdown and related restrictions during COVID-19. Meher *et al.* (2021) in their study on poultry farmers also found that highest number of farmers responded to heavily problem for the statement of COVID-19 hinder poultry farming, economic losses by poultry farming during COVID-19 as well as affected the channel of the poultry business.

Table 3: Attitude of the farmers towards COVID-19 (n=240)

S. No.	Attitude Statements	True		False		Not Sure	
		f	%	f	%	f	%
1	COVID-19 situation would be successfully controlled;	181	75.4	16	6.7	43	17.9
2	Government and the health care system are handling the health crisis well.	147	61.3	57	23.8	36	15.0
3	After knowing the information on the number of cases of COVID-19, I felt worried/scared.	216	90.0	14	5.8	10	4.2
4	Keeping up with the information regarding the government's call for COVID-19 preventive efforts is important for the community.	114	47.5	40	16.7	86	35.8
5	All people with COVID-19 are those who violate the government's call in the efforts to prevent transmission of COVID-19.	27	11.3	92	38.3	121	50.4
6	People with COVID-19 should not be given a negative stigma in society.	214	89.2	8	3.3	18	7.5
7	People with COVID-19 who isolate themselves show that they have a responsibility in preventing the transmission of COVID-19.	206	85.8	11	4.6	23	9.6

Table 4: Attitude of farmers towards Agriculture during COVID-19 (n=240)

S. No.	Attitude Agri. Statements	SA		A		D		SDA		DK	
		f	%	f	%	F	%	f	%	f	%
1	As a farmer, this COVID-19 pandemic has decreased my confidence levels in farming.	135	56.3	68	28.3	27	11.3	8	3.3	2	0.8
2	Distress sale of agricultural products has increased due to the wake of the COVID-19 pandemic.	115	47.9	53	22.1	57	23.8	13	5.4	2	0.8
3	Fear of COVID-19 infection has affected the conduct of regular activities on the farm.	148	61.7	72	30.0	14	5.8	4	1.7	2	0.8
4	COVID-19 has made you experience income shock.	156	65.0	71	29.6	12	5.0	0	0	1	0.4
5	COVID-19 will have a greater negative impact on Agriculture & farmer.	123	51.3	67	27.9	11	4.6	5	2.1	34	14.2
6	Practicing farming in this COVID-19 situation was stressful.	139	57.9	75	31.3	15	6.3	6	2.5	5	2.1
7	Doing all the regular farming activities along with preventive & protective measures (masks, sanitizers & social distance) of the COVID-19 is not problematic.	22	9.2	38	15.8	158	53.3	49	20.4	3	1.3
8	Due to COVID-19, there was a shortage of Labor and hike in their Cost.	137	57.1	49	20.4	34	14.2	12	5.0	8	3.3
9	Marketing and sale points for goods were decreased due to the COVID-19 pandemic.	160	66.7	51	21.3	16	6.7	9	3.8	4	1.7
10	Restriction to the Transportation sector has reduced their availability and raised their demand.	100	41.7	65	27.1	52	21.7	11	4.6	12	5.0
11	There was a Shortage of Agricultural Inputs in this pandemic period.	32	13.3	19	7.9	117	48.8	65	27.1	7	2.9
12	The market restrictions and consumer behavior has affected the agriculture producers of Perishable goods.	167	69.6	39	16.3	17	7.1	4	1.7	13	5.4
13	Procurement of Produce by government in COVID-19 situation was satisfactory.	14	5.8	45	18.8	64	26.6	59	24.6	58	24.2
14	Implementation of policies and handling of Agriculture sector by Government was satisfactory.	10	4.2	66	27.5	52	21.7	60	25.0	52	21.7
15	By considering Agriculture and Farmers, the preventive and protective measures of COVID-19 and implementation of lockdown were well managed by Government.	11	4.6	66	27.5	52	21.7	60	25.0	51	21.3

SA- Strongly Agree, **A**- Agree, **DA**- Disagree, **SDA**- Strongly Dis Agree, **DK**- Don't Know

Correlation between Knowledge and attitude of farmers towards COVID-19 with demographic variables is shown in Table 5. The results of the study showed that knowledge about the COVID-19 had statistically significant negative correlation with age (r = -.262, p = 0.001), experience in farming (r = -.191, p = 0.001), secondary occupation (r = -.325, p = 0.001), crop grown (r = -.127, p = 0.05) and member of the community (r = -.220, p = 0.001). Positive significant correlation with knowledge was found with education (r = .324, p = 0.001). Similarly, Moradzadeh (2020) also found weak positive correlation between knowledge and years of education,

Table 5: Correlation between knowledge and attitude towards COVID-19 with demographic variables

Parameters	Correlation	Knowledge total	Attitude Covid total	Attitude Agri. total
Age	Correlation Coefficient	-.262**	-.281**	.016
	Sig. (2-tailed)	.000	.000	.807
Gender	Correlation Coefficient	-.113	-.096	-.037
	Sig. (2-tailed)	.080	.138	.569
Education	Correlation Coefficient	.324**	.358**	.053
	Sig. (2-tailed)	.000	.000	.418
	Correlation Coefficient			
Primary Occupation	Correlation Coefficient	.100	.056	.022
	Sig. (2-tailed)	.456	.467	.678
Secondary Occupation	Correlation Coefficient	-.325**	-.273**	-.219**
	Sig. (2-tailed)	.000	.000	.001
Caste	Correlation Coefficient	-.007	-.044	.014
	Sig. (2-tailed)	.912	.499	.824
Family Size	Correlation Coefficient	-.042	-.015	.103
	Sig. (2-tailed)	.516	.816	.112
Experience in Farming	Correlation Coefficient	-.191**	-.092	.047
	Sig. (2-tailed)	.003	.154	.471
Land Owned	Correlation Coefficient	.076	.056	.059
	Sig. (2-tailed)	.238	.389	.366
Land Area	Correlation Coefficient	.064	.077	.123
	Sig. (2-tailed)	.322	.232	.056
Type of Irrigation	Correlation Coefficient	-.087	-.105	.101
	Sig. (2-tailed)	.178	.105	.120
Crops Grown	Correlation Coefficient	-.127*	.044	.192**
	Sig. (2-tailed)	.049	.495	.003
Crops Sold	Correlation Coefficient	-.012	.070	-.119
	Sig. (2-tailed)	.854	.279	.066
Livestock owned	Correlation Coefficient	.059	.072	-.157*
	Sig. (2-tailed)	.359	.266	.015
Member of Community	Correlation Coefficient	-.220**	-.173**	-.052
	Sig. (2-tailed)	.001	.007	.425
Type of Family	Correlation Coefficient	.000	.006	.142*
	Sig. (2-tailed)	.999	.925	.028
Knowledge Total	Correlation Coefficient	1.000	.380**	.259**
	Sig. (2-tailed)	.	.000	.000
Attitude Covid total	Correlation Coefficient	.380**	1.000	.092
	Sig. (2-tailed)	.000	.	.155

which was statistically significant ($r = 0.29$, $p = 0.001$) but there was no correlation between attitudes with education. While attitude towards COVID-19 had negative correlation with age ($r = -.281$, $p = 0.001$), secondary occupation ($r = -.273$, $p = 0.001$), and member of the community ($r = -.173$, $p = 0.001$) at 1 percent level of significance and positive correlation with education ($r = .358$, $p = 0.001$) and knowledge about COVID-19 ($r = .380$, $p = 0.001$) at 1 per cent level of significance. The finding indicates that membership in a community helps the farmers to form positive attitude towards the control of COVID-19. Members in the community discuss and share information

and help each other in the time of need. Community emerges as a important social institution at time of distress. With respect to respondent's attitude towards agriculture during COVID-19, correlation analysis showed significant positive relation with crop grown (r = .192, p = 0.001) and knowledge about COVID-19 (r = 0.29, p = 0.001) at one percent level of significance while significant negative correlation was found with secondary occupation (r = -.219, p = 0.001) and livestock owned (r = .259, p = 0.001) at one percent level of significance. Al Ahdab (2021) also showed in their study that significant positive correlation was present between knowledge and attitude of the respondents towards COVID-19.

CONCLUSION

In summary, this study provides insights into Farmers' knowledge, and attitude towards COVID-19 and also their attitude towards agriculture during lockdown and pandemic period. The results of the study showed that the majority of farmers had the knowledge about the symptoms and transmission of the disease but the knowledge about the asymptomatic transmission was less. They also had positive attitude toward the control of the pandemic. The farmer had faith in the control measures taken by the government. the findings also indicated that pandemic had decreased the confidence of the farmers in agriculture and led to the Distress sale of agricultural products. The study highlighted that education was positively correlated with the knowledge and attitude of the farmers towards COVID-19. The study will help the government and health authorities to formulate suitable measures to counter the spread of COVID-19 and develop best practices for future epidemics. Hence, there is a need for targeted health education as a response strategy to COVID-19 along with measures taken by government to safeguard farming activities during these times.

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Measures of Rural Livelihoods during COVID-19 in West Bengal

Suman Roy and Souvik Ghosh*
Department of Agricultural Extension, Institute of Agriculture, Visva-Bharati University, Sriniketan, West Bengal

ABSTRACT

The COVID-19 pandemic has been considered as the most crucial global health calamity of the century. The pandemic has also severe effects on the livelihoods of the rural households. Present study has examined the livelihood status of rural people including migration pattern during COVID-19 pandemic in Cooch Behar district of the West Bengal. Among five types of assets viz. human, social, physical, financial and natural assets defining livelihood, financial assets were suffered the most. The pandemic caused lowering of income (average annual income from Rs. 94363 before the pandemic to Rs. 56235 after the pandemic) while increasing expenditure for rural households. Most of the respondents were migrating outside state (67.5%) engaging as mason (31%) and labour (17.5%); 54 per cent of the respondents have stayed after pandemic and 46 per cent have return back to their home during pandemic. Different schemes are being introduced by the government for improving the livelihood of rural people and migrants.

Keywords: COVID-19, Impact, Level of living, Migration, Rural household

INTRODUCTION

COVID-19 more specifically Corona virus is being identified as the cause of an outbreak of respiratory illness that was first detected in Wuhan, China. It has been named coronavirus disease 2019 (COVID-19) – 'CO' stands for corona, 'VI' for virus, and 'D' for disease. Formerly, this disease was referred to as '2019 novel coronavirus' or '2019-nCoV'. The COVID-19 virus is linked to the same family of viruses as severe acute respiratory syndrome (SARS) and some types of common cold. (Yi-chi Wu, 2020). The first case was reported in Kerala on 30th of January, 2020 in India. After that many more cases were reported from all over the country. Due to the pandemic spread of the disease, the Government of India decided to impose lockdown on 24th March, 2020 for 21 days limiting movement of the entire 1.3 billion population of India as a preventive measure which was divided into five phases. After the 21-day period expires, it was planned to maintain the full lockdown in "hotspot" areas and relax it in other places. These measures might have helped in limiting the health crisis, but the complete shutdown of all economic activities except essential services has created an economic crisis and misery for the poor, affecting the rural households the most, with massive job losses and rising food insecurity.

India is the second most populous country having 68.84 per cent of rural population out of which 37.8 per cent of population are migrants; 56.6 per cent of workers depend on agriculture and ailed activities (Census, 2011). The COVID-19 with its increasing rate day by day have an enormous effect on the livelihood pattern of rural households besides their health. The worst outcome was faced by the rural poor who had arrived at the more industrialized and affluent parts of the country to toil as wage labourers, often receiving small, uncertain, and irregular incomes. During the lockdown, an estimated 14 crore (140 million) people lost employment while salaries were cut for many others. More than 45 per cent of households across the nation have reported an income drop as compared to the previous year (Dev and Sengupta, 2020).

With a population of over 90 million, West Bengal is the fourth most populous state in India, and ranks first in terms of population density. The first case of COVID-19 was reported in Kolkata on 23rd March of 2020 in West Bengal. This pandemic was entwined with its health and humanitarian effects, including unemployment, hunger, migration resulting in an unprecedented migrant worker crisis and the loss of livelihood for many people. The measures which were followed to prevent the pandemic

*Corresponding author email id: souvik.ghosh@visva-bharati.ac.in

like social distancing resulted in shutdown of all the industries, market, transport and many other infrastructures which provides sole source of livelihood to most of the rural people. They didn't have access to their basic amenities as a result of loss of their sources of income. West Bengal ranks fourth among states from where people migrate for work and employment. Between 2001 and 2011, nearly 5.8 lakh people migrated from Bengal looking for work. The pandemic has severe effects on the livelihood pattern of the rural households.

MATERIALS AND METHODS

Present study was undertaken in Cooch Behar district of West Bengal, which was one of the hardest hits during pandemic in northern region of the state. When the total COVID-19 cases per 1000 households was compared, the top five districts were Kolkata, Darjeeling, North 24 Parganas, Howrah and Cooch Behar. COVID-19 cases per 1000 households were 123, 52, 51, 33, and 29 accordingly. Similarly, when COVID-19 cases per One Million population was analysed, the top five districts were Kolkata, North 24 Parganas, Darjeeling, Howrah and Cooch Behar with 2811, 1199, 1100, 726 and 690 COVID-19 cases per one billion population (Biswas *et al.,* 2021). Moreover, agriculture of Cooch Behar district shows a special feature of agro-ecology for its geographical location (Terai Zone). Agriculture is the main source of livelihood and employment for rural people.

Out of 12 development blocks of Cooch Behar two blocks i.e., Cooch Behar-I and Cooch Behar-II blocks were purposively selected due to its highest number of households among all other blocks. Two villages under each block were randomly selected. A sample of 10 rural households having migrants from each village were selected purposively for present study. Thus, a total of 80 respondents were chosen in present study. Livelihood status which was determined with the help of Department for International Development (DFID) framework (1999), under which five categories of assets were measured viz., human, social, natural, physical and financial assets. Various indicators under each asset were chosen, which were measured on the basis of responses of respondents obtained with the help of a structured interview schedule. Data were compiled and analysed with help of descriptive statistics.

RESULTS AND DISCUSSION

Human capital: Table 1 shows the distribution of respondents on the basis of different aspects of human capital such as age, family type, education and occupation. Majority of the respondents i.e., 57.5 per cent were young (upto 35 years), 40 per cent belonged to the middle age (36-60 years) and 2.5 per cent belonged to the old age group (greater than 60 years). More than half of the respondents (51.25%) had nuclear family and 48.75 per cent had joint family.

Table 1: Distribution of respondents according to their socio-personal profile

Particular	Frequency (%) (N=80)	Mean (SD)	Range
Age (years)		36.03 (11.78)	17-89
Young (upto 35 years)	46 (57.5)		
Middle aged (36-60 years)	32 (40)		
Old (>60 years)	2 (2.5)		
Family type		-	-
Nuclear (1-4)	41 (51.25)		
Joint (5-6)	39 (48.75)		
Education		-	-
Illiterate	10 (12.5)		
Primary	18 (22.5)		
Secondary	32 (40)		
Higher secondary	18 (22.5)		
College and above	2 (2.5)		
No. of years of education completed		7.45 (4.10)	0-15
Occupation		-	-
Agriculture and allied	27 (33.75)		
Labour	22 (27.5)		
Mason	7 (8.75)		
Weaving	6 (7.5)		
Others	18 (22.5)		

Education plays a vital role in creating awareness of population and adaptation to COVID-19 pandemic. Most of the respondents i.e., 40 per cent had completed their secondary level of education while 22.5 per cent had completed primary and high secondary, 12.5 per cent were illiterate, whereas 2.5 per cent had attended college or graduated. The average of number of years of education completed by all was 7.45 within the range 0 to 15 years. The main occupation practiced by most of the respondents was agriculture and ailed sector, where as 27.5 per cent were labour, 8.75 per cent were mason and 7.5 per cent were involved in weaving; while 22.5 per cent were engaged in other occupations during the pandemic period.

Table 2 indicates the communication sources use pattern of the respondents. It was studied considering different sources of communication like personal localite, personal cosmopolite, mass media, ICTs (website, portal, mobile apps) and social media (Facebook or WhatsApp). From the table it is evident that 66.25 per cent of the respondents very often used personal localite sources of information during the pandemic. Most of the respondents (68.75%) used personal cosmopolite rarely. Half of the respondents used mass media very often during pandemic period. ICTs like website portal, mobile apps were rarely used. Contrastingly, 46.25 per cent of the respondents used social media very often during COVID-19 pandemic period.

Table 3 presents the distribution of respondents according the information available to them during the pandemic period. It was observed that majority of the respondents most often received information on several areas such as weather (62.5%), agriculture practices (52.5%), livestock management (50%), agriculture inputs (53.75%), market price (45%) and health (68.75%). About 60% of the respondents sometimes received information on government programmes. About 47.5 per cent and 65 per cent also sometimes got information on subsidy and credit facilities, respectively.

Table 4 shows the distribution of respondents according to their family health status during pandemic. About 57 of the respondents had suffered from illness. 17.5 per cent of the respondents had suffered from illness once or twice in a month. In addition to that, 24.5 per cent of the respondents had also suffered from illness once in a week whereas only 7.01 per cent had suffered from illness during the pandemic once in a year.

Table 2: Distribution of respondents according to their communication sources use

Source of information	Frequency (%) (N=80)				Mean (SD)
	Very often	Often	Sometimes	Rarely	
Personal localite sources	53 (66.25)	26 (32.5)	1(1.25)	-	3.65 (0.50)
Personal cosmopolite sources	-	-	25(31.25)	55 (68.75)	1.31 (0.46)
Mass media	40(50)	30 (37.5)	6(7.5)	4(5)	3.32 (0.82)
ICTs	-	-	8(10)	72(90)	1.1 (0.30)
Social media	37 (46.25)	32(40)	6(7.25)	5 (6.25)	3.26 (0.85)

Table 3: Distribution of respondents according to information availability to them

Particulars	Frequency (%) (N=80)				Mean (SD)
	Always	Most often	Sometime	Rarely	
Weather	11 (13.75)	50(62.5)	17(21.25)	2(2.5)	2.8 (0.66)
Agricultural practices	9 (11.25)	42(52.5)	26(32.5)	3(3.75)	2.71 (0.71)
Livestock management (Veterinary services)	34 (42.5)	40(50)	5(6.25)	1(1.25)	3.34 (0.65)
Agricultural inputs (Seeds, fertilizer, pesticides)	24(30)	43(53.75)	10(12.5)	3(3.75)	3.1 (0.75)
Market prices	33 (41.25)	36(45)	10(12.5)	1(1.25)	3.26 (0.72)
Health	23 (28.75)	55(68.75)	2(2.5)	1(1.25)	3.26 (0.49)
Government programmes	-	28(35)	48(60)	4(4)	2.3 (0.56)
Subsidies	-	32(40)	38(47.5)	3(3.75)	1.8 (0.67)
Credit's facilities	-	7(8.75)	52(65)	3(3.75)	1.8 (0.56)

Table 4: Distribution of respondents according to their family health status

Particulars	Frequency (%) (N=57)						
	Once in a week	Once or twice in a month	A few times a month	More than a week	More than a month	Months together	Year
Number of family members suffered from illness	10(17.5)	14 (24.5)	8(14.03)	9 (15.78)	5(8.78)	7(12.3)	4(7.01)

Table 5 shows on an average one migrant was there in the sampled household's family; however, it ranged from 1 to 4. The mean age of migrants was 33.76 years with a range of 18 to 55 years. Most of the respondents were migrating other states (67.5%), whereas 18.75 per cent of the respondents were migrating to other districts. Mostly the migrants were migrating for a duration of year (71.25%). About 36.25 per cent of the respondents reported high wage rate as the major cause of migration whereas 30 per cent have reported lack of job as a cause of migration in the present study. About 31.25 per cent of the respondents were working as mason at the places of migration while 17.5 per cent were working as labour.

Table 5: Distribution of respondents according to the migration pattern in their family

Particular	Frequency (%)
Number of migrants	1-4/ family
Age of migrants	
Mean (SD)	33.76 (8.4)
Range	18-55
Place of migration	
Intra district	5 (6.25)
Inter district	15 (18.75)
Inter state	54 (67.5)
International	6 (7.5)
Duration of migration	
Within weeks	4 (5)
Months	12 (15)
Six months	7 (8.75)
Year	57 (71.25)
Causes of migration	
High wage rate	29 (36.25)
Better job opportunities	10 (12.5)
Consistent income	2 (2.5)
Lack of Job	24 (30)
Lack of industries	6 (7.5)
Low land holding	9 (11.25)
Kind of job (at the migrated places)	
Labour	14 (17.5)
Carpenter	6 (7.5)
Mason	25 (31.25)
Business	14 (17.5)
Tobacco industry	3 (3.75)
Pipe factory	7 (8.75)
Others	11 (13.75)
Stay at migrated places during pandemic	
Yes	43 (53.75)
No	37 (46.25)
Remittance received during pandemic	
Yes	20 (25)
No	60 (75)

Keshri and Bhagat (2013) had also reported that male migration to urban areas has been mainly due to lack of employment opportunities, agricultural crisis and small landholdings in rural areas and better opportunities in urban areas. While Rowthorn (2010) examines the external forces of migration and suggests that migration of rural population is not only caused by poverty, land reforms, division of land, lack of employment opportunities, and natural calamities but also due to unequal development among regions, policy-level changes affecting poor people by enhanced risk in one hand, and creation of opportunity on the other.

Evidently from Table 5, about 53.75 per cent of the respondents have stayed back during the pandemic; however, 46.25 per cent have returned back to their home during pandemic. Three-fourth of the migrants (75%) of the respondents have not received any remittances while 25% have received remittances.

Caritas India (2020) had revealed that 28.7 per cent migrants did not want to come back to the cities, whereas 32.1 per cent showed their willingness to return when the situation gets alright and COVID-19 pandemic is over; while 31.3 per cent migrants were in a dilemma. Dev and Sengupta (2020) reported that around 40 to 50 million workers are seasonal migrant, who are directly and harshly affected and moved back to their native places (reverse migration) due to lack of employment, income, shelter, and so forth. According to Jan Sahas (2020), 90 per cent of migrant workers in India have lost their incomes within 3 weeks during the pandemic. They were evicted from their informal settlements or labour camps, and have been either unpaid or abandoned by their contractors, leaving them with no means for sustenance. This tyranny situation has forced migrant workers to walk on foot to reach their home villages finding no public transport.

Social capital: Table 6 shows the distribution of respondents according to their social participation. According to the data presented, 93.75 per cent of the respondents were members of FPO/ SHG/ FIG; 13.75 per cent were members of farmer club of fisheries society,

Table 6: Distribution of respondents according to their social participation

Membership in social organizations	Frequency (%)
Farmer's club/ Fisheries society	11 (13.75)
Farmer's association	13 (16.25)
FPO/SHG/FIG	75 (93.75)
Village Panchayat/village development committee/ farmer advisory committee on ATMA	3 (3.75)
Political organization	2 (2.5)

whereas 16.25 per cent were member of any farmer association. Only 3.75 per cent had the membership of village panchayat/ Village development committee/ farmer advisory committee under ATMA and 2.5 per cent belonged to any political organization as members. None of them where in the position of office bearer.

Table 7 represents the distribution of respondents according to their extent of cohesiveness. Majority of the respondents (55%) opined that that there was high level of economic cooperation among the neighbours during pandemic period. More than 60 per cent of the respondents perceived that there was a high level of political peace in the area. About 53.75 per cent of the respondents felt that there was high level of socio-cultural cooperation among the neighbours. About 38.75 per cent of the respondents indicated very high level of trustworthiness amongst the neighbours. About 70 per cent of the respondents opined high level of safety in their locality.

Figure 1 shows the distribution of respondents according to their social recognition. About 66 per cent of the respondents belonged to the medium level of household status whereas 29 per cent belonged to the low-level and only 5 per cent belonged to the high level of household status.

Physical capital: Table 8 shows the distribution of respondents according to types of houses for themselves and their livestock. About 43 per cent of the respondents had semi pucca house for themselves whereas 20 per cent had pucca house. The data shows that majority (61.25%) had kutcha house for their livestock and only 2.5 per cent had pucca house for the same.

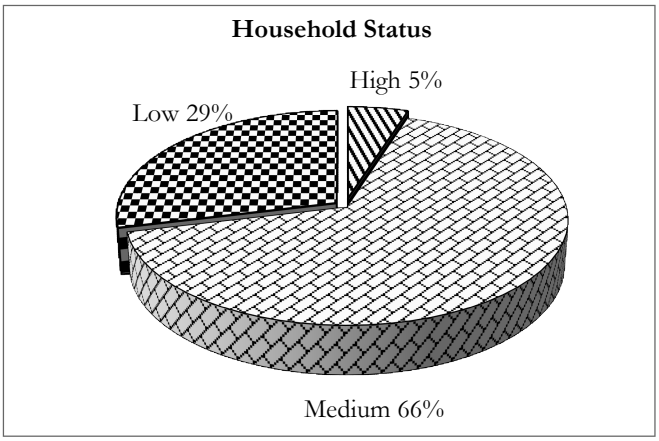

Figure 1: Distribution of respondents according to social status

Table 8: Distribution of respondents according to house type

Particulars	Frequency (%)		
	Pucca	Semi pucca	Kutcha
For human	20 (20)	35 (43.25)	25 (31.25)
For livestock	2 (2.5)	9 (11.25)	49 (61.25)

Table 9 indicates the distribution of respondents according to their assets holding with respect to communication devices, mode of transportation and farm tools. It is evident that 96.25 per cent respondents had internet access whereas 91.25 per cent had television. No respondents had radio but all the respondents had mobile phone. Only 2.5 per cent of the respondents had access to newspaper. All most all (98.75%) had bicycle and 40% of the respondents had motorbike. Majority of the respondents (96.25%) had plough whereas 48.75 per cent of the respondents had tractor. All the respondents had electricity connection for the domestic use, whereas only

Table 7: Distribution of respondents according to their extent of cohesiveness

Particulars	Frequency (%) (N=80)					Mean
	Very low	Low	Medium	High	Very high	(SD)
Economic cooperation among the neighbours	2 (2.5)	4(5)	18(22.5)	44(55)	12(15)	3.75 (0.86)
Political peace in the area	-	-	6(7.5)	50 (62.5)	24(30)	4.2 (0.57)
Socio-cultural cooperation among the neighbours	-	4(5)	21 (26.25)	43 (53.75)	12(15)	3.78 (0.75)
Trustworthiness of the neighbours	-	2(2.5)	18(22.5)	29 (36.25)	31 (38.75)	4.11 (0.84)
Safety in locality	-	5(6.25)	18(22.5)	56(70)	1 (1.25)	3.66 (0.61)

Table 9: Distribution of respondents according to their different physical assets holding

Particulars	Frequency (%)	
	Yes	No
Communication		
Radio	-	80 (100)
Television	73 (91.25)	7 (8.25)
Phone (land or cell)	80 (100)	-
Internet access	77 (96.25)	3 (3.75)
Newspaper access	2 (2.5)	78 (97.5)
Transportation		
Bicycle	79 (98.75)	1 (1.25)
Motorbike	32 (40)	48 (60)
Vehicle (Four-wheeler)	-	80 (100)
Farm tools		
Cart	58 (72.5)	22 (27.5)
Tractor	39 (48.75)	41 (51.25)
Plough	77 (96.25)	3 (3.75)
Cultivator (tractor drawn)	4 (5)	76 (95)
Weeder	31 (38.75)	49 (61.25)
Seed drill machine	1 (1.25)	79 (98.75)
Pesticide sprayer/knapsack sprayer	62 (77.5)	18 (22.5)
Threshing machine	7 (8.75)	73 (91.25)
Organic manure pit	1 (1.25)	79 (98.75)
Diesel/ Electric pump	54 (67.5)	26 (32.5)
Fodder cutting machine	-	80 (100)
Electricity		
Domestic	80 (100)	-
Farm	52 (65)	28 (35)
Sanitation facility	80 (100)	-

65 per cent had the same for the farm use as well. All the respondents had proper sanitation facility.

Table 10 shows the distribution of respondents according to their water resources, type and condition of road and cooking facilities. The data show that 78.75 per cent of the respondents have used tube well for domestic use and 50% of them have borrowed from neighbouring well owners for the irrigation. About 67.5 per cent of the respondent's house were connected to pucca road whereas 28.75 per cent to kutcha road and remaining 3.75 per cent to bricks road. Majority of the respondents (60%) reported good road condition where as 13.75% opined road condition as medium and remaining 26.25% mentioned it poor. Majority (96.25%) used to have gas for cooking and the remaining 3.75% used kerosene stove for cooking.

Table 10: Distribution of respondents according to their physical assets like water resources, road infrastructure and cooking facilities

Particulars	Frequency (%) (N=80)
Type of water sources for domestic use	
Pipe	3 (3.75)
Supply	12 (15)
Tube well	63 (78.75)
Dug well	2 (2.5)
Source of irrigation	
Lift irrigation- own well	36 (45)
Borrowed or shared from neighbouring well owners	40 (50)
Community or village pond	4 (5)
Type of road	
Pucca	54 (67.5)
Bricks	3 (3.75)
Kutcha	23 (28.75)
Condition of road	
Good	48 (60)
Medium	11 (13.75)
Poor	21 (26.25)
Cooking Facility	
Gas	77 (96.25)
Kerosene	3 (3.75)

Financial capital: Among the sampled respondents' households in present study area, 70 per cent of the respondents belonged to the BPL category and remaining 30 per cent were APL according to economic status. Table 11 presents the distribution of respondents according to their annual family income, source of income and expenditure before and after the pandemic.

The mean annual family income was Rs. 94363 (range of Rs. 30000 to Rs. 240000) before the pandemic which had decreased to Rs. 56235 (range of Rs. 12000 to Rs.150000). Vyas & Centre for Policy Research (2020) had described that as per some studies throughout the lockdown period, more than 45% of households across the country have reported an income drop as compared to the previous year. The source of income was highest from dairy, which had mean value of Rs. 21515 (range of Rs. 3000 to Rs. 60000) before the pandemic. During the pandemic, it was decreased to Rs. 16534 (range of Rs. 2000 to Rs. 50000). Before pandemic, the highest expenditure was on food having a mean expenditure of

Table 11: Distribution of respondents according to their annual family income and expenditure before and after the pandemic

Particulars	Before the pandemic			During the pandemic		
	Freq (%)	Mean (SD)	Range	Freq (%)	Mean (SD)	Range
Annual family income		94364 (37529)	30000-240000		56235 (29797)	12000-150000
Low (< Mean-SD)	7 (8.75)			14 (17.5)		
Medium (Mean-SD to Mean+SD)	62 (77.5)			57 (71.25)		
High (>Mean+SD)	11 (13.75)			9 (11.25)		
Source of monthly income						
Agriculture/ Horticulture (n= 76)		5694 (2862)	1000-14000		4000 (1860)	800-8000
Dairy (n=60)		21515 (14468)	3000-60000		16534 (11434)	2000-50000
Poultry (n=54)		566(257)	150-1500		327 (185)	50-800
Business (n=43)		6930 (4330)	2000-30000		209.5 (640)	0-3000
Service (n=8)		5750 (1165)	4000-7000		4375 (2387)	0-7000
Total		26243 (13536)	8500-66800		17053 (12180)	2050-55500
Expenditure (Monthly)		10903.9 (4223.8)	2800-22800		11830 (4223.8)	3600-26700
Low (< Mean-SD)	10 (12.5)			11 (13.75)		
Medium (Mean-SD to Mean+SD)	57 (71.25)			60 (75)		
High (>Mean+SD)	13 (16.25)			9 (11.25)		
Heads of expenditure						
Food		4315 (1701)	1000-9000		4956(1745)	1500-10000
Health		537 (240)	100-1000		627 (350)	100-2000
Farm		3615 (350)	300-1000		3810 (2651)	200-10000
Education		1846 (1750)	200-6000		1888 (1608)	200-5000
Clothing		439 (192)	150-1000		420 (174)	100-1000
Telephone/Mobile		250 (161)	50-800		306 (177)	50-800
Transportation		596 (180)	100-1000		744 (236)	100-1200
Social occasion		600 (253)	300-1000			

Rs. 4315 (range of Rs. 2000 to Rs. 9000), which had increased to Rs. 4956 (range Rs. 1500 to Rs. 10000) during the pandemic. Thus, the pandemic caused lowering of income while increasing expenditure for rural households.

Table 12 represents the distribution of respondents according to their credit behaviour. More than half of the respondents (51.25%) found it moderately difficult to borrow credit from money lenders, whereas 62.5 per cent found it easy to borrow from friends or relatives. About 86.3 per cent of respondents found it easy to borrow credit from SHG, while 13.8 per cent found it moderately difficult to lend from the same.

Table 13 shows the distribution of respondents according to their financial awareness and safety. It shows that 93.75 per cent were aware about the life insurance; however, only 23.75 per cent have availed it. About 84 per cent were aware about the crop insurance and only 15 per cent have enrolled under it. All the respondents were aware about the health insurance and only 16.25 per cent have availed it. About 88.75 per cent were aware about the kisan credit card and 40% have taken it. Table 14 shows the distribution of respondent according to their most reliable source of credit and amount of savings during pandemic. It shows that 57.5 per cent found SHG most reliable source of credit. It was also found that 81.25 per cent had cash in hand in the form of savings present in the time of crisis.

Natural capital: Table 15 shows the distribution of respondents according to the net land holding, the crops grown and food supplies in times of crisis due to COVID-19 pandemic. Most of the respondents were marginal farmers (58.75%), while 28.75 per cent were small farmers. In kharif season, about 92.5 per cent of the respondents cultivated rice (aman rice), whereas rabi season was

Table 12: Distribution of respondents according to their credit behaviour

Source of credit	Frequency (%) (N=80)			Mean (SD)
	Easy	Moderately difficult	Difficult	
Moneylenders	-	41 (51.25)	39 (48.75)	1.51 (0.50)
Friends/Relative	50 (62.5)	28 (35)	2 (2.5)	2.6 (0.54)
SHG	69 (86.3)	11 (13.8)	-	2.86 (0.35)
Cooperative	54 (67.5)	25 (31.25)	1 (1.25)	2.66 (0.50)
Banks	7 (8.75)	32 (40)	41 (51.25)	1.57 (0.65)

Table 13: Distribution of respondents according to their financial awareness and safety

Particulars	Frequency (%) (N=80)			
	Awareness		Adopted	
	Yes	No	Yes	No
Life insurance	75 (93.75)	5(6.25)	19 (23.75)	61(76.25)
Crop insurance	67 (83.75)	13 (16.25)	12(15)	68(85)
Health insurance	80(100)	-	13 (16.25)	67(83.75)
Kisan credit card	71 (88.75)	9(11.25)	32(40)	48(60)
Jan Dhan Yojana/Bank account	70 (87.5)	10(12.5)	42 (52.5)	38(47.5)

Table 14: Distribution of respondents according to their most reliable source of credit and types of savings during pandemic

Particulars	Frequency (%)
Most reliable source of credit during pandemic	
Friends	11 (13.75)
Relatives	10 (12.5)
SHG	46 (57.5)
Cooperative	8 (10)
Banks	5 (6.25)
Types of savings present during the time of crisis	
Hands in cash	65 (81.25)
Remunerative	13 (16.25)
Bank account	2 (2.5)

Table 15: Distribution of respondents according to their net land holding, the crops grown and food supplies in time of crisis during pandemic

Particulars	Frequency (%)
Net land holding	
Mean (SD)	1.24 (1.22)
Range	0.1-7.5
Marginal (<1 ha)	47 (58.75)
Small (1-2 ha)	23 (28.75)
Semi-medium (2-4 ha)	8 (10)
Medium (4-10 ha)	2 (2.5)

Table 15 contd...

Particulars	Frequency (%)
Crops cultivated	
Kharif season	
Aman rice	74 (92.5)
Rabi season	
Potato	35 (43.75)
Maize	13 (16.25)
Mustard	16 (20)
Chilli	33 (41.25)
Tomato	3 (3.75)
Cabbage	29 (36.25)
Cauliflower	25 (31.25)
Bottle gourd	1 (1.25)
Ridge gourd	3 (3.75)
Pointed gourd	6 (7.5)
Amaranthus	17 (21.25)
Colocasia	4 (5)
Spinach	13 (16.25)
Pumpkin	3 (3.75)
Dhaincha	1 (1.25)
Brinjal	2 (2.5)
Lady's finger	4 (5.25)
Radish	5 (6.25)
Pre kharif/ Summer season	
Jute	36 (45)
Boro rice	79 (98.75)

Table 16: Distribution of respondents according to the livestock owned

Types	Mean (SD)			Range		
	Numbers	Present value	Income	Numbers	Present value	Income
Cows	3 (1.92)	91200 (77473)	21528 (14466)	1-8	15000-285000	3000-60000
Goat	3 (0.99)	1112 (443)	840 (658)	1-5	400-2000	400-2000
Poultry birds	3 (1.48)	1060 (635)	538 (221)	1-6	200-3500	150-1000

dominated by potato cultivation (43.75%). About 41.25% of the respondents cultivated chilli in their fields and 36.25 per cent grew cabbage in rabi season. Almost all the respondents (98.75%) cultivated rice (boro rice) in pre-kharif or summer season. About 51.25 per cent of the respondents have got food from government school in the time of crisis, whereas remaining 48.75 per cent of the respondents got food supply from ration shops.

Table 16 shows the distribution of respondents according to the livestock owned by them. On an average respondents kept three cows with an average value of Rs. 91200. Likewise, the average number of goats kept were three with mean value of Rs. 1112. The poultry birds were also kept by the respondents on an average three in number with mean value of Rs. 1060. The respondents obtained an average monthly income of Rs. 21528, Rs. 840 and Rs. 538 from cows, goats and poultry birds, respectively.

CONCLUSION

The COVID-19 pandemic has brought disruptions in all sector including agriculture and rural life. The present study has explored the livelihood profile of rural people in a hard-hit district due to COVID-19 pandemic in state of West Bengal. The study explored the rural people's livelihood profile during the pandemic which will help to formulate different strategic plan at the ground level to minimise the impact of pandemic through various adaptation measures. It will also help in forming contingency planning according to the needs of the rural people. The study focuses on the need for skill-based training programmes, diversified farming and jobs through secondary agriculture activities for migrants ensuring sustainable income of rural people. Present analyses of rural livelihoods may be a precursor of future research as well as policy advocacies in revamping livelihood sustainability and migration phenomena in the state of West Bengal and also in other region of the country.

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Perception and Awareness of Hill Farm Women Regarding COVID-19

Bindia Dutt[1]* and Anju Kapoor[2]
[1]Assistant Professor, [2]Research Associate, Department of Extension Education and Communication Management, College of Community Science, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidayala, Palampur, Himachal Pradesh

ABSTRACT

COVID-19 is not only a challenge for global health systems, but also a test of our mortal spirit. The present study was conducted to investigate the knowledge and awareness of Hill Farm Women regarding COVID-19. Data were collected from randomly selected 100 farm women from six villages of Baijnath block of Kangra District of Himachal Pradesh. Telephonic interview method was used for data collection. The collected data was tabulated and analyzed using frequency and percentages. The study revealed that only 39 per cent farm women know that it is a viral disease. Majority of the farm women were aware about use of masks (91%), washing hands frequently with soap and water (88.00%) and follow social distancing norms (71.00%) from getting trapped in such an infectious disease. Majority of the farm women (83.00%) were aware about the general methods of drinking hot water, use of spices and yoga practicing as directed by Ministry of AYUSH.

Keywords: Novel Corona Virus, COVID- 19, Pandemic, Perception, Awareness and Hill Farm Women

INTRODUCTION

Coronavirus disease (COVID-19) is an infectious disease caused by a recently discovered coronavirus. Most people infected with the COVID-19 virus experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease and cancer are more likely to develop serious illness. COVID-19 a worldwide pandemic with no technological alternatives available have adversely affected countries to such an extent that almost all the countries had followed lockdown as only solution for curtailing its spread. In India its first case was reported in the month of January. In the end of the month of March the whole country was in lockdown situation. This lockdown had adversely affected every segment of the society be it the rich or poor, service or business sector, urban or rural segment. Rural India comprise of 68.84 per cent of India. The challenges faced by people in rural India are very different from the challenges faced by people living in cities. Although the life experienced by city people is very fast and full of luxurious whereas rural people has to struggle hard to achieve even the basic requirements of their life. However, COVID-19 has adversely affected the life of people but the more influence is observed on the city life people. This lockdown has had some rather severe behavioral and social impacts on rural society. Rural people has a general lack of awareness about the seriousness of this disease. They generally associate the disease with normal cold and cough and just not to step out of homes. In one of the research findings it was reported by Nanjunda and Lakshmi (2021) that in Karnataka state the health workers found that some elders are going to crowded places to collect water, paddy fields, and other agricultural/ horticultural activities, and they not maintaining any social distancing or using masks. When they are asked about this, a respondent said, "we know these people over the years and they are all healthy and nothing can be harmful to them."

Elderly women spend their time with their traditional groups by playing some games to kill time without maintaining any social distance or protection. This kind of group game has caused a drastic and sudden increase in the positive cases in a district of the northern part of the Karnataka state. For this the respondents, said, "we are already old and have seen in and out of life; we are not at

*Corresponding author email id: duttbindia@gmail.com

all worried about our life." Respondents have a mixed knowledge about the impact of "community spreading of the virus," and they have just heard about it on news channels and dailies.

MATERIALS AND METHODS

An exploratory study was conducted with an aim to identify the knowledge and awareness of farm women about COVID-19. Data were collected from randomly selected 100 farm women from six villages of Baijnath Panchayat Samiti of Kangra District from Himachal Pradesh. Telephonic interview method was used for data collection. The collected data was tabulated and analyzed using frequency and percentage.

RESULTS AND DISCUSSION

Table 1 depicts that more than half (51.00%) of the respondents were middle aged followed by young (34.00%) and old (15.00%). More than fifty percent of the farm women were educated upto Matric and Higher Secondary. Some of the respondents were also highly educated holding graduate and post graduate degrees. It is worth mentioning that none of the respondents were illiterate. Out of 100 respondents, 51.00 per cent were having medium sized families.

Large family size was mentioned by only 7.00 per cent. In the study area it was found that the major source of income was both agriculture and service as reported by equal number of respondents i.e. 29.00 per cent.

Regarding comprehension of Corona Virus / COVID-19, Figure 1 depicts that farm women did not have much knowledge of the pandemic. All the respondents correlated it with the symptoms of having cold and cough and not getting out of the house. Out of 100 respondents only 39.00 percent know that it is a viral disease and only twenty percent of the women knew that children and elderly people are more vulnerable to this virus. Nwafor (2020) in a study on knowledge of pregnant women towards coronavirus revealed that cough and difficult breathing were the symptoms reported by 75.5 percent and 82.4 percent of the respondents which were associated with corona virus.

With respect to comprehension about lockdown Table 2 shows that according to all farm women lockdown simply means moving out of house for some important work and not going out for offices, schools etc. as reported by 71 per cent women.

For the dissemination of information there are personal localite sources (like friends, relatives and neighbors), personal cosmopolite sources (like extension agents, health workers), personal cosmopolite channels (trainings, kisan madals, meetings, farmers fairs, educational

Table 1: Distribution of respondents according to general background information (N=100)

Categories	Percentage
Age	
Young (less than 30 years)	34.00
Middle aged(31 to 50 years)	51.00
Old (above 50 years)	15.00
Education	
Illiterate	0.00
Primary and Middle	25.00
Matric and Higher Secondary	56.00
Graduate	15.00
Postgraduate	4.00
Family Size	
Small (less than 5 members)	42.00
Medium (5–8 members)	51.00
Large (9 members and above)	7.00
Source of Income	
Agriculture	29.00
Business	9.00
Service	29.00
Other	
Dairy	12.00
Poultry	-
Goat rearing	17.00
Other	4.00

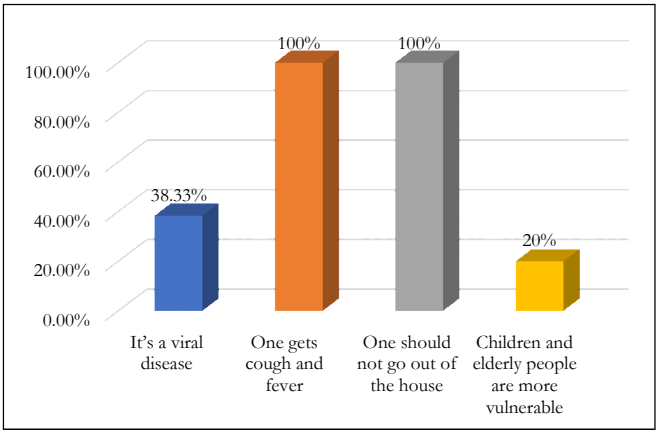

Figure 1: Distribution of farm women with respect to comprehension about corona virus

Table 2: Distribution of the farmwomen according to comprehension of lockdown (N=100)

Understanding related to	Percentage
Not to go out of the house	100.00
Go out when necessary	100.00
Not to go out to work	71.00
Do not know	0.00

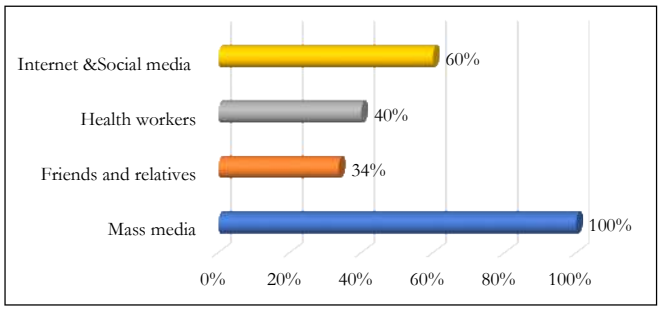

Figure 2: Distribution of farm women about sources of information about coronavirus

tours, etc. and impersonal cosmopolite channels (mass media, internet, etc.), Godara and Bhimawat, 2012. It is evident from Figure 2. that impersonal cosmopolite communication channel like mass media specially television, internet and social media played major role in disseminating information related to coronavirus among farm women as reported by 100 percent and 60 percent, respectively. It has acted as an only source among people to be gather various types of information in pandemic too. Nwafor (2020) also reported that the commonest source of information reported by the pregnant women under study were television (82.7%). Sinha and Hazra (2021) reported that mass media like television and mobile phobes played a great role in creating awareness and consciousness about agricultural activities during the pandemic period among santals.

To curtail the spread of Corona virus Government has issued various directives like wearing of face masks, follow social distancing of one meter distance, proper hand sanitation and downloading arogya setu app. Hence an effort has been made to judge the knowledge and awareness level of farm women about these preventive measures. Visualization of Table 3 depicts that majority of the farm women were aware about use of masks (91%), washing hands frequently with soap and water (88.00%) and follow social distancing norms (71.00%). Table further shows that approximately half of the respondents (46.00%) only know about importance of Arogya setu app. Nawafor (2020) mentioned that regarding such measures to be taken only Significant number of the study cohorts had adequate knowledge of preventive measures to prevent human-to-human transmission of coronavirus infection. The preventive measures known by participants were washing hands frequently with soap and water or rubbing hands with alcohol-based sanitizers (93.7%), maintaining at least 1 meter distance between yourself and others (87.7%), avoiding touching eyes, nose and mouth with hands (75%), covering mouth and nose when coughing or sneezing (97.5%), wearing facemask in public (98.6%) and staying indoor (74.3%).

Table 3: Distribution of farm women regarding awareness of preventive measures issued by ministry to curtail the spread of corna virus (N=100)

Preventive Measures	Percentage
Use of masks	91.00
Social distancing	71.00
Use of sanitizers	60.00
Washing hands with soap and water frequently	88.00
Arogya setu app	46.00

Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (abbreviated as AYUSH) is purposed with developing education, research and propagation of indigenous alternative medicine systems in India. It was established on 9th November 2014 to ensure the optimal development and propagation of AYSUH system of health care (Anonymous). During the pandemic of COVID-19 this ministry has issued Ayurveda's immunity boosting measures for self-care. Table.no. 4 exhibit the awareness of the respondents regarding specific directives of Ministry of AYUSH and use of some indigenous measures during this pandemic.

Recommended Measures by Ministry of AYUSH

I. General Measures

1. Drink warm water throughout the day.
2. Daily practice of Yogasana, Pranayama and meditation for at least 30minutes as advised by Ministry of AYUSH
3. Spices like Haldi (Turmeric), Jeera (Cumin), Dhaniya (Coriander) and Lahsun (Garlic) are recommended in cooking.

II. Ayurvedic Immunity Promoting Measures

1. Take Chyavanprash 10gm (1tsf) in the morning. Diabetics should take sugar free Chyavanprash.

2. Drink herbal tea / decoction (Kadha) made from Tulsi (Basil), Dalchini (Cinnamon), Kalimirch (Black pepper), Shunthi (Dry Ginger) and Munakka (Raisin) - once or twice a day. Add jaggery (natural sugar) and / or fresh lemon juice to your taste, if needed.
3. Golden Milk-Half tea spoon Haldi (turmeric) powder in 150 ml hot milk -once or twice a day.

III. Simple Ayurvedic Procedures

1. Nasal application - Apply sesame oil / coconut oil or Ghee in both the nostrils (Pratimarsh Nasya) in morning and evening.
2. Oil pulling therapy- Take 1 table spoon sesame or coconut oil in mouth. Do not drink, Swish in the mouth for 2 to 3 minutes and spit it off followed by warm water rinse. This can be done once or twice a day.

IV During dry cough / sore throat

1. Steam inhalation with fresh Pudina (Mint) leaves or Ajwain (Caraway seeds) can be practiced once in a day.
2. Lavang (Clove) powder mixed with natural sugar / honey can be taken 2-3 times a day in case of cough or throat irritation.
3. These measures generally treat normal dry cough and sore throat. However, it is best to consult doctors if these symptoms persist.

Information about these directives was disseminated by the use of various Information and Communication Technologies and after that awareness among the women was judged which revealed that majority of the farm women (83.00%) were aware about the general methods of drinking hot water, use of spices and yoga practicing as directed by Ministry of AYUSH. More than half of the respondents (60.00%) are aware of the ayurvedic methods to increase immunity. Specific methods to cure dry cough and throat pain was reported by only 32.00 per cent women (Table 4).

Table 4: Distribution of the farmwomen according to awareness regarding the directives of Ministry of AYUSH (N=100)

Categories	Percentage
Do not know	13.00
General methods	83.00
Ayurvedic methods to increase immunity	60.00
General ayurvedic methods	42.00
Specific methods to cure dry cough & pain in throat	32.00

Table 5 shows that about free time availability to the hill farm women. It was reported by majority of the respondents (83.00%) that although they have free time but for very short span it may be 1-2 hours a day only. At that time they go for using social media and WhatsApp (90.00%) and for watching T.V. (83.00%). Kamala *et al.* (2019) in a study on 100 farm women revealed that Television and Mobile phones were regarded as the most frequently used ICT tool as compared to other ICTs. As far as Television is concerned, Majority of them (75%) used to watch religious programmes. It is worth mentioning here that more than half (56.00%) of the respondents also spent time with their family members too. However, this figure is less as compared to time spent on other activities. Only 28 per cent of the women mentioned that they use their free time to learn new skills which were taught to them before lockdown during trainings by university and government officials. Like they had started preparing *jeevamrut* (a liquid organic manure popularly used as means of organic farming, *ghana jeevamrut*. (It is an organic fertilizer which enriches the soil and plant and provides all the nutrients required for the growth of the plant) etc.

Table 6 shows that majority of the farm women (70.00%) reported that increase in household workload was the major deleterious effect of lockdown. Those women whose source of income was business had reported (60.00%) decrease in their income levels due to lockdown. It was also found that this lockdown had created stress on the minds of the farm women (56.00%).

Table 5: Distribution of the farmwomen according to availability of free time during lockdown and its utilization (N=100)

Activities	Frequency	Percentage
Availability of free time	50	83.00
Use of free time		
Television watching	50	83.00
Type of programs watched		
News	22	36.00
Religious	45	75.00
Films	24	40.00
Use of WhatsApp	42	90.00
Learning new skills	17	28.00
Spent time with family	34	56.00

Table 6: Distribution of the farmwomen according to their perception of deleterious effects of the lockdown on their lives and problems faced due to lockdown (N=100)

Categories	Percentage
Deleterious effects of lockdown on their lives	
Increase in household workload	70.00
Decrease in income	60.00
Domestic fights	31.00
Lack of medical facilities for the sick	5.00
Stress	56.00
Perception of the lockdown	
Lockdown is good/ useful	83.00
Lockdown is not good/ not useful	11.00
Do not know	5.00
Difficult to manage	48.00
To curtail the spread of coronavirus	58.00
Problems faced due to lockdown	
Household level	
Non conducive household environment	31.00

Regarding distribution of the farmwomen according to their perception of the lockdown majority of them (83.00%) reported that it is good and need of the hour to curtail the spread of disease (58.00%). Approximately one-third of the respondents reported that lockdown had adverse effect on their daily routine. It was further mentioned by 31.00 per cent of the women that due to restrictions on not moving out of homes hereby staying of all the family members at home there is an extra burden of work on them thus leading to non- conducive environment at home.

During lockdown countries whole economy has shattered. The people who had moved to cities to earn their livelihood had started migrated back to their homes. This has created a great financial imbalance and stress among people. As far as financial aspects are concerned Figure 3 depicts that it was reported majority of the women (81.00%) were using their household savings. Use of government help was reported by 64 per cent of the respondents. Very few respondents i.e. 8 per cent had reported that they had taken loan during lockdown to meet out their household expenses. It was reported by 25 per cent of farm women that it will be very difficult for them to run their houses for more than 2-3 months if the lockdown extends.

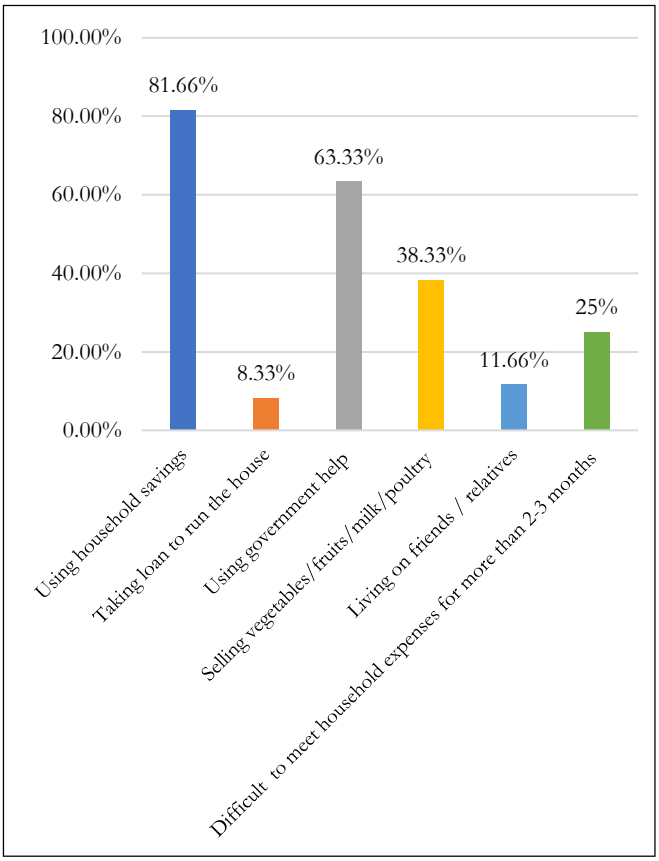

Figure 3: Financial management during lockdown

CONCLUSION

The COVID-19 virus blowouts primarily through droplets of saliva or discharge from the nose when an infected being coughs or sneezes, so it is important that we also practice respiratory etiquette (by coughing into a flexed elbow). Although vaccines or treatments are available for COVID-19 but still self-discipline in adopting the preventive measures/guidelines (stay at home as far as possible, maintain the social distancing, bear mask when and wherever necessary and wash the hands frequently with soaps and water for at least twenty seconds) issued by the Govt. time to time is the only way out to stay safe. People with strong immunity has a direct relationship with the spread of the disease. Hence, the immunity boosting food should be promoted and the foods which reduce the immunity should be avoided.

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Agricultural Vulnerability to Climate Change: A Case Study of Kerala

B.J. Giridhar[1], K.J. Raghavendra[2], Dharam Raj Singh[1] and Philip Kuriachen[1]*
[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]ICAR-Indian Institute of Farming Systems Research, Modipuram-250110, Uttar Pradesh

ABSTRACT

Vulnerability assessment has become a vital tool for policy response since it helps in identifying vulnerable regions or sections of the society. Indicator method has been used predominantly in literature as it provides single values, are easy to comprehend and assist policy makers in identifying vulnerable sectors as setting targets. Kerala being one the important state for its agricultural contribution, it saw erratic climate fluctuations in recent times which makes it more pressing for the need to study the climate change and its impacts on agriculture and livelihoods. The paper tries to capture macro-level vulnerable districts using secondary data sources and construct a composite Agricultural Climate Vulnerability Index of Kerala using a set of 17 indicators classes representing Exposure, Sensitivity, and Adaptive Capacity. The paper also includes a crop loss index to represent potential damages to agriculture due to climate change. Crop loss index was calculated for 9 principle crops of Kerala using de-trended time series data. The assessment reveals that Palakkad was highly vulnerable to crop loss, Alappuzha had highest scores of exposure and sensitivity, whereas, Ernakulam had highest adaptive capacity. Overall index suggests that Palakkad and Malappuram were highly vulnerable while the remaining districts were moderately vulnerable to climate change.

Keywords: Agriculture, Climate change, Kerala, Vulnerability

INTRODUCTION

Climate change affects several climate sensitive sectors such as agriculture, forests, coastal ecosystems, availability of water and on human health. Agricultural sector is expected to impacted in several ways, among them are, the increased variability with regards to rainfall and temperature, increase in the frequency and intensity of occurrence of extreme weather events, such as floods, droughts and windstorms. These are typical examples where climate and socio-economic systems interact resulting in loss of lives, economic damages, damages to infrastructure, and ecosystems. The consequences of these extreme events on agriculture could be the decrease in yield of crops in certain areas and shift in cropping patterns . Hence there is a need to study challenges of climate change on agriculture to cope and build resilience in agriculture sector (Fellmann, 2011). The impacts of climate change are likely to be severe for countries like India that have limited arable land but are heavily dependent on agriculture (Mendelsohn *et al.*, 2006; Stern, 2006; Nelson *et al.*, 2009). Additionally, the limited financial and technological capabilities of the farming community limits their ability to pursue adaptation and mitigation options.

Agriculture in India is double vulnerable to climate change. First about 60 per cent of total agricultural area is rainfed, which depends entirely on monsoons. Secondly, more than 80 per cent of farmers are small and marginal land holders who have very less capacity of coping with climate change. India's climate change projection estimates indicates that all India annual mean temperatures could increases by 1.7-2.02°C by 2030 and by about 2-4.8°C by 2080s and increase in precipitation by 1.2–2.4 per cent by 2030 and by 3.5–11.3 per cent by 2080s except for a few regions (Chaturvedi *et al.,* 2012). The projections of climate impacts on agriculture by 2100 for India have suggested that with significant changes in temperature and rainfall, the rice yield will decrease by 15 per cent and wheat yield by 22 per cent. Coarse cereals will be less affected, whereas pulses will be affected more than cereals (Birthal *et al.*, 2014). It is predicted that for every 2°C rise in temperature, the GDP will reduce by 5 per cent (Ranuzzi and Srivastava, 2012).

*Corresponding author email id: philipkuriachen@gmail.com

The present climate extremities faced by several countries across the world signals that climate change is in existence and it is affecting various sectors in many ways. But it will not affect everyone equally i.e., not in the same way, not at the same time, and not at the same magnitude. Poorer countries and poor people will be hit hardest and earliest. With its characteristical uncertainties and variability associated with, climate change is adversely impacting both biophysical systems and socio-economic systems. Vulnerability assessments have emerged as an important tools in identifying structural weaknesses which make a system vulnerable (Tonmoy *et al.,* 2014), explore the capacity of people and systems to adapt (Ford and Smit, 2004), and inform prioritising adaptation funding and implementation. Vulnerability index is one of the most widely used tool for policy making and to convey information about which parts and sectors are highly vulnerable.

IPCC in its sixth assessment report defined vulnerability as "the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (IPCC, 2014). Literature on vulnerability assessment for Kerala revealed that studies were confined to particular sectors and particular areas. Overall assessment for the agriculture sector of the state were lacking, hence an attempt has been made to the construct a composite vulnerability index of different districts for Kerala, which has seen major climate disasters in recent years.

MATERIALS AND METHODS

Kerala is a state on the southwestern Malabar Coast of India. Kerala is the starting point of monsoon rains in India and has the unique distinction of receiving substantial quantum of rainfall from both the south-west and north–east monsoons. The economy of Kerala is the 11th largest state economy in India with Rs. 8.76 trillion gross domestic product and a per capita GDP of Rs. 199,000.

Study uses district-wise time series data on area and yield (2004–05 to 2018–19) collected from the Directorate of Economics and Statistics, Kerala and Ministry of agriculture, Government of India. Data pertaining to 14 districts of the state was collected for nine major crops viz., Paddy, Coconut, Pepper, Cashew, Rubber, Banana, Jack, Mango, and Areca nut. The data for other indicators were collected from Central Ground Water Board (CGWB); Ministry of Water Resources, Government of India, Planning commission, Indian Metrological Department, Agriculture Census 2015-16, Department of Economics and Statistics, Government of Kerala, Census 2011 Government of India, Kerala State Disaster Management Authority, National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), Economic Review 2016, State Planning Board, Socio Economic and Caste Census 2011, Government of India.

RESULTS

Crop production loss index represent the extent of production loss due to fluctuation in climate variable. The estimated values of crop production losses in cereals, oilseeds and pulses were provided given in Table 1. The loss of crop yield due to change in climate is highly affected in Palakkad district, with severity in crops like paddy, areca nut and mango. This central district is facing huge loss in yield due to more fluctuation in area under cultivation and also the natural calamities impacting every year. Crops like paddy is more susceptible to yield loss in the all the districts followed by mango, arecanut and coconut. The commercial crops like pepper, cashew and jack fruits production are less prone to climate change in the state. Remaining districts falls in the category of medium loss of crop yield. On the other hand, Kasaragod (0.05) and Pathanamthitta (0.07) have shown resilience to crop production loss with the change in climate over the period. There is minimal change in area under cultivation for major crops and also less frequent calamities made these districts to sustain the yield to potential levels. a Overall majority of the districts in Kerala accompanied with medium degree of crop loss due to climate change.

Exposure of region to the significant climate variations in the year was measured in to index based on growth and its instability of North-east and south-west monsoon (Table 2). The districts under exposure index were made into three classifications high, medium and low. The index value ranges from as high as 0.630 for Alappuzha to 0.135 for Kollam at lower level. The districts Alappuzha, Idukki and Thrissur highly exposed to climate variations making it possibility of vulnerable regions. On the other hand, southern adjacent districts Pattanamthitta, Kottayam and Kollam are very less exposed to the variation in rainfall distribution. Palakkad, Wayanad, Thiruvananthapuram, Ernakulam, Kannur, Malappuram, Kasaragod and Kozhikode are under medium exposure level. There exists

Table 1: Crop Production Loss index (CPLI)

District	Paddy	Coconut	Pepper	Cashew	Rubber	Banana	Jack	Mango	Arecanut	CLI	Degree of CLI
Palakkad	0.585	0.014	0.004	0.007	0.008	0.029	0.001	0.175	0.144	0.956	High
Thrissur	0.285	0.030	0.003	0.003	0.002	0.003	0.008	0.061	0.051	0.432	Medium
Alappuzha	0.312	0.013	0.000	0.005	0.000	0.000	0.006	0.035	0.029	0.388	Medium
Kannur	0.020	0.022	0.002	0.001	0.011	0.005	0.009	0.168	0.138	0.367	Medium
Malappuram	0.130	0.032	0.003	0.002	0.008	0.011	0.002	0.096	0.079	0.357	Medium
Kottayam	0.288	0.005	0.005	0.000	0.031	0.004	0.000	0.001	0.001	0.329	Medium
Ernakulam	0.182	0.012	0.002	0.006	0.016	0.006	0.002	0.040	0.033	0.290	Medium
Kollam	0.075	0.017	0.007.	0.006	0.008	0.003	0.001	0.090	0.074	0.267	Medium
Kozhikode	0.000	0.028	0.008	0.006	0.004	0.002	0.002	0.127	0.105	0.266	Medium
Idukki	0.002	0.002	0.001	0.003	0.009	0.003	0.008	0.089	0.074	0.182	Medium
Wayanad	0.067	0.000	0.003	0.005	0.000	0.022	0.004	0.020	0.016	0.126	Medium
Thiruvananthapuram	0.020	0.019	0.004	0.004	0.007	0.005	0.002	0.038	0.031	0.120	Medium
Pathanamthitta	0.049	0.005	0.004	0.005	0.013	0.003	0.003	0.000	0.000	0.070	Low
Kasargod	0.014	0.014	0.001	0.007	0.008	0.001	0.001	0.006	0.005	0.050	Low

Table 2: Exposure index scores and degree of Exposure

District	NEM (CAGR)	SWM (CAGR)	NEM (Instability)	SWM (Instability)	Exposure Index	Degree of Exposure
Alappuzha	0.18	0.10	0.02	0.33	0.630	High
Idukki	0.36	0.09	0.14	0.00	0.593	High
Thrissur	0.31	0.09	0.05	0.09	0.542	High
Palakkad	0.22	0.12	0.11	0.04	0.491	Medium
Wayanad	0.12	0.10	0.16	0.06	0.430	Medium
Thiruvananthapuram	0.18	0.11	0.06	0.05	0.402	Medium
Ernakulam	0.19	0.04	0.05	0.09	0.370	Medium
Kannur	0.07	0.13	0.02	0.09	0.299	Medium
Malappuram	0.04	0.09	0.10	0.05	0.284	Medium
Kasaragod	0.07	0.11	0.00	0.10	0.282	Medium
Kozhikode	0.02	0.15	0.04	0.05	0.258	Medium
Pathanamthita	0.09	0.00	0.06	0.02	0.166	Low
Kottayam	0.00	0.04	0.05	0.04	0.137	Low
Kollam	0.02	0.04	0.07	0.01	0.135	Low

NEM & SEM - North East Monsoon Rainfall & South East Monsoon Rainfall
CAGR – Compound Annual Growth Rate

very high instability in South-western monsoon in Alappuzha (0.33) and Wayanad (0.16) and Idukki (0.14) face instability of north-east monsoons more. Fluctuations in the growth and instability of precipitation makes the districts exposure to climate change.

Sensitivity of districts to climate parameters are given in Table 3. Parameters like ground water, area under cultivation, small holders numbers will influence the sensitivity to climatic aberrations. Based in the indicators the sensitivity index ranges from 0.78 to 0.30 with high, medium and low classifications. Again the coastal districts like Alappuzha (0.78) has high degree of sensitivity due to considerable ground water extraction and small holders presence, followed by Ernakulum (0.73) and Thrissur

Table 3: Sensitivity index scores and degree of sensitivity

District	Stage of ground water development	Small and marginal farmers	Population density	Net sown area	Flood prone area	Degraded and waste lands	Sensitivity index	Degree of sensitivity
Alappuzha	0.145	0.228	0.014	0.049	0.0006	0.000	0.780	High
Ernakulam	0.102	0.210	0.004	0.031	0.0001	0.064	0.733	High
Thrissur	0.064	0.238	0.005	0.022	0.0001	0.068	0.705	High
Malappuram	0.048	0.222	0.010	0.032	0.0003	0.087	0.665	Medium
Kollam	0.115	0.258	0.007	0.034	0.0002	0.041	0.570	Medium
Palakkad	0.032	0.123	0.004	0.027	0.0001	0.126	0.563	Medium
Kannur	0.088	0.200	0.003	0.056	0.0001	0.065	0.553	Medium
Thiruvananthapuram	0.064	0.259	0.011	0.049	0.0005	0.028	0.520	Medium
Kottayam	0.146	0.126	0.008	0.073	0.0005	0.033	0.502	Medium
Kozhikode	0.053	0.237	0.008	0.056	0.0004	0.038	0.500	Medium
Pathanamthita	0.116	0.216	0.003	0.000	0.000	0.047	0.464	Medium
Wayanad	0.182	0.000	0.002	0.039	0.0008	0.028	0.335	Low
Idukki	0.098	0.061	0.000	0.029	0.000	0.127	0.315	Low
Kasaragod	0.000	0.127	0.004	0.073	0.0002	0.024	0.302	Low

(0.70). On the other hand, Wayanad, Idukki and Kasaragod have low degree of sensitivity due to the presence of very few small holders and less ground water extraction. Being area under cultivation is more the Wayanad and Kottayam has high water development in the state. The districts like Malappuram, Kollam, Palakkad, Kannur, Thiruvananthapuram, Kottayam, Kozhikode and Pattanamthitta were in the medium degree of sensitivity. It can be said that high ground water extraction and large small holders presence shows more sensitive to climate variations.

The ability of districts to accommodate climate change induced technologies to sustain the livelihood. Table 4 shows the degree of adoptive capacity of the districts in Kerala. It represents a negative relation with vulnerability, i.e., higher the adaptive capacity, lower the vulnerability. Result shows that among the districts Ernakulum (0.93) has high degree of adaptive capacity characterised with high per capita income and literacy rate in the state. Majority of all the districts fall into medium category of adoptive capacity. In the extreme districts like Malappuram, Palakkad and Wayanad stands in the low adaptive capacity causing more impact by change in climate, these districts described with less per capita income and literacy rate. Thiruvananthapuram with per capita income above state average has less literacy rate, more IMR and less landless households has medium capacity to climate change adaptations. The northern and southern districts are found to exhibit medium degree of adoptive capacity climate change.

The vulnerability index shows the potential negative impact the communities can face in districts of Kerala are provided in Table 5. The sub index like crop production losses, sensitivity, exposure and adaptive capacity determines the score of vulnerability index, and thereby the degree of vulnerability of a particular district in Kerala. However only two degree of vulnerability i.e. high and medium were classified here. Vulnerability for the given time period reveals that Palakkad and Malappuram district with communities depend on agriculture are vulnerable to climate change with index score of 1.857 and 1.130 respectively. These two districts are characterised with high crop production loss and medium sensitive and exposure to change in climate with low adoptive capacity. On the contrary, none of the districts were safest in terms of vulnerability with VI scores. The remaining districts of south and north were in the category of medium level of vulnerability. The state of Kerala as a whole is in compliance with high to medium degree of vulnerable to change in climate with less adoptive capacity and more exposure.

DISCUSSION

The present study highlights the need for introducing crop loss indices while estimating regional vulnerability to climate change in addition to traditionally used components like

Table 4: Adaptive capacity index scores and degree of adaptive capacity

District	Landless households	Kuccha walls and roof	Female headed	Literacy rate	Per capita income	IMR	Adaptive capacity	Degree of adaptive capacity
Ernakulam	0.201	0.017	0.012	0.107	0.569	0.029	0.933	High
Alappuzha	0.134	0.011	0.009	0.097	0.425	0.035	0.711	Medium
Kollam	0.180	0.012	0.006	0.040	0.430	0.040	0.707	Medium
Kottayam	0.198	0.018	0.012	0.065	0.386	0.021	0.701	Medium
Idukki	0.148	0.013	0.010	0.094	0.376	0.037	0.677	Medium
Thrissur	0.120	0.008	0.007	0.099	0.323	0.024	0.582	Medium
Kannur	0.229	0.018	0.008	0.105	0.190	0.031	0.581	Medium
Pathanamthita	0.169	0.012	0.008	0.132	0.109	0.033	0.463	Medium
Thiruvananthapuram	0.090	0.002	0.000	0.037	0.316	0.013	0.458	Medium
Kozhikode	0.141	0.000	0.007	0.087	0.159	0.000	0.395	Medium
Kasaragod	0.209	0.004	0.007	0.001	0.111	0.038	0.368	Medium
Malappuram	0.053	0.013	0.006	0.069	0.000	0.035	0.177	Low
Palakkad	0.000	0.001	0.002	0.019	0.093	0.037	0.153	Low
Wayanad	0.057	0.003	0.008	0.000	0.041	0.035	0.143	Low

Table 5: District-wise vulnerability index scores and degree of vulnerability

Districts	Vulnerability Index	Rank	Degree of vulnerability
Palakkad	1.857	1	High
Malappuram	1.130	2	High
Thrissur	1.098	3	Medium
Alappuzha	1.088	4	Medium
Wayanad	0.748	5	Medium
Kannur	0.639	6	Medium
Kozhikode	0.630	7	Medium
Thiruvananthapuram	0.584	8	Medium
Ernakulam	0.461	9	Medium
Idukki	0.413	10	Medium
Kottayam	0.268	11	Medium
Kasaragod	0.266	12	Medium
Kollam	0.266	13	Medium
Pathanamthitta	0.237	14	Medium

exposure, sensitivity and adaptive capacity. Several studies in the past have attempted the integration of crop loss indices (Kumar *et al.,* 2016; Sendhil *et al.,* 2018). This study broadens the scope of integrating crop loss index to high rainfall regions. The pre-dominance of water intensive crops coupled with lower level of irrigation in comparison to national average indicate that planting decisions are highly reliant on good monsoon rains. Although the state holds comparative advantage in cash crop production, rice is still a major cereal crop and its cultivation is substantially affected by climatic variability (Sasendran *et al.,* 2000; Palanisami *et al.,* 2017) thereby paving the way for effective integration of crop loss index into the composite vulnerability index. Climatic variability is also predicted to affect banana cultivation, yields and profitability adversely (Jyotsana *et al.,* 2019). This is reflected in our findings with banana registering the highest value in crop loss across the states after rice.

Previous studies on climate vulnerability in the state have focused on two dimensions namely environmental vulnerability and socio-economic vulnerability (Sarun *et al.,* 2018). The study has identified Waynad, Idukki and Alapuzha districts as regions with high levels of environmental vulnerability and Palakkad and Ernakulam have medium levels of vulnerability. In our study the exposure and sensitivity index are approximate proxies for environmental vulnerability. The districts Idukki and Alapuzha had high levels of exposure to climate change and rainfall variability while Palakkad had medium level of vulnerability. Alapuzha also had high level of sensitivity to climate change, hence our studies have findings that are in partial agreement with previous works. Overall vulnerability in the agriculture sector is higher in the Northern districts of Malapuram and Palakkad while vulnerability in general is higher in wayanaad, Palakkad, Alapuzha and Idukki districts. The integration of crop loss

indices enables us to demarcate regions with vulnerable agriculture sectors with greater precision.

CONCLUSION

The study here undermines examination of agricultural vulnerability of Kerala State in India, the paper tries to improve methodological aspects of vulnerability assessment of IPCC framework by adding an additional component of crop loss index to suit for agriculture vulnerability assessment. Agriculture is being dependent on climate a deviation from normality would disrupt food security. Kerala being one such state which saw erratic climate fluctuations in recent times it makes it more pressing for the need to study the climate change and its impacts on agriculture and livelihoods. The paper tries to capture macro-level vulnerable districts using secondary data sources but, the studies have to be conducted at block or village levels conceptualising vulnerability as socially constructed or as resilient or using livelihoods perspective to identify the indigenous coping strategies and guide communities on better climate change adoption techniques. The state should periodically predict and forecast weather fluctuation and devise a strategy to adopt crops that are less prone to erratic climatic events.

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Price Forecasting as a tool to aid Market-Led Extension

Nandini Saha[1]* and Pramod Kumar[2]
[1]Ph.D. Scholar, [2]Principal Scientist, Division of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi

ABSTRACT

Extension has played a very important role in making India become self-reliant in food production. The main focus of extension agencies on production-oriented strategies made this possible. But the farmers at individual level are not realizing remunerative prices for their produce (Krishna *et al*., 2019). Therefore, extension services should be focused towards market-oriented strategies which will equip the farmers with necessary market information as well as will help them to obtain optimum return from their investment. The market-led extension would be of an effective instrument to protect the interest of the farming community (Krishna *et al*., 2019). Market-led extension is a new dimension of agricultural extension and this devises interventions for the farmers from planting to final market transaction (Shinogi *et al.,* 2013). For successful implementation of this approach relevant and timely availability of price information is crucial. Many agencies are now disseminating current price information however very less focus is given to equip the farmers with forecasted price. Keeping this in background the present study is taken up to explore how this price forecasting techniques can help in protect the interest of the farmers and the roles of extension system. It was found that when price series of any agricultural commodity (here potato) is associated with high price volatility, GARCH model provide better forecast than ARIMA which is in line with the findings of several other authors. Extension system play very important role in light of price forecasting by not only disseminating forecasted price to farmers but also by capacity building of extension personnel and helping farmers in taking their marketing decision.

Keywords: ARIMA, GARCH, Market information, Market-led extension

INTRODUCTION

Market-Led Extension is the market-ward orientation of agriculture through extension, includes agriculture and economics and is the perfect blend for reaching at the door steps of farming community with the help of appropriate technology. Market-Led Extension stress the need of agriculture extension to be more than just a delivery vehicle for agriculture technology (Shitu *et al.,* 2013) and is designed for transforming a top-down extension system into bottom-up, farmer–centered and demand–driven system (Thakur, 2017). Market-led extension helps farmers improve the quality of farm produce, which not only increase the value of the commodity but also escalate marketability, contributing to an increase in farmers' incomes. Market-led Extension approach is particularly important because even after gaining self-sufficiency in food grain production, increased production has failed to attract the farmers with remunerative incentives, most of the farmers don't remain aware of the market situation. Along with that, with the globalization of commodity market, farmers have to transform themselves from mere producer-seller in domestic market to producer cum seller in wide market to realize the optimum returns from the investments (Krishna *et al.,* 2019). So, in this situation, Market-Led extension approach would be of an effective instrument to protect the interest of the farming community.

Some of the objectives of Market Led Extension (M-L-E-) are:

- M-L-E aims to convert the traditional agricultural sector into a profit-oriented business
- It also aims to strengthen the Research-Extension-Farmer linkages, specially between various department who are working at various levels
- Strengthening market linkages to farmers is another objective of M-L-E which is intended to achieve through IT application in Agricultural marketing.

*Corresponding author email id: nansnew@gmail.com

- M-L-E also focuses on wider use of electronic mass media for Agricultural Extension

Extension system play a major part in M-L-E Services by doing SWOT analysis of the market, Organizing Farmers' Interest Groups (FIGs) on commodity basis, supporting and enhancing the capacities of locally established groups under various schemes, establishing marketing and agro-processing linkages between farmers' groups, markets and private processors etc. But for the success of M-L-E approach some information are required by the extension system and farmer such as

- Present agricultural scenario and land use pattern
- Crops in demand in near future
- Availability of inputs
- Market prices of produces
- Credit facilities
- Transport facilities
- Market network of the local area and the price differences of in various markets

Among all these information which are required price information of produces are very important for farmers because

a. Reliable and timely availability of price information improves the welfare of farmers and also improves their bargaining power (Kumar *et al.,* 2020)
b. It helps in better allocation of factors of production
c. It has a significant influence on the decision making pattern of farmers regarding the crop acreage
d. The farmers can take informed decision about alternative markets to dispose of the produce
e. The farmers can use the information to make choices around the timing of marketing (Fafchamps and Minten, 2012)

Realizing the importance of price information to farmers, many agencies are now disseminating price information, like-

Agmarknet- More than 3200 markets are covered and more than 2700 markets are reporting data at Agmarknet portal. More than 350 commodities and 2000 varieties are covered under the scheme

National Agriculture Market or e-NAM- Total 1000 mandis of 18 states and 3 Union territories are connected through e-NAM and total 175 crops including food-grains, oilseeds, spices, vegetables, fruits are traded on this platform

Multi-Commodity Exchange (MCX)– It is India's largest commodity derivatives exchange which provides price information of 19 agricultural commodities

National Commodity and Derivatives Exchange Limited (NCDEX)- An online commodity exchange based in India which provides price information of 33 agricultural commodities

Apart from these agencies several ICT initiatives has been taken up to disseminate price information such as,

Warana Wired Village Project- Initiated in 1998 by the Prime Minister's Office Information Technology (IT) Task Force Aims to provide villagers of 70 villages around Warana information in local language about crops and agricultural market prices, employment schemes from the government of Maharashtra, and educational opportunities.

i-Kisan- An one-stop solution for farmers in providing information on crops, crop management techniques, fertilizers, pesticides and other related information like market updates and weather forecasts

Earik- Single window to improve the access to agricultural information and technology in north-eastern India. It provides expert consultation on production, plant protection and marketing.

e-Krishi- Utilised to educate farmers, provide real time information on prices, arrivals and issue disaster warning and weather forecast. The aim is to enable farmers to take informed decisions on sale of their produce and bring transparency in the working of the Madhya Pradesh State Agricultural Marketing Board

Mahindra Kisan Mitra - The initiate provide information on daily market prices, weather updates, crop advisories, agri related news, etc.

e-Choupal - An initiative by ITC provides alternative marketing channel, information on weather, agricultural practices, input sales, etc. It is a kiosk located in a village and equipped with computer with internet access managed by trained *sanchalak*.

Importance of price forecasting of agricultural commodity- However, all these agencies and ICT initiatives are concerned with the current price information of the produces, very few initiatives have been taken up to equip the farmers with the forecasted price i.e., how price will behave in the near

future. In order to know how the price will behave in the near future we can take help of Price forecasting technique. Price forecasting basically helps to predict the future price of any commodity. It is particularly important because-

- It protects the farmers from high and uncertain price fluctuation because when farmers know what could be the prevailing price in the near future, they can avoid the damage caused by uncertain price fluctuation.
- Price forecast is particularly important for farmers because they rely on the anticipated prices while taking decision of production and marketing, and it may have financial consequences several months later (Jha and Sinha, 2013).
- Modelling and forecasting of price are crucial for policymakers and also for specific players in the marketing chain of agricultural commodities, starting from farmers to consumers (Lama *et al.,* 2015).

Keeping this in the background, this study was taken up to examine the importance of price forecasting in Market-led Extension.

MATERIAL AND METHODS

So, there are a number of price forecasting techniques, like–

ARIMA or Auto Regressive Integrated Moving Average- A class of models that explains a given time series based on its own past values, that is, its own lags and the lagged forecast errors, so that equation can be used to forecast future values.

SARIMA or Seasonal Auto Regressive Integrated Moving Average- An extension of ARIMA which is used for time series forecasting with univariate data containing trends and seasonality because ARIMA does not support time series with a seasonal component.

ARCH or the Auto Regressive Conditional Heteroscedasticity- The ARCH model describes the variance of the current error term as a function of the previous time periods' error terms.

GARCH or Generalized Autoregressive Conditional Heteroskedasticity- An extension of the ARCH model that incorporates a moving average component together with the autoregressive component.

Among these 4 techniques, ARIMA and GARCH method has been used in the study to illustrate how these techniques work. ARIMA is used because it is the easiest to do and most widely used in forecasting studies, and GARCH have been used when high price volatility was observed in the data series.

It is assumed that the time series variable in an ARIMA model would be a linear function of past values and random shocks. A process $\{y_t\}$ is said to follow an integrated ARMA model, denoted by ARIMA (p, d, q), if

$$\Phi(B)\ (1-B)^d y_t = \theta\ (B)\ \varepsilon_t$$

where, $\varepsilon_t \sim WN\ (0, \sigma^2)$ and WN indicates white noise, B= Backward shift operator. The integration parameter d is a non-negative integer. When d = 0, ARIMA (p, d, q) = ARMA (p, q)

GARCH model is used to measure the extent of volatility in monthly wholesale prices of potato. GARCH model as defined below-

$$\sigma^2_t = \alpha_0 + \alpha_1 u^2_{t-1} + \beta\sigma t^2_{t-1}$$

Here conditional variance of *u* at time *t* depends not only on the squared error term in the previous time period but also on its conditional variance in the previous time period.

The sum of $(\alpha_1+\beta_1)$ gives the degree of persistence of volatility in the price series. The closer the sum to one, greater is the tendency of price volatility to persist for longer time in the variable under consideration

RESULTS AND DISCUSSION

For the study, monthly wholesale price data of potato crop was collected from Burdwan market of West Bengal for the period January 2006 to December 2020. Out of total 180 months' data 174 data points were used to develop the models and rest 6 points were used to compare with the forecasted price and check the models' accuracy (Table 1 and Figure 1). At first, ARIMA model was used on the data, and then, the data was tested for presence of price volatility using GARCH model (Table 2). The table reveals that the sum of α & β is 0.73, so it is concluded that the price series has high price volatility which is why GARCH model has also been used to forecast prices because when high volatility is present in the data, the AR-GARCH model offers better future point prediction than the ARIMA model (Lama *et al.* 2015).

In the Table 3, price forecasted through both the models are being compared with the actual price of the 6

Table 1: Descriptive statistics

Mean	844.74
Standard Error	33.16
Median	700.33
Mode	585.56
Standard Deviation	437.51
Sample Variance	191418.1
Kurtosis	-0.33
Skewness	0.80
Range	1822.92
Minimum	216.21
Maximum	2039.13
Sum	146985.7
Count	174

Table 2: Estimates of GARCH model

	Estimate	P value
Constant	372.95	0.01
AR	0.97	<0.001
MA	0.47	<0.001
Omega	9537.03	0.01
Alpha	0.38	0.01
Beta	0.35	0.03

Table 3: Comparison of Actual and Forecasted Price

Time	Actual (Rs/q)	Forecasted (Rs/q) ARIMA (1,1,3)	Forecasted (Rs/q) GARCH (1,1)
July, 2020	2380	2053.94	2107.17
August, 2020	2506.67	1934.17	2056.52
September, 2020	2778.26	1786.25	2008.02
October, 2020	2902.23	1668.76	1960.54
November, 2020	2125.24	1575.42	1914.00
December, 2020	2224.78	1501.28	1870.26

Table 4: Mean Absolute Percentage Error (MAPE) values

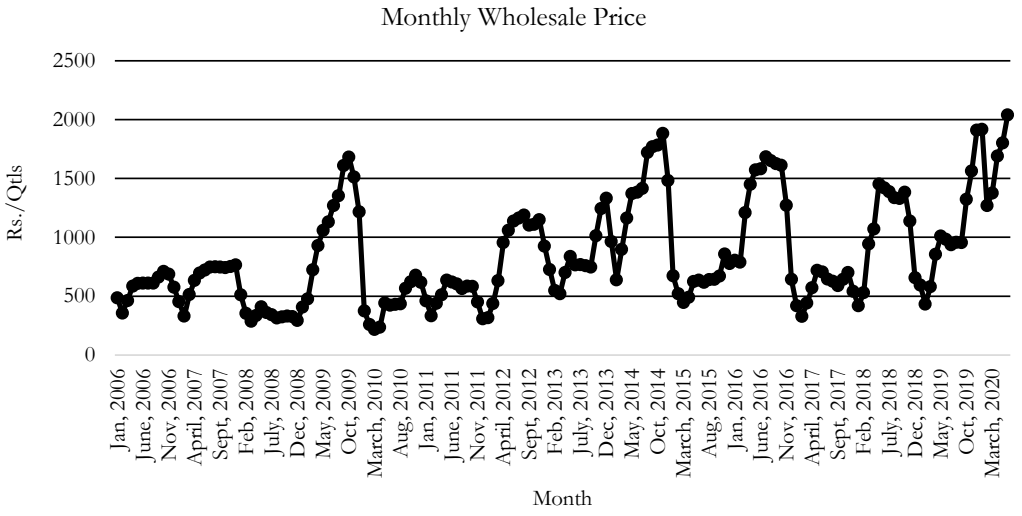
	ARIMA (1,1,3)	GARCH (1,1)
MAPE	21.56	11.08

Table 5: typical MAPE values for and their interpretation

MAPE	Interpretation
<10	Accurate forecasting
10-20	Good forecasting
20-50	Reasonable forecasting
>50	Inaccurate forecasting

months which were not used for model development. From the Table 4, it is observed that the price forecasted through GARCH model are nearer to the actual prices. To check the model accuracy Mean Absolute Percentage Error (MAPE) values has been calculated which is given in Table 4. The table revealed that GARCH model forecasted better than ARIMA model. However, in order to know whether these models forecast are good or bad we need to take help of a Table 5 by Lewis (1982) containing typical MAPE values for and their interpretation. According to the table, GARCH model provide good forecasting and ARIMA model provides reasonable forecasting Hence, both the models can be used to predict future prices, however since GARCH model is more accurate than ARIMA model, so it's better to use GARCH than ARIMA.

Figure 1: Time plot of potato wholesale price (January 2006-December 2020)



CONCLUSION

However, the work doesn't end here after doing the price forecasting, after that extension plays very vital role in here, which are –

- *Capacity building of extension personnel-* Data collection, Tabulation, Running the software, Interpretation of the result
- *Dissemination of the forecasted price through* Kisan Call Centre, Web based extension services like e-Krishi, Mahindra Kisan Mitra, iKisan etc., Mobile based advisory services like m-Krishi, Reuters market light, Earik etc, AGMARKNET, e-NAM, TV channels and programmes like DD Kisan, Radio programmes
- *Helping the farmers in taking decision about marketing based on the Forecasted price-* If the forecasted price is higher than anticipated, extension personnel can suggest him to delay his harvesting or can suggest him to store the produce.

If the forecasted price is lower than anticipated price, they can suggest the farmers to sell in other markets where the price is expected to be higher or they can suggest to opt for some vale addition services in order to get better price

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Identify and Prioritization of the Challenges Associated with Incubation in Agricultural Sector

Sushil Kumar[1], Rashmi Singh[2]*, M.S. Nain[2] and Pramod Kumar[4]
[1]Ph.D. Scholar, ICAR-IARI & Indian Police Service, Rajasthan
[2,3,4]Principal Scientist, ICAR-Indian Agricultural Research Institute, New Delhi-110012

ABSTRACT

The current research study was carried out by covering purposively selected agri-business incubators of ICAR- a) IARI, New Delhi; b) CIPHET, Ludhiana and c) NAARM, based on their performance scores (NAIP, ICAR Report, 2014). Besides these, one more business incubator viz. RUDSETI (Rural Development and Self-Employment Training Institute) was studied to aid in useful comparison between the business incubators. Ranking technique by Garret was used in order to identify and then further rank some major factors that were responsible to establish the business, also to the hindrances faced by trainees and trainers. Afterwards, the most influencing factor or be it the most inhibiting factor in under each and every sub-head was identifiable by the means of mean score in the statements. Change in the sequence of factors and plus points in consideration with numerical scores were provided under the Garret's ranking technique. Primary advantage of this technique above normal distribution of frequency can be that the variables are arranged according to the significance from the view point of respondents. Whereas the incubatee rank first the lack of adequate marketing facilities followed by delay in payment and long distance of the market. The results revealed that staff and incubatees ranked first the Non- availability of raw materials followed by non- availability of equipment's and lack of electricity as major constraints for production and labour. For personal and general constraints, staff and incubatees ranked first to the Health Problems followed by lack of leisure time and excessive tension and challenges.

Keywords: Agri-business, Challenges, Incubation, Prioritization

INTRODUCTION

Agriculture is the back bone of the Indian economy and it contributes to 65 per cent of Indian economy with its share is around 17-18 per cent and more than 50 per cent of the populations of the country are directly or indirectly dependent on agriculture. Farmers are the only ones that are always ignored even after their key role in sustenance of life. It is due to this ignorance of the government the number of cases of farmer's suicide is increasing considerably which is an alarming situation. The ignorance of the same for a longer period will not only hamper the national development but, will make us deprived of the vast resource of knowledge and experience in farming.

Agriculture by virtue produces goods that is perishable in nature and the long distance from the market makes it prone for decay of the yield thus it was necessitated that government should encourage entrepreneurs to set up their industry near to the farmers so as to reduce the distance between the farmers and the market. Thus, if a small plant is set up in the vicinity of the farmers it is feasible for them to approach easily and this will also increase the farmer's income as the middle trader has been omitted who takes a considerable margin of the farmer. Thus, agribusiness is a sector which seeks evolution by increasing the means of communication through road and awareness to the farmers and production in accordance to the demand of the industry to strengthen up the farmer's income. Agribusiness encompasses all the steps to deliver the goods from the farmer to the market stating the necessary advancement in the infrastructure with the bottom line to increase the farmer's income (James Chen, 2019).

The villages in India even are such that the access to these is very limited and transportation rate as compared to the other places is nil. And in such a scenario where the

*Corresponding author email id: rashmi.iari@gmail.com

roads are meagre the tools of information also fail to reach and the destination. When the means of communication is limited the farmers continue with their old traditional farming and the new methods of farming are seldom introduced. This asymmetry creates an imbalance of power in transactions, which can sometimes cause the transactions to go awry, a kind of market failure in the worst case. Similar examples of this situation can be visualized and leads to moral hazard and monopolies of the knowledge. The wider the gap of the asymmetrical information this further leads to non-economic behaviour. The asymmetry also benefits the middle men who further widen the gap between the consumer and farmer.

The National Agricultural Research and Education System (NARES) is major institute which is constantly in executing various researches and developing new methodologies in agriculture through latest technologies. The technologies are also being developed by the various technological institutes as a part of the development program. A major fillip came with the establishment of National Science and Technology Entrepreneurship Development Board (NSTEDB) under the Department of Science and Technology (DST). NSTEDB is responsible for establishment of Technology Business Incubators (TBIs) in India. NSTEDB has contributed in the field of innovations for agriculture and since the start-up of the board more than 100 institutes have been developed and are in operation. The NSTEDB has successfully classified the incubators and depending upon the access and motive, they have been classified.

Business incubation is emerging as one of the most innovative instruments to support SME creation and development all over the world. Business Incubation refers to the process, where an individual or an organization supports the establishment and growth of a start-up. The supporting staff employed in this process are known as business incubators. The role of business incubators is to see the growth potential and weigh the opportunity before supporting or funnelling funds into any start-up. The proper selection of a start-up involves a high level of research before any decision is taken to support or fund a start-up. In a nutshell, it can be stated that the goal of incubation is to increase the success chances of business.

A major achievement came with the establishment of National Science and Technology Entrepreneurship Development Board (NSTEDB) under the Department of Science and Technology (DST). NSTEDB is bestowed with establishment of Technology Business Incubators (TBIs) in India. A similar effort was made by the Indian Council of Agricultural Research (ICAR) through its World Bank funded National Agricultural Innovation Project (NAIP) with the establishment of 10 Agri Business Incubators (ABIs) in the name of Business Planning and Development (BPD) Units across the length and breadth of the country in 2008-09.

The incubators face a serious challenge in arrangement of funds which serve as the fuel in the nurturing. This issue affected the longevity of the model and in absence of the basic support appropriate results could not achieved (Tengeh and Choto, 2015). In the social and agri-business incubation centres, services like marketing assistance to access market, training on managerial and legal issues and access to fund performed in such a pathetic manner that the incubator had no option to accept the failure and shut his venture. The non-acquaintance to the legal issues had a severe impact on his venture (Bagchi and Chaterjee, 2017). A well-structured incubation program led him the start up from idea generation stage to setting up the business and most crucial funding support. The challenge faced by the incubators in India is finding good start-ups that solve the problems in the market or in value chain (Srinivas *et al.,* 2019).

MATERIALS AND METHODS

The current inspection uses *ex-post facto* research design as the indication of fluctuations that were pre-assumed as it had occurred already, and hence there was no space for the bluffing of any variables and fluctuations. According to the words of Kerlinger (1964) an *ex-post facto* research is a well-defined enquiry with system where the researcher does not directly control the variables, reason being the bluffing of the research has already taken place or another reason could be that they are not bluff-able inherently. The current research study was carried out by covering purposively selected agri-business incubators of ICAR- a) IARI, New Delhi; b) CIPHET, Ludhiana and c) NAARM, based on their performance scores (NAIP, ICAR Report, 2014). Besides these, one more business incubator viz. RUDSETI (Rural Development and Self-Employment Training Institute) was studied to aid in useful comparison between the business incubators. The IARI, New Delhi and RUDSETI, Gurugram are now chosen due to the close proximity to the national capital. ICAR-CIPHET, Ludhiana and NAARM are headquarters in respective areas. Amongst the chosen evolution centres, 40 incubates/

trainees are being chosen with the help of simple random sampling technique as respondents. From the same institutes, 10 institutional stakeholders were also taken as respondents. Thus, a total of 160 incubates and 40 institutional stakeholders were selected as sample making it a total of 200 respondents as sample size. These have been consulted and questioned for the data collection process being involved in the research.

When the training programme was going on; some hindrances were experienced by both trainers as well as trainees that might be opted and seen differently by variants in view-points of various individuals according to the severity levels, which using the open questions were identifiable. After counting on the hindrances, trainees were asked to give them ranks on the severity level basis. Ranking technique by Garret was used in order to identify and then further rank some major factors that were responsible to establish the business, also to the hindrances faced by trainees and trainers. Afterwards, the most influencing factor or be it the most inhibiting factor in under each and every sub-head was identifiable by the means of mean score in the statements. Change in the sequence of factors and plus points in consideration with numerical scores were provided under the Garret's ranking technique. Primary advantage of this technique above normal distribution of frequency can be that the variables are arranged according to the significance from the view point of respondents. For conversion of ranks into percentage, here is the Garrett's formula:

Percent position = $100 * (R_{ij}-0.5)/N_j$

Where, R_{ij} = Rank given for i^{th} factor by j^{th} individual

N_j = Number of factors ranked by j^{th} individual

Each ranks per cent label was in conversion to the scores been referred to the table that was stated by Garret and Woodworth (1969). In reference to each one of the factor, each individual respondent's score was added and further divided by the total number of the respondents by which the scores were added previously. Average scores for all the variables were then organized in descending order and the ranks were allotted and the most significant factors were then finally identifiable.

RESULTS AND DISCUSSION

To find out the association of finance between Institute staff and Incubatee, Spearman's rank correlation co-efficient test was applied (Table 1). The R value was found to be 0.70 which showed that there is perfect positive correlation between both the groups.

The above table depicts the mean value of RBQ of Staff and Incubatee for finance. It was found that the major constraint for finance among the staff and incubatee was securing working capital which they scored as (I), insufficient financial assistance by financial institution was considered as the second major constraint, the third major constraint for finance according to them was margin money, Tight repayment schedule was the fourth major constraint for finance, Inadequate loan was found as the fifth major constraint for finance, the next major constraint was delay in sanction of loan, another major constraint was that the entire loan is not given at a time and the least responsible constraint for finance was that the subsidy amount is less.

Table 1: Preferential ranking and Spearman's rank correlation co-efficient between constraints perceived by Institute staff and Incubatee for Finance

Constraints	RBQ Values (Staff)	RBQ Values (Incubatee)	Mean R.B.Q. Value	Preferential Ranking	D	Di^2
Securing working capital (X_1)	92.8	97.3	95	I	0	0
Insufficient financial assistance by financial institution (X_2)	68.5	76.6	72.5	II	-3	9
Margin money (X_3)	77.8	60.3	69	III	4	16
Tight repayment schedule (X_4)	72.8	54.6	63.7	IV	4	16
Inadequate loan (X_5)	63.5	61.7	62.6	V	-1	1
Delay in sanction of loan (X_6)	59.2	61.9	60.5	VI	-3	9
Entire loan is not given at a time (X_7)	70.7	48.9	59.8	VII	4	16
Subsidy amount is less (X_8)	47.8	70.5	59.1	VIII	-5	25
			R=0.70			Σ 92

Spearman's rank correlation co-efficient test was applied to find out the association of Technical and Managerial constraints perceived by Institute staff and Incubatee (Table 2). The R value was 0.83 which means that there exists a perfect positive correlation between the RBQ values of staff and of incubatee.

The mean value of RBQ of Staff and Incubatee showed that the major reason for technical and managerial constraints was Ineffective consultancy services which was ranked I, followed by Highly expensive consultancy services of private agencies (II), the third constraint was non-availability of efficient managers, the fourth major constraint was lack of guidance from technical departments / resource persons, the fifth major marketing constraint was that the training facilities were not good and the least responsible marketing constraint was the complex procedural formalities in getting to start an enterprise respectively (Table 3).

It was found that the mean RBQ value of non-availability of raw materials (X_1) was 69, which was ranked (I) which means that lack of raw materials is the main constraint among the staff and incubatees, non-availability of equipment's (X_2) was scored rank by the staff and incubate, Lack of electricity (X_3) was considered as the third constraint, high labour cost was found as the fourth constraint, non-availability was found as the fifth constraint for production and the least affected reason for production was non-availability of many inputs respectively (Table 4).

To find out the constraints perceived by Institute staff and Incubatee for Personal/General constraints, Spearman's rank correlation co-efficient test was applied. The R value was calculated as 0.68 which implies that the RBQ value of institute staff and of incubatee shows a positive correlation. From the above table it was observed that rankings were given to the staff and incubates for personal/general constraints on the basis of their mean RBQ values. The main constraint found among both of them was Health problems (X_1) which was ranked (I), lack of leisure time was considered as the second constraint, Excessive tension and challenge (III), Resistance from husband /family at the time of start (IV), Dual duties (V), Indifference attitude of society (VI), Non- cooperation

Table 2: Preferential ranking and Spearman's rank correlation co-efficient between constraints perceived by Institute staff and Incubatee for Technical and Managerial constraints

Constraints	RBQ values (Staff)	RBQ values (Incubatee)	Mean R.B.Q. value	Preferential ranking	D	Di^2
Ineffective consultancy services (X_1)	97.1	96.5	96.8	I	0	0
Highly expensive consultancy services of private agencies (X_2)	85.7	81.4	83.5	II	0	0
Non-availability of efficient managers (X_3)	77.1	70.3	73.7	III	0	0
Lack of guidance from technical departments / resource persons (X_4)	62.8	61.1	61.9	IV	0	0
Training facilities are not good (X_5)	56.4	59.8	58.1	V	-1	1
Complex procedural formalities in getting to start an enterprise (X_5)	52.8	59.5	56.1	VI	3	9
			R=0.83			Σ 10

Table 3: Preferential ranking and Spearman's rank correlation co-efficient between constraints perceived by Institute staff and Incubatee for production and labour constraints

Constraints	RBQ values (Staff)	RBQ values (Incubatee)	Mean R.B.Q. value	Preferential ranking	D	Di^2
Non-availability of raw materials (X_1)	77.8	60.3	69	I	3	9
Non-availability of equipment's (X_2)	72.8	54.6	63.7	II	3	9
Lack of electricity (X_3)	63.5	61.7	62.6	III	-1	1
High labour cost (X_4)	59.2	61.9	60.5	IV	-3	9
Non- availability of skilled workers (X_5)	70.7	48.9	59.8	V	3	9
Non-availability of many inputs (X_6)	47.8	70.5	59.1	VI	-5	25
		R=0.63				Σ 62

Table 4: Preferential ranking based on mean value of RBQ of Staff and Incubatee for Personal/General constraints

Constraints	RBQ values (Staff)	RBQ values (Incubatee)	Mean R.B.Q. value	Preferential ranking	D	Di^2
Health problems (X_1)	85.7	81.4	83.5	I	0	0
Lack of leisure time (X_2)	77.1	70.3	73.7	II	0	0
Excessive tension and challenge (X_3)	62.8	61.1	61.9	III	0	0
Resistance from husband /family at the time of start (X_4)	56.4	59.8	58.1	IV	-1	1
Dual duties (X_5)	52.8	59.5	56.1	V	3	9
Indifference attitude of society (X_6)	55	51	53	VI	-1	1
Non- cooperation of family members (X_7)	49.2	54.4	51.8	VII	-1	1
Backbiting by others (X_8)	47.8	52.2	50	VIII	0	0
			R=0.68			Σ12

of family members (VII) and the least responsible for personal/general constraint was Backbiting by others.

CONCLUSION

According to the research, trainees as well as staff ranked first to Ineffective consultancy services followed by Highly expensive consultancy services of private agencies and Non-availability of efficient managers as technical and managerial constraints. When the process of data collection took place, it was observed that agriculture is perceived as non-viable and non-profitable area by most of the people. Therefore, those particular people were to invest and involve themselves in agri-business that they were not positioned anywhere by the society. The staff ranked first the Lack of adequate marketing facilities followed by delay in payment and lack of transportation facilities as the marketing constraints. Whereas the incubatee rank first the lack of adequate marketing facilities followed by delay in payment and long distance of the market. The results also revealed that staff and incubatees ranked first the Non-availability of raw materials followed by non- availability of equipment's and lack of electricity as major constraints for production and labour. For personal and general constraints, staff and incubatees ranked first to the Health Problems followed by lack of leisure time and excessive tension and challenges.

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Sustainability of Commercial Crop Profitability and Enhanced Farm Income Levels on Smallholder Farming in Closed Sugarmill Command Area in Bihar State

A.K. Sharma[1], Rakesh K. Singh[2], Y.P. Singh[3]* and Sumit Kumar[4]
[1]Principal Scientist (Agriculture Economics), ICAR-Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh
[2]ACTO/SMS, KVK, ICAR-Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh
[3]STO, ATIC, ICAR-Indian Agricultural Research Institute, New Delhi
[4]Research Scholar, ICAR- Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh

ABSTRACT

The paper aims to study the impact of policy changes introduced through agricultural roadmaps in Bihar state in enhancing the farm profitability and income of the smallholder agriculture in the state. The paper is based on an analysis of crop cultivation behavior of 36 smallholder farmers for two time periods of 3 years each, period 1 from 2014-15 to 2016-17 and period 2 from 2017-18 to 2019-20, in Vaishali district of Bihar State. The smallholders who were following the conventional cropping pattern of rice-wheat earlier shifted to commercial cropping (brinjal, tobacco, flowers, vegetables like ladies fingers and cucurbits) during period 1 by allocating 42 per cent of GCA to commercial crops under the influence of new policy initiatives, favorable farm and market situations. The main factors responsible for this shift was the need for cash inflows on daily basis, the awareness creation with the opening of more number of fertilizers and pesticides sale-points, and the easy availability of the leased-in land. The change towards commercial cropping resulted in higher profitability and farm income. The farm income generated was Rs.4.0 lacs per ha in period 1 and was 5.42 times more than under the conventional farming in period 2. The casual labour absorption during this period was also quite high, 190 days per farm (317 days per ha) and the casual labour use was to the extent of 79.2 per cent of the total labour requirement. The farm prices were lower than the declared MSPs except for the pulses. The same small holders abandoned the commercial cropping to a greater extent in period 2. The main reasons responsible for shifting back to conventional cropping was the poor rain water drainage on account of uplands and contiguous low lands in the village resulting in continuous flooding ranging from a week to a month long period, and the very low prices of commercial vegetable crops during one year. In order to sustain the commercial cropping and higher incomes to small holders in the state, strengthening of market infrastructure like cold storages, agro-processing units, crop based support services and market intellingence. Further, the village/block level drainage cum irrigation works need to be designed and massive investment is required to execute the ground-level works under qualified technical supervision and as a major inter-departmental project or a MGNREGA work for increasing farm income as well as non-farm employment in the area. Locally developed institutional mechanism for organizing supplies of smallholders also need to be integrated with a formal mechanism like FPOs to reap the synergies in production and marketing.

Keywords: Commercial, Crop profitability, Enhanced, Farming, Income levels, Smallholder, Sustainability

INTRODUCTION

As per SDGs commitments, the resilience of the poor and those in vulnerable situations needs to be rebuild by 2030 (GOI, 2015) and their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters be reduced. The Govt has also set the ambitious target for ensuring sustainable food production systems by 2030. Promoting sustainability of agriculture at higher levels of productivity and profitability, requires implementing resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve

*Corresponding author email id: ypicar2016@gmail.com

land and soil quality. In order to generate higher income opportunities in agriculture, the goal of the agricultural production system should be to maximize the income of land owning and landless rural populace to improve their livelihoods.

Bihar has acquired considerable attention throughout the country for its remarkable performance on the above development fronts from 2001 onwards. For a state which had suffered stagnation for long this was a turning point or structural transformation in its economy. The growth process of the state's economy was not a short term phenomenon, but has been considered as the beginning of a long term stable growth process. Bihar is gaining back its lost pride in the last few years. The data on state income shows that the economy of Bihar has been showing a steady growth trend for the last 6 years. During the first 5 years after separation of Jharkhand in 2000, the economy had grown at an annual rate of 4.42 per cent at constant prices. However, the economy witnessed a turnaround due to policies pursued by the state government and, as a result; the economy grew at an annual rate of 11.36 per cent during the period 2004-05 to 2010-11. This growth process was termed as 'revival of a stagnant economy'. Due to different changes now the economy can claim to be at a 'taking off' stage 'to a sustained development path. The buoyancy in the economy was viewed as to be easily sustained by the inter linkages in its various sectors. Agricultural sector in the state, by contributing significantly to the state income and rural employment, occupied a prominent place in the structural changes of the economy. Bihar's agricultural growth has been accelerated from 2.0 per cent per annum during the period 2000–01 to 2007–08 to 3.1 per annum during the period 2008–09 to 2011–12, however, it decelerated to 1.3 per cent during the subsequent period of five years (2012–13 to 2016–17). Although, the economy has shown a turnaround throwing new issues and enhancing people's aspirations in the last two decades, but, the rural Bihar, despite this progress, is still far from benefiting fully from the opportunities generated by rapid growth. Despite significant gains, the state continues to lag behind other Indian states in per capita income and a large segment of the population remains below poverty level. There has remained a high volatility in growth in Bihar economy. The indicators (Bihar's GSDP in agriculture is 4 percent of India's agricultural GDP, it lies below the national average of 74.04 literacy rate, and it being the 3rd most populous state after UP and Maharashtra) prove that Bihar is yet much below in the ladder of development (Kumar and Maulick, 2016). In order to achieve the desired levels of productivity, immediate steps are needed to improve infrastructure in Bihar – such as power, rural roads and marketing in particular and, arrange for the supply of quality seeds, balanced use of fertilizers, adequate machinery, required changes in land policy, a farmer friendly extension service and an effective credit delivery system in keeping with adequate credit absorptive capacity of the farmers in the state. The most often used and resorted to policy of any government to help the small and marginal farmers is the promotion of commercial sector, the horticulture or the vegetable sector in a big way. These sectors are also experiencing substantial competition in order to meet the growing demand for affordable and high-quality products for markets. Since crops in these sectors are highly perishable and seasonal in nature, and these require adequate post-harvest and market infrastructure, the implications for smallholders with limited income base are far reaching. A better understanding of the smallholder agricultural production system would help to devise appropriate policy for its sustainability and less-volatile growth in future.

MATERIALS AND METHODS

The paper is based on secondary as well as primary data. The primary data was collected in a survey conducted by interviewing 36 marginal famers in 4 villages in Vaishali District of Bihar state during 2021. In order to study the changing scenario of the agriculture in the district, the information was compiled for any changes in their cropping pattern and on any new crops introduced during the period of 6 years from 2014-15 to 2019-20. This period was further divided into two periods, P1 and P2. P1 was the period from 2014-15 to 2016-17 and it was named as the farmer favourable period (FFP). P2 was the period from 2017-18 to 2019-20 and it was named as the farmer unfavourable period (FUP). The periods were considered as favourable and unfavourable as per the opinions and experiences of the farmers. The data was compiled on aspects of economics of crops, labour employment, farm income trends and on the facilitating government policies helping in any change on the selected farms. the secondary data was compiled on the state level estimates of area and production of vegetable crops. Simple mathematical techniques including compund annual growth rates (CAGR) were used to describe the findings.

RESULTS AND DISCUSSION

Impact of policy changes on growth in agriculture sector and on small holder farming in Bihar: Agriculture being the main employer of the rural population, ensuring enabling environment to agricultural development in the state has remained a priority of the state government. The government of Bihar has introduced various policy initiatives as agriculture roadmaps since 2008 in different phases for accelerating agricultural growth in the state. The state government strengthened its administrative machinery and introduced a number of institutional reforms. It has led to laudable achievements in agriculture sector. The Government of India has conferred the Krishi Karman Award to the state on 2nd January 2020, for its achievements in production and productivity of Maize and Wheat. The other policy changes include the Jal-Jeevan-Hariyali campaign, a new State government scheme of Jalvayuke Anukul Krishi (Climate Resilient Agriculture) Karykram. In the first phase, the project is implemented in 8 districts, where 40 villages (5 villages per district) are being developed as model climate resilient agriculture village. Another policy change include a direct financial support to the farmers through Prime Minister Kisan Samman Nidhi Yojana, a centrally sponsored scheme, which aims to increase the income of farmers by providing income support of Rs. 6000 per year in three equal instalments.

Under these policy directives, the state government is trying utmost to bridge the rural–urban divide by promoting higher agricultural growth. The support mechanisms for enhancement of agricultural development are being further strengthened, to ensure that growth of Bihar economy remains sustainable in the years ahead. Support services like irrigation, seed, fertilisers, farm mechanization, credit flows, and awareness programmes are being stressed to make agriculture more viable. The state government is exploring ways so that rural areas (all sections and communities within them) can participate fully in the growth process.

Bihar commercial crop growth scenario: The most important source of livelihood of majority of rural population in Bihar is their own landholdings. The total number of operational holdings in Bihar was 16.41 million in 2015-16, and the small and marginal landholdings accounted for nearly 97 per cent of these landholdings operating about 76 per cent of the total area of these operational holdings in the state. The average size of landholdings is 0.39 hectares. The rich Gangetic plains, fertile alluvial soil, and abundant water resources provide impetus for a diversified farming system in the state, producing both food and non-food crops. The main crops such as rice, wheat, and maize, along with vegetables and fruits are cultivated. The agricultural production in the state is largely dependent on south-west monsoon. The cropping pattern in the state is largely determined by biophysical and climatic factors, irrigation, technological adoption and socio-economic capability of the farmers. These factors have led to cultivation of cereals, pulses, oilseeds, fibre, and cash crops. Cereals dominate the cropping pattern in the state, occupying more than 86 per cent of the gross cropped area. Within cereals, rice and wheat together contribute more than 70 per cent of the total gross cropped area. Rice is everywhere the dominant crop, but wheat, corn (maize), barley, and pulses (legumes) are important supplementary crops. Bihar is one of India's top producers of vegetables and fruits, the largest producer of lady's finger, third largest producer of vegetables and fourth largest producer of fruits in the country. Chilies and tobacco are important cash crops on the banks of the Ganges. The state is the sixth largest tobacco producing state in the country. Sugarcane is grown in a fairly well-defined belt in the northwest. It has competitiveness in maize, rice and fruit such as banana, mango, litchi and vegetables like onions, tomato, potato and brinjal. The total production of horticulture crops was around 20,676.37 thousand metric tonnes (from 1175.98 thousands ha area) in 2019-20 out of which the total production of vegetables and fruits in the state was estimated at 16,327.53 thousand metric tonnes and 4,256.21 thousand metric tonnes, respectively (IBEF, 2021).

Horticulture has emerged as one of the most important agricultural enterprises in Bihar in the last two decades, as it offers a wide range of opportunities for farmers to diversify their cropping pattern. The increasing diversification provides opportunities for absorption of labour and earning remunerative returns to the farmers. With the implementation of the National Horticulture Mission in 2005, the production of vegetables has received special impetus in Biharas a high-income generating sector. The State Government is providing substantial support through investments in technology, post-harvest management and processing of vegetables in the state. Further, the climate, alluvial soil and water resources are conducive to produce vegetables at low cost. The trends in area and production level of important vegetables in

Table 1: Growth of vegetable production in Bihar State

Crop	Area, 000 ha		Prod, 000 tns		CAGR Area	CAGR Prod	
	2016-17	2019-20	2016-17	2019-20	p2	p1	p2
Potato	320.48	257.98	6377.5	7710.07	-8.00	1.60	-0.20
Onion	54.06	57.53	1248.96	1214.67	3.44	2.80	-2.09
Brinjal	57.88	61.88	1141.2	1320.5	3.10	-4.56	3.12
Ladies finger	58.00	60.44	765.95	842.01	2.60	-0.78	3.39
White gourd	40.35	44.02	634.73	660.55	3.08	-1.15	-2.84
Bitter gourd	9.71	11.86	67.32	95.56	8.90	-1.17	7.02
Total vegetables	823.75	801.24	14362.22	16046.39	-0.15	-0.14	0.87

CAGR p1 and p2 refers to the period 2014-15 to 2016-17 and 2017-18 to 2019-20, respectively
Source: Govt of Bihar. 2018 Bihar Economic Survey, 2017-18, Finance Department, Govt of Bihar.
Govt of Bihar. 2021 Bihar Economic Survey, 2020-21, Finance Department, Govt. of Bihar.

the state (Table 1) for the years 2014-15 to 2016-17 and 2017-18 to 2019-20. A look into the table reveals that during 2019-20, a total of 160.46 lakh tonnes of vegetables were produced in an area of 8.01 lakh hectares. The area under vegetables has recorded a negative growth (-0.15% per year) while the production has recorded a positive growth (0.87% per year) in period-2 (2017-18 to 2019-20). The growth in vegetable production in p2 is primarily led by growth in productivity. It also reflects towards improved post-harvest management and the resultant reduction in the crop losses during this period. However, during p1 (2014-15 to 2016-17), the production of vegetables exhibited a negative growth rate. Potato, brinjal and cauliflower are first three vegetable crops in the state in terms of area coverage. Brinjal and ladies finger are the most important kharif vegetable crops in Bihar and are being grown in 61.88 and 60.44 thousand ha area during 2019-20. Potato, cauliflower and onion are important rabi season vegetable crops. Potato though occupies the largest acreage compared to any other vegetable crop, its acreage has decreased over the years. The analysis over a period of six years reveals that the area under brinjal, ladies finger and white gourd has increased at the rate of more than 2.5% per year) while under bitter gourd, it has increased at 8.9% per year over a period of last 3 years (p2). The production of all these four vegetable crops decreased during p1 period, and the decrease was more prominent in brinjal (-4.56%). In other vegetables like ladies finger, white gourd and bitter gourd, the production decreased at a rate of 0.78 to 1.17% per year. In other words, brinjal, ladies finger, white gourd and bitter gourd experienced reduction in their state-level total production during p1 (the period 2014-15 to 2016-17), and experienced substantial increase during p2 (2017-18 to 2019-20).

Economics of conventional cropping vis-a vis commercial cropping: The impact of commercial cropping penetration on small holder farming was studied based on the information of 36 such small holders in vaishali district of Bihar.The sampled small holders are having around 0.20 ha (16 kathas) of owned land to which they have added around 0.125 ha (10 kathas) of land by leasing-in of area available in the vicinity of their owned land. They have also leased-out around 4 per cent of their distantly located owned land parcels. In this way, the small holders were having 60 per cent of owned land and 40 per cent of leased-in land as their net cultivated area. During p1 (the farm favourable period, FFP), the small holders were going-in for commercial cropping cultivation to the extent of 42.42 per cent of the gross cultivated area (GCA) in order to meet the need for cash income. The share of food grains cropping was also the same at 43.43 per cent. The main commercial crops being grown for immediate cash flow needs were brinjal, ladies finger, white gourd and bitter gourd during kharif season and tobacco during rabi season. The kharif season main commercial crops being grown were mainly 4 to 5 types of vegetables wherein one farmer was growing only one vegetable crop as per mutual understanding in the group of 4 to 5 smallholders as well as the expertise of the farmer. However, at present, the weather vagaries (high rainfall and consequent waterlogging) have rendered the commercial cultivation difficult. The extent of commercial cropping was reduced to just 22.22 per cent in p2 and that too has remained confined to *rabi* season cropping of tobacco crop on these small holder farms.

Table 2: Land-use and cropping pattern on sampled households in Vaishali district of Bihar State

Particulars	Season	FFP (TE 2017-18)		UFP (TE 2020-21)	
		Area (ha)	% share@	Area (ha)	% share@
Total owned area	-	0.200	64	0.200	64
Leased out area**	-	0.013	4	0.013	4
Owned cultivated land	-	0.188	60	0.188	60
Leased-in area	-	0.125	40	0.125	40
Net cultivated area	-	0.313	-	0.313	-
Gross cultivated area, GCA	-	0.619	-	0.550	-
Crop-wise details of GCA					
Rice	*Kharif*	0.100	16.16	0.150	24.24
Brinjal/Ladies finger/white gourd/ bitter gourd 0.00		Kharif	0.125	20.20	0.000
Moong	*Kharif*	0.075	12.12	0.038	6.06
Tobacco	*Rabi*	0.125	20.20	0.125	20.20
Sarson	*Rabi*	0.075	12.12	0.050	8.08
Wheat	*Rabi*	0.094	15.15	0.175	28.28
Banana*	Whole year	0.013	2.02	0.013	2.02
Cropping Intensity %		194.00	-	176.00	-
Share of food grain cropping			43.43		58.59
Share of commercial cropping			42.42		22.22

Note: Additional information is given under marks as follows: *Banana area considered double of its area cultivated for working out GCA; ** area leased out is being a distantly located land parcel; FFP and UFP represents farmer friendly period of 2014-15 to 2016-17 and UFP represents unfriendly farmer period of 2018-18 to 2019-20 as per farmers opinion; Notations @ and @@ stands for per cent share of net cultivated area and gross cultivated area, respectively.

The per farm output on small holders (0.313 ha NCA) was quite meagre, about 6.4 quintals of rice, 4.5 quintals of wheat, 0.75 quintals of moong and 1.05 quintals of sarson under farmer favourable conditions (p1). However, the productivity levels are at higher levels and are 64,48, 10 and 14 quintals per ha for these crops respectively (Table 3). The productivity levels of brinjal fresh crop were 200 tonnes/ha and that of tobacco marketable product were 4.8 tonnes/ha. The growth in production in crop sector in Bihar owes a great deal to expansion in productivity, rather than increases in area, since the scope for any additional land for cultivation is very limited in the state. So is the case on selected smallholder farming. Other studies also highlights that the average productivity of brinjal, okra, potato, onion and sweet potato is higher in Bihar compared to average productivity of Eastern region (Singh *et al.,* 2015).

Table 3: Per farm output and productivity levels of smallholders in Bihar

Crop	Total quantum (qtls) per holder	Productivity levels (qtls/ha)
Rice	6.4	64
Brinjal	250	2000
Moong	0.75	10
Tobacco	2.75	48
Sarson	1.05	14
Wheat	4.5	48

The policy initiatives has resulted in diversifying agricultural output on these smallholders through adoption of HYV seeds, chemical fertilizers, pesticides and limited market intelligence. Though growing population, at the state level, is considered to have accentuated the need to step up production to meet the needs of food and nutritional security, at the individual farm level on sampled smallholders, the need for more cash income and that too for regular cash inflow is the prime factor to increase farm production and have more diversified output. However, during p2 period when the conditions were not favourable to the farmers due to high rainfal and resultant

waterlogging, the output levels per farm were 9.6 qtls of rice, 8.4 qtls of wheat, 0.38 qtls of moong and 0.70 qtls of sarson and no kharif vegetable output per farm (Table 4). The increased levels of output were only due to increased allocation of area to these crops. The PDS system is of much help to the smallholders. The PDS system is operating for these small holders in the area and is helping in tiding over the crop production shocks to these farers. The availability of ration at the rate of 12kg wheat and 13 kg rice per month per family is helping these small holders. The joint families are also getting benefitted of additional 25 kg ration after registering the family of sons as a separate family, after the marriage of the sons. Instances of selling the PDS ration if it is not of good quality were also there to meet the dire cash needs for the family.

The farm income estimates of sampled small holder farms reveal that during FFP the farmers resorted to commercial farming and earned farm income of Rs. 2.41 lacs per farm (Rs. 4.00 lakhs per ha). The cropping intensity was 194%. The major contributor to farm income was the cultivation was vegetable cropping of brinjal/ladies finger, white and bitter gourd during kharif season and tobacco during rabi season. However, after a period of three years, the scenario got changed and the cultivation of vegetables could not be undertaken successfully and the farmers have to resort back to conventional farming as was the practice around 10 years back. The farm income due to the shift back to conventional farming cultivation reduced to Rs. 40607 per farm (Rs. 73841 per ha). The farm prices obtained by the smallholders were lower that the MSP declared for cereals and oilseeds (sarson) during p1 as well as p2. However, it was lower for moong crop in p1 and higher to MSP in p2. It thus highlights that in the absence of lack of government procurement system for cereals and oilseeds, the farmers have received less than the MSP declared for the crop. Higher farm price for moong compared to its MSP may be due to its limited supply and high demand.

Labour use on small holder farming: The labour use pattern on smallholder farming was analysed and it was observed that there was employment of around 1521.6 hrs (190 standard labour days of 8 hrs work) per farm and 79.2 per cent of which was casual labour (Table 5). Also the extent of male labour use was to the extent of 32.3 per cent and the female labour use was to the extent of 67.7%. The main contributor to the casual labour use was the cultivation of tobacco crop followed by vegetable cultivation. Both these crops accounted for 84% of total labour use (48% in tobacco and 36% in vegetable) and 98 per cent of the total casual labour use (58% in tobacco and 40% in vegetables) on small holder agriculture. The per ha total labour use, casual labour use and female labour use was 400, 317 and 272 standard labour days on these smallholder farms.

Adoption level of land, water and crop management practices: The study found that land tenancy is illegal but widespread, around 25 per cent of cultivated area under short-term oral tenancy and this, together with a moribund organized rural credit system, and small and fragmented farms (average farm size in Bihar of about 0.6 hectare is half the national average), acts as a severe disincentive to

Table 4: Farm Income estimates of small holders under conventional and commercial cropping

Crop	P1 (FFP, 2014-15 to 2016-17)			P2 (FUP, 2017-18 to 2019-20)			Prices			
	Area (ha)	Prod. (qtls)	Net farm income (Rs.)	Area (ha)	Prod. (qtls)	Net farm income (Rs.)	Farmer Price p1	Farmer price p2	MSP p1	MSP p2
Rice	0.100	6.40	3352	0.150	9.60	5028	1300	1300	1480	1809
Brinjal	0.125	250	204575	0.000	0.00	0.00	1000	1000		
Moong	0.075	0.75	3810	0.038	0.38	1905	5500	8000	5212.5	7085.5
Tobacco	0.125	2.75	23500	0.125	2.75	23500	14000	16000		
Sarson	0.075	1.05	2195	0.050	0.70	1463.3	3000	3500	3675	4400
Wheat	0.094	4.50	4238	0.175	8.40	7910.9	1500	1700	1630	1907.5
Banana*	0.013		800	0.013		800				
Farm Income (Rs.)										
Per farm			242470			40607				
Per ha			400115			73831				

Table 5: Labour absorption on smallholder farming

Crop	Labour use (hrs) per farm				Tot L	Tot L days	Ml L	CL
	Ml L	Fm L	CL	FL	(hrs)	(STD days)	(%)	(%)
Rice	12.8	12.8	25.6	0	25.6	3.2	50.0	100.0
Brinjal	248	300	480	68	548	68.5	45.3	87.6
Moong	4	92	0	96	96	12	4.2	0.0
Tobacco	204	528	700	32	732	91.5	27.9	95.6
Wheat	18	6	0	24	24	3	75.0	0.0
Sarson	4	92	0	96	96	12	4.2	0.0
All crops	490.8	1034.8	1205.6	316	1521.6	190.2	32.3	79.2
Crop	**Labour use (hrs) per ha**				**Tot L**	**Tot L days**	**Ml L**	**CL**
	Ml L	**Fm L**	**CL**	**FL**	**(hrs)**	**(STD days)**	**(%)**	**(%)**
Rice	128	128	256	0	256	32	50.0	100.0
Brinjal	1984	2400	3840	544	4384	548	45.3	87.6
Moong	0	1280	0	1280	1280	160	4.1	0.0
Tobacco	1632	4224	5600	256	5856	732	27.9	95.6
Wheat	192	64	0	256	256	32	75.0	0.0
Sarson	53	1227	0	1280	1280	160	4.2	0.0
All crops	1033.26	2178.53	2538.11	665.26	3203.37	400.42	32.3	79.2

Note: Ml L, Fm L, CL, FL, Tot L, STD day stands for male labour, female labour, casual labour, family labour, total labour, labour standard day of 8 hrs respectively.

private investments on land. The rate of leasing–in of cultivated area is Rs. 80000 per ha per year.

There is improper water management, resulting in lower water productivity. The rainfall and flash floods cause inundation and intermittent droughts. Higher income due to commercial farming has prompted to invest in groundwater extraction by installing borings, however, such investment by making use of institutional credit is still not preferred, due to high interest fear factor. For efficient utilization of ground water, the popularization of micro irrigation system and involvement of farmers through participatory irrigation management (PIM) as well as non-traditional and conventional energy sources like wind and solar energy may be explored. As per hearsay in the villages, one canal exists in revenue papers however there was no such irrigation infrastructure in the study area. The existence of a canal may also helped in pumping out of excess water accumulated due to high rainfall conditions. Area specific plans/programmes may be drawn and implemented to check water logging and facilitate drainage of flood water, by promoting percolation tanks or any other such measures appropriate in the local conditions. A separate drainage plan need also be formulated and implemented in the state (also emphasized by Jha and Viswanathan. 1999). Scheme of low cost protective/supplemental irrigation may be given special emphasis to save the crop from wide inter-spell of rainfall. Holistic approach for water management need to be made based on local intelligence and historical inputs in order to have a long-term planning for efficient use of irrigation water or for the drainage of excess water in the area.

There is a need for the identification of crop sequences with better water productivity and post-harvest management facilities for small holders. Balanced use of micro and macro nutrients have been carried out for the commercial crops while it is required for food-grain cropping to remove deficiency in soil and improved quality of production. Bihar has immense potential for sugar and allied industries, particularly in ethanol and captive power generation. Keeping in view the vast scope of its expansion, the state government has decided to encourage the sugarcane based industries in the state, which will go a long way in strengthening the rural economy. The area under survey was also served by one sugar mill which is now closed now like 18 other sugar mills in the state. If proper nurturing is carried out, the sugar industry can grow as an important industry in the area to provide non-farm employment avenues in the area.

Bihar produces large quantities of fruits, vegetables and other commercial crops, but do not have proper infrastructure to support value addition and marketing. The purchase of rice, wheat and moong from the smallholders was only through brokers in the market at the price provided by the broker and not at the price notified by the Government. The brokers are largely fixed for these smallholders, as these farmers have also established rapports with one or two brokers in an attempt to ensure a fair treatment to the marketing farmers in the market yards. The state should develop commodity specific agro-export zones and give necessary support to the farmers in their marketization. With proper development of markets, cooling arrangements in storage and transportation, processing and maintenance of quality, through grading, standardization, packaging, etc., products like vegetables can be exported to other states and even beyond the country, which will help improve farmers' income. Market information, village-level support services for storage infrastructure including cold storages/ development of cold chain for value addition and the improvement of market yards is lacking for the small holders. These services need to be developed on priority.

Though the farmers are working in a group of 4 to 5 farmers and are growing one vegetable per farmer after mutual understanding, the farmers are not a part of any FPOs. These farmers are interested in forming FPOs but are not getting the requisite knowledge and requisite number of likeminded people for forming FPOs.

Sustainability issues of small holders: The smallholders are producing extremely volatile agricultural output mainly due to shocks from regular monsoon flooding and also drought conditions sometimes. The main factors responsible for going in for commercial cropping by smallholders was the dire need for cash flow on daily basis or on regular basis to meet out the daily cash needs of the farm family. This prompted the small holders to know more about income earning enterprises and their visits to fertilizer/pesticide sale points in the vicinity coupled with the extension work carried out by the people manning these points resulted in the much needed motivation to the small holders. The favourable weather conditions led to quite high increase in farm income and also in labour absorption with the adoption of commercial cropping. The general lack of efficient market infrastructure and rural electrification was a formidable barrier to commercial cropping of vegetables and for both farm and non-farm development in the area, especially during p1 period. Small holders were not having access to surface irrigation and they have to rely mainly on diesel, rather than electricity, to tap groundwater sources which raises production costs and affects competitiveness, especially p1 period

The occurrence of floods, water logging, the poor drainage and low level of output compared to market risks were the main constraints in p2 period. The factors that led to the abandonment of the commercial cropping was high rainfall which resulted in water-logging in the cultivated area. Also the quite low price of the produce for one year discouraged the small holders to abandon the commercial cropping of vegetables. Considering the situations, the small holders are withdrawing from agriculture. Two out of 36 farmers have come out of agriculture and started grocery shop business. Five others are also interested to quit the agriculture if the situation remains like this in the next 4-5 years.

CONCLUSION

The impact of policy changes introduced through agricultural roadmaps in Bihar state in enhancing the farm profitability and income of the smallholder agriculture in the state was analysed for 2 time periods. The smallholders changed their cropping pattern and resorted to commercial cultivation of vegetable crops which resulted in higher profitability and farm income to the level of Rs. 4.0 lacs per ha which was about 5.42 times more than under his conventional farming. The casual labour absorption during this period was also quite high, 190 days per farm (317 days per ha) and the casual labour use was to the extent of 79.2 per cent of the total labour requirement. Despite govt policy to ensure remunerative prices of the crops to the farmers, the farm prices received were lower than the declared MSPs, except for the pulses. The small holders abandoned the commercial cropping after some time and the main reasons responsible for shifting back to conventional cropping was the poor rain water drainage and lower farm prices. In order to sustain the commercial cropping and higher incomes to small holders in the state, strengthening of market infrastructure, crop based support services, market intelligence and village/block level drainage cum irrigation works need to be undertaken.

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Consumer Brand Preference and Awareness of Sanitizers among College Going Students

Varnam Radhika[1]* and Swetha Kodali[2]
[1]Research Scholar, Department of RMCS; [2]Scientist, AICRP-WIA, PJTSAU, Department of FRM, College of Community Science, PJTSAU, Hyderabad

ABSTRACT

In current scenario awareness of sanitizers are the most important because of increasing severity of COVID-19. According to sanitizer brands people preferred the sanitizers. So there is a need to know how much people were aware about sanitizers and how college going students were prefer sanitizer brands. Structured questionnaire was developed and sent to the respondents through the Google form. Purposive sampling technique was used to collect the data from 36 respondents from the College of Home Science. Statistical tools used for this study were Pearson's Correlation coefficient and Pearson's chi-square tests were run by using SPSS software to analyze the data. Results revealed that there is a significant relationship between brand popularity with age and willing to pay for sanitizers with income of the family. A significant association was found between brand popularity with education of the respondents and price attributes with family income.

Keywords: Awareness, Brand popularity, Brand preference, Price attributes, Sanitizers

INTRODUCTION

Hand Sanitizer is an antiseptic disinfectant available in the form of a liquid, gel, foam and many others. It is said to be more effective than soaps due to its ability to eliminate most microorganisms. Public awareness campaigns by global health authorities such as the WHO (World Health Organization, 2020) also play a significant role in promoting the use of hand sanitizers. Increasing consumer awareness about hygiene coupled with such government initiatives is driving the hand sanitizer market. Alcohol-containing hand sanitizers are part of the strategy to prevent person-to-person transmission during the COVID-19 pandemic.

Humans have long suffered from the accidental consumption of methanol. Toxicity has been described as far back as the late 1800s, frequently from consumption of home-distilled alcohols. Methanol is a byproduct of the fermentation of alcoholic spirits, and individuals may be exposed when they drink alcohol which has not had the methanol component effectively removed. A wide range of marketed disinfectants such as household bleach, alcohol, and hand sanitizers that can be used to prevent and control the spread of the virus. Although disinfectants can be effective, if misused, they can also be hazardous to humans as well as to the environment. The active biocide ingredients of these products range from natural materials such as ethanol, L-lactic acid, citric acid, and hydrogen peroxide to synthetic substances such as sodium hypochlorite, hypochlorous acid, quaternary ammonium compounds, octanoic acid, peroxyacetic acid, and glycolic acid at different concentrations (Samara *et al*., 2020).

Best 10 hand sanitizer brands in India: Sterillium, Savlon, Dettol, Lifebuoy, Godrej, Dabur, Multani, Corvil, Trust, DCM Shriram

REVIEW OF LITERATURE

Hayat and Munnawar (2016) investigated on "Antibacterial Effectiveness of Commercially Available Hand Sanitizers" concluded that the efficiency of hand sanitizers was based on its active ingredient which should be in appropriate concentration. Every sanitizer was not efficient in killing the microorganism. Therefore, awareness of choosing effective alcohol based hand sanitizers was important to reduce the transmission of infection especially when dealing with patients in hospitals, clinical laboratories, among school children, etc.

*Corresponding author email id: radhikavarnam58@gmail.com

Narang (2018) conducted a study on "Comparing the effectiveness of various hand-sanitizers against *E. coli*". Compared to the effectiveness of various hand-sanitizers, both commercial and home-made concluded that the strongest hand-sanitizer solution was Wellness Tree whereas the weakest was the home-made anti-bacterial solution and also, there was a minor fluctuation in the efficiency of the different commercial hand-sanitizer.

MATERIALS AND METHODS

This research is conducted based on current situation and does not have any information available from the past researchers related to sanitizers. So I want to know about consumer awareness and brand preference of sanitizers and what are the major considerations while selecting sanitizers. Exploratory research design was followed. Purposive sampling technique was used as the study was designed especially for girl's (Home Science College) with the 36 samples. Structured interview schedule was developed for the present study by taking the objectives and variables under consideration and sent through Google form to collect data. Frequency and percentages were used to analyze the Socio-demographic profile of the sample. Statistical tools like Pearson's correlation coefficient and chi-square test were used to find both the relationship and association between dependent and independent variables.

RESULTS AND DISCUSSION

Here I have discussed about results generated by Google form after collecting data.

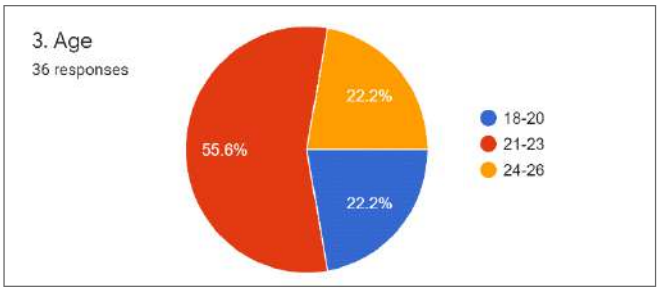


Figure 1: Frequency distribution of age

The Figure 1, shows that more than half (55.6%) of the respondents were in between the age group of 21-23 years and another (22.2%) were in between 18-26 years. All the respondents were females only because I choose the students from Girls College.

The Figure 2 shows that more than half (53%) of the respondents did their graduation followed by post-graduation (36%) and Doctoral degree (11%).

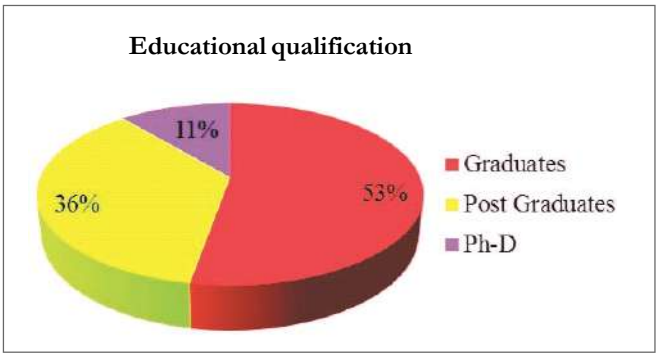


Figure 2: Frequency distribution of educational Qualification

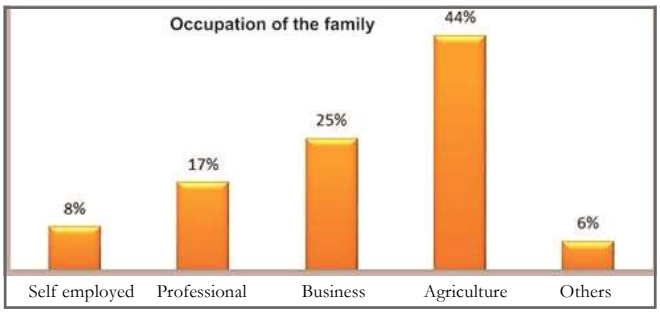


Figure 3: Frequency distribution of Occupation of the respondent

The Figure 3 shows that (44%) of the respondents families occupation was agriculture followed by business (25%), self-employed (8%), professional (17%) and others like health department employee.

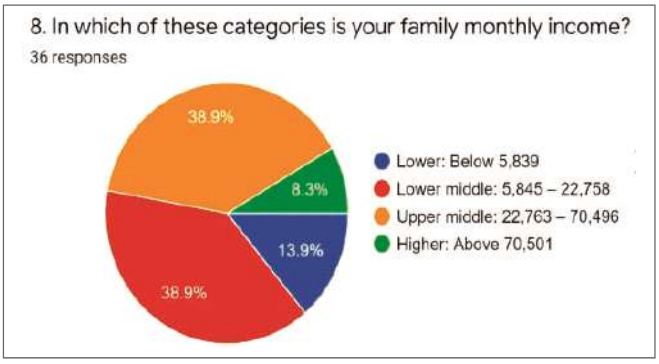


Figure 4: Frequency distribution of monthly Income

The Figure 4 shows that most of the respondent's monthly income (class) was upper middle and lower middle income classes (38.9%) followed by lower income (13.9%) and higher income (8.3%). All the respondents were aware about sanitizers because of pandemic.

Figure 6 shows that most of the respondents were using Dettol (39%) sanitizer followed by lifebuoy (25%), savlon (17%); others (11%) like Bath & body works, herbal.

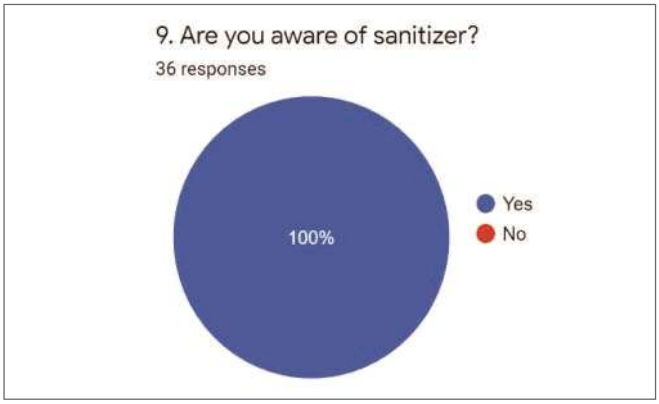


Figure 5: Frequency distribution of awareness of sanitizers

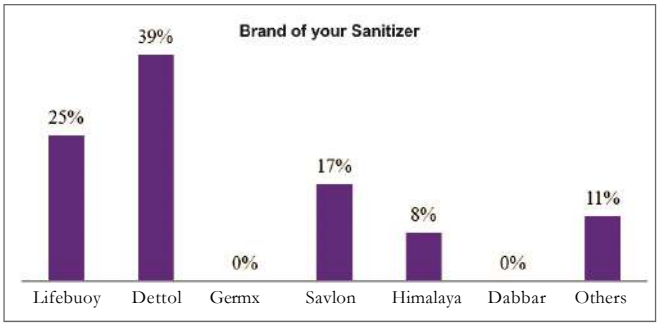


Figure 6: Frequency distribution of sanitizer brand

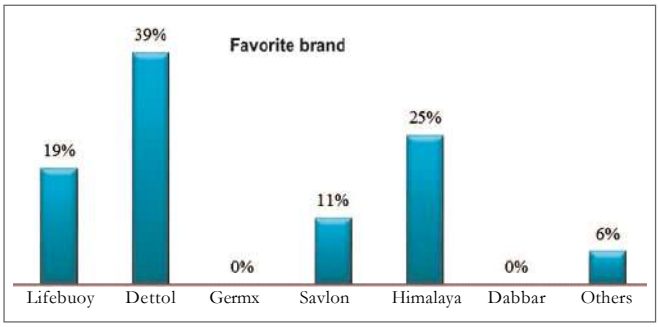


Figure 7: Frequency distribution of favorite brand in sanitizers

Figure 7 revels that most of the respondent's favorite brands in sanitizers were Dettol (39%) followed by Himalaya (25%), lifebuoy (19%), Savlon (11%) and others (6%) like Bath and body works, herbal.

Figure 8 revels that most of the respondents were choosing sanitizer brands based on protection/Safety from germs (53%) followed by quality (36%) of sanitizer, brand image (5%) and others like, kill's bacteria and protect our health.

Figure 9 revels that most (50%) of the respondents were willing to pay 30-50 rupees for sanitizer followed by 51-70 rupees (27.8%), 100 and above (13.9%) and 71-90

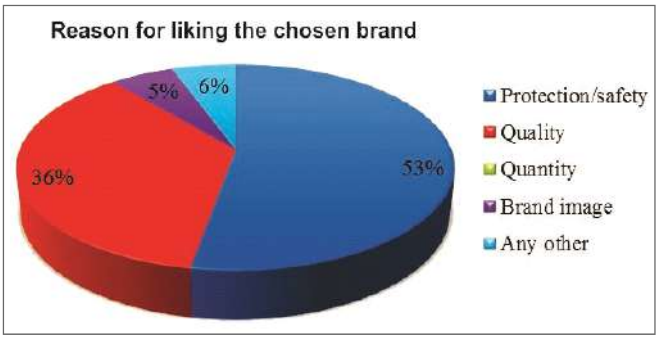


Figure 8: Frequency distribution of reason for liking chosen brand

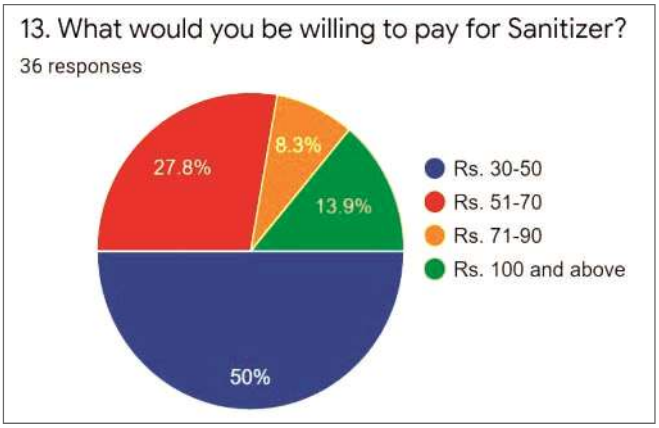


Figure 9: Frequency distribution of expenditure on Sanitizer

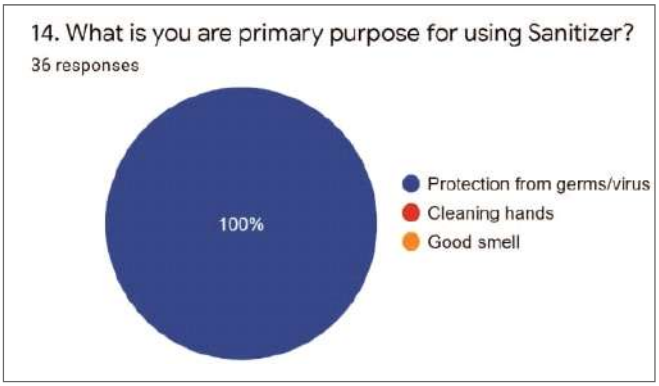


Figure 10: Frequency distribution of primary Purpose of sanitizer

rupees (8.3%). Most of the respondents said that main purpose of sanitizer was protection from germs and viruses, kill's bacteria and protect our health.

Figure 11 shows that majority of the respondents were agree with some statements like while choosing a sanitizer they considered brand popularity and associate brand popularity with the choice they make (50%), associate brand popularity with sanitizer quality and quantity (47%) and

Figure 11: Frequency distribution of Brand popularity

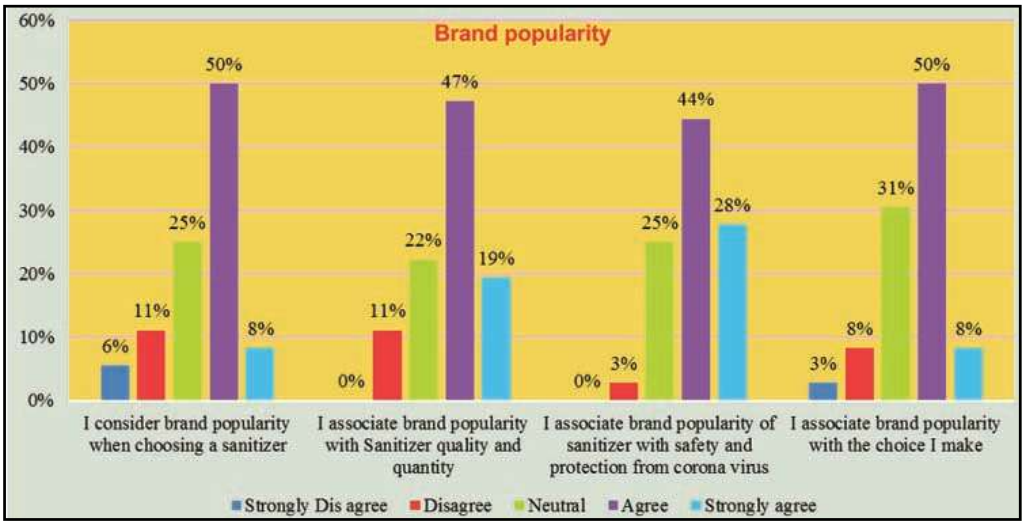
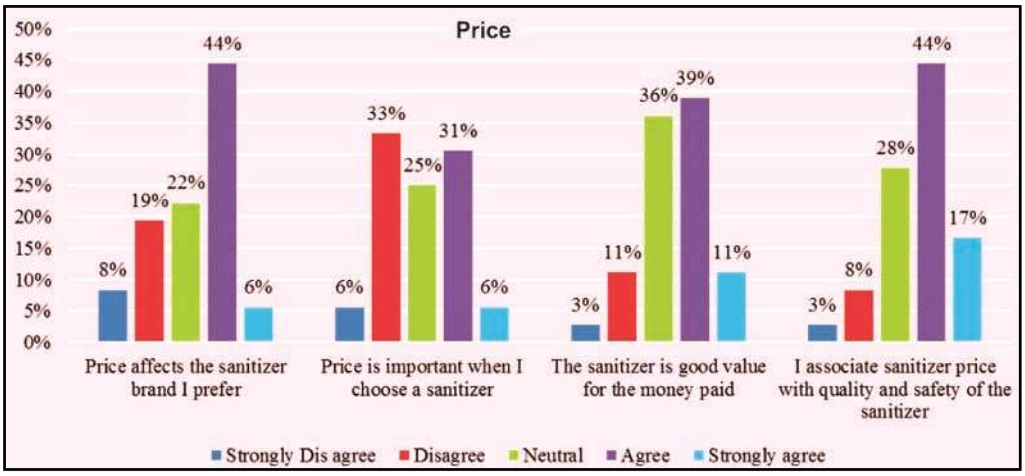


Figure 12: Frequency distribution of Price



associate brand popularity of sanitizer with safety and protection from corona virus (44%). Most of the respondents were strongly agree for associate brand popularity of sanitizer with safety and protection from corona virus (28%).

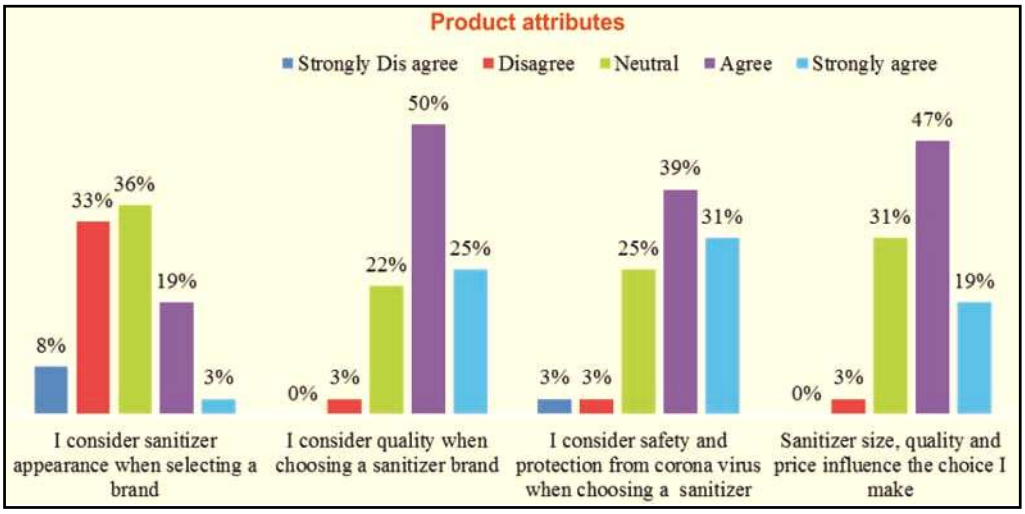
Few of the respondents were strongly disagree with some statements like while choosing a sanitizer they considered brand popularity (6%) and associate brand popularity with the choice they make (3%).

Figure 12 shows that majority of the respondents were agree with some statements like price affects the sanitizer brand they prefer and they associate sanitizer price with quality and safety of the sanitizer (44%) followed by the sanitizer was good value for the money paid (39%) and price was important when they choose a sanitizer (31%).

Few of the respondents were strongly agree with association of sanitizer price with quality and safety of the sanitizer (17%) followed by the sanitizer was good value for the money paid (11%). Some of the respondents were strongly disagree with price affects the sanitizer brand they prefer (8%) followed by price was important when they choose a sanitizer (6%), sanitizer was good value for the money paid and association of sanitizer price with quality and safety of the sanitizer (3%).

Figure 13 shows that majority of the respondents were agree with some statements like considered the quality when they choose brand of sanitizer (50%) followed by sanitizer size, quality and price influence the choice they make (47%), considered safety and protection from corona virus when choose a sanitizer (39%) and considered sanitizer appearance when select a brand (19%). Few of the respondents were strongly agree with considered safety and protection from corona virus when they choose a sanitizer (31%) followed by considered quality when they choose a sanitizer brand (25%), sanitizer size, quality and price influence the choice they make (19%) and considered sanitizer appearance when select a brand (3%)

Figure 13: Frequency distribution of Product attributes



Some of the respondents were strongly disagree for considering sanitizer appearance when select a brand (8%) and considering safety and protection from corona virus when choose a sanitizer (3%).

STATISTICAL ANALYSIS

From Table 1 it could be observed that the coefficient of correlation on brand popularity between age of the respondents and consideration of brand popularity while selecting a sanitizer was found to be **r= -.376*,** which was more than the table value of **"r" (0.172)** at 5 per cent level of significance. Hence the null hypothesis was accepted and empirical hypothesis was rejected. Therefore, it could be inferred that there was a negative and significant relationship between the age and consideration of brand popularity while selecting a sanitizer brand of the respondents. It was clear from the values that as age increases consideration of brand popularity while selecting a sanitizer also increase

Table 1: Correlation analysis between dependent and independent variables

Dependent variables	Independent variables	
Brand popularity	**Age**	**Income of the Family**
Consider brand popularity when choosing a sanitizer	-.376*	-
Associate brand popularity with the choice	-.337*	-
Willing to pay for Sanitizer	-	.364*

* = Significant at 0.05 level of probability

H0: There is a significant relationship between brand popularity and age

H1: There is no significant relationship between brand popularity and age

H0: There is a significant relationship between willing to pay for sanitizer and income of the family.

H2: There is no significant relationship between willing to pay for sanitizer and income of the family.

The correlation between age and association of brand popularity with choice they make was found to be **r= -.336*,** which was more than the table value of **"r" (0.172)** at 5 per cent level of significance. Hence the null hypothesis was accepted and empirical hypothesis was rejected. Therefore, it could be inferred that there was a negative and significant relationship between the age and association of brand popularity with choice they make of the respondents. Above values clearly indicates that as age increases association of brand popularity with choice they make also increases. The correlation between income of the family and willing to pay for sanitizer was found to be **r= -.364*,** which was more than the table value of **"r" (0.172)** at 5 per cent level of significance. Hence the null hypothesis was accepted and empirical hypothesis was rejected. Therefore, it could be inferred that there was a significant relationship between the income of the family and willing to pay for sanitizer of the respondents. Above values clearly indicates that as higher the family income and higher the money spent for sanitizer.

From the Table 2 by using Chi square test, it was found that p value is greater than 0.05, which shows that null hypothesis is accepted. Therefore, there is a significant association between brand popularity and education of the respondent. It shows that according to education respondents were selecting their sanitizer brands, if education is less there is less knowledge about sanitizers.

Table 2: Chi Square test between brand popularity and education of the respondents

Brand Popularity Statements	Value	df	p-value
Pearson Chi-Square			
Consideration of brand popularity while selecting a sanitizer	8.32	6	.215
Association of brand popularity with Sanitizer quality and quantity	5.94	6	.430
Association of brand popularity with sanitizer safety and protection	5.89	6	.435
Association of brand popularity with the choice they make	5.88	8	.660

H0: There is a significant association between brand popularity and education of the respondent
H3: There is no significant association between brand popularity and education of the respondent

Table 3: Chi Square test between brand popularity and age of the respondents

Brand Popularity Statements	Value	df	p-value
Pearson Chi-Square			
Consideration of brand popularity while selecting a sanitizer	10.83	6	.094
Association of brand popularity with Sanitizer quality and quantity	18.50	6	.005
Association of brand popularity with sanitizer safety and protection	7.63	6	.266
Association of brand popularity with the choice they make	9.34	8	.314

H0: There is a significant association between brand popularity and age of the respondent
H4: There is no significant association between brand popularity and age of the respondent

From the Table 3 by using Chi square test, it was found that p value is greater than 0.05, except brand popularity with sanitizer quality and quantity with age which shows that null hypothesis is accepted. Therefore, there is a significant association between brand popularity and age of the respondent. It shows that as age increases consideration of brand popularity while selecting the sanitizer brands increases. There is no association between brand popularity with sanitizer quality and quantity with age which shows that null hypothesis is rejected alternate hypothesis is accepted. It shows that as age increases respondents were not considering the brand popularity with sanitizer quality and quantity.

From the Table 4 we can observe that Chi square test, it was found that p value is greater than 0.05, which shows that null hypothesis is accepted. Therefore, there is a significant association between price attributes and family income of the respondents. It shows that price attributes like sanitizer appearance, quality, quantity, protection from virus and price were considered more while selecting a sanitizer brands. Therefore higher the family income high cost, qualitative, protective sanitizers were selected.

From the Table 5 we can observe that Chi square test, it was found that p value is greater than 0.05, which shows that null hypothesis is accepted. Therefore, there is a significant association between price attributes and occupation of the family of the respondents. It shows that price attributes like sanitizer appearance, quality, quantity, protection from virus and price were considered more while selecting a sanitizer brands. If families'

Table 4: Chi Square test between price attributes and family income of the respondents

Price attributes	Value	df	p-value
Pearson Chi-Square			
Consideration of sanitizer appearance when selecting a brand	6.84	12	.0867
Consider of quality when choosing a sanitizer brand	5.15	9	.821
Consideration of safety and protection from corona virus when choosing a sanitizer	7.48	12	.824
Sanitizer size, quality and price influence the choice	4.55	9	.871

H0: There is a significant association between price attributes and family income of the respondents
H1: There is no significant association between price attributes and family income of the respondents

Table 5: Chi Square test between price attributes and occupation of the family of the respondents

Price attributes	Value	df	p-value
Pearson Chi-Square			
Consideration of sanitizer appearance when selecting a brand	10.64	12	.560
Consider of quality when choosing a sanitizer brand	12.75	9	.174
Consideration of safety and protection from corona virus when choosing a sanitizer	13.89	12	.308
Sanitizer size, quality and price influence the choice	16.50	9	.057

H0: There is a significant association between price attributes and occupation of the family of the respondents
H1: There is no significant association between price attributes and occupation of the family of the respondents

occupation is more professional selection of sanitizer is based on cost, qualitative, protectiveness. Highly professionalized occupation of the family higher the consideration of cost, quality, safety, protectiveness of sanitizer form virus while choose.

CONCLUSION

All the respondents were aware about sanitizer. Most of the respondents were using Dettol sanitizer as well as favorite brand also Dettol main reason for using this brand was protection from germs and most of them were willing to spend 30-50 rupees and most of the respondents were under upper middle and lower middle income class. Majority of the respondents were considering brand popularity with the choice they make, sanitizer quality and quantity and sanitizer with safety and protection from corona virus when choosing a sanitizer brand. Majority of the respondents were agree for price affects the sanitizer brand they prefer, sanitizer price with quality and safety, sanitizer was good value for the money paid. Most of the respondents were considering the product attributes like the safety and protection from corona virus, sanitizer quality, size, price and appearance when choose a sanitizer brand.

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Drudgeries and Occupational Health Hazards Perceived by the Women Farmers in Central zone of Uttar Pradesh

Sadhna Pandey, S.K. Dubey*, Atar Singh, U.S. Gautam, Raghwendra Singh, Kirti M. Tripathi[1], Saurabh[2], Anuradha Ranjan Kumari[3], Archana Singh[4] and Nimisha Awasthi[5]
ICAR-ATARI (Agricultural Technology Application Research Institute), Zone III, Kanpur, Uttar Pradesh
[1]KVK, Bulandshahar, U.P., [2]KVK, Sitapur II, U.P., [3]KVK, Bhagwanpur, Bihar, [4]KVK, Unnao, U.P., [5]KVK, Kanpur Dehat, U.P.

ABSTRACT

Study was carried out to assess the perception of women farmers regarding extent and magnitude of drudgery and gender gap experienced by them in central zone of U.P. Investigation was carried by eight KVKs Kanpur Dehat, Kannauj, Auraiya, Jhansi, Unnao, Pratapgarh, Kaushambi and Raibareilly. Further, from the selected KVKs' operational areas, two villages from each KVK in which KVK was implementing the activities since last two years were selected. Twenty farm women/village from each enterprise i.e. crop production, livestock and post harvest were selected for the study purpose comprising total sample of 960 respondents from 16 selected villages. It was found out that all the respondents possessed sickle (100%), hand hoe and hand plough (*Phawda*) followed by Khurpi (46.88%) and chaff cutter (29.175). Very few of them possessed improved tools like hand ridger, maize sheller, fertilizer sprayer and fruit harvester. Farm implements like Engine (9.17%) and tractor+ trolly (8.75%) was kept by very limited number of respondents. Most of the respondents (68%) opined that these tools and implements are not comfortable to them, needs change (56%), are heavy (79%) and cause discomfort/ Injury during farm/ allied activities (100%). High extent of discomfort/ Injury Faced by them in various farm/ allied activities were in transplanting (75.24%), harvesting (65.25%), weeding (57.41%), cleaning of fields (55.21%) and in threshing (35.89%). Various types of health problems experienced were numbness in feets/hands, back ache, head ache and pain in knees, shoulders and other joints by all the respondents (100%) followed by blisters on palm by 84.68 per cent, skin cuts/ fungal infection and allergies by 84 per cent of the respondents. Based on the above findings, the research based technologies were selected for the KVKs in central Uttar Pradesh for conducting on farm trials on hanging type grain cleaner with sack holder, sugarcane stripper, cono weeder, rice transplanter, tubular maize sheller, rotary maize sheller, groundnut stripper, standing type groundnut decorticator, sitting type groundnut decorticator, twin wheel hoe, Naveen dibbler, rotary dibbler and hand ridger for reducing the drudgery of women farmers.

Keywords: Agriculture, Drudgery, Farmwomen, Hand tools and implements, Health hazards

INTRODUCTION

Woman is the backbone of agricultural workforce but worldwide her hard work has mostly been unpaid. She does the most tedious and back-breaking tasks in agriculture, animal husbandry and homes. (Singh and Arora, 2010). It is a fact that the women of rural areas contribute to agricultural work in addition to their domestic work. Presently, they constitute one-third of the agricultural labour force and about 48 per cent of self employed farmers (Praveena *et al.,* 2005). It is also estimated that on an average, the Indian woman, especially - the poverty group spends above five hours per day more than the Indian man in work, including the visible burden of family. As per recent findings, women in India are major producers, of food in terms of value, volume and number of hours worked (Dash, 2000).

Most of the works performed by farmwomen are tedious as well as time consuming. As most of these operations like weeding, harvesting, digging, seed separation from pods, winnowing, threshing, seed shelling, cleaning and preparation etc. are done manually or by traditional tools, which are slow and cause considerable

*Corresponding author email id: skumar710@gmail.com

fatigue and drudgery. Many of these operations are traditionally done in varying body postures, some of which if done for long duration are not only inconvenient but also cause serious health hazards. All these factors result in drudgery by causing physical and mental fatigue, monetary hardships, exploitation, pain, economic stress etc. Majority of the farmwomen perceived farm activities as either moderately difficult or difficult. The farmwomen are employed in the operations which are either not mechanized or least mechanized and involve a lot of drudgery (Singh *et al.,* 2001).

Verma and Sinha (1991); Gite and Singh (1997); Bimla *et al.* (2001); Mohanty *et al.* (2008) experienced in their study that many believe that women's involvement in agricultural tasks is a source of heavy burden of drudgery on them. Tripathi *et al.* (2016) in their study reported that when the training need of farm women was assessed in district Bulandshahr it was found that almost all respondents were curious to know about the new and improved drudgery reduction tools followed by time management techniques.

Singh *et al.* (2016) highlighted that Occupational Health Hazards have been a widespread problem in agriculture in more than a decade. With women predominant at all levels production, pre harvest, post harvest, processing ,packaging, marketing- of the agriculture value chain, to increase productivity in agriculture, it is imperative to adopt gender specific interventions. There is need to initiate women oriented researches in agriculture. As woman has different ergonomical characteristics than man, design of women friendly tools and equipment would be of greater help in reducing their occupational health hazards.

Against the above background, therefore, the present study was planned with the specific objective to quantify the extent of drudgery experienced by the women farmers and to identify research based technologies for reducing their drudgeries in various farm-related activities in the central districts of Uttar Pradesh.

MATERIALS AND METHODS

All the nine agro-climatic zones of Uttar Pradesh (UP) were grouped into three zones of western, central and eastern zones and from central UP, 8 KVKs namely Kanpur Dehat, Kannauj, Auraiya, Jhansi, Unnao, Pratapgarh, Kaushambi and Raibareilly were selected purposively on the ground of availability of SMS (Home Science) in those KVKs for execution of the study and also because of prominence of crop, livestock and post harvest handling related activities in these districts. Further, from the each selected KVKs' operational areas, two villages in which KVK was implementing the activities since last two years were selected. Thus, there were 16 villages for the study. From each selected village, group of farm women performing crop production, dairy and livestock production and post harvest handling related activities were grouped. In each group, there were 20 farm women making a sample of 60 farm women from each village were chosen. Thus, from all the selected villages, there were 960 women farmers who acted as the subject of the study.

The study envelopes the assessment of the drudgery experienced by the farm women in the different areas namely crop production, dairy production and post harvest handling. Based on the survey and further analysis, a roadmap has been planned which consists of different need-based, situation specific and farm women preferred interventions in terms of on-farm trials for them so as to empower farm women in these important areas. This action plan shall be also implemented by the partner KVKs in subsequent seasons.

RESULTS AND DISCUSSION

Distribution of respondents on social indicators: Maximum respondents (43.85%) fell under the age category 20-35 years followed by range 35-50 years (38.33%). 33.85 per cent of respondents were illiterate whereas, 23.02 per cent acquired primary education. In the survey, it was found that 82.92 per cent were housewives and agricultural work. It was assessed that 68.54 per cent women started working in early morning till late night whereas, 30 per cent women followed morning and evening patterns. The majority of the respondents 59.38 per cent, had their mode of payment of wages Weekly-cash/In kind. While 30 per cent of this zone had Daily-cash/In kind payments (Table 1).

Possession of tools and implements: On assessing the possession of farm tools, implements, and livestock acquired by respondents, it was found out that respondents possessed more than one type of farm tools, implements, and livestock. This fact was when graduated it was found out that all the respondents possessed sickle (100%), hand hoe and hand plough (*Phawda*) followed by Khurpi (46.88%) and chaff cutter (29.175). Other improved hand tools like hand ridger, maize sheller, fertilizer sprayer and fruit harvester were found with very less number of respondents. If we look at the farm implements, Engine (9.17%) and tractor + trolly (8.75%) was kept by very

Table 1: Details of female respondents engaged in farm activities (N=960)

Parameters	Central Zone (n=960)	
	Frequency	Percentage
Age of the respondents		
20-35	421	43.85
35-50	368	38.33
above 50	172	17.92
Education		
Illiterate	325	33.85
Primary	221	23.02
Junior High School	152	15.83
High School	138	14.38
Intermediate	104	10.83
Graduate/Post Graduate	20	2.08
Occupation		
Housewife (HW)	0	0.00
Housewife and Agri work (AW)	796	82.92
HW+Ag Labour/ Labour	164	17.08
HW+ AW+ AH	410	42.71
HW+ AW+ Bussiness/ Service	0	0.00
HW+ Dairy Farming	0	0.00
The duration of work		
8 am to 6 pm	14	1.46
Morning and Evening Pattern	288	30.00
Early Morning till Late Night	658	68.54
Mode of payment of Wage		
Daily-cash/In kind	288	30.00
Weekly-cash/In kind	570	59.38
Fortnightly/Cash	0	0.00
monthly-cash/In kind	102	10.63

Table 2: Possession of Farm Tools, Implements and livestock (N=960)

Parameters	Central Zone (n=960)	
	Frequency	Percentage
Farm tools and implements		
Sickle	960	100
Hand Ridger	24	2.50
Hand Weeder/ Khurpi	450	46.88
Hand Hoe	960	100
Hand Plough (*Phawda*)	960	100
Maize sheller	40	4.17
Chaff Cutter	280	29. 17
Sprinkler	0	0
Fertilizer sprayer/Broad Caster	174	18.13
Fruit Harvester	6	0.63
Farm Implements		
Tractor + Trolly	84	8.75
Tractor	0	0.00
Trolly	0	0.00
Thresher	50	5.21
Engine	88	9.17
Cultivator	26	2.71
Harrow	14	1.46
Seed Drill	4	0.42
Winnowing fan	0	0.00
Others (Sprayer)	0	0.00
Livestock possession		
Bullock	4	0.42
Cattle	311	32.40
Buffalo	292	30.42
Goat	114	11.88
Sheep	0	0
Ducks	0	0
Poultry	10	1.04
Pigs	8	0.83
Pigeon	0	0

limited number of respondents. Cattle (32.40%) and buffalo (30.42%) was possessed maximum in this zone followed by goat (11.88).

Distribution of respondents on drudgery indicators: Most of the respondents (68%) opined that these tools and implements are not comfortable to them, needs change (56%), are heavy (79%) and cause discomfort/ Injury during farm/ allied activities (100%). High extent of discomfort/ Injury faced by them in various farm/ allied activities were in transplanting (75.24%), harvesting (65.25%), weeding (57.41%), cleaning of fields (55.21%) and in threshing (35.89%).

Majority expressed that tools help in reducing force (81%) but they felt tired after performing the work (100%). The majority of the respondents facing joint problems (98%), feel difficulty in bending (88%) and got scratches / cuts/ injuries problems (75%) in farm/ allied activities. Various types of health problems experienced were heat exhaustion/ heat strokes, numbness in feets/hands, back

Table 3: Comfortability and drudgery with equipments as perceived by the women respondents (N=960)

Parameters	Central Zone (n=960)	
	Frequency	Percentage
Comfortability in using these tools		
Yes	307	32
No	653	68
Do tools which you are using needs change		
Yes	538	56
No	422	44
Do you feel tools are heavy		
Yes	758	79
No	201	21
Sickle handle is wooden		
Yes	96	10
No (Plastic)	864	90
Faced discomfort/ Injury during farm/ allied activities		
Yes	960	100
No	0	0
If yes, during which activity		
Harvesting	627	65.25
Weeding	551	57.41
Transplanting	722	75.24
Threshing	345	35.89
Cleaning of fields	530	55.21
Tools helps in reducing the force		
Yes	778	81
No	182	19
Feel Tired after performing work		
Uncertain	0	0
Yes	960	100
No	0	0
Facing joint problems in farm/ allied activities		
Yes	941	98
No	19	2
Feel difficulty in bending in farm/ allied activities		
Yes	845	88
No	115	12
Got Scratches/ cuts/ injuries in farm/ allied activities		
Yes	720	75
No	240	25

Table 3 contd....

Parameters	Central Zone (n=960)	
	Frequency	Percentage
Suffered from diseases/ health problems due to farm/ allied activities		
Eye infections	239	24.87
Ear disorders/ hearing problems	40	4.12
Skin cuts/ Fungal infection	614	64
Allergy	614	64
Heat exhaustion/ Heat strokes	960	100
Breathing problems/Bronchitis/ Asthma	521	54.26
Numbness in feets/hands	960	100
Back ache	960	100
Head ache	960	100
Pain in Knees, shoulders and other joints	960	100
Blisters on palm	813	84.68
Any other	0	0
To what extent you adopted one posture in farm/ allied activities		
30 min	463	48.25
1 hr	319	33.25
2 hr	177	18.5
Above 2 hr	0	0
How frequently you take care of hand tools and implements		
Yes	768	80
No	192	20
Do you go to the doctor after injuries/ allergies/ infections		
Always	0	0
Sometimes	22	2.25
Only when condition is serious	678	70.56
Never	261	27.19

ache, head ache and pain in knees, shoulders and other joints by all the respondents (100%) followed by blisters on palm by 84.68 per cent, skin cuts/ fungal infection and allergies by 84 per cent of the respondents. 48.25 per cent of the respondents adopted one posture in farm/ allied activities up to half an hour followed by 33.25 per cent up to one hour. Most of the respondents (66.15%) take care of their tools and implements. The majority of them saw the doctor when the condition got miserable (70.56%) (Table 3).

Based on above findings, on-farm trials have been formulated for KVKs of central Uttar Pradesh on hanging

Table 4: Details of proposed on-farm trials

S. No.	Problem diagnose	Farmers practices	Technologies selected	No. of farmers	Source of Technology
1.	Low work efficiency, injury and high drudgery in cleaning of grains	Traditional sieves and *soop*	Hanging type grain cleaner with sack holder	05	CIAE, Bhopal
2.	Low work efficiency, injury and high drudgery in sugarcane stripping	Traditional sickle	Sugarcane stripper	05	CIAE, Bhopal
3.	Low work efficiency and high drudgery in manual transplanting of paddy	Manual Transplanting	Rice Transplanter	05	CRRI Cuttack
4.	High drudgery in manual weeding of paddy	Manual Transplanting	Cono weeder	05	TNAU, Coimbatore
5.	High drudgery in shelling maize through traditional practice	By hand or using Sickle	1. Tubular Maize Sheller 2. Rotary Maize Sheller	05	CIAE, Bhopal
6.	High drudgery in stripping Groundnut pods	By Hand	Groundnut stripper	05	CIAE, Bhopal
7.	High drudgery in separating Kernels from Groundnut Pods	By hand or teeth	1. Groundnut decorticator, Sitting type 2. Groundnut decorticator, Standing type	05	CIAE, Bhopal
8.	High drudgery in cutting and uprooting of weeds	Hand Hoe	Twin Wheel Hoe	05	CIAE, Bhopal
9.	High drudgery in dibbling bold or costly/ scarce seeds in less area and for gap filling	Hand Hoe	1. Naveen Dibbler 2. Rotary Dibbler	05	CIAE, Bhopal
10.	High drudgery in in making ridges in field	Spade	Hand Ridger	05	CIAE, Bhopal

Performance Indicator

Technical: Physiological Cost of work-(a) Heart Rate, (b) Energy Expenditure Rate, (c) Energy Consumption Rate, (d) Muscular Stress, efficiency/hour, health hazards reduced etc.

Economic: Labour Saving, B:C ratio; ***Social:*** Acceptability, Farmers' feed back

type grain cleaner with sack holder, sugarcane stripper, cono weeder, rice transplanter, tubular maize sheller, rotary maize sheller, groundnut stripper, standing type groundnut decorticator, sitting type groundnut decorticator, twin wheel hoe, Naveen dibbler, rotary dibbler and hand ridger for drudger reduction of women farmer. Details have been synthesized under the Table 4.

CONCLUSION

Most of the women farmers in Central Zone of Uttar Pradesh possessed traditional types of hand tools. Farm implements like Engine and tractor + trolly was kept by very limited number of respondents. Most of the respondents opined that existing tools and implements are not comfortable to them, needs change, are heavy and cause discomfort/ Injury during farm/ allied activities. High extent of discomfort/ Injury faced by them mainly in transplanting, harvesting, weeding, cleaning of fields and threshing. Various types of health problems experienced were heat exhaustion/ heat strokes, numbness in feets/ hands, back ache, head ache and pain in knees, shoulders and other joints by all the respondents followed by blisters on palm, skin cuts/ fungal infection and allergies. Hence, research based technologies were selected for the KVKs in central Uttar Pradesh for conducting on farm trials on hanging type grain cleaner with sack holder, sugarcane stripper, cono weeder, rice transplanter, tubular maize sheller, rotary maize sheller, groundnut stripper, standing type groundnut decorticator, sitting type groundnut decorticator, twin wheel hoe, Naveen dibbler, rotary dibbler and hand ridger for reducing the drudgery of women farmers.

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Economic Viability of Organic Farming in Chamba District of Himachal Pradesh

Arshdeep Singh[1]*, Rajesh Kumar Thakur[2], Kanika Mehta[3] and Sukhjinder Singh[4]
[1]Ph.D. Student, Department of Economics and Sociology, Punjab Agricultural University, Ludhiana-141001, Punjab
[2]Principal Scientist, [3]Ph.D. Student, Department of Agricultural Economics, Extension Education & Rural Sociology, College of Agriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176062, Himachal Pradesh
[4]Senior Scientist, Business Development and Marketing Unit, C.S.I.R.-I.H.B.T., Palampur-176061, Himachal Pradesh

ABSTRACT

Present study conducted to analyse the economics of major organically produced crops in Chamba district of Himachal Pradesh, India. Where large number of farmers are engaged in organic cultivation by default revealed that the typical size of land holding of the sample households was 0.7838 ha of which 84 per cent is cultivated land on overall farm scenario. The analysis of cropping pattern unconcealed that main organic crops are maize and paddy in *kharif* season and wheat and barley in *rabi* season. The further study disclosed that resource use pattern of organic input were *jivamrit, matka khad, vermiwash, beejamrit* and *fermented butter milk* prepared by the farmers themselves at the farm for usage within the crops. Among *kharif* crops, net return over variable cost was higher in maize (Rs.27,667 /ha) whereas in *rabi* crops, wheat (Rs. 18,023 /ha) on overall farm scenario. The benefit cost ratio of *kharif* crops were it was 1.24 in maize whereas in *rabi* crops it was 0.98 in wheat.

Keywords: Hill agriculture, Marginal and Small farmers, Organic farming, Organic inputs

INTRODUCTION

Agriculture has been a passion and a way of life for more than 70 per cent of the rural population of India, with 83 per cent farmers being small and marginal (Chand *et al.*, 2011). As soon as Indian got independence, the agriculture sector was given priority with the objective of improving the socio-economic conditions of the farming community (Dhanagare, 1984; Fujita, 2010) and to achieve self-sufficiency in food grain production (Singh, 2000; Fujita, 2010). In order to achieve the twin objectives, huge investments for creation of infra-structural facilities, creation of need based, location specific research and extension network were made in the country. Through the concerted efforts, the country achieved green revolution in mid 60s and emerged as a self-sufficient nation in food grain production (Nelson *et al.*, 2019) as well as a major exporter of many agricultural commodities (GOI, 2019). In process of diversification and intensification of the crop production practices, the level of inorganic inputs like fertilizers, herbicides, insecticides etc. has increased to a greater extent (Rahman and Thapa, 1999; Fox *et al.*, 2001; Power *et al.*, 2001; Udeigwe *et al.*, 2015). Bulk studies on the use of inorganic inputs revealed its adverse impact on soil microorganisms (Pimentel, 2005), soil quality (Dahal, 1996), soil heath & fertility (Rahman and Thapa, 1999; Chetri *et al.*, 2004), human health (Pingali, 1995; NRC, 2003; Pimentel, 2005; Pimentel *et al.*, 2005; Zhang *et al.*, 2018), ecological environment (NRC, 2003; Pimentel, 2005; Pimentel *et al.*, 2005; Udeigwe *et al.*, 2015; Zhang *et al.*, 2018), pollution of ground water & underground water (McCasland *et al.*, 1998; Fawell and Nieuwenhuijsen, 2003; Sasakova *et al.*, 2018;) and air (Zhang *et al.*, 2018) which ultimately poses threat for the sustainability of the agricultural production (Rahman and Thapa, 1999; Chetri *et al.*, 2004). Moreover, the cost of cultivation under this system is consistently increasing over the years (Chadha *et al.*, 2012) and will be beyond the reach of resource poor farmers. Thus, keeping in view the positive internalities and externalities of organic farming like sustainability of production, eco-friendly and healthy approach, low cost

*Corresponding author email id: arshdeep.singh.khosa1@gmail.com

of production, high demand, etc., planners and researcher are advocating promotion of organic farming as one of the vital alternative for sustainable agricultural development in the country.

Presently, organic agriculture is being practiced in 181 countries on an area of 69.80 million hectares engaging approximately 2.90 million farmers in the world. The increasing area under organic crops is contingent to the continuous increase in demand of organically produced products and their premium prices. As per the report of International Federation of Organic Agriculture Movements 2019, the global sales of organic food and drinks in 2017 was about 97 billion US dollars indicating an expansion of the business by six folds over a period of 18 years from 1999-2017 (Willer and Lernoud, 2019). Among the different countries, Australia has highest area (35.60 million hectares) under organic farming, whereas India was at 8th position having an acreage of 1.78 million hectares during 2017. In total area of organic farming the proportion of cultivable land was to the tune of 50 per cent while about 50 per cent comprises the area of forests from which minor forest products are collected (GOI, 2018).

Despite this, the organic market remains a distinct segment market, placed primarily in developed countries, wherever it's possible to charge a premium worth for certified organic commodities and products. The demand for organic food is steady increasing each in developed and developing countries, with annual growth rate of 20-25 per cent. The total volume of export from India throughout 2017-18 was 4.58 lakh MT. The organic food export realization was around 298 million US dollars in which the share of oilseed was highest (47.65%) followed by processed food commodities (1.69%), cereals & millets (10.44%), dry fruit (8.88%), plantation crops (8.96%), spices & condiments (7.76%) as per APEDA, 2017-18.

The proportion of cultivated area in the Himachal Pradesh is quite low (about 10 per cent of total geographical area) due to hilly and undulating topography (Anonymous, 2009). In general, the farming system in the state is mixed and subsistence in nature and the use of chemical inputs is low as compared to its neighbouring states like Punjab and Haryana. The state Department of Agriculture is promoting organic farming in different parts of the state under *Paramparagat Krishi Vikas Yojana* (PKVY). The Department of Organic Agriculture and Natural Farming, College of Agriculture, CSK HPKV, Palampur (Anonymous, 2017b) and National Centre of Organic Farming, Ghaziabad is developing package of practices for organic production (Anonymous, 2008) and nursery production of organic vegetables (Chadha, 2011). There are some pockets, especially in Chamba, Shimla, Solan, Kinnaur, Lahaul & Spiti where farmers have not yet shifted to inorganic farming and by default practicing organic practices in crop production (Anonymous, 2009). The input use and yield levels of organically produced crops are different to that of inorganically produced crops. Thus, it is imperative to study economics of major organically produced crops.

MATERIALS AND METHODS

In order to fulfil the requirements of the study, primary data were collected from selected farming households. The data were collected through specifically well-designed survey schedules by personal interview method during the period of March 2019 to April 2019 in Chamba district of Himachal Pradesh, India. The district was purposively selected as large number of farmers in the district is engaged in organic cultivation by default. Further, three stage random sampling design was employed for the selection of organic farmers. At the first stage of sampling two blocks viz., Mehla and Chamba were selected randomly. At the second stage of sampling, three clusters were selected randomly from each block. In the third stage, 10 farmers from each cluster were selected randomly thus constituting a sample of 60 organic farmers out of which 44 were marginal farmers ($\leq$1 ha) and 16 were small farmers (>1 ha). These organic clusters were formed by Department of Agriculture, Chamba under guidelines of *Paramparagat Krishi Vikas Yojana* (PKVY) according to which in each cluster, a minimum of 65 per cent of the farmers should belong to small and marginal categories, respectively (Anonymous, 2017a).

RESULTS AND DISCUSSION

Table 1 reveals that the average size of land holding on sample farms was 0.5113, 1.5333 and 0.7838 ha on marginal, small and overall farm categories, respectively. The interaction with the respondents revealed that the existing allocation of land for the cultivation of crops was sufficient to meet out the household requirements on marginal farms for cereals, pulses, etc. but also some land holding area remained uncultivated due to lack of irrigation and higher labour cost in study area.

Table 1: Socio-economic characteristics of the sample farmers

Particulars	Marginal	Small	Overall
Land holding (ha)			
Total land holding	0.5113	1.5333	0.7838(100.00)
Cultivated land holding	0.4010	1.3545	0.6553(83.60)
Age of farmers (years)			
<25	3	2	5(8.33)
2-40	15	5	20(33.33)
40-60	24	9	33(55.00)
>60	2	-	2(33.34)
Educational status of farmers			
Illiterate	9	4	13(21.67)
Primary	7	1	8(13.33)
Middle	9	5	14(23.33)
Matriculation	8	2	10(16.67)
Senior secondary	6	1	7(11.67)
Graduation	3	2	5(8.33)
Post-Graduation	2	1	3(5.00)
Occupation			
Agriculture	24	11	35(58.33)
Agriculture + Others	20	5	25(41.67)

Note: Figures in parenthesis indicate percentage to the total.

Majority of farmers of the sample families were in the age group of 40-60 years (about 55%) followed by 25-40 years on an overall farm situation. The study further revealed that only about 8 per cent farmers were below the age of 25 years, which can be attributed to the fact that the land ownership rights are with the elder members of the family. It can be concluded that about 88 per cent on an overall sample farms were headed by relatively middle age persons, who have opted organic farming as their major source of income. Among different categories of education, the proportion of farmers educated up to middle was highest (23.33%) followed by matriculate (16.67%) and primary (13.33%), on an overall farm situation. It is interesting to note that majority of farmers had their education up to senior secondary level and the proportion of farmers having higher education i.e. graduates and post graduates were quite low i.e. about 8 and 5 per cent, respectively on overall farm situation.

It can be seen from the table that about 55 and 69 per cent of the farmers were associated with agriculture as their main occupation on marginal and small farm categories, respectively, whereas, this proportion under overall farm situation was about 58 per cent. Off-farm activities (like govt. services, private jobs, labour and business) were reported to be the major occupations for about 42 per cent of farmers on overall farm situation.

Table 2 represents the farm inventory on sample farms. It was observed that Rs. 6,49,033 was being invested on residential buildings, Rs. 45,917 on cattle shed and Rs. 13,174 on store houses, on overall farm situation. Among the different farm categories, the investment made on residential buildings was observed to be relatively higher on small farms (Rs. 7,51,875) as compared to marginal farms (Rs. 6,11,636). It may be attributed to relatively better financial position of the small farm category. The total investment on implements/machinery by sample farms was estimated to the tune of Rs. 16,469, Rs. 51,308 and Rs. 25,758 on marginal, small and overall farms, respectively. About 80 per cent of the total investment was made on major farm machinery while, the proportion of minor farm implements was just about 20 per cent of the total investment on an overall farm situation.

Generally, the farming community accustomed to maintain livestock unit of 4-6 animals so as to satisfy their household necessities for milk, milk product, meat, eggs, wool, draught power and Farm Yard Manure (FYM). The scale of unit depends on the supply of fodder, household and farm requirements. This component of farming additionally provides around the year financial gain and employment opportunities to farm families. The total value of livestock were Rs. 65,299, 73,919 and 67,598 on

Table 2: Farm inventory of sample farmers (Value/farm)

Particulars	Marginal	Small	Overall
Buildings			
Residential house	611636	751875	649033(91.66)
Cattle shed	43727	51939	45917(6.48)
Store house	12681	14531	13174(1.86)
Implements			
Major farm implements	11788	44991	20642(80.14)
Minor farm implements	4543	6059	4947(19.20)
Tools/implements for organic inputs	138	259	170(0.66)
Livestock			
Total livestock	65299	73919	67598(100.00)
Standard Livestock Units	3.28	4.20	5.53(-)

Note: [1]Figures in parenthesis indicate percentage to the total. [2]Standard Livestock Units was in numbers per farm.

marginal, small and overall farm categories, respectively. It can be observed from the table that, the average size in term of standard livestock units (Sastry and Thomas, 2005) on an overall farm situation was 3.36 animals which comprised adult cows & buffaloes, bullocks, heifer, young stock, sheep and goats. It was 3.28 on marginal farms and 3.58 in case of small farm categories, respectively.

It can be observed from the Table 3 that the net cultivated and total cropped area on an overall farm situation was estimated to be 0.6553 and 1.1263 ha, respectively. The cropping intensity was found to be about 176, 169 and 174 per cent on the marginal, small, and overall farm categories, respectively.

In the *kharif* season, on overall farm situation, maize occupied the highest area (25.40%) followed by paddy (3.91%). During the *rabi* season, among the different organic crops, the area under wheat (23.99%), barley (3.52%). Maize, paddy are major organic crops which are grown by farmers during the *kharif* season. Among the different organic crops, the highest area was allocated for production of maize, followed by paddy having acreage of 0.2861, 0.0440, hectares, respectively. It was found that maize in *kharif* and wheat in *rabi* season occupied an important place among the different organic crops in the study area. The area allocated to each crop depends upon the productivity, home consumption and market prices.

The resource use of different organic crops *viz.* maize, paddy, wheat and barley has been analysed and represented in Table 4. It was discovered that the different organic inputs are prepared by farmers from household, farm and locally available materials like cow dung, cow urine, jiggery, cow milk etc. and are used in crop production in the study area. The concentration of these organic inputs was differing from place to place and farm to farm. Further, economics of these organic inputs was calculated and represented in Table 5. Economics of these different organic inputs was Rs. 1.49, 1.74 per kg of Farm yard manure and vermi-compost on overall farm situation, respectively while other like *jivamrit, matka khad, vermiwash, beejamrit and fermented butter milk* was Rs. 2.84, 3.83, 4.85, 1.52, 22.96 per litre on overall farm category, respectively.

It can be observed that among the different organic crops, the quantity of seed used was found to be highest in case of wheat (about 119 kg/ha) followed barley (42.21kg/ha) and by paddy (31.5 kg/ha) on overall farm situation. Across the different farm situations, the quantity of seed rate used in various organic crops was relatively higher on small farms, except for paddy.

Among the various organic crops grown in the study area, the quantity of FYM used in maize was found to be highest i.e. about 46 q/ha followed by paddy (about 32 q/ha) followed by wheat (28.49 q/ha) and potato (24.92 q/ha) on overall farm situation. It was observed that the application of vermi-compost was estimated at 2.71, 2.58, 2.24, and 1.73 q/ha in case of wheat, maize, paddy, barley on overall farm situation, respectively. The use of vermi-compost was found to be higher on marginal farms as compared to small farm situation except for barley. The use of vermi-compost in maize was 2.8, 1.99 and 2.58 q/

Table 3: Cropping pattern on sample farms (ha/farm)

Particular	Marginal		Small		Overall	
	Area	Per cent	Area	Per cent	Area	Per cent
Kharif	0.3628	(51.52)	1.1612	(50.77)	0.5757	(51.11)
Maize	0.1772	(25.16)	0.5855	(25.60)	0.2861	(25.40)
Paddy	0.0286	(4.06)	0.0865	(3.78)	0.0440	(3.91)
Other crops	0.1570	(22.30)	0.4892	(21.39)	0.2456	(21.80)
Rabi	0.3414	(48.48)	1.1259	(49.23)	0.5506	(48.89)
Wheat	0.1633	(23.19)	0.5643	(24.67)	0.2702	(23.99)
Barley	0.0283	(4.02)	0.0708	(3.10)	0.0396	(3.52)
Other crops	0.1498	(21.27)	0.4908	(21.46)	0.2408	(21.38)
Total cropped area	0.7042		2.2871		1.1263	
Net cultivated area	0.4010		1.3545		0.6553	
Cropping intensity (%)	175.64		168.85		173.83	

Note: Figures in parenthesis indicate percentage to the total.

Table 4: Resource use pattern of different organic crops produced on sample farms (per ha)

Particulars	Maize			Paddy			Wheat			Barley		
	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall
Seed (kg)	21.78	23.04	22.12	32.35	29.17	31.50	117.41	124.7	119.35	41.88	43.11	42.21
Organic inputs												
FYM (q)	45.88	47.87	46.41	31.21	33.49	31.82	27.81	30.35	28.49	13.96	10.57	13.06
Vermi-compost (q)	2.80	1.99	2.58	2.42	1.75	2.24	2.57	3.10	2.71	1.86	1.39	1.73
Liquid organic inputs												
Jivamrit (l)	88.55	64.05	82.02	30.80	32.50	31.25	78.05	80.32	78.66	44.80	45.50	44.99
Matkakhad (l)	55.86	53.47	55.22	45.98	34.96	43.04	63.46	67.72	64.60	15.20	18.24	16.01
Vermiwash (l)	40.00	26.50	36.40	33.00	29.00	31.93	61.25	54.50	59.45	13.75	19.50	15.28
Biopesticides inputs												
Beejamrit (l)	1.90	2.12	1.96	3.10	2.92	3.05	9.78	10.20	9.89	3.52	4.06	3.66
Fermented butter milk (l)	29.58	34.34	30.85	34.51	43.35	36.87	39.27	46.58	41.22	23.29	31.28	25.42

Note: Units was represented in Kg is kilogram, q is quantal, l is litre, respectively.

Table 5: Working out economics of different organic inputs

Particulars	Marginal	Small	Overall
Farm yard manure (FYM) (kg)	1.49	1.50	1.49
Vermi-compost (kg)	1.69	1.90	1.74
Jivamrit (Litre)	2.85	2.83	2.84
Matka khad (Litre)	3.81	3.85	3.83
Vermiwash (Litre)	4.77	4.93	4.85
Beejamrit (Litre)	1.47	1.56	1.52
Fermented butter milk (Litre)	22.45	23.29	22.96

ha on marginal, small and overall farm situations, respectively. Farmers usually preferred more quantity of FYM instead of vermi-compost. Among the farmers, quantity of vermi-compost was comparatively less as compared to recommended quantity of vermi-compost.

Liquid organic inputs like *jivamrit*, *vermiwash* and *matkakhad* are being recently promoted under organic agriculture schemes like *Paramparagat Krishi Vikas Yojana* (PKVY) and *Subhash Palekar Natural Farming* (SPNF) in the state other than FYM/Vermi-compost.

The Table revealed that among organic crops, the use of liquid organic inputs was found to be highest in case of maize and application of *jivamrit*, *matkakhad* and *vermiwash* was estimated at about 82, 55 and 36 litre/ha, respectively on overall farm situation. In case paddy per hectare utilization of *jivamrit*, *matkakhad* and *vermiwash* was about 31, 43 and 32 litre/ha, respectively. Use of *jivamrit* in wheat and barley was about 79 litre/ha and 45 litre/ha, respectively on overall farm situations. The use of *matkakhad* varied between about 16 litre/ha in case of barley to 64 litre/ha in case of wheat. As far as use of *vermiwash* was concerned, it was highest in wheat (about 59 litre/ha), followed by barley (about 15 litre/ha), respectively on overall farm situation.

It is the general perception among the sample farmers that the crops which are grown by using organic inputs are resistant to many insect pest and diseases, but the incidence of disease is low. However, in order to manage insect pest & diseases of crops the farmers were using *beejamrit* and *fermented butter milk*. The use of biopesticides inputs for the management of insect-pest and diseases in the major organic crops was analysed and the usage of *beejamrit* was highest in wheat (about 10 litre/ha) followed by barley (about 4 litre/ha), paddy (about 3 litre/ha) and maize (about 2 litre/ha). The utilization of *fermented butter milk* was about 41 litre/ha in case of wheat followed by 37 litre/ha in case of paddy, 31 litre/ha in case of maize and 26 litre/ha in case of barley on overall farm situations, respectively. The table further indicated that the usage of *fermented butter milk* was higher on small farms as compared to marginal farms.

The cost of cultivation of major organic crops grown by the farmers has been analysed and is depicted in Table 6. It can be observed from the table that in case of organic crops, the total cost of cultivation varied between Rs. 32,431/ha in case of barley to Rs. 40,396/ha in case of paddy on overall farm situation. The per hectare total fixed cost was found to be same in all the major organic crops because the average total investment on the fixed factors of production was same for all the crops grown by farmers.

The magnitude of total variable cost of different organic crops depends upon the use of labour and different organic inputs like; seed, fertilizers, FYM, vermi-compost, liquid organic inputs, etc. The total variable cost in case of maize, was worked out to be at Rs. 19,208, 19,661 and 19,328/ha on marginal, small and overall farm situation, respectively. Among the major cost components of variable cost, the human labour was found to be the major constituent amounting to Rs. 10,130/ha followed by FYM (Rs. 6,915/ha) and use of biopesticides measures (Rs. 711/ha) on overall farm situation. The proportions of these constituents to the total cost of production of maize were about 52, 36 and 4 per cent, respectively. The total fixed and total variable costs accounted for about 49 and 51 per cent of the total cost of cultivation, respectively on overall farm situation.

The total cost of cultivation of barley was found to be Rs. 32,538, 32,119 and 32,431 /ha on marginal, small and overall farm situation, respectively. The share of total fixed and total variable cost was estimated at about 58 and 42 per cent of the total cost of cultivation on overall farm situation, respectively. In the total cost of cultivation, about 73 per cent of the investment was made on the human labour followed by FYM about 14 per cent and seed about 4 per cent on overall farm situations. The pattern of net returns over variable cost for the different organic crops has been presented in Table 7. The analysis of data reveals that the net returns over variable cost from all the organic crops were found to be positive and was found to be highest in case of maize (Rs. 27,667/ha) and similar pattern is followed in net returns over total cost (Rs. 8,979/ha) on overall farm situation. The benefit cost

Table 6: Cost of cultivation of different organic crops produced on sample farms (Rs./ha)

Particulars	Maize			Paddy			Wheat			Barley		
	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall
Fixed cost												
Interest on total fixed investment	2339 (12.41)	2243 (12.28)	2313 (12.38)	2339 (12.41)	2243 (12.28)	2313 (12.38)	2339 (12.41)	2243 (12.28)	2313 (12.38)	2339 (12.41)	2243 (12.28)	2313 (12.38)
Depreciation	3003 (15.94)	2520 (13.80)	2875 (15.38)	3003 (15.94)	2520 (13.80)	2875 (15.38)	3003 (15.94)	2520 (13.80)	2875 (15.38)	3003 (15.94)	2520 (13.80)	2875 (15.38)
Land rent	13500 (71.65)	13500 (73.92)	13500 (72.24)	13500 (71.65)	13500 (73.92)	13500 (72.24)	13500 (71.65)	13500 (73.92)	13500 (72.24)	13500 (71.65)	13500 (73.92)	13500 (72.24)
Total fixed cost	18842 (49.52)	18263 (48.16)	18688 (49.16)	18842 (46.72)	18263 (45.02)	18688 (46.26)	18842 (49.62)	18263 (47.07)	18688 (48.93)	18842 (57.91)	18263 (56.86)	18688 (57.62)
Variable cost												
Seed	316 (1.64)	334 (1.70)	321 (1.66)	598 (2.79)	540 (2.42)	583 (2.68)	1937 (10.13)	2058 (10.02)	1969 (10.10)	586 (4.28)	604 (4.36)	591 (4.30)
Organic inputs												
FYM	6836 (35.59)	7181 (36.52)	6915 (35.78)	4650 (21.64)	5024 (22.52)	4741 (21.84)	4144 (21.66)	4553 (22.17)	4245 (21.76)	2080 (15.19)	1586 (11.44)	1945 (14.15)
Vermi-compost	473 (2.46)	378 (1.92)	450 (2.33)	409 (1.90)	333 (1.49)	390 (1.80)	434 (2.27)	589 (2.87)	472 (2.42)	314 (2.30)	264 (1.91)	302 (2.20)
Liquid organic inputs	656 (3.42)	518 (2.63)	621 (3.21)	420 (1.96)	370 (1.66)	408 (1.88)	756 (3.95)	757 (3.68)	759 (3.89)	251 (1.83)	295 (2.13)	263 (1.92)
Biopesticides measures	667 (3.47)	803 (4.08)	711 (3.68)	779 (3.63)	1014 (4.55)	851 (3.92)	896 (4.68)	1101 (5.36)	961 (4.93)	528 (3.86)	735 (5.30)	589 (4.29)
Labour cost	10082 (52.48)	10263 (52.20)	10130 (52.41)	14492 (67.45)	14880 (66.71)	14595 (67.23)	10800 (56.45)	11298 (55.02)	10933 (56.04)	9861 (72.00)	10304 (74.36)	9979 (72.61)
Interest on working capital	179 (0.93)	184 (0.94)	180 (0.93)	137 (0.64)	146 (0.65)	139 (0.64)	163 (0.85)	181 (0.88)	168 (0.86)	75 (0.55)	70 (0.50)	74 (0.54)
Total variable cost (A +B)	19208 (50.48)	19661 (51.84)	19328 (50.84)	21486 (53.28)	22305 (54.98)	21708 (53.74)	19131 (50.38)	20536 (52.93)	19507 (51.07)	13696 (42.09)	13856 (43.14)	13743 (42.38)
Total cost	38050	37924	38166	40328	40568	40396	37973	38799	38195	32538	32119	32431

Note: Figures in parentheses indicate percentages to the total in each category.

Table 7: Net returns from different organic crops produced on sample farms (Rs./ha)

Particulars	Maize			Paddy			Wheat			Barley		
	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall	Marginal	Small	Overall
Total fixed cost	18842	18263	18688	18842	18263	18688	18842	18263	18688	18842	18263	18688
Total variable cost	19208	19661	19328	21486	22305	21708	19131	20536	19507	13696	13856	13743
Total cost	38050	37924	38016	40328	40568	40396	37973	38799	38195	32538	32119	32431
Gross returns	46345	48781	46995	41063	41949	41300	36895	39275	37530	29779	26875	29004
Net returns over variable cost	27137	29121	27667	19577	19644	19592	17764	18739	18023	16082	13019	15261
Benefit cost ratio	1.22	1.29	1.24	1.02	1.03	1.02	0.97	1.01	0.98	0.92	0.84	0.89

ratio was highest in maize (1.24) followed by paddy (1.02), wheat (0.98) and barley (0.89). The table further reveals that when the total cost of cultivation was taken in account to the estimation of net returns, then farmer less incurred a loss of Rs. 665/ha in case of wheat and Rs. 3,427/ha in barley on overall farm situation due to two main reasons (i) sale of produce less than Minimum Support Price (MSP); (ii) lack of irrigation facilities and undistributed rainfall pattern in *rabi* season.

CONCLUSION

The study will be helpful for improving the socio-economic status of the organic farmers and to provide status and economics of organic farming in the state. A quantitative assessment of the contribution of various organic input factors to the crop output in the study area is helpful in re-orienting the programmes and priorities to achieve more production per unit area and time. The resource use pattern in the study area has indicated the present scenario of resource allocation in organic farming in the study area. The study further gives the better understanding of cropping pattern, productivity, resource use pattern, cost of cultivation, gross returns, net returns, production and its utilization pattern of organic farmers in the state. In order to reduce the cost of cultivation, the farmers should be motivated to collective use of mechanical power to bring down the fixed costs. It is further suggested that the farmers should be provided with extension services so that they can follow organic practices on their farms with high productivity of crops. As there is absence of standardization of methods/practices for vegetable crops under organic farming so, there is a need to formulate appropriate package of practices for vegetable crops.

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Growth Analysis of LAC Production During XII Plan *vis-a-vis* XI Plan Period in Odisha, India

A.K. Jaiswal[1], Alok Kumar[2]*, Sharmila Roy[1] and S.N. Sushil[1]
[1]ICAR-Indian Institute of Sugarcane Research, Lucknow-226002, Uttar Pradesh
[2]ICAR-National Academy of Agricultural Research Management, Hyderabad-500030, Telangana

ABSTRACT

The research is based on secondary data on lac production during Plan XI (2007-08 to 2011-12) and Plan XII (2012-13 to 2016-17). A few econometric parameters *viz.* minimum, maximum, mean production, growth rate, % changes in mean value during XII plan over XI plan period and instability was assessed. Odisha state which contributed around 2.50 per cent in national production during the XI plan period increased its share to 2.90 per cent during the XII plan. There is a 16.0 per cent increase in % share during the XII plan. The state registered a negative growth rate of (-) 9.96 per cent during the XI plan, an increase to positive growth of 1.90 per cent per annum during the XII plan. District wise % change in mean value from XI to XII plan indicated that Keonjhar and other minor lac producing districts together recorded the highest increase to the extent of 422.80 per cent followed by Mayurbhanj (54.52%). However, the mean value in Baleshwar, Koraput and Nabrangpur declined to 34.39, 36.32 and 17.81 per cent, respectively from XI to XII plan. The state as a whole recorded a 45.38 per cent increase in mean value over the XI plan. The increase % is due to a 326.32 per cent increase *kusmi* winter lac production in Mayurbhanj district and a particular increase in both *kusmi* and *rangeeni* crop in Keonjhar and other minor lac producing districts. In respect of instability in production during the XII plan, only Nabrangpur, Keonjhar and other minor lac producing districts together recorded lower instability than the states figure of 35.29 per cent.

Keywords: *Butea monosperma*, Lac Production, *Schleichera oleosa,* Shellac, *Ziziphus mauritiana*

INTRODUCTION

Lac, a non-timber forest product (NTFP), is a natural resinous substance with significant commercial value in India. It is the only animal-derived resin, making it ideal for a variety of applications such as protective and ornamental coatings in thin films, adhesives, and plastics. It contributes a tiny but considerable amount to the country's foreign exchange earnings, but the most important role that lac plays in the economy is that it provides a secondary income to around 3-4 million tribal people. Sticklac (crude lac) produced in the country is processed in a huge number of cottage industry-scale plants to make seed lac or shellac before being exported. These production facilities are located throughout the lac-growing regions and handle the majority of the country's produce. The refining procedure is straightforward, yet it relies on manual labour. This industry employs a significant number of highly skilled individuals (Kumar *et al.,* 2015). Lac is a significant source of income for forest and sub-forest dwellers (Jaiswal et al. 2006; Borah et al. 2019). It is also one of the natural polymers produced by an insect called *Kerria lacca.* The lac production technology is eco-friendly and very economical. The potential of lac in terms of demand is well known given its use in different sectors. *Schleichera oleosa*, *Ziziphus mauritiana, Butea monosperma* are the major lac host species in India. Of the two types of lac, *S. oleosa* is most suited for *kusmi* lac while *B. monosperma* for *rangeeni* lac. *Z. mauritiana* is suitable for both *rangeeni* and *kusmi* lac but only during a specific season. Due to economic value, the forest dwellers protect these trees for their sustainable livelihood. There is two crop cycle in a year for each lac insect strain, *Rangeeni* summer crop starts in October-November and mature in June-July, covering eight months' period. *Rangeeni* rainy crop starts in June-July and matures in October-November, covering four months only. Though *rangeeni* summer crop mature in June-

*Corresponding author email id: alok.education@gmail.com

July but lac growers generally harvest sometimes in April as *ari* crop. Similarly, *kusmi* summer crop starts in January-February and the crop mature in June-July. *Kusmi* winter crop starts in June-July and matures in January-February. Several studies have been carried out on growth analysis of lac production during past years (Saha and Jaiswal, 1993a; Jaiswal and Saha, 1998; Jaiswal *et al.,* 1999; Jaiswal *et al.,* 2011a,b, 2012; Jaiswal and Singh, 2014d). Odisha state remained forest-rich and known for its substantial minor forest produce. Production of lac is also one of the important livelihood activities mainly by forest and Sub-forest dwellers. The potential and performance assessment of different districts in respect of lac production will help develop strategies to enhance livelihood opportunities in the state. Considering this in view, crop-wise and district wise secondary data on lac production have been analysed for XI and XII plan period and assessed the trend.

MATERIALS AND METHODS

The district-wise and crop-wise secondary data on lac production, about the year 2007-08 to 2011-12 and 2012-13 to 1016-17 have been collected from published information namely Annual Lac Bulletin, Directorate of Lac Development, Ranchi; Lac Bulletin, Indian Lac Research Institute, Ranchi (Pal *et al.,* 2006, 2007, 2008, 2009, 2010a, 2010b, 2011) and various issues of "Lac, Plant and Resins and Gums Statistics: At a glance" (Pal *et al.,* 2012, 2013; Yogi *et al*., 2014, 2015, 2017, 2018, 2020). Five major lac growing districts of Odisha state and a few other districts categorized as others have been covered under the study. Minimum, maximum, mean values and growth rate (compound) in lac production were considered as standard parameters for each district. The compound growth rate for lac production has been calculated as per the standard procedure. The percentage change in mean value from XI plan to XII plan period was also calculated. The instability in production was calculated in terms of percentage by adopting the formula: Instability = (Standard deviation/ mean) *100.

RESULTS AND DISCUSSION

A perusal of data indicated that during the XII plan, the average state production was 534 tons per annum. The minimum production was 310 tons and a maximum of 775 tons per annum during these five years. During the XI plan, however, the average production was 368 tons. Amongst different districts, the highest production was recorded in the Sundergarh district (174 tons per annum) followed by Nabrangpur, Mayurbhanj, Baleshwar and Koraput. Sundergarh district alone contributes around 34.06 per cent of state lac production during the XII plan. After Sundergarh, Nabrangpur contributes 21.05 per cent followed by Mayurbhanj (18.65%), Baleshwar (6.99%), Koraput (5.83%) and Keonjhar (4.07%). A comparison of annual average production of both plan periods indicated a decline in Baleshwar, Koraput and Nabrangpur districts. Their collective share in-state production is around one-third (33.87%). In other districts, the % increase in production was highest for Keonjhar + other areas of the state (422.8%) followed by Mayurbhanj (54.52%). The state as a whole produced around 22.17 per cent *rangeeni* and 77.83 per cent *kusmi* lac. Baleshwar and Koraput are predominantly *rangeeni* lac producing districts. Whereas, Mayurbhanj, Nabrangpur and Keonjhar are *kusmi* lac producing districts.

A comparison of data on the mean value for the XI and XII plan indicated that there is a 45.83% increase in lac production during the XIIth plan in the state. In respect of *rangeeni* lac, however, there is a 32.66 per cent reduction during the XII plan *vis-a-vis* the XI plan. There is a sharp increase of 81.33 per cent in *kusmi* lac production during the XII plan in the state. Similarly, overall there is a 54.52 per cent increase in mean production in the Mayurbhanj district. Koraput recorded the highest reduction in mean value during the XII plan followed by Baleshwar and Nabrangpur. The overall increase in state production is due to a very high increase (422.8%) in Keonjhar and other minor lac producing districts together. This is followed by an increase in Mayurbhanj production. In respect of *rangeeni* lac, the mean production decrease in all districts and varied 5.60 to 32.63 per cent. However, it increases substantially in Keonjhar and other minor lac producing districts together. It appears lac production was introduced successfully in some new areas. Both summer and rainy season crop *rangeeni* was affected in districts with decreased production except summer crop in Koraput district (Table 1).

The *kusmi* lac production increases by 81.83 per cent over the XI plan. Similarly, in respect of *kusmi* lac crop, the Baleshwar district recorded the highest decrease in mean value followed by Koraput and Nabrangpur. The increase in the mean value of *kusmi* lac was highest in Keonjhar and other minor lac producing districts together followed by Mayurbhanj districts. It is interesting to note that the increase in the mean value of *kusmi* crop in the Mayurbhanj

Table 1: Mean (tons), share and change in lac production during XI and XII plan periods in Odhisa

Districts	Plan period	Attributes	*Rangeeni*			*Kusmi*			Grand Total
			Summer	Rainy	Total	Summer	Winter	Total	
Whole State	XI	Mean	68	71	139	106	123	229	368
	XII	Mean	56	62	118	134	282	416	534
	XII	% Share	10.54	11.63	22.17	25.12	52.71	77.83	100
	XI-XII	% Change	-17.06	-12.39	-32.66	26.79	129.27	81.83	45.38
Baleshwar	XI	Mean	11	14	25	15	17	32	57
	XII	Mean	10	13	24	4	10	14	37
	XII	% Share	27.27	35.83	63.10	10.16	26.74	36.90	100
	XI-XII	% Change	-7.27	-4.29	-5.60	-74.67	-41.18	-56.88	-34.39
Koraput	XI	Mean	9	9	18	9	11	20	38
	XII	Mean	9	7	16	7	8	15	24
	XII	% Share	38.02	29.75	67.77	28.10	33.06	61.16	100
	XI-XII	% Change	2.22	-20.00	-8.89	-24.44	-27.27	-26.00	-36.32
Mayurbhanj	XI	Mean	12	13	25	18	19	37	62
	XII	Mean	4	8	13	6	81	87	96
	XII	% Share	4.38	8.77	13.15	6.47	84.55	91.02	100
	XI-XII	% Change	-65.00	-35.38	-49.60	-65.56	326.32	135.68	54.52
Nabrangpur	XI	Mean	19	19	38	45	54	99	137
	XII	Mean	9	16	26	24	63	87	113
	XII	% Share	8.35	14.39	22.74	21.31	55.95	77.26	100
	XI-XII	% Change	-50.53	-14.74	-32.63	-46.67	16.67	-12.12	-17.81
Keonjhar*	XII	Mean	0.2	0	0.2	10.6	11	21.6	21.8
	XII	% Share	0.92	0	0.92	48.62	50.46	99.08	100
Sundergarh*	XII	Mean	5	0	5	73	96	169	174
	XII	% Share	3.09	0.0	3.09	41.92	54.98	96.91	100
Keonjhar+ Others	XI	Mean	5	5	10	15	20	35	50
	XII	Mean	23	17	40	95	127	222	261
	XII	% Share	8.65	6.50	15.15	36.27	48.58	84.85	100
	XI-XII	% Change	352.00	240.00	296.00	532.00	535.00	533.71	422.80

*District wise data for XI plan not available

district during the XII plan is due to a substantial increase in *kusmi* winter crop (326.32%). The summer crop production dipped substantially (65.56%). Hence Mayurbhanj, Keonjhar and other minor lac producing districts played a significant role in achieving 45.38 % increases in state total lac production during the XII plan (Table 1).

The state recorded 35.29 per cent instability in production during these five years. Only Baleshwar (33.96%), Nabrangpur (26.07%) and Keonjhar (25.0%) registered lower instability than the state figure. Mayurbhanj and Koraput districts recorded higher instability than the state to the tune of 70.10 and 52.48 per cent, respectively.

The state registered positive growth of 1.90 per cent per annum in lac production during the XII plan period. Except for Sundergarh, Mayurbhanj and Keonjhar districts all other three lac producing districts recorded negative growth during the XII plan period. Despite negative growth in Koraput and Baleshwar district, the positive growth in the state is attributed due to positive growth in Sundergarh, Mayurbhanj and other minor lac producing districts during the XII plan. Overall, the declining trend in

Table 2: The compound annual growth rate for lac production during XII plan *vis-a-vis* XI plan in Odisha

Districts	Plan period	*Rangeeni*			*Kusmi*			Total
		Summer	Rainy	Total	Summer	Winter	Total	
Whole State	XI	-16.02	-9.01	-12.75	-9.32	-7.59	-8.38	-9.96
	XII	-24.40	-26.48	-24.96	6.21	13.34	10.95	1.90
Baleshwar	XI	31.95	37.41	34.93	-16.40	-22.32	-19.60	0.77
	XII	-47.25	-36.90	-41.51	17.74	0.00	7.02	-20.97
Koraput	XI	-6.70	-6.70	-6.70	-22.00	-28.08	-25.41	-15.86
	XII	-49.35	-32.38	-42.66	11.61	-27.52	0.24	-21.02
Mayurbhanj	XI	-35.06	-30.12	-33.14	-24.03	-20.57	-22.42	-26.83
	XII	-27.52	-16.74	-21.40	16.98	47.58	35.22	19.23
Nabrangpur	XI	-17.62	-13.86	-15.86	-4.98	-2.21	-3.50	-6.77
	XII	-27.52	-36.90	-31.57	2.26	5.76	4.70	-0.59
Keonjhar and Others	XI	-30.12	-24.21	-27.52	5.92	8.45	7.39	-8.23
	XII	-1.92	-10.40	-4.52	9.03	6.93	5.86	4.36
Sundergarh	XI*	-	-	-	-	-	-	-
	XII	82.28		82.28	97.60	10.58	12.49	14.11

*District wise data not available

the state lac production which was very fast during the XI plan (9.96% per annum) showed an increasing trend during the XII plan (1.90% per annum). All districts in the state registered a negative growth rate during the XI plan except Baleshwar where the trend is more or less stable (0.77%). Mayurbhanj and Keonjhar + other minor districts follow the state pattern of negative growth rate during the XI plan but become positive during the XII plan. Baleshwar is the only district that registered a positive trend during the XI plan but recorded a negative during the XII plan (Table 2).

The state registered negative growth of *rangeeni* lac production to the extent of (-) 12.75 and 24.96 per cent per annum during XI and XII plan period respectively. Thus negative growth rate for *rangeeni* lac production during the XII plan was around two times that of the XI plan. The highest negative growth rate for *rangeeni* lac was recorded in the Koraput district followed by Baleshwar, Nabrangpur, Mayurbhanj and Keojhar + other districts during the XII plan. A similar negative growth rate was recorded during the XI plan also except in the Baleshwar district which registered positive growth. Baleshwar is the only district where the growth of *rangeeni* lac production during the XI plan was positive during both seasons but becomes negative during the XII plan. This is to be noted that despite negative growth of *rangeeni* lac in all districts during XII plan, Sundergarh district registered positive growth of 82.28 per cent per annum and that during the summer season. This may be due to a newer intervention by some entity in this district to promote lac farming.

The state registered negative growth of *kusmi* lac production to the extent of 8.38 % during the XI plan but positive growth of 10.95 per cent per annum was recorded during the XII plan period. All the districts studied registered positive growth during the XII plan. The highest was recorded in Mayurbhanj district followed by Sundergarh, Baleshwar, Keonjhar + Others, Nabrangpur and Koraput. Districts, where the growth rate of *kusmi* summer crop is more than *kusmi* winter crop during the XII plan, include Sundergarh, Baleshwar and Keonjhar + other districts. At the state level growth rate of both *kusmi* summer and winter crops was negative during the XI plan but become positive during the XII plan. A similar trend was recorded in all the districts for this crop. However, in Keonjhar + other districts growth rate was positive during both plan periods (Table 2).

CONCLUSION

The study showed negative growth during the XI period in the state but becomes positive during the XII plan. The comparison of mean value between both periods indicated a substantial increase in *kusmi* lac production from XI plan to XII plan. But *rangeeni* lac production declined substantially. Sundergarh district which was considered in

minor lac production district earlier now becomes main lac producing district. Sundergarh and Mayurbhanj are the two major contributing districts in state with positive growth. These contributed due to enhanced production of *kusmi* lac. Odisha is one of the potential states for lac production having the strength of a large number of *B. monosperma* and *S. oleosa*. Most of the lac produced in Odisha is marketed in adjoining states like Jharkhand and Chhattisgarh. Unlike in Jharkhand and West Bengal, Transit pass (TP) is very much required in the state for the movement of produce, a scientific technique for higher productivity and facilitation marketing of produce will open more options for livelihood.

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Impact of Urea-Molasses Multinutrient Block (UMMB) Technology Adoption on Dairy Animal Performance and Factors Associated with its Adoption

Vidya Nimbalkar*, H.K. Verma, Jaswinder Singh
Department of Veterinary and Animal Husbandry Extension Education, Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana, Punjab

ABSTRACT

An expost-facto research design was applied to study impact of UMMB technology adoption in six different districts of Punjab. Multi-stage random sampling technique was followed for sample selection (N=600) and personal interview technique for data collection. The significant (P<0.01) comparative results between technology adopter (n=210) and non-adopter (n=390) farms revealed lower mean difference in respect of morbidity rate, anestrus, repeat breeding and reproductive disorder at technology adopter farms, indicating better herd health status. Around 397 (66.16%) dairy farmers were rearing cattle for milk production. Significant difference (P<0.05) in mean values of daily milk production per animal and almost all reproductive parameters in cattle was observed at technology adopter (n=130) and non-adopter (n=267) farms. Viability of the technology at farmer's field has been proved by this study with further need for vigorous extension at the grass-root level to improve adoption as most of socio-economic variables found closely associated with its implementation.

Keywords: Adoption, Cattle productivity, Health status, Impact, UMMB technology

INTRODUCTION

India - the largest producer as well as the highest consumer of milk in the world (GOI 2012), herding the world's largest cattle and buffalo population but depicting very poor productivity of the dairy animals (Chander *et al.*, 2010). This may be due to the prevalent feeding system in India, which is predominantly fibrous and bulky in nature. However, these fibrous feeds are deficient in protein, energy, and minerals, with poor palatability and digestibility and without additional supplements, such feeds cannot support even body maintenance (Garg *et al.,* 2007).

Punjab, an agrarian state of Northern Indian, is sixth largest producer of milk in country despite its small geographical area and population (NDDB, 2017). During year 2017-18, Punjab produced 11.86 million tonnes milk contributing around seven per cent of total milk production of country with less than 2.5 per cent bovine population (SRD, 2019). The state has also achieved highest milk per capita availability which is 1120 gms per day (ETB, 2019). Sustainable dairy farming is emerging as a major alternative to wheat-rice cropping system in the state, however shortage of feed and fodder, low animal productivity, diseases and poor management remain as the major hurdles in achieving optimum animal productivity at field level.

Uromin-lick (UML)/ Urea-molasses multi nutrient block (UMMB) is a convenient and inexpensive technology encompassing multi-nutrient blocks which act as an important feed supplement and life saver by providing a blend of energy, protein, and minerals. It serves range of nutrients and thereby enhance nutritional, productive, and reproductive status of ruminant animals (Makkar, 2007). The adoption of this technology is carried out over 60 countries of the world including India where it introduced first in 1983 by National Dairy Development Board (NDDB), Anand (Kunju, 1986a,b). On farm and large-scale field trials of same conducted on replacement heifers and lactating crossbred cattle and buffaloes revealed

*Corresponding author email id: vgnimbvet2002@yahoo.co.in

improvement (Sanyal and Singh, 1995a, b, Sanyal *et al.*, 1995 and Tanwar, 2013). However, the impact of UMMB feeding on herd health, productive and reproductive performance at farmer's field under routine management conditions in India is found rare. With this backstop, the study was aimed to assess the impact of UMMB on herd health, productive and reproductive performance of dairy animals under the prevalent field conditions. Further, association between the adoption of technology and various socio-economic factors was also studied during this research.

MATERIALS AND METHODS

The target population comprised of dairy farmers residing in the rural areas of Punjab, India (31.1471° N, 75.3412° E) rearing cattle or buffaloes or both for milk production with the intention of income generation. The study population was the dairy farmers belonging to 24 selected villages of Punjab.

An expost-facto research design was used to study the implementation of UMMB technology as described by Wadhawa and Bakshi (2010) in six different districts of Punjab (Barnala, Bhatinda, Hoshiarpur, Ludhiana, SAS Nagar, Tarn Taran). Multi-stage random sampling technique was followed to achieve a sample size of 600 dairy farmers calculated as per procedure given by Dhand and Khatkar (2014) for the proposed study. The authors visited each village and got an authentic list of dairy farmers from the Veterinary Dispensary. The selection of respondents within each village was based on the age of respondents above 18 years, availability at home, possession of dairy animals at the time of the survey, doing regular milk sale and on farmer's willingness to participate in the study.

An interview schedule as a research instrument was designed for the purpose of collecting data and piloted on dairy farmers of selected districts in proportion of 5% of sample size having similar characteristics. The questions comprised both open and closed ended type regarding socio-economic profile of respondents covering gender, age, family type and size, education, dairy farming experience, occupation, land holding, animal holding, species and breed of dairy animals, annual family income, dairy income details, training attended *etc.* Technology adoption part of the questionnaire was dealt with use, source and duration of adoption. Information regarding extension contacts, mass media exposure, institutional accessibility of the respondents was also collected. The quantitative data focusing health status, productive and reproductive parameters were also recorded. Personal interview technique was employed for data collection. The interview was followed in local language after receiving the farmer's participatory consent for the study. The study was conducted from June 2018 to May 2019 and data for the preceding one year was recorded during this study.

A dictomous response in form of Yes (Score-1) or No (Score-0) was recorded for adoption of technology. Based on the response of farmers, the farms were categorized as adopter (TAF) and non-adopter of technology (TNAF). If the response is "Yes" for technology adoption further details of extent of adoption i.e. fully and partially (implementation deviated from scientific recommendations) adopted was recorded. The detail information about duration of adoption was also recorded. To assess the impact of technology adoption, the herd health status of farm was measured in terms of incidence of diseases, morbidity, reproductive disorders and number of animals affected were recorded.

The effect of UMMB supplementation on cattle productivity of dairy farms was evaluated by considering various productive and reproductive parameters at both TAF and TNAF. Productive parameters like average daily milk yield per cattle, peak yield and lactation yield of farm was recorded in litres along with the average fat percentage reported by the farmer. Reproductive parameters such as age at maturity (AM) and age at first calving (AFC) were recorded in months, while Service period (SP), Dry period (DP), Lactation length (LL) and calving interval (CI) were measured in days. Services per conception (SPC) was measured as the average number of natural services or artificial insemination required by the animal to get conceived or become pregnant.

All the data were compiled by Microsoft Excel and descriptive analysis was done by using SPSS Statistic software for Windows, Version 20 developed by IBM company, USA.

Descriptive statistics including frequencies and percentages were run for continuous/categorical variables. Percentage analysis was performed for the incidence of diseases and reproductive disorders among the dairy farms categorized as TAF (n = 210) and TNAF (n = 390). Independent 't' test was performed to analyze subgroup differences in relation to outcome variables. The test was

also applied to compare means for productive and reproductive parameters of cattle between technology adopter (n = 130) and non-adopter (n = 267) farms. Correlation analysis was performed to study the association between the adoption and various socio-economic factors. All results were considered statistically significant when P $\leq$ 0.05.

RESULTS AND DISCUSSION

Socio-economic characteristics of dairy farmers presented in Table 1, revealed that most of the respondents belonged to middle age (43.50%) and had high school (32.20%) education. About 2/3rd respondents were engaged in agriculture activities and dairying as their occupation and possessed more than 10 years of dairy farming experience. About 30.83 per cent farmers were small land holders followed by marginal (21.83%), semi-medium (21.33%), medium (12.17%), land less (11.00%). Majority owned medium herd size (between 6-15 animals). Very few respondents (12.20%) attended training and about 37 per cent respondents had social participation.

From the data of the study, it was found that 35.00 per cent dairy farmers were adopting the technology comprised of 13.80 per cent regular and 21.20 per cent partial adoption. The farmers of TAF reported that they purchased it from Krishi Vigyan Kendras (KVKs) present in all districts of the state and veterinary university of the state. Majority of adopters (93/100, 44.29%) were using this technology 2-3 years whereas 38.57 per cent (81/210) were found using the same for 1-2 years, 15.24 per cent (32/210) had started implementing it less than one year. Mere adoption (4/210, 1.90%) was observed above three years of duration. The variation in duration of adoption might be related with awareness and socio-economic factors of the dairy farmers. Accessibility and availability

Table 1: Distribution of farmers based on Socio-economic characteristics

Characteristics	Categories	Frequency	Percentage
Age (yrs)	Young (< 36)	175	29.20
	Middle (36-50)	261	43.50
	Old (> 50)	164	27.30
Education level	Illiterate (no education)	65	10.80
	Primary (upto 4th)	74	12.30
	Middle (5th – 8th)	94	15.70
	High school (9th – 10th)	193	32.20
	Higher secondary (11th - 12th)	124	20.70
	Graduate and above (above 12th)	50	8.30
Dairy farming experience (yrs)	High (more than10)	440	73.30
	Medium (between 5-10)	111	18.50
	Low (upto 5)	49	8.20
Land holding (Hectors)	Land less (0.0)	66	11.00
	Marginal (< 1.0)	131	21.80
	Small (1.1 -2.0)	185	30.80
	Semi-medium (2.1 – 4.0)	128	21.30
	Medium (4.1 – 10.0)	73	12‘20
	Large (> 10.0)	17	2.80
Herz size (No. of dairy animals)	Large (> 15)	66	11.00
	Medium (6-15)	318	53.00
	Small (<5)	216	36.00
Social Participation	No	380	63.30
	Yes	220	36.70
Dairy farming Training received	No	527	87.80
	Yes	73	12.20

of the licks might have also played role in varying duration of adoption as Bhattu *et al.* (2013) found that the availability of urea molasses mineral block (UMMB) licks was also a problem for further adoption in the study area.

The comparative results between TAF (n = 210) and TNAF (n = 390) presented in Table 2, depicted significant (P<0.01) difference in mean values of morbidity, anestrus, repeat breeding and reproductive disorder percentage. The mean difference was lower by 9.98, 2.40, 10.43 and 6.84 per cent in respect of morbidity rate, anestrus, repeat breeding and reproductive disorder incidence rate respectively at TAF compared to TNAF. Previously, Khan (2007), also reported the benefits of uromin lick feeding on body condition and reproductive status of calved animals.

Majority (397/600, 66.16%) dairy farmers from total sample were rearing cattle, while rest were owing buffaloes only. Those farms rearing cattle were further categorized as TAF (n = 130) and TNAF (n = 267) based on feeding of multinutrient blocks. The results presented in Table 3, showed significant difference (P<0.05) in mean values of daily milk production per animal, while other variables had non-significant observations. The average daily milk yield per animal was found higher by 0.861 litre among the TAF. Positive effects on milk production and reproductive performance of indigenous cows were also reported by Maih *et al.* (1999, 2000). The mean values for other productive parameters were found non-significant which might be the reason that UMMB feeding was found on lower side among dairy farmers who reared cattle only.

The mean values of all reproductive parameters in Table 4 were found significantly lower (P<0.01) in TAF than TNAF indicating that UMMB feeding plays important role in improving the reproductive performance of dairy cattle. The TAF observed early maturity (MD - 2.023) and first calving age (MD - 1.994), lower service period (MD - 9.814), dry period (MD - 4.901), calving interval (MD - 22.830) and lactation length (MD - 17.929) than TNAF. The services per conception was also found less at TAF. The findings of the study indicated that UMMB supplementation played pivotal role in productivity enhancement by improving productive and reproductive

Table 2: Effect of UMMB feeding on disease occurrence at technology adopter and non-adopter farms (Adopters: 210, Non-adopters: 390)

Variables	Category	Mean	Std. error mean	Mean difference	't' Value	Sig.
Morbidity (%)	TAF	15.94	1.04	-9.98	-6.511**	.000
	TNAF	25.92	1.13			
Mastitis Incidence (%)	TAF	12.72	1.27	2.21	1.375	.170
	TNAF	10.51	0.96			
Anestrus (%)	TAF	2.22	0.68	-2.40	-2.533**	.012
	TNAF	4.62	0.66			
Repeat breeding (%)	TAF	8.60	1.10	-10.43	-6.398**	.000
	TNAF	19.03	1.20			
Prolapse (%)	TAF	0.48	0.35	-.03	-.086	.931
	TNAF	0.51	0.18			
Dystokia (%)	TAF	0.17	0.11	.00	-.016	.988
	TNAF	0.17	0.12			
Retention of placenta (%)	TAF	0.14	0.12	.06	.459	.646
	TNAF	0.09	0.06			
Abortion (%)	TAF	0.21	0.12	-.18	-.465	.642
	TNAF	0.38	0.27			
Reproductive disorder (%)	TAF	11.82	1.34	-12.99	-6.842**	.000
	TNAF	24.81	1.34			

TAF: UMMB technology adopter farms, TNAF: UMMB technology non-adopter farms

Table 3: Effect of UMMB feeding on production performance of cattle at technology adopter and non-adopter farms (Adopters: 130, Non-adopters:267)

Variables in cattle	Category	Mean	Std. error mean	Mean difference	't' Value	Sig.
Daily milk production per	TAF	7.33	0.28	.831	2.271*	.054
animal (litres)	TNAF	6.50	0.22			
FAT percentage	TAF	3.90	0.03	.026	.790	.997
	TNAF	3.88	0.02			
Peak yield (litres)	TAF	15.16	0.54	1.023	1.428	.477
	TNAF	14.13	0.43			
Lactation yield (litres)	TAF	2365.23	84.41	194.482	1.716	.058
	TNAF	2170.75	67.57			

TAF: UMMB technology adopter farms, TNAF: UMMB technology non-adopter farms

Table 4: Effect of UMMB feeding on reproduction performance of cattle at technology adopter and non-adopter farms (Adopters: 130, Non-adopters:267)

Variables in cattle	Category	Mean	Std. error mean	Mean difference	't' Value	Sig.
Age at maturity (months)	TAF	18.98	0.57	-2.023	-2.683**	.005
	TNAF	21.01	0.50			
First calving age (months)	TAF	29.58	0.58	-1.994	-2.553**	.002
	TNAF	31.58	0.52			
Service period (days)	TAF	82.08	1.55	-9.814	-4.568**	.003
	TNAF	91.89	1.49			
Dry period (days)	TAF	77.92	1.37	-4.901	-2.551**	.000
	TNAF	82.82	1.35			
Lactation length (days)	TAF	325.42	2.80	-17.929	-4.854**	.001
	TNAF	343.35	2.41			
Services per conception (In nos)	TAF	2.27	0.06	-.382	-5.019**	.000
	TNAF	2.66	0.05			
Calving Interval (days)	TAF	403.35	3.22	-22.830	-5.036**	.000
	TNAF	426.18	3.19			

TAF: UMMB technology adopter farms, TNAF: UMMB technology non-adopter farms

performance of cattle at field level under various management conditions.

Similar findings were recorded by Wadhawa and Bakshi (2011) with UMMB supplementation. They found that, first service conception rate was improved, while services per conception declined along with reduced culling rate due to infertility. They further observed improvements in calving intervals, service period and conception rates.

The correlation between technology adoption and thirteen socio-economic characteristics of dairy farmer were studied and results are presented in Table 5. The variables like education level, dairy income contribution, social participation, project beneficiary, training attended, extension contacts and mass media exposure showed positive ($P < 0.05$) correlation with UMMB technology adoption, while rest six variables were not significantly associated. The farmers with higher level of education would make more level of technology adoption and could easily learn and understand the importance of the technology from different sources as reported by Singha *et al.* (2012). They were more receptive to other things indicating their innovativeness to accept changes towards new innovations. Most adopters had dairy farming as a

Table 5: Correlation analysis between UMMB technology adoption and socio-economic characteristics of dairy farmers

Variables	Pearson 'r' value	Sig.
Gender	-.073	.072
Age	-.080	.051
Education level	.142**	.001
Family size	-.027	.513
Dairy farming experience	-.021	.605
Land holding	.044	.281
Herd size	.024	.562
Dairy income contribution	.088*	.031
Social participation	.109**	.008
Project beneficiary	.196**	.000
Training attended	.101*	.013
Extension contacts	.478**	.000
Mass media exposure	.210**	.000

*. Correlation significant @ 0.05 level, **. Correlation significant @ 0.01 level

primary source of income which focused more on feeding management as it was the main source of income, indicated positive correlation with dairy in come contribution to total household annual income.

The adoption was found increased with more social participation and among project beneficiaries as well as after attending the training on dairy farming. These variables might lead to increase of change in knowledge, skill, and attitude, which contributed in rising the inclination of the farmers to use the technology. The finding corroborates with the study conducted by Kaaya *et al.* (2005) and Dehinenet *et al.* (2014). With the higher level of extension contacts and mass media exposure, dairy farmers might have exposed to more interactions with the extension personnel and received scientific guidance as well as technical information to access technology from different sources which helped in more adoption at their dairy farms. The variables were also found having significant influence on UMMB adoption.

CONCLUSION

The study concluded that feeding of UMMB had reduced the incidence of various diseases and reproductive disorders by reducing number of anestrus and repeat breeding cases at dairy farms. The feeding of these multinutrient blocks had beneficial effects in improving productivity of dairy cattle by increasing daily milk production per animal and improving reproductive efficiency by means of lowering age at maturity, first calving age and calving interval with a smaller number of services. UMMB supplementation played pivotal role in improving overall productivity of cattle farms maintained under rural management practices, hence, it can be easily propagated in other parts of the country dominated by small and marginal farmers. Thus, the study had proved the viability of the technology at farmer's field and further suggested that UMMB technology can be widely proposed for economic welfare of dairy farmers. Vigorous extension at the grass-root level is also suggested to increase usage of the technology through extension contacts, mass media publicity, training, demonstration, field visits, experience sharing *etc.,* as these variables found closely associated with technology adoption.

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Impact of Agromet Advisory Services on Farmers' Operational Decisions Related to Crop Cultivation in Thiruvananthapuram District of Kerala

R.V. Manjusree[1], Sanjit Maiti[1]*, Sanchita Garai[1], K.V. Manjunath[1], Mukesh Bhakat[2], A.K. Dixit[3], S.K. Jha[4] and K.S. Kadian[1]

[1]Dairy Extension Division, ICAR-National Dairy Research Institute, Karnal-132001, Haryana
[2]Livestock Production and Management, ICAR-National Dairy Research Institute, Karnal-132001, Haryana
[3]Dairy Economics, Statistics and Management Division, ICAR-National Dairy Research Institute, Karnal-132001, Haryana
[4]ICAR-Indian Institute of Soil and Water Conservation (ICAR-IISWC), Regional Research Centre, Chandigarh

ABSTACT

Indian agriculture is highly vulnerable to climate change and weather based agromet advisory services are very much crucial for day to day management of farm operations, efficient input usage and enhancing the crop production. Therefore the present study was undertaken to ascertain the impact of agromet advisory services on farmers' decision making for various farm operations in Thiruvananthapuram District of Kerala state. Two blocks of Thiruvananthapuram District of Kerala were chosen randomly and after ensuring that the villages were not receiving any services from the Agromet Field Unit (AMFU) situated in Thiruvananthapuram, two experimental and two control villages were chosen from each block. From each experimental village, 15 farmers were selected randomly as beneficiaries and given treatment i.e. Agromet Advisory Bulletins twice a week (Tuesday and Friday) for 6 months through a WhatsApp group, and 15 non-beneficiary farmers were chosen randomly from each control village. Total sample size of the study was 120 farmers. The impact of the Agromet Advisory services was assessed on farmers' operational decisions in Banana, Vegetable and Coconut cultivation using Difference in difference quasi-experimental design and regression model. The study revealed that despite of having positive treatment effect on almost all the farm operations, treatment effect was found only on land preparation, seed sowing, scheduling of irrigation, fertilizer application and spray scheduling of pesticides followed by the experimental group farmers.

Keywords: Agromet Advisory Services (AAS), Difference in difference design, Regression model

INTRODUCTION

A forecast which is agriculturally applicable is helpful not only for effective farm input management, but also for accurate impact assessment (Gadgil, 1989). The study by Singh *et al.* (2019) revealed that timely weather information allows farmers to plan their farm-level operations and is useful in making decisions about planting, harvesting dates, and investment in farm inputs, reducing cost and crop losses. The establishment of a district agromet field unit to provide agromet advisory service is potentially very useful to farmers in avoiding crop yield losses due to abnormal weather conditions, and the application of agromet advisory bulletins based on current and forecasted weather is a prospective tool for enhancing production and farm income through judicious and timely input utilization (Thakur *et al.*, 2020). The practices included in the agromet advisory service were changing the variety of the crop, arrange for storage of harvest, depending on weather events, hasten / delay harvesting according to forecasts, hasten / delay sowing, changing the schedule of ploughing / land preparation, changing pesticide application schedule, changing the fertilizer application schedule and irrigation schedule. Farmers who utilize the weather-based bulletin, according to Maini and Rathore (2011), have effectively decreased the cost of agriculture by 2-5 per cent. Ramachandrappa *et al.* (2018) studied usability and

*Corresponding author email id: sanjit.maiti@icar.gov.in/sanjit.ndri@gmail.com

impact of the agromet advisory services in the eastern dry zone of Karnataka and reported that farmers who followed the agromet advisories saw a significant advantage. In a case study on the economic impact of agrometeorological advisory services in the Aurangabad district of the Marathwada region, it was discovered that the total cost of cultivation was lower among farmers who had regularly followed and effectively adopted the agromet advisory services compared to farmers who did not receive the services. Furthermore, the net income as well as the B:C ratio improved among the farmers. Farmers that included the agromet recommendations into their daily farm operations and used the recommended contingency cropping scheme experienced extra benefits (Khobragade *et al.*, 2014). It has been found that a good amount of research has been conducted on economic impact of the agromet services while an assessment on the impact of the services on farmers' operational decisions was largely missing from the literatures and thus the study was undertaken to investigate the impact of agromet advisory services on farmers' operational decision in Thiruvananthapuram district of Kerala.

MATERIALS AND METHODS

Two blocks namely Nemom and Athiyanoor selected randomly from the Thiruvananthapuram district and from each block two villages were selected as experimental villages and two villages were selected as control villages after verifying that the villages were not receiving any kind of agromet advisory services from Agromet Field Unit (AMFU) of Thiruvananthapuram. Respondents were the crop and dairy farmers with smart phone and internet connectivity and 15 such respondents were selected randomly from each village making a sample of 120. The beneficiary farmers in the experimental villages were provided with treatment i.e., block level agromet advisory bulletins prepared by AMFU, Thiruvananthapuram was disseminated regularly for 6 months (1st Jan – 30th June 2021) through WhatsApp. The experimental and control group was undergone pre-test as well as post-test, before and after the treatment was administered.

Difference in difference quasi-experimental research design was used to compare the outcome of groups exposed to different factors at different times. After-before difference in outcomes in the treatment group was calculated, and from this difference, the after-before difference in the control group subtracted. The indicators used for the assessment of impact were land preparation, date of seed sowing, scheduling of irrigation, selection of variety, scheduling of irrigation, scheduling of fertilizer, herbicide and pesticide application, harvesting, storage and transportation.

RESULTS AND DISCUSSION

It is evident from the Table 1 that majority of the respondents were males and middle aged farmers with low farming experience. All the respondents were literates and having at least primary education. It was also found that majority of the respondents were marginal landholders belonging to other backward caste category and depends on farming for their livelihood. It is also revealed that both the experimental and control group farmers were having a similar socio-economic profile.

Table 1: Socio-economic profile of the sample respondents

Categories	Experimental group (n = 60) (%)	Control group (n = 60) (%)
Age		
Young	41.67	40.00
Middle aged	51.67	50.00
Older	6.67	10.00
Gender		
Male	88.33	86.89
Female	11.67	13.11
Education		
Primary	13.33	11.67
Secondary	48.33	43.33
Higher secondary	33.33	30.00
Graduation and above	18.33	15.00
Farming experience		
Low	68.33	66.70
Medium	23.33	23.33
High	8.33	10.00
Caste		
SC	3.33	10.00
OBC	75.00	80.00
UR	21.67	10.00
Occupation		
Farming	60.00	51.67
Others	40.00	48.33
Average operational landholding		
Landless	3.33	5.00
Marginal	88.33	81.67
Small	8.33	13.33

Table 2: Average productivity of the major crops in the study area

Major Crops	Variety	Average Productivity
Banana (n = 86)	Nendran, Rasakadali, Palayankodan, Red Banana	8-10 kg (local var); 10-15 kg (Nendran) 20-25 kg (Red banana)
Cassava (n=33)	Local variety	3-5 kg/plant
Rubber (n=18)	RRII 105, 106	15-20 sheets/day
Coconut (n=66)	Local variety	30-35 nuts/plant/harvest
Vegetables (n=79)	Amaranthus [Arun, krishnasree, CO1 (green)], Snake gourd (Kaumudi)Salad cucumber (Local)	1.5 t/ha – 5 t/ha
Rice (n=6)	Shreyas, Uma	3.2-3.5 t/ha
Pepper (n=15)	Karimunda, Panniyur1	0.5-1 kg/plant

It was found from the Table 2 that Banana, Vegetables such as amaranthus, snake gourd, cucumber, and coconut were the major cultivated crops in the study area. *Nendran*, *Rasakadali*, *Palayankodan* and Red banana were the most common banana varieties grown in the locale of the study. It was also found that red banana variety had the highest yield among the cultivated varieties and the major cultural operations followed for the crop includes weeding, desuckering, fertilizer application and irrigation. Major cultural operations followed for coconut includes fertilizer application, mulching and irrigation whereas major cultural operations in vegetable cultivation were fertilizer and pesticide application, weeding and irrigation.

The results presented in the Table 3 shows that there were positive treatment effects of agromet advisory services on almost all the operational decisions of banana cultivation except weed management. From the Table 4, it can be concluded that even though there was a positive treatment effect on almost all the operational decisions in banana cultivation, but, only the treatment effect on land preparation, date of seed sowing and scheduling of pesticide application were found significant at 1 per cent level of significance and treatment effect on storage and transportation were significant at 5 per cent level of significance.

This is because prior to planting banana, the ploughed land is kept for sundry as well as the rhizomes are sun dried before planting to prevent the plants from pest and disease. Hence most of the farmers reported that sunny days are good for land preparation and planting and thus farmers consider agromet advisory services for land preparation as well as planting the rhizomes in banana

Table 3: Average treatment impact of the Agromet Advisory Services (AAS) on the operational decision of the Banana cultivation

Particulars	Experimental group (n=60)		Control group (n=60)		Treatment
	Pre-test	Post-test	Pre-test	Post-test	effect
Land preparation	1.13	3.00	1.12	1.92	1.06
Selection of variety	1.13	1.18	1.12	1.12	0.05
Fixing seed rate	1.13	1.28	1.12	1.12	0.15
Date of seed showing	1.13	2.57	1.12	1.69	0.86
Cultural operation	1.13	2.58	1.12	2.00	0.57
Irrigation scheduling	1.20	2.57	1.46	1.77	1.06
Fertilizer application	1.27	1.60	1.15	1.15	0.33
Scheduling of pesticide and herbicide application	1.23	3.15	1.19	1.58	1.53
Weed management	1.13	1.13	1.12	1.19	-0.08
Harvesting	1.13	1.23	1.12	1.12	0.10
Storage and transportation	1.13	1.70	1.12	1.15	0.53
Overall effect	**1.33**	**1.92**	**1.12**	**1.69**	**0.01**

Table 4: Regression analysis on impact of the Agromet Advisory Services (AAS) on the operational decision of the Banana cultivation

Particulars	Constant	Δ	T	δT	R^2
Land preparation	1.12** (0.20)	0.02 (0.24)	0.81** (0.28)	1.06** (0.34)	0.42
Selection of variety	1.12** (0.07)	0.02 (0.08)	0.001 (0.09)	0.05 (0.12)	0.001
Fixing seed rate	1.12** (0.07)	0.02 (0.08)	0.001 (0.11)	0.15 (0.12)	0.03
Date of seed sowing	1.12** (0.17)	0.02 (0.21)	0.58* (0.25)	0.86** (0.29)	0.36
Cultural operation	1.12** (0.18)	0.02 (0.22)	0.88**(0.26)	0.56 (0.31)	0.35
Irrigation scheduling	1.46** (0.19)	-0.26 (0.31)	0.31 (0.27)	1.06 (0.32)	0.28
Fertilizer application	1.15** (0.16)	0.11 (0.19)	0.001 (0.23)	0.33 (0.27)	0.05
Scheduling of pesticide and herbicide application	1.19** (0.18)	0.04 (0.22)	0.38 (0.26)	1.53** (0.31)	0.49
Weed management	1.12** (0.07)	0.02 (0.08)	0.08 (0.10)	-0.08 (0.12)	0.001
Harvesting	1.12** (0.07)	0.02 (0.09)	0.001 (0.10)	0.10 (0.12)	0.02
Storage and transportation	1.12** (0.13)	0.02 (0.16)	0.04 (0.19)	0.53* (0.22)	0.14

Values in parenthesis indicates standard error; ** & * indicates significant at 1 percent and 5 percent level of significance, respectively. Δ- Treatment T- Time δT- Interaction effect

cultivation. As pest and diseases are the major reason behind the yield reduction in banana and because of the erratic rainfall in the region, farmers considered agromet advices significant for particularly these operations in banana cultivation.

The results in the Table 5 shows that there was a positive treatment effect of agromet advisory services on almost all the operational decisions of vegetable cultivation apart from weed management and selection of variety for which the treatment effects were found to be zero. From Table 6, it can be concluded that even though there was a positive treatment effect on almost all the operational decisions in vegetable cultivation, but, only treatment effect on land preparation, irrigation scheduling and scheduling of pesticide and herbicide application were significant at 1 percent level of significance and treatment effect on date of seed sowing as well as storage and transportation, were significant at 5 percent level of significance. Because of the highly unpredictable rain availability in the region,

Table 5: Average treatment impact of the Agromet Advisory Services (AAS) on the operational decision of the Vegetable cultivation

Particulars	Experimental group (n=60)		Control group (n=60)		Treatment
	Pre-test	Post-test	Pre-test	Post-test	effect
Land preparation	1.15	3.15	1.09	1.97	1.12
Selection of variety	1.15	1.15	1.09	1.09	0.00
Fixing seed rate	1.15	1.32	1.09	1.12	0.15
Date of seed showing	1.15	2.94	1.09	2.09	0.79
Cultural operation	1.15	2.91	1.09	2.03	0.82
Irrigation scheduling	1.15	2.94	1.50	2.06	1.24
Fertilizer application	1.26	1.56	1.26	1.21	0.35
Scheduling of pesticide and herbicide application	1.21	2.97	1.24	1.53	1.47
Weed management	1.15	1.15	1.09	1.09	0.00
Harvesting	1.15	1.24	1.09	1.12	0.06
Storage and transportation	1.15	1.88	1.09	1.09	0.74
Overall effect	**1.29**	**2.12**	**1.09**	**1.53**	**0.38**

Table 6: Regression analysis on impact of the Agromet Advisory Services (AAS) on the operational decision of the Vegetable cultivation

Particulars	Constant	Δ	T	δT	R^2
Land preparation	1.11** (0.13)	0.08 (0.20)	0.75** (0.18)	1.24** (0.28)	0.45
Selection of variety	1.06** (0.04)	0.08(0.06)	0.001 (0.06)	0.001(0.09)	0.01
Fixing seed rate	1.06** (0.05)	0.08 (0.08)	0.06 (0.07)	0.11 (0.11)	0.06
Date of seed sowing	1.06** (0.12)	0.08 (0.19)	0.91** (0.18)	0.88* (0.27)	0.42
Cultural operation	1.06** (0.12)	0.08 (0.19)	0.95**(0.17)	0.81* (0.27)	0.43
Irrigation scheduling	1.42** (0.13)	-0.27 (0.20)	0.53 (0.18)	1.26**(0.28)	0.34
Fertilizer application	1.24** (0.11)	0.02 (0.16)	0.001 (0.15)	0.29 (0.23)	0.03
Scheduling of pesticide and herbicide application	1.24** (0.13)	-0.04 (0.20)	0.33 (0.18)	1.43** (0.28)	0.38
Weed management	1.06** (0.04)	0.08 (0.07)	0.04 (0.06)	-0.04 (0.10)	0.01
Harvesting	1.06** (0.05)	0.08 (0.08)	0.06 (0.07)	0.02 (0.11)	0.03
Storage and transportation	1.06** (0.09)	0.08 (0.14)	0.06 (0.13)	0.66* (0.22)	0.20

Values in parenthesis indicates standard error; ** & * indicates significant at 1 percent and 5 percent level of significance, respectively. Δ- Treatment T- Time δT- Interaction effect

Table 7: Average treatment impact of the Agromet Advisory Services (AAS) on the operational decision of the Coconut cultivation

Particulars	Experimental group (n=60)		Control group (n=60)		Treatment
	Pre-test	Post-test	Pre-test	Post-test	effect
Land preparation	1.09	2.82	1.18	1.91	1.00
Cultural operation	1.09	2.61	1.18	2.23	0.48
Irrigation scheduling	1.25	2.59	1.23	2.32	0.25
Fertilizer application	1.30	1.66	1.18	1.32	0.32
Scheduling of pesticide and herbicide application	1.23	3.16	1.27	1.45	1.75
Weed management	1.09	1.09	1.18	1.27	-0.09
Harvesting	1.09	1.25	1.18	1.09	0.25
Storage and transportation	1.09	1.80	1.18	1.18	0.70
Overall effect	**1.32**	**1.98**	**1.18**	**1.55**	**0.30**

farmers followed agromet advices for scheduling of irrigation in vegetables. Farmers also considered agromet advices important for scheduling of pesticide and plant protection as well because of the erratic rains and frequent pest and disease infestations in vegetables.

Table 7 indicates that there were positive treatment effects of agromet advisory services on all the operational decisions of coconut cultivation except the weed management. From the Table 8, it is clearly evident that even though there was a positive treatment effect on almost all the operational decisions in coconut cultivation, but, the treatment effect of agromet advisory services were significant only on land preparation, fertilizer application and scheduling of pesticide and herbicide application at 1 percent level of significance. Drastic yield reduction in coconut is observed due to root wilt and other pest and disease incidence. Therefore, farmers were more concerned about the agromet advices related with land preparation, intercultural operations and plant protection measures.

CONCLUSION

Agromet advisory services were having a positive treatment effect on all most all the farm operations related for the cultivation of banana, vegetable and coconut. But, land

Table 8: Regression analysis on impact of the Agromet Advisory Services (AAS) on the operational decision of the Coconut cultivation

Particulars	Constant	Δ	T	δT	R^2
Land preparation	1.18** (0.21)	-0.09(0.26)	0.73* (0.29)	1.00** (0.36)	0.38
Cultural operation	1.18** (0.21)	-0.09 (0.24)	1.04**(0.28)	0.48 (0.34)	0.39
Irrigation scheduling	1.22** (0.21)	0.02(0.26)	1.09**(0.30)	0.25(0.37)	0.29
Fertilizer application	1.18** (0.21)	0.11 (0.23)	0.04(0.26)	1.32**(0.32)	0.05
Scheduling of pesticide and herbicide application	1.27** (0.21)	-0.04 (0.24)	0.18 (0.28)	1.75** (0.34)	0.48
Weed management	1.18** (0.07)	-0.09 (0.09)	0.09(0.10)	-0.09(0.12)	0.04
Harvesting	1.12** (0.07)	-0.09 (0.09)	-0.09 (0.11)	0.10 (0.12)	0.04
Storage and transportation	1.12** (0.13)	-0.09 (0.19)	0.001(0.23)	0.70(0.27)	0.15

Values in parenthesis indicates standard error; ** & * indicates significant at 1 percent and 5 per cent level of significance, respectively. Δ- Treatment T- Time ΔT- Interaction effect

preparation, seed sowing, irrigation scheduling, fertilizer application, and pesticide and herbicide spray scheduling in banana, vegetable, and coconut cultivation were having significant treatment effect. Hence, agromet advisory services may minimize the crop loss due to the extreme climatic events. At the same time, farmers can minimize the input cost by following the agromet advisory services particularly in irrigation, land preparation and crop protection measure. The study also highlighted the importance of regular training and awareness programmes to inform farmers about the importance and utility of agromet advisory services in managing various farm activities, as well as the need for an efficient mechanism to deliver block level agromet advisory services to farmers' door steps from the AMFU.

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Frequency of Use of Different ICT Tools by the Agricultural University Teachers

Vikas Kumar[1]*, I.M. Khan[2], S.S. Sisodia[3] and Ajit Kumar Ghoslya[1]
[1]Ph.D. Research Scholar, [2]Professor, Department of Extension Education, SKNAU, Jobner, Jaipur, Rajasthan
[3]Professor, Department of Extension Education, MPUAT, Udaipur, Rajasthan

ABSTRACT

The present 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 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, 60 per cent of teachers were selected from every college by using simple random sampling technique. Agricultural university teachers most frequently used mobile phone (99.79 MPS) which was ranked first, followed by internet (MPS 96.85) and e-mail (MPS 94.60). There is no significant difference between teachers of SKNAU Jobner, SKRAU Bikaner and MPUAT Udaipur with regard to frequency of use of different ICT tools.

Keywords: ICT tools, Frequency, Teachers and Agriculture University

INTRODUCTION

Information and Communication Technology (ICT) in education is the mode of education that use information and communications technology to support, enhance, and optimise the delivery of information. ICT is often associated with sophisticated technologies. But ICT also includes the conventional technologies, such as, radio, television and telephone. In today's networked society, the technology used is often blended, and we use multiple technologies simultaneously. We use satellite, internet and video conferencing facilities to connect with people who may be across different geographical locations. Through the application of ICT, one can diminish 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 & other people who are engaged in the application of information and communication technology in one way or the other (Aboh, 2008; Ann, 2013).

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 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 frequency of use of different ICT tools was measured on six point continuums, *viz.* every day, 2-3 times in a week, once in a week, once in a fort–night,

*Corresponding author email id: veer5agri@gmail.com

monthly and never with scores of 5, 4, 3, 2, 1 and 0, respectively. The mean per cent score (MPS) for a particular ICT tool was worked out and ranked accordingly.

Statistical analysis: After collecting the data from respondents the data were transferred to the work tables and tally sheets were prepared. The data were classified, analyzed and subjected to statistical analysis. The cross tables were prepared and the data were interpreted in light of the objectives of the study. 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

Table 1 indicate that agricultural university teachers most frequently used mobile phone (99.79 MPS) which was ranked first, followed by internet (MPS 96.85) and e-mail (MPS 94.60) which were ranked second and third respectively. The teachers were having least frequently used kindle (MPS 13.73) which was assigned rank last.

Data in Table 1 further indicate that regarding the university wise extent of frequency of use of ICT tools the agricultural university teachers the highest extent of frequency of use was found about mobile phone in all the agricultural universities i.e. MPUAT, Udaipur (MPS 100.00), SKRAU, Bikaner (MPS 100.00) and SKNAU, Jobner (MPS 99.38) and stood at first rank. The second most frequently used ICT tools by SKRAU, Bikaner (MPS 97.85), MPUAT, Udaipur (MPS 96.71 MPS) and in SKNAU, Jobner (MPS 96.00) was Internet which was assigned rank second. The least frequently used ICT tools in SKNAU, Jobner was digitizer (MPS 19.38), kindle in SKRAU, Bikaner (MPS 7.86) and analytical packages in MPUAT, Udaipur (MPS 10.61) which were assigned last rank in the use of ICT

Table 1: Frequency of use of ICT tools by the agriculture university teachers

S.No.	ICT Tools	SKNAU, Jobner (n_1=65)		SKRAU, Bikaner (n_2=28)		MPUAT, Udaipur (n_3=73)		Total (n=166)	
		MPS	Rank	MPS	Rank	MPS	Rank	MPS	Rank
1	Mobile phone	99.38	I	100	I	100	I	99.79	I
2	Desktop	90.15	IV	96.42	III	92.87	IV	93.15	IV
3	Laptop	72.61	VIII	84.28	VI	74.79	VII	77.23	VII
4	Tablet	26.46	XVI	26.42	XVII	15.06	XIX	22.64	XVII
5	Office tools								
I	MS Word	91.38	I	95.71	I	94.79	I	93.96	I
II	MS Excel	74.76	II	79.28	II	74.24	II	76.09	II
III	MS PowerPoint	69.53	III	72.85	III	66.57	III	69.65	III
Office tools average		**78.56**	**VI**	**82.61**	**VII**	**78.53**	**VI**	**79.90**	**VI**
6	Analytic packages								
I	SPSS	32.61	I	26.42	I	24.10	I	27.71	I
II	SAS	23.07	II	11.42	IV	10.95	II	15.15	II
III	STATA	12.00	III	14.28	II	4.10	III	10.13	III
IV	R	12.00	III	12.85	III	3.28	IV	09.38	IV
Analytic packages average		**19.92**	**XXI**	**16.24**	**XXI**	**10.61**	**XXI**	**15.59**	**XXI**
7	Internet	96.00	II	97.85	II	96.71	II	96.85	II
8	e-mail	93.84	III	95.71	IV	94.24	III	94.60	III
9	Storage devices								
I	Video CD	38.46	III	37.14	IV	34.52	III	36.70	III
II	DVD	38.46	III	40.00	III	30.41	IV	36.29	IV
III	Pen drive	87.07	I	81.42	I	88.76	I	85.75	I
IV	Hard drive	64.61	II	58.57	II	66.02	II	63.07	II

Table 1 contd...

S.No.	ICT Tools	SKNAU, Jobner (n_1=65)		SKRAU, Bikaner (n_2=28)		MPUAT, Udaipur (n_3=73)		Total (n=166)	
		MPS	**Rank**	**MPS**	**Rank**	**MPS**	**Rank**	**MPS**	**Rank**
Storage devices average		**57.15**	**XIII**	**54.28**	**X**	**54.93**	**XIII**	**55.45**	**XII**
10	e-Books	59.69	XI	53.57	XI	61.36	X	58.21	X
11	e-journals	58.15	XII	52.14	XII	60.54	XI	56.94	XI
12	e-agricultural Magazines	54.46	XIV	49.28	XIII	50.68	XIV	51.47	XIV
13	Kindle	21.84	XIX	7.86	XXII	11.50	XX	13.73	XXII
14	Web based search engine	73.53	VII	61.42	IX	73.97	VIII	69.64	IX
15	Web-based Agriculture Information portals	63.07	X	45.00	XIV	56.16	XII	54.74	XIII
16	Multimedia projectors	46.76	XV	40.71	XV	48.76	XV	45.41	XV
17	Printer	85.23	V	92.85	V	87.67	V	88.58	V
18	Scanner	69.23	IX	73.57	VIII	72.87	IX	71.89	VIII
19	e- Podium	26.15	XVII	34.28	XVI	27.94	XVI	29.46	XVI
20	Digitizer	19.38	XXII	23.57	XVIII	18.35	XVII	20.43	XVIII
21	Visualiser	20.30	XX	19.28	XIX	18.08	XVIII	19.22	XIX
22	Video-conferencing	23.38	XVIII	17.85	XX	15.06	XIX	18.76	XX
	Overall MPS	**54.79**		**53.40**		**52.48**		**53.55**	

Table 2: Analysis of variance of frequency of use ICT by the teachers of selected agriculture universities

S. No.	Source of variation	d.f	S.S	M.S.S	"F" cal
1	**Between the universities** (SKNAU Jobner, SKRAU Bikaner and MPUAT Udaipur)	2	412.7271	206.3636	0.436 NS
2	**Error**	163	77168.9837	473.4293	
	Total	165	77581.7108		

NS= Non significant

tools in the respective universities These findings were partially supported by the reports of Sharma (2017) and Malik *et al.* (2021).

The analysis of variance test was applied to see the significant difference in relation to frequency of use of ICT tools by the teachers of selected agriculture universities i.e. SKNAU Jobner, SKRAU Bikaner and MPUAT Udaipur. The results are presented in Table 2.

Hypotheses:

H_0: There is a no significant difference between teachers of SKNAU, Jobner, SKRAU, Bikaner and MPUAT, Udaipur with respect to their frequency of use of ICT tools.

H_1: There is a significant difference between teachers of SKNAU, Jobner, SKRAU, Bikaner and MPUAT, Udaipur with respect to their frequency of use of ICT tools

Table 2 reveals that the calculated 'F' value is (0.436) which is lower than the tabulated value at 5 per cent level of significance and 2 degree of freedom. Thus, the null hypothesis (N_0) entitled "There is no significant difference between teachers of SKNAU, Jobner, SKRAU, Bikaner and MPUAT, Udaipur with respect to their frequency of use of ICT tools was accepted and research hypothesis (H_1) was rejected. It infers that there is no significant difference between teachers of SKNAU Jobner, SKRAU Bikaner and MPUAT Udaipur with regard to frequency of use of different ICT tools.

CONCLUSION

University wise extent of frequency of use of ICT tools the agricultural university teachers the highest extent of frequency of use was found about mobile phone in all the agricultural universities i.e. MPUAT, Udaipur (MPS 100.00), SKRAU, Bikaner (MPS 100.00) and SKNAU, Jobner (MPS 99.38).

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Genetic Divergence Studies in Turnip (*Brassica rapa* var. *rapifera* L.)

Mir Tabasum Ashraf[1]*, Shahnaz Mufti[1], K. Hussain[1] and Z.A. Dar[2]
[1]Division of Vegetable Science, [2]Division of Genetics and Plant Breeding, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar-190025, J&K

ABSTRACT

The present investigation was carried out at Vegetable Experimental Field, SKAUST-K, Shalimar during *rabi* 2019. The experiment was carried out in Randomized complete block design (RCBD) with three replications. Twenty-eight turnip genotypes were used during the study. The genotypes were grouped into five clusters. Cluster I had maximum number of genotypes (17), followed by cluster II with six genotypes, cluster III with three genotypes and Cluster IV and V with one genotype each. Maximum intra-cluster distance was recorded in cluster II (179.19) followed by cluster III (177.92). Maximum inter-cluster distance was observed between cluster IV and V (1518.63) followed by inter-cluster distance between cluster III and V (996.20). Maximum contribution towards total divergence was shown by total root weight (33.86%) followed by leaf area (26.23%) and anthocyanin content (18.78%).

Keywords: Clusters, Divergence, Genotypes

INTRODUCTION

Turnip (*Brassica rapa* var. *rapifera* L.) (2n=2x=20) is an important food crop which is a biennial root vegetable cultivated worldwide as vegetable and fodder (Rakow, 2004; Hammer *et al*., 2013). It belongs to family Brassicaceae (mustard family). The scientific classification for the plant is either *Brassica rapa* or *Brassica campestris*. It is an important crop adapted to wide agricultural variations worldwide and displays massive morphological diversity in the organ used for consumption. It is an important winter vegetable grown for its fleshy edible roots, which are eaten as raw, salad, pickled, or cooked as vegetable.

The genetic variability is of prime importance in identifying best genotypes for making rapid progress in desirable traits as well as for selecting most potential diverse parents for further breeding programs. Genetic variability studies reveal the variation present in different quantitative and quality parameters. This variation may be due to genetic factors, environmental factors, mutation agents or may be due to attack of any biological agents. Also genetic variability is a basic requirement for crop improvement as it provides wider scope for selection, for initiating an effective breeding program. Thus, it becomes imperative to study the level of genetic variability available and effectiveness of selection is dependent upon the magnitude of genetic variability present in the germplasm and the extent to which it is heritable. Genetic divergence analysis among genotypes is helpful to screen the genetically diverse parents that are likely to produce high heterotic effects among crosses and also generate large spectrum of variability during segregation and recombination of genes at heterozygous polygenic blocks.

MATERIAL AND METHODS

The present investigation was carried out at Vegetable Experimental field, SKAUST-K, Shalimar during *rabi* 2019. The site of experimental field is located at an altitude of 1685 meters above mean sea level and situated at 34°N latitude and 74.89° E longitude. The climate of the site is temperate characterized by mild summers. The mean maximum and minimum temperatures are recorded in June-July and January-February (respectively). Twenty-eight genotypes of turnip were evaluated for various quantitative and quality traits. The experiment was carried out in Randomized block design with three replications for each genotype. The crop was sown at a spacing of 30 cm row to row distance and 15cm plant to plant distance. The crop was grown according to recommended package of practices. The observations were recorded for traits viz.,

*Corresponding author email id: mirtabassum123@gmail.com

seedling length, seedling fresh weight, seedling dry weight, leaf length, leaf breadth, petiole length, root length, root breadth, plant length, leaves/plant, total plant weight, total root weight, total shoot weight, root shoot ratio, root compactness, harvest index, root yield/ha, plant spread, leaf area, total dry matter, total soluble solids, vitamin C, anthocyanin content, total sugars, reducing and non-reducing sugars. The data recorded on these 26 traits was subjected to cluster analysis using Mahalanobis D^2 statistic. The genotypes were grouped into different clusters by tocher's method (Rao, 1952).

RESULTS AND DISCUSSION

In the present investigation, twenty-eight turnip genotypes were evaluated to estimate the genetic divergence using Mahalanobis D^2 statistics in order to identify the potential genotypes hat could be used as parents in future breeding programmes. D^2 statistics grouped the genotypes into five clusters. Maximum number of genotypes were observed in cluster I (17 genotypes) followed by cluster II (6 genotypes), cluster III with (3 genotypes) and cluster IV and V with one genotype each (Table 1 and Figure 1). Intra-cluster distance (D^2) was recorded maximum in cluster II (179.19) followed by cluster III (177.92) and cluster I (165.53). Maximum intercluster distance was observed between cluster IV and V (1518.63) followed by cluster III and cluster V (996.20), cluster I and IV (835.67) and cluster II and V (724.52) (Table 2 and Figure 2). The maximum intracluster distance (cluster II) depicts the higher heterogenity in the genetic constitution of genotypes in this cluster while as minimum value (cluster I) indicates the homogenity in the genetic constitution of the genotype in this cluster. High value of inter cluster distance (cluster IV and V) reveals that the genotypes in these clusters are more diverse with each other while as minimum value (cluster II and IV) depicts that the genotypes in these clusters are more similar with each other. This was in conformity with the findings of Qureshi *et al.* (2009); Singh and Ahmed (2010); Kumar *et al.* (2012); Naseeruddin *et al.* (2014).

The percent contribution (Table 3) of traits towards total divergence revealed that the trait viz., total root weight was the main contributing trait, accounting for about 33.86 per cent followed by leaf area (26.23%), anthocyanin content (18.78%), root yield/ha (3.6%), vitamin C (2.91%), total soluble solids (2.38%), seedling dry weight (2.12), non-reducing sugars (1.85%), total sugars (1.32%) and plant spread (1.06%).

The traits contributing maximum towards total divergence should be given preference while selection and during selection the genotypes should be selected from those clusters which showed maximum/minimum cluster mean for that respective trait on which selection is based. An insight into the results representing cluster means (Table 4) for different characters depicted that minimum cluster mean for seedling length (21.17), seedling fresh weight

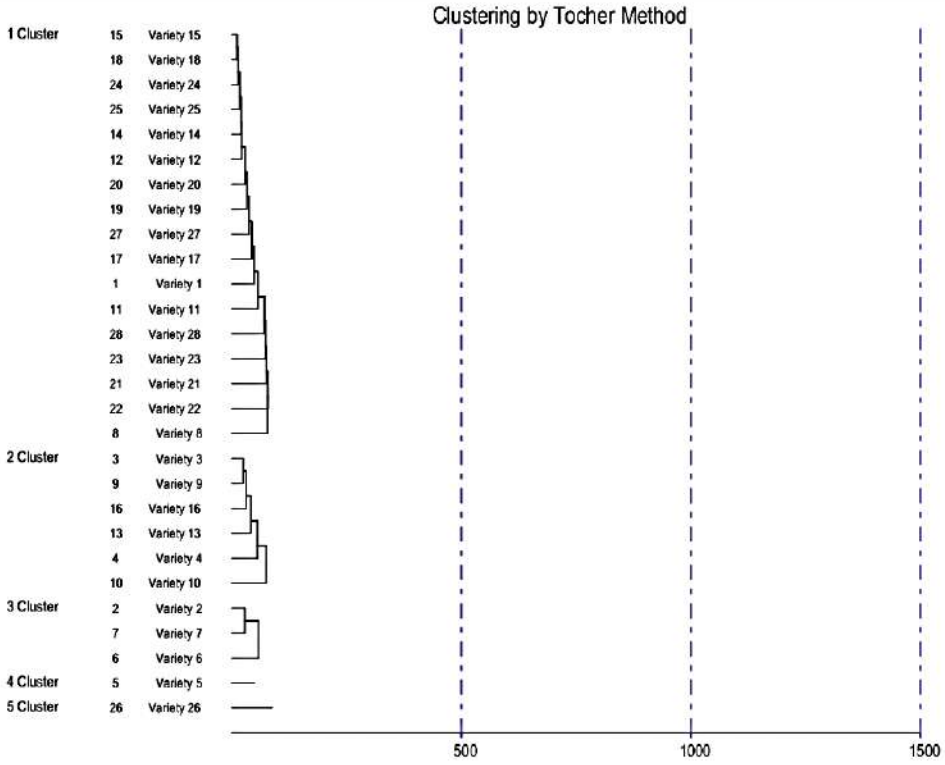
Table 1: Distribution of turnip (*Brassica rapa* var. *rapifera* L.) genotypes in different clusters based on D^2 statistics

Cluster No.	No. of genotypes	Genotypes
I	17	SKAU-T-13, SKAU-T-16, SKAU-T-22, SKAU-T-23, SKAU-T-12, SKAU-T- 11, SKAU-T-18, SKAU-T-17, SKAU-T-25, SKAU-T-15, SKAU-T-1, SKAU-T-10, SKAU-T-26, SKAU-T-21, SKAU-T-19, SKAU-T-20, SKAU-T-7
II	6	SKAU-T-3, SKAU-T-8, SKAU-T-14, PTWG, SKAU-T-4, SKAU-T-9
III	3	SKAU-T-2, SKAU-T-6, SKAU-T-5
IV	1	Nageen
V	1	SKAU-T-24

Table 2: Average intra cluster (Diagonal) and inter cluster (above diagonal) distance values in turnip (*Brassica rapa* var. *rapifera* L.).

S.No.	Cluster	I	II	III	IV	V
1	I	**165.53**	384.72	371.49	835.67	366.48
2	II		**179.19**	465.39	309.91	724.52
3	III			**177.92**	537.07	996.20
4	IV				**0.00**	1518.63
5	V					**0.00**

Figure 1: Clustering by Tocher method (Dendrogram)



S.No.	Genotype	S.No.	Genotype	S.No.	Genotype	S.No.	Genotypes
1	SKAU-T-1	8	SKAU-T-7	15	SKAU-T-13	22	SKAU-T-20
2	SKAU-T-2	9	SKAU-T-8	16	SKAU-T-14	23	SKAU-T-21
3	SKAU-T-3	10	SKAU-T-9	17	SKAU-T-15	24	SKAU-T-22
4	SKAU-T-4	11	SKAU-T-10	18	SKAU-T-16	25	SKAU-T-23
5	Nageen	12	SKAU-T-11	19	SKAU-T-17	26	SKAU-T-24
6	SKAU-T-5	13	PTWG	20	SKAU-T-18	27	SKAU-T-25
7	SKAU-T-6	14	SKAU-T-12	21	SKAU-T-19	28	SKAU-T-26

Table 3: Per cent contribution of twenty six characters towards total genetic divergence in Turnip (*Brassica rapa* var. *rapifera* L.).

S.No.	Characters	Contribution (%)
1	Seedling length (cm)	0.4
2	Seedling fresh weight (g)	0.21
3	Seedling dry weight (g)	2.12
4	Leaf length (cm)	0.13
5	Leaf breadth (cm)	1.26
6	Petiole length (cm)	0.13
7	Root length (cm)	0.08
8	Root breadth (cm)	0.79
9	Plant length (cm)	0.62
10	Leaves/plant	0.06
11	Total plant weight (g)	0.79
12	Total root weight (g)	33.86
13	Total shoot weight (g)	0.12

Table 3 contd...

S.No.	Characters	Contribution (%)
14	Root shoot ratio	0.17
15	Root compactness	0.31
16	Harvest Index (%)	0.26
17	Root yield (q/ha)	3.6
18	Plant spread (cm)	1.06
19	Leaf area (cm^2)	26.23
20	Total dry matter (%)	0.03
21	Total soluble solids (°Brix)	2.38
22	Vitamin C (mg/100g)	2.91
23	Anthocyanin content (mg/100g)	18.78
24	Total sugars (%)	1.32
25	Reducing Sugar (%)	0.53
26	Non-reducing Sugars (%)	1.85
	Total	**100.00**

Table 4: Cluster means for various characters in Turnip ((*Brassica rapa* var. *rapifera* L.).

S.No.	Parameter	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V
1	Seedling length (cm)	23.22	21.55	21.31	21.17	27.23
2	Seedling fresh weight (g)	4.61	3.89	3.69	3.10	5.71
3	Seedling dry weight (g)	0.53	0.45	0.33	0.30	0.71
4	Leaf length (cm)	20.17	22.14	22.37	24.43	18.70
5	Leaf breadth (cm)	11.64	11.83	12.52	16.30	10.70
6	Petiole length (cm)	13.77	12.98	12.65	14.80	15.13
7	Root length (cm)	5.18	5.18	5.31	5.60	5.20
8	Root breadth (cm)	6.05	7.31	7.23	7.10	5.23
9	Plant length (cm)	51.51	54.87	51.00	52.97	53.00
10	Leaves/plant	9.86	9.83	10.33	9.00	8.67
11	Total plant weight (g)	158.08	245.50	184.56	295.00	135.00
12	Total root weight (g)	122.45	193.42	139.33	235.33	103.67
13	Total shoot weight (g)	38.27	55.47	44.78	56.00	31.33
14	Root shoot Ratio	3.24	3.53	3.11	4.17	3.64
15	Root compactness	68.71	79.41	58.22	91.47	374.77
16	Harvest Index (%)	76.60	78.12	75.34	79.01	76.77
17	Root Yield (q/ha)	245.10	386.83	278.67	470.67	207.33
18	Plant spread (cm)	51.86	50.26	53.18	50.47	59.47
19	Leaf area (cm^2)	219.64	218.73	271.17	262.33	188.20
20	Total dry matter (%)	11.89	12.18	10.33	8.64	12.73
21	Total soluble solids(°Brix)	5.40	5.02	5.69	5.47	5.20
22	Vitamin C (mg/100g)	26.43	25.00	22.44	25.33	22.00
23	Anthocyanin Content(mg/100g)	3.00	2.43	2.38	1.73	5.96
24	Total sugars (%)	2.60	2.70	2.31	2.36	3.91
25	Reducing Sugars (%)	1.91	2.05	1.69	1.54	2.43
26	Non-reducing Sugars (%)	0.69	0.66	0.61	0.82	1.49

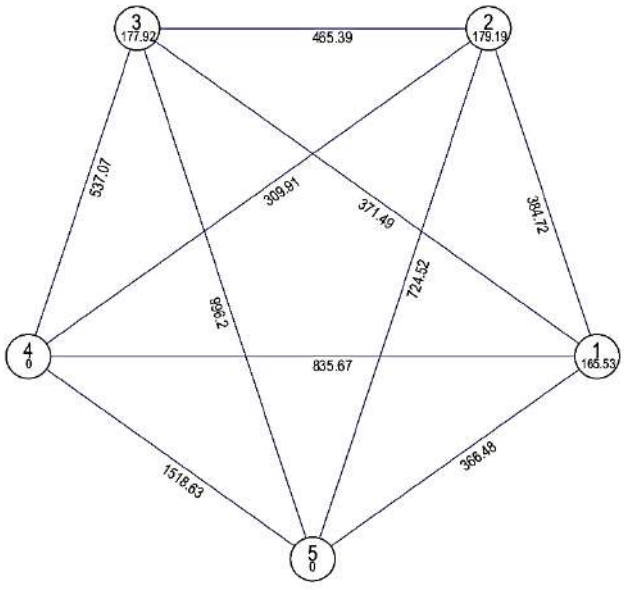


Figure 2: Mahalanobis Euclidean distance (Not to the scale)

(3.10), seedling dry weight (0.30) were recorded in cluster IV, maximum cluster mean for leaf length (24.43), leaf breadth (16.30), petiole length (14.80), root length (5.60), total plant weight (295), total root weight (235.33), total shoot weight (56.00), root shoot ratio (4.17), root compactness (91.47), harvest index (79.01), root yield/ha (470.67) were recorded in cluster IV while as for root breadth (7.31) in cluster II and for plant spread (59.47), total dry matter (12.73), anthocyanin content (5.96), total sugars (3.91), reducing sugars (2.43) and non-reducing sugars (1.49) in cluster V and for leaf area (271.17) and total soluble solids (5.69) in cluster III.

Hence, it was concluded from the present study that there is a great variation present in the genotypes which form a potential base for improvement as well as hybrid development in future breeding programmes. Genotypes to be used as parents in future hybridization programmes

should be selected from diverse clusters showing maximum inter cluster distance and these parents (genotypes) should have high *per se* performance for the traits contributing maximum towards divergence. Clusters having only one genotype with specific traits could be used for getting higher heterosis in hybridization programme mainly as tester for expression of maximum heterosis.

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Usage of Digital Tools and Techniques by Students of Agricultural Universities

Nabanita Das[1], Chandan Kumar Panda[1]*, Anil Paswan[1], Meera Kumari[2], Suborna Roy Choudhury[3] and R.K. Sohane[4]

[1]Department of Extension Education, [2]Department of Agricultural Economics, [3]Department of Agronomy, [4]Director Extension Education, Bihar Agricultural University, Sabour, Bhagalpur-813210, Bihar

ABSTRACT

Usage of digital learning was gaining popularity for last one decade due to development of science and technology. However, in the wake of the Covid-19 pandemic, it becomes mandatory to conduct online classes for the students to continue their academic curriculum. Besides the institutional curriculum, now students are also interested in extra online courses. The current study was taken in Agricultural universities. The purpose of the study was to study the different digital tools' use patterns by the students. For this research, two universities, namely Bihar Agricultural University, Sabour and Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, were purposefully selected, and from each college, 60 students were randomly selected. Total of 120 students was chosen from both colleges. The study results depict that the majority (98.3%) of the students had smartphone followed by 65.0 per cent students had laptops. The tools used by the students of both the university are found indifferent from each other, whereas the difference was found in the use of applications used for virtual classroom and content collection. The findings of the study also showed that time spent by the students in digital learning was positively and significantly correlated with their academic performance

Keywords: Agricultural universities, Digital devices, Digital learning, Online class, Social media

INTRODUCTION

We are in digital era, where we give importance to digital tools and technologies to rule our lives and education was not an exception here. Students can get its full benefit in their education as well as their career growth. When students perceived that courses were supportive for their learning, they are more likely to be satisfied with the online course (Lee *et al.,* 2011). Among the online applications Zoom was frequently used for an online class at the time of the COVID-19 pandemic (Nambiar, 2020). Digital devices are physical equipment that utilizes discrete, numerical data and processes it for all its operations. Report of the study found that, the vast majority of respondents owned smartphones and televisions followed by laptop (Bhatt and Upadhay, 2020). Significant advantages of utilization of digital devices are social connectivity, information storage, speeding up communication, low cost, entertainment, and generation of learning opportunities (Doddamani and Sisodia, 2020). In the present era, most university students have diversified social media community groups like Whatsapp, Facebook pages following different academic web pages to upgrade their knowledge (Ansari and Khan, 2020). Before the current scenario, a traditional method was used in which the teacher guided students directly in the classroom. The traditional environment was rapidly changing, the transition to digital education, the use of the internet, and technology was becoming a requirement in the classroom. It allows students to learn outside of the classroom and gain access to a wealth of information by using digital technology. It was self-evident that learners no longer rely on written content. The students born after the year 2000 popularly known as millennials has experienced digital ways of living since their birth (Bhushan *et al.,* 2021). They prefer a learner-centric approach because it focuses on what they want to learn, when they want to learn it, and how they want to learn it. Inspite of the benefits that will accrue to students when e-

*Corresponding author email id: dr.ckpanda@gmail.com

learning was incorporated into teaching and learning at university level, there are certain challenges that need to addressed upfront by the University administration (Tamta, 2015). In viewing the above concept current study taken over with particular objective "A Comparative Study on Usage of Digital Tools and Techniques by the Agricultural Students in Agricultural Programme".

MATERIALS AND METHODS

The current study was taken over in Bihar Agricultural University, Sabour and Bidhan Chandra Krishi Viswavidyalaya, Mohanpur. These two academic institutions are renowned agricultural universities in eastern India. Sixty students were selected randomly from each university for the study, where 30 students were from Under Graduate (UG), 20 students from Post Graduate (PG) and 10 students from PhD. Over all 120 students were selected from both the universities. Questionnaire was developed for data collection and it included both, closed-ended as well as open-ended questions. Student's personal profile data were collected in terms of gender, academic programme, academic performances, and digital inventories they had and used. The responses of the respondents regarding the tools and techniques used for digital learning by the students was collected in 5-point Likert Scale (1932) i.e. to very frequent, frequent, sometimes, rarely and never. The gathered data was collected, tabulated, analysed and interference were made in accordance with objective. Considering the importance of the factors selected to the studied with reference to the objective of the present study mentioned was earlier, the null hypothesis and also alternate hypothesis also formulated for the study have been stated below:

H_0: There was no difference between usage of tools for digital learning by the respondents

H_1: There was significant difference between usage of tools for digital learning by the respondents

H_2: There was no difference between usage of application for virtual classroom by the respondents

H_3: There was significant difference between usage of application for virtual classroom by the respondents

H_4: There was no difference between usage of applications for content collection by the respondents

H_5: There was significant difference between usage of applications for content collection by the respondents

H_6: There was no difference between source of data/ internet used by respondents

H_7: There was significant difference between source of data/internet used by respondents

H_8: There was no difference between time spends in digital learning by the respondents

H_9: There was significant difference between time spends in digital learning by the respondents

H_{10}: There was no difference between perception on social media in digital learning by the respondents

H_{11}: There was significant difference between perception on social media in digital learning by the respondents

H_{12}: There was no difference between perception on friendliness in use of digital learning tools and techniques by the respondents

H_{13}: There was significant difference between perception on friendliness in use of digital learning tools and techniques by the respondents

H_{14}: There was no difference between training need on digital learning by the respondents

H_{15}: There was significant difference between training need on digital learning by the respondents

H_{16}: There was no difference between responses about digital learning tool's performance during digital learning by the respondents

H_{17}: There was significant difference between responses about digital learning tool's performance during digital learning by the respondents

RESULTS AND DISCUSSION

Table 1 shows that majority of the overall respondents were female (51.7%) followed by male (48.3%). The same trend shows in both the universities with majority of the respondents are female with 53.3 per cent and 48.3 per cent from BAU and BCKV respectively. The perusal of the table also indicates that more than half (55.0%) of over all students were fall in between 7.1 to 8.5 OGPA category, which was 66 students. It was also found that 60.0 per cent students of BAU fall under between 7.1 to 8.5 OGPA category. Likewise, in BCKV majority 62.7 per cent students were in between 8.6 to 9.9 OGPA. In case of access to smartphones there have not much difference amongst students of different universities. Access to laptop was more among students of BAU (68.3%) As compared

Table 1: Distribution of student according to their personal profile

S.No.		BAU, Sabour (n_1=60)		BCKV, Mohanpur (n_2=60)		Overall (n=120)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Gender							
1	Female	32	53.3	29	48.3	62	51.7
2	Male	28	46.7	31	51.7	58	48.3
Academic programme							
1	UG	30	50	30	50	60	50
2	PG	20	33.3	20	33.3	40	33.3
3	PhD	10	16.7	10	16.7	20	16.7
Academic Performance in OGPA							
1	5.5-7.0	7	11.7	0	0	6	5.0
2	7.1-8.5	36	60.0	22	37.3	66	55.0
3	8.6-9.9	17	28.7	38	62.7	48	45.0
Digital inventories*							
1	Smartphone	58	96.7	60	100.0	118	98.3
2	Laptop	41	68.3	36	60.0	78	65.0
3	Tablet	6	10.0	4	6.7	10	8.3
4	Desktop	3	5.0	2	7.0	5	4.2
5	TV	13	21.66	23	38.33	36	30.0

*Multiple responses

to BCKV (60.00%). Although overall access to tablet and desktop was low, but comparatively students of BAU had better access (10.00% and 5.00% respectively) followed by students of BCKV (6.7% and 7.00% respectively). Comparatively, students have better access to TV, where 13(21.66%) students of BAU and 23(38.33%) students agreed.

It was found that the majority of the students use 'smartphone' for digital learning with weighted mean 3.52 and ranked 1st followed by 'laptop' ranked 2nd with weighted mean 2.3. In university wise comparison it was also found that the majority of the students of both universities used 'Smartphone' for digital learning with weighted mean 3.71 and 3.33 for BAU, Sabour and BCKV, Mohanpur respectively and ranked 1st followed by 'Laptop' ranked 2nd with weighted mean 2.42 and 2.18 for BAU, Sabour and BCKV, Mohanpur respectively. The use of 'Desktop' ranked 3rd in BAU with weighted mean 1.28 and ranked 4th in BCKV with weighted mean 0.98. The use 'Tablet' ranked 4th in BAU with 1.23 and ranked 5th in BCKV with weighted mean 0.97 and lastly 'TV' ranked 5th in BAU with weighted mean 1.08 and ranked 3rd in BCKV with weighted mean 1.18. (Table 2).

It was found that majority of the students used 'Google meet' for virtual classroom with weighted mean 2.56 and rank 1st. 'Cisco webex' user ranked 2nd with weighted mean 2.30. It also revealed that in comparison of both universities' Cisco Webex' ranked 1st by the

Table 2: Ranks on tools used for digital learning

S.No.	Name of the tools	BAU, Sabour (n_1= 60)		BCKV, Mohanpur (n_2= 60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Smartphone	3.71	I	3.33	I	3.52	I
2	Laptop	2.41	II	2.18	II	2.3	II
3	Desktop	1.28	III	0.98	IV	1.03	V
4	Tablet	1.23	IV	0.97	V	1.1	IV
5	TV	1.08	V	1.18	III	1.13	III

WM= Weighted Mean

Table 3: Ranks on students' usage of application for virtual classroom

S.No.	Name of applications	BAU, Sabour (n_1=60)		BCKV, Mohanpur (n_2=60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Zoom Cloud Meeting	2.51	II	1.93	II	2.25	III
2	Cisco Webex	3.26	I	1.35	IV	2.30	II
3	Google Meet	2.16	III	2.97	I	2.56	I
4	Google Duo	1.36	VI	1.41	III	1.39	IV
5	Whatsapp Video Call	1.5	V	1.06	V	1.28	VI
6	Google Classroom	1.51	IV	1.2	VI	1.35	V

WM= Weighted Mean

students of BAU with weighted mean 3.26, whereas, Google meet ranked 1st in case of students of BCKV with weighted mean 2.97. Second rank (2nd) rank occupied by 'Zoom Cloud Meeting' in use of both university students with weighted mean of 2.51 and 1.93 respectively by BAU and BCKV. Third rand (3rd) rank taken by 'Google meet' with weighted mean 1.36 in BAU whereas in BCKV it was 'Google Duo' with weighted mean 1.41. It was also found that 4th rank was taken by 'Google classroom' with weighted mean 1.51 in BAU whereas in BCKV it was taken by 'Cisco Webex' with weighted mean 1.35. 'Whatsapp video call' ranked 5th with weighted mean 1.5 in BAU and 'Google classroom' ranked 5th with weighted mean 1.35 in BCKV. At last 6th ranked taken by 'Google Duo' with weighted mean 1.36 in BAU and 'Whatsapp video call' got 6th rank with weighted mean 1.28 in BCKV. (Table 3)

It was found that majority of the students of both the universities use 'YouTube' for content collection, hence YouTube ranked 1st with weighted mean 2.87. 'e-course' ranked 2nd with weighted mean 2.47. With the comparison of both the universities in relation to their application used for content collection it was shown that 'YouTube' ranked 1st as most used application for content learning with weighted mean of 3.13 and 2.61 for BAU and BCKV respectively. Same way 'e-course' ranked 2nd in both the universities with weighted mean of 2.7 and 2.25 for BAU and BCKV respectively, along with 'e-course', 'Research Gate' also ranked 2nd with same weighted mean 2.25 in BCKV. 'Web portals' ranked 3rd with weighted mean 2.68 in BAU and it ranked 4th with weighted mean 2.1 of in BCKV. 'Online books' ranked 4th with weighted mean of 2.55 in BAU and it ranked 3rd with weighted mean 2.12 in BCKV. 'Research gate' ranked 5th with weighted mean 2.48 in BAU. 'Quora' ranked 6th by students of BAU with weighted mean 2.0 and it ranked 5th with weighted mean 1.78 in BCKV. 'Blogging' ranked 7th with weighted mean of 1.68 in BAU and in BCKV it ranked 6th with weighted mean of 1.43. At last, 'Facebook' ranked 8th with weighted mean 1.57 in BAU and in BCKV it ranked 7th with weighted mean 1.36. (Table 4).

Majority of the overall students use personal data for digital learning ranked 1st with weighted mean 3.51. Next College Wi-fi' ranked 2nd with weighted mean 1.52. The

Table 4: Ranks on students' perception in their applications used for content collection

S.No.	Name of applications	BAU, Sabour (n_1=60)		BCKV, Mohanpur (n_2=60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	YouTube	3.13	I	2.61	I	2.87	I
2	Blogging	1.68	VII	1.43	VI	1.56	VII
3	Web-portals	2.68	III	2.10	IV	2.39	III
4	Quora	2.00	VI	1.78	V	1.89	VI
5	Facebook	1.57	VIII	1.36	VII	1.46	VIII
6	e-Course	2.70	II	2.25	II	2.47	II
7	Research Gate	2.48	V	2.25	II	2.17	V
8	Online Books	2.55	IV	2.12	III	2.33	IV

WM= Weighted Mean

Table 5: Ranks on students' source of data/ internet

S.No.	Name of source	BAU, Sabour (n_1=60)		BCKV, Mohanpur (n_2=60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Personal data	3.7	I	3.36	I	3.51	I
2	College Wifi	2.08	II	1.43	II	1.52	II
3	Internet cafe	1.05	IV	1	IV	1.02	IV
4	Hostel wifi	1.08	III	1.3	III	1.19	III

WM= Weighted Mean

comparison of university wise data revealed that students of both the universities use 'Personal data' for digital learning, hence ranked 1st with weighted mean 3.7 and 3.36 for BAU and BCKV respectively. 'College Wifi' ranked 2nd with weighted mean 2.08 and 1.43 for BAU and BCKV respectively. 'Hostel Wi-fi' ranked 3rd with weighted mean of 1.08 and 1.3 for BAU and BCKV respectively. 'Internet Cafe' ranked 4th with weighted mean 1.05 and 1 for BAU and BCKV. (Table 5)

From the Table 6 it was found that majority (65%) students of overall students spend 1 to 4 hours per day in digital learning, followed by (22.5%) students spend more than 4 to 7 hours/day in digital learning. The rest 12.5% students spend more than 7 to 10 hours/day in digital learning. It was also revealed that in university wise comparison it showed 73.4 per cent students of BAU spend 1 to 4 hours/day in digital learning, whereas 80% students of BCKV spend 1 to 4 hours/day in digital learning. Also 18.3 per cent students from BAU and 16.7 per cent students from BCKV spend more than 4 to 7 hours/day in digital learning. The rest 8.3 per cent students of BAU and 3.3 per cent % students of BCKV spend more than 7 to 10 hours/day in digital learning (Table 6).

Table 7 revealed that majority of the respondents of the universities agreed that social media provide better connectivity with learning groups, with weighted mean 4 it ranked 1st. In comparison to both the universities, students agreed to 'better connectivity with learning groups' ranked 1st in BAU and BCKV with weighted mean 4.18 and 3.81 respectively. Most of the students of both the universities agreed that social media fasten the diffusion of information and ranked 2nd in both universities with weighted mean 3.9 and 3.67 for BAU and BCKV respectively. The 3rd rank was same for both universities for ease of communication with instructors with weighted mean 3.88 and 3.5 for BAU and BCKV respectively.

The perusal of Table 8 revealed that most of the overall students agreed that digital learning tools are useful

Table 6: Ranks on students' time spends in digital learning usage

S.No.	Time (hours/day)	BAU, Sabour (n_1=60)		BCKV, Mohanpur (n_2=60)		Overall (n=120)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	1 to 4	44	73.4	48	80.0	78	65
2	>4 to 7	11	18.3	10	16.7	27	22.5
3	>7 to 10	5	8.3	2	3.3	15	12.5

Table 7: Ranks on students' perception on usage of social media in digital learning

S. No.	Perception on social media	BAU, Sabour (n_1= 60)		BCKV, Mohanpur (n_2= 60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Providing real time data	3.36	V	3.27	IV	3.31	V
2	Faster diffusion of information	3.90	II	3.67	II	3.78	II
3	Connectivity with the learning groups	4.18	I	3.81	I	4.00	I
4	Ease of communication	3.88	III	3.5	III	3.69	III
5	Ease of building social credibility	3.60	IV	3.25	V	3.42	IV

WM= Weighted Mean

Table 8: Ranks on students' friendliness in usage of digital learning tools and techniques

S. No.	Friendliness in usage of digital learning tools and techniques	BAU, Sabour (n_1= 60)		BCKV, Mohanpur (n_2= 60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Increases in efficiency.	3.67	IV	3.40	V	3.53	IV
2	Ease to track the weekly task	3.77	III	3.83	I	3.57	III
3	Improves teacher-learner interaction	2.95	VII	3.33	VI	2.88	VII
4	Better concept building	3.55	VI	3.50	III	3.52	V
5	Useful for part time students	4.03	I	3.56	II	3.80	I
6	Hinders practical knowledge	3.97	II	3.46	IV	3.73	II
7	Helping student to update knowledge	3.58	V	3.36	V	3.47	VI

WM= Weighted Mean

for part time students, it ranked 1st with weighted mean 3.8. Subsequently students agreed that digital learning hinders in practical knowledge or experiment with weighted mean 3.73 ranked 2nd. In University wise comparison it can be said that students of BAU agreed that it was useful for part time students with weighted mean 4.03, whereas students of BCKV agreed that it's easy to keep track in digital learning with weighted mean of 3.83 ranked 1st.Students of BAU ranked 2nd to respond that digital learning hinders practical knowledge with weighted mean of 3.97, and students of BCKV ranked 2nd to response that digital learning was usefulness for part time students with weighted mean of 3.56. 3rd rank obtained by the respond that in digital learning its easy to track weekly task with weighted mean 3.77 and in BCKV 3rd rank given to two responses with weighted mean of 3.50 that digital learning helps in concept building.

From Table 9 it revealed that most of the overall students strongly agreed that they are unable to upload and download files required in digital learning, ranked 1st with a weighted mean of 3.96. The majority of students also agreed that digital learning tools are more time-consuming than traditional learning ranked 2nd with weighted mean 3.3. It was also revealed that in both the universities students unable to upload and download files got 1st rank with weighted mean 4.16 and 3.76 in BAU and BCKV respectively. Most of the students of both universities agree that digital learning tools are time consuming than tradition learning tools ranked 2nd with weighted mean 3.3 and 3.3 respectively. 3rd rank was given to respond that students lack confidence in communication with a weighted mean of 3.1 and 3.26. 4th rank was given to respond that students need assistance while using digital learning tools with a weighted mean of 2.6 and 2.73 respectively.

It was found that majority of the students preferred Google Meet during online classes with weighted mean 3.86 and it was ranked 1st. Students responded for Cisco Webex and Zoom Cloud Meeting both got 2nd rank with weighted mean 3.65. Students of BAU responded for performance to Cisco Webex as 1st rank with weighted mean 4.2, and 2nd rank to Zoom Cloud Meeting with weighted mean 4, 3rd rank to Google Meet with weighted mean 3.78, 4th rank to Google classroom with weighted mean 3.2, 5th rank given to Google Duo with weighted mean 2.95 and Whatsapp Video call got 6th rank with weighted mean 2.85. Whereas, students of BCKV responded for performance to Google Meet as 1st rank

Table 9: Ranks on students' training needs on digital learning

S. No.	Training Needs	BAU, Sabour (n_1= 60)		BCKV, Mohanpur (n_2= 60)		Overall (n=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Inability to upload and download files	4.16	I	3.76	I	3.96	I
2	Inability to use tools without assistance	2.6	IV	2.73	IV	2.66	IV
3	Lack of confidence in communication	3.1	III	3.26	III	3.18	III
4	Time management in DL use	3.3	II	3.3	II	3.3	II

WM= Weighted Mean

Table 10: Ranks on students' perception on digital learning tool's performance during online class

S.No.	Name of the digital tools	BAU, Sabour (n_1= 60)		BCKV, Mohanpur (n_2= 60)		Overall (N=120)	
		WM	Rank	WM	Rank	WM	Rank
1	Zoom Cloud Meeting	4.00	II	3.30	III	3.65	II
2	Cisco Webex	4.20	I	3.15	IV	3.65	II
3	Google Meet	3.78	III	3.95	I	3.86	I
4	Google Duo	2.95	V	3.30	III	3.13	IV
5	Whatsapp Video Call	2.85	VI	2.93	V	2.89	V
5	Google Classroom	3.20	IV	3.43	II	3.31	III

WM= Weighted Mean

with weighted mean 3.95, and 2nd rank to Google classroom with weighted mean 3.43, 3rd rank to Google Duo and Zoom Cloud meeting with weighted mean 3.3, 4th rank to Cisco webex with weighted mean 3.15, 5th rank given to Whatsapp video call with weighted mean 2.93.

Table 11 presented correlation between independent variables and academic performances of respondents. The findings showed that Tools used for digital learning (X_1) was significantly positively correlated to academic performance of the students. Applications used for content collection (X_3) was also significantly and positively correlated to academic performance of students. Time spends in digital learning (X_5) also significantly and positively correlated with academic performance of students. Social media in digital learning (X_6) showed significant positive correlation with academic performance. Performance of tools in digital learning (X9) significantly and positively correlated with academic performance of respondents.

Table 11: Correlation between Academic performance and independent variables

S. No.	Independent Variables	Correlation coefficient (r)
1	Tools Used for digital learning (X_1)	0.235*
2	Applications used for virtual classroom (X_2)	0.178 ^{NS}
3	Applications used for content collection (X_3)	0.231*
4	Source of data/ internet (X_4)	0.165 ^{NS}
5	Time spends in digital learning (hours/day) (X_5)	0.312**
6	Social media in digital learning (X_6)	0.216*
7	Friendliness in use of digital learning (X_7)	0.186 ^{NS}
8	Training need on digital learning (X_8)	0.153 ^{NS}
9	Digital learning tool's performance during online class (X_9)	0.263*

*Significant at 5% level. ** Significant at 1% level ^{NS}Non-Significant

Whereas, correlation of academic performance of students with applications used for virtual classroom (X_2), source of data/ internet (X_4), friendliness in use of digital learning (X_7) and training need on digital learning (X_8) was showed non-significant. The positive and significant relation implied that as the respondents used the digital learning tools so their result will be better.

Table 12, indicates that calculated p-value for 'Tools Used for digital learning' was greater than its tabulated value (0.05) at 5 per cent level of significance. Therefore, the null hypothesis (H_0) was accepted. It clearly shows there was no significant difference in regard to tools usage of students in digital learning. It also gives findings that calculated p-value for 'Applications used for virtual classroom' was lesser than its tabulated value (0.05) at 5 per cent level of significance. Therefore, the null hypothesis (H_2) was rejected, and the alternative hypothesis (H_3) was accepted. That means there was a significant difference in regard to applications used for the virtual classroom. From the table it found that the calculated p-value for **'**Applications used for content collection' was lesser than its tabulated value (0.05) at 5 per cent level of significance. Therefore, the null hypothesis (H_4) was rejected, and the alternative hypothesis (H_5) was accepted. That means there was a significant difference in regard to applications used for content collection by the students of both the universities. The p-value for 'Source of data/internet' was greater than the tabulated value (0.05) at a 5% level of significance. Therefore, the null hypothesis (H_6) was accepted, and the alternative hypothesis (H_7) was rejected. That means there was no significant difference in regard to data source used by the of both the universities. The table shows that p-value of 'Time spends in digital learning (hours/day)' was greater than the tabulated value (0.05) at 5% significance level. Therefore, the null hypothesis (H_8) was accepted and the alternative hypothesis (H_9) was

Table 12: Comparison of respondents according to their use of tools and techniques in digital learning

S.No.	Variables	Mean Score		p-value	Z Value	Null hypothesis
		BAU, Sabour	BCKV, Mohanpur			
1	Tools Used for digital learning	65.22	55.78	0.135	-1.493	Accepted (H_0)
2	Applications used for virtual classroom	67.68	53.32	0.023*	-2.268	Rejected (H_2)
3	Applications used for content collection	69.68	51.31	0.004*	-2.898	Rejected (H_4)
4	Source of data/ internet	63.81	57.18	0.292	-1.054	Accepted (H_6)
5	Time spends in digital learning (hours/day)	56.65	64.35	0151	-1.437	Accepted (H_8)
6	Social media in digital learning	66.15	54.84	0.073	-1.791	Accepted (H_{10})
7	Friendliness in use of digital learning	67.37	53.63	0.030*	-2.169	Rejected (H_{12})
8	Training need on digital learning	61.58	59.41	0.732	-0.343	Accepted (H_{14})
9	Digital learning tool's performance during online class	62.23	58.77	0.583	-0.548	Accepted (H_{16})

*$p<0.05$

rejected. Means there was no significant difference regarding time spend in digital learning by the students of both the universities. It indicates that the calculated p-value for 'Social media in digital learning' was greater than the tabulated value (0.05) at 5% significance level. Therefore, the null hypothesis (H_{10}) was accepted, and the alternative hypothesis (H_{11}) was rejected. The p-value for 'Friendliness in use of digital learning' was lesser than the tabulated value (0.05) at a 5% significance level. Therefore. The null hypothesis (H_{12}) was rejected and the alternative hypothesis was accepted. That means there was a significant difference regarding friendliness in the use of digital learning among the students of both the universities. p-value for 'Training need on digital learning' was greater than the tabulated value (0.05) at 5% level of significance. Therefore, the Null hypothesis (H_{13}) was accepted, and the alternative hypothesis was rejected. That means there was no significant difference regarding training needs on digital learning between the students of both the universities. p-value for 'Digital learning tool's performance during online class was greater than the tabulated value (0.05). Therefore, the null hypothesis was accepted and the alternative hypothesis was rejected. That means there was no significant difference in regard to the tool's performance during online classes between the students of both the universities.

CONCLUSION

Digital learning can be the future in mode of education in the country. We need to concentrate more on students' perspectives about digital learning. From the current study, it was found that the majority of the students are using smartphone followed by laptops for their digital learning. YouTube was preferred by the students for content collection with significant differences between respondents from respective universities. Whereas students selecting google meet as a platform for virtual classrooms with substantial differences between respondents of each university. The study itself found that respondents have a positive perception of social media as a digital learning platform. The academic performance of students showed a positive correlation with time spend in digital learning. Using the study's findings, further planning, operation of different digital projects, and access to the capabilities and efficacy of projects related to digital devices in education can be done in future dates. The findings of the study would guide the administrators for framing new strategies for utilization of digital devices in teaching and governing them with specific rules and regulations for their smooth conduction.

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Utilization of Information Sources by the Potato Seed Producers of Punjab

Lakhwinder Singh[1]*, Dharminder Singh[2] and R.K. Dhaliwal[3]
[1]M.Sc. Scholar, [2]Senior Extension Scientist, [3]Director Students Welfare, Department of Extension Education, Punjab Agricultural University, Ludhiana-141004, Punjab

ABSTRACT

Potato (*Solanum tuberosum* L.) is a third most important food crop, grown in more than 150 countries in the world. Punjab account for 20.8 per cent of the area under potato cultivation of the country. The present study was conducted to analyse the utilization of information sources by the potato seed producers by selecting 180 farmers from a cluster of three potato seed producing districts of Punjab i.e. Jalandhar, Hoshiarpur and Kapurthala. The data were collected from the respondents using structured interview schedule. Study revealed that majority of the unorganized and organized respondents were seeking farm information from pesticide dealers and seed company representatives, respectively with average mean score of 2.27. More number of organized respondents were found to be seeking advice from formal sources like PAU scientists, Agricultural Development Officers and KVK officials. TV program, Mera Pind Mere Khet and newspapers also served as important sources of farm information for the farmers. WhatsApp emerged as a useful ICT tool for the 64.4 and 50.0 per cent of the organized and unorganized respondents.

Keywords: Potato, Seed producers, Information sources, ICT, WhatsApp, Punjab

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a third most important food crop, grown in more than 150 countries in the world (Anonymous, 2015). It is one of the most productive crop which can play a significant role in ensuring food security and it can be cooked in many ways, processed into number of products (Marwaha *et al.,* 2002). It produces the highest dry matter and proteins per unit area and time among the major food crops (Ram, 1997). The potato is a crop which has always been the 'Poor man's friend'. Potato may prove helpful in solving problem of under and malnutrition (Gustavsen, 2021). In India, about 68 per cent potatoes are utilized for table purpose, 7.5 per cent for processing, 8.5 per cent for seed and remaining 16 per cent produce goes waste due to pre and post-harvest handling. (Gupta *et al.,* 2014). Year 2008 was declared as the *International Year of the Potato* by the United Nations, to raise the profile of potato crop in developing nations, by referring the crop as a 'hidden treasure' (FAO, 2008). World acreage of potato is 18.2 million hectares with average productivity of 17.2 tonnes per hectare. At present, India rank 2nd after China with 48 million tonnes of potato production and average yield is 23.6 tonnes per hectare (Anonymous, 2014). The increase over last 60 years in area, production and productivity is 550, 1745 and 178 per cent, respectively. This growth can be attributed to indigenously developed technologies which were used in India for cultivation of potato. Majority 70.5 per cent of potato producing area and 80 per cent of the total production in the country is located in three states namely Bihar, Uttar Pradesh, and West Bengal (Rana and Anwer, 2018).

Punjab rank 6th in Potato production. Potato was grown on 96.6 thousand hectares during 2016-17 with total production of 2.42 million tones and average productivity around 25 tonnes per hectare (GOI, 2018). Punjab account for 20.8 per cent of the area under potato cultivation of the country, which results in wide variations in the productivity levels of potato in different states. Therefore, all efforts may be put in develop location-specific technologies to increase the productivity of potato crop. The main potato crop is planted from mid-October to mid-November and harvested from January onwards depending upon prevailing market prices in Punjab (Luthra *et al.,* 2009). Thus, for early harvesting the quick bulking

*Corresponding author email id: lakhwinder-ee@pau.edu

varieties are preferred which can produce high yield of acceptable tuber quality. Recently, a large number of companies including multinationals such as Fritolay, ITC, Ace Foods have stepped into the field of potato processing (Marwaha *et al.,* 2010).

MATERIALS AND METHODS

The study was carried out in a cluster of three potato seed producing districts of Punjab i.e. Jalandhar, Hoshiarpur and Kapurthala were selected purposively because these districts were having their maximum area under potato seed production. Different seed production associations or organisations operating in these districts were identified. List of potato seed producers working with identified seed producing organization such as Confederation of Potato Seed Farmers (POSCON), Jalandhar Potato Grower's Association, Kapurthala Potato Grower's Association, Pepsico in selected districts were obtained from these organisations. These farmers were termed as organised potato seed producers. List of individual potato seed producers were also taken from Department of Horticulture. These farmers were termed as unorganised seed producers for the present study. From each selected district, 30 organised and 30 unorganised farmers were selected, randomly. Thus, a total of 180 respondents comprising of 90 organised and 90 unorganised potato seed producers were selected for the study. Various information sources are being used these farmers for potato cultivation viz. farm literature, mass media, ICT tools, farm telecasts, radio broadcasts etc.

Utilization of information sources referred to the frequency of contacts made by the respondents with different sources of farm information related to potato seed production. It was measured on the three point continuum such as Always, Sometimes and Never and score 3, 2 and 1 was assigned respectively and mean score was calculated. Structured interview schedule was constructed for the study. The data were collected through personal interview method from the respondents. Proper precautions were taken to ensure an unbiased response of the farmers by providing them necessary instructions after explaining the objectives of the study. The data were transferred on the master-sheets in Microsoft-excel and were tabulated according to the objectives of the study. Appropriate statistical tools such as frequencies, percentage, mean score, range method were used for analysis.

RESULTS AND DISCUSSION

The information regarding socio-personal characteristics of selected farmers which include age, education, family type, family size, operational land holding, extension contacts, risk bearing capacity, economic motivation and innovativeness was analyzed. The information pertaining to the socio personal characteristics of the farmers has been given in Table 1. Data revealed the age of the unorganised and organised respondents varied from 24-71 years. One third (33.33%) and around 48.00 per cent of unorganised respondents belonged to the age group of 24-39 years and 40-55 years, respectively while only 18.88 per cent of the unorganised respondents were in the age group of 56-71 years. On the other hand, 36.66 per cent of the organised respondents belonged to the age group of 24-39 years. Around half of the organised respondents (56.77%) and very less (5.55%) of the respondents were in the age group of 40-55 years and 56-71 years, respectively. These findings are in line with those of Kumar (2010) where it was reported that majority of the family heads belonged to age group of 35 to 55 years.

It can be seen from Table 1 that 34.44 per cent of the unorganised respondents were educated up to matric, 26.66 per cent of the unorganised respondents were educated up to senior secondary followed by 13.33 per cent of these respondents were graduated. As many as 16.66 per cent of the unorganised respondents were either illiterate or studied up to primary education. In contrast to this, half of the organised respondents (51.11%) has got senior secondary education. Around 29.00 per cent of the organised respondents were matric and 11.00 per cent of the respondents were graduated. Very less 6.66 per cent and 2.22 per cent of the organised respondents have passed middle and primary level of education, respectively. None of the organised seed producers were illiterate.

It was found that 58.88 per cent of the unorganised respondents belonged to joint family and 40.11 per cent of the unorganised respondents belonged to nuclear family. Similarly, majority (70.00%) of the organised respondents belonged to joint family and 30.00 per cent of these respondents belonged to nuclear family. The findings are in line with the study conducted by Singh (2013). It was observed that majority (60.00%) of the unorganised respondents had family size of 4-6 members followed by 30.00 per cent of these respondents had 7-9 members in the family. Only 10.00 per cent of the unorganised

Table 1: Distribution of respondents according to their socio-personal characteristics

S.No.	Socio-personal characteristics	Category	Unorganised (n_1=90)		Organised (n_2=90)	
			Frequency	Percentage	Frequency	Percentage
1.	Age (years)	24-39	30	33.33	33	36.66
		40-55	43	47.77	52	57.77
		56-71	17	18.88	5	5.55
2.	Education	Illiterate	10	11.11	-	-
		Primary	5	5.55	2	2.22
		Middle	8	8.88	6	6.66
		Matric	31	34.44	26	28.88
		Senior Secondary	24	26.66	46	51.11
		Graduation	12	13.33	10	11.11
3	Family type	Joint	53	58.88	63	70.00
		Nuclear	37	40.11	27	30.00
4	Family size (members)	4-6 members	54	60.00	43	47.77
		7-9 members	27	30.00	31	34.44
		10-12 members	9	10.00	16	17.77
5	Operational land holding	Semi-medium (2-4 ha)	7	7.77	-	-
		Medium (4-10 ha)	24	26.66	10	11.11
		Large (> 10 ha)	59	65.55	80	88.88

*Multiple response

respondents had 10-12 members in the family. Similarly, half of the organised respondents (47.77%) had 4-6 members followed by 34.44 per cent of respondents were 7-9 members in the family. Only 17.77 per cent of the organised respondents had 10-12 members in the family.

Majority (65.55%) of the unorganised respondents had large (>10 ha) operational land holding (Table 1). One-fourth (26.66%) of these respondents had medium (4-10 ha) land holding. Only 7.77 per cent of the unorganised respondents had semi-medium (2-4 ha) and none of the unorganised respondents had marginal (<1 ha) and small (1-2 ha) operational land holding. Interestingly, most of i.e. 88.88 per cent of the organised respondents had large (>10 ha) and only 11.11 per cent had medium land holding. None of the organized respondents had marginal (<1 ha), small (1-2 ha) and semi-medium (2-4 ha) operational land holding. The findings are in line with the study conducted by Singh (2013).

The data in the Table 2 reveals that 35.55 per cent of the unorganised respondents sought information from pesticide dealers frequently whereas 28.88 per cent of unorganised respondents frequently consulted artias/ commission agents. It was found that 17.77 per cent and16.66 per cent of unorganised respondents consulted private company representatives and agricultural development officers (ADO's) or horticultural development officers (HDO's), respectively. Only 12.22 per cent and 8.88 per cent of unorganised respondents frequently took advice from KVK's and PAU scientists for getting farm information, respectively. On the other hand, 43.33 per cent of the organised respondents frequently sought information from pesticide dealers followed by 32.22 per cent of the organized respondents who has consulted private company representatives. About 28.88 per cent organised respondents got information frequently from private company representatives and artias/commission agents.

Nearly half (56.66%) of the unorganised respondents sought information from private company representatives and pesticide dealers occasionally. Nearly half of the unorganised respondents (47.77%) got information from artias/ commission agents. Around one-fourth of each the unorganised respondents got advice from PAU scientists, agricultural development officers (ADOs)/ horticultural development officers (HDOs) and KVKs occasionally, respectively. Similarly, majority (63.33%) of the organised respondents gotinformation from private representative along with 56.66 per cent,43.33 per cent,

Table 2: Distribution of respondents according to their sources of seeking information regarding potato seed production

Source	Frequently		Occasionally		Never		Mean Score		z-value
	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	
ADO/HDO	16.66	18.88	25.55	32.22	57.77	48.88	**1.58**	**1.70**	**0.97**
KVK	12.22	13.33	25.55	37.77	62.22	48.88	**1.50**	**1.64**	**1.36**
PAU scientists	8.88	13.33	23.33	35.55	67.77	51.11	**1.41**	**1.62**	**2.07***
Private company representatives	17.77	32.22	56.66	63.33	25.55	4.44	**1.92**	**2.27**	**3.96***
Arthia's/commission agents	28.88	28.88	47.77	56.66	23.33	14.44	**2.05**	**2.14**	**0.86**
Pesticide dealers	35.55	43.33	56.66	43.33	7.77	13.33	**2.27**	**2.30**	**0.22**

*0.05% level of significance

37.77 per cent and 35.55 per cent of the respondents occasionally got information from artias/commission agents, pesticide dealers, KVKs and PAU scientists occasionally, respectively. One-third i.e. 32.22 per cent of the organised respondents sought information agricultural development officers (ADOs)/horticultural development officers (HDOs). Majority of the unorganised respondents never sought information from PAU scientists and KVKs and agricultural development officers (ADOs)/horticultural development officers (HDOs). Half of the organised respondents i.e. 51.11 per cent and 48.88 per cent each of the organised respondents never got information from PAU scientists, agricultural development officers (ADOs)/ horticultural development officers (HDOs), KVKs, respectively. These findings are in line with those of Sharma and Aparna (2021).

The mean score was calculated for each source of information by providing the score of 3, 2 and 1 for frequently, occasionally and never, respectively. In unorganised sector, the pesticide dealers, artias / commission agents and private company representatives had got the highest mean score of 2.27 and 2.05 and 1.92, respectively. Similarly, in organised sector, the pesticide dealers, private company representatives and artias/ commission agents had got highest score of 2.30, 2.27 and 2.14, respectively. It shows that these were the major sources for seeking information by unorganised respondents because they were most easily approachable sources for the village farmers and were regular in the contact of the respondents. It was found that the difference seeking farm information between unorganised and organised respondents was found to be significant in PAU scientists and private company representative (z=3.96, 2.07 at 5% level of significance).

The data in Table 3 reveals that the distribution of potato growers according to their use of agriculture literature farm telecasts/ radio broadcasts for seeking farm information. Nearly half of the unorganised respondents always read newspapers for getting agricultural information, whereas only 7.77 per cent and 6.66 per cent of the unorganised respondents read magazines and PAU literatures. Similarly, most of the organised respondents (85.55%) always read newspapers for agricultural information followed by 42.22 per cent and 30.00 per cent of the organised respondents read magazines and PAU literatures.

Most of the unorganised respondents i.e. 81.11 per cent and 72.22 per cent never read PAU literatures and magazines. Also, 22.22 per cent of the unorganised respondents never read newspapers. Similarly, around 47.00 per cent and 41.00 per cent of the organized respondents never read PAU literatures and magazines. Only 11.11 per cent of the organised respondents never read newspapers for agricultural information. The mean score was calculated for each source by providing the score of 3, 2 and 1 for always, sometimes and never, respectively. In unorganised and organised respondents, getting information from newspapers got the highest mean score of 2.2 and 2.74, respectively. The difference between unorganised and organised sector regarding use of newspapers, magazines and PAU literatures was found to be significant (z= 4.78, 5.60 and 5.28 respectively) at 5% level.

One-fourth of the unorganised respondents always viewed *Mera Pind Mere Khet* and *DD kisan channel*. About 14.44 per cent of the unorganised respondents always viewed *Sohna Punjab* on farm telecast. Only 17.77 per cent, 16.66 per cent and 6.66 per cent of the organised

Table 3: Distribution of respondents according to use of agricultural literature and Farm telecasts/ radio broadcasts for seeking farm information

Sources	Always (3-5 times/week)		Sometime (1-2 times/week)		Never		Mean score		z-value
	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	Unorganised (n_1=90)	Organised (n_2=90)	
Farm Literature									
Newspapers	48.88	85.55	28.88	3.33	22.22	11.11	**2.20**	**2.74**	**4.78***
Magazines	7.77	42.22	20.00	16.66	72.22	41.11	**1.35**	**1.99**	**5.60***
PAU Literature	6.66	30.00	12.22	22.22	81.11	46.66	**1.25**	**1.81**	**5.28***
Farm telecasts									
Mera Pind Mere Khet	25.55	17.77	54.44	63.33	20.00	18.88	**2.05**	**1.98**	**0.69**
Sohna Punjab	14.44	6.66	31.11	38.88	54.44	54.44	**1.60**	**1.52**	**0.76**
DD Kisan Channel	25.55	16.66	27.77	53.33	46.66	30.00	**1.78**	**1.84**	**0.69**

*0.05% level of significance

respondents viewed *Mera Pind Mere Khet, DD kisan channel* and *Sohna Punjab*, respectively. Nearly half (54.44%) of the unorganized respondents sometimes viewed *Mera Pind Mere Khet*, whereas 31.11 per cent and 27.77 per cent of these respondents viewed sometimes *Sohna Punjab* and *DD kisan* channel. Majority of the organised respondents (63.33%) sometimes viewed *Mera Pind Mere Khet*. Half of the organised respondents i.e. 53.33 per cent and 38.88 per cent of these respondents viewed *DD kisan channel*, *Sohna Punjab,* respectively. The mean score for unorganised respondents was highest for*MeraPind Mere Khet*, and *DD kisan* channel i.e. 2.05 and 1.78, respectively. For organised sector, highest mean score was 1.98 and 1.84 for *MeraPind Mere Khet* and *DD kisan* channel. It was found that there is non-significant difference regarding use of farm telecasts in unorganised and organised respondents (z= 0.69, 1.33, 0.76 & 0.69 at 5% level of significant). Television was reported as second most utilized medium after mobile phones by the farm women of HP (Kapoor *et al.,* 2020).

Table 4: Distribution of respondents according to usage of ICT tools for seeking agriculture information

Source*	Unorganised (n_1=90)		Organised (n_2=90)	
	f	%	f	%
Whatsapp	45	50.00	58	64.44
Facebook	29	32.22	33	36.66
Weather apps	38	42.22	54	60.00
SMS	44	48.88	49	54.44
Internet (Google search)	30	33.33	52	57.77

*Multiple response

The data in Table 4 reveals that, half of the unorganized respondents used Whatsapp application followed by 48.88 per cent and 42.22 per cent used weather app and subscribed SMSs.

It was also found that 33.33 per cent and 32.22 per cent of unorganised respondents used internet and Facebook for getting agricultural information. Majority of the organised respondents i.e. 64.44 per cent and 60.00 per cent used WhatsApp and weather apps, respectively. About 57.77 per cent of the respondents used search engines like Google, Yahoo for searching information as followed by54.44 per cent 36.66 per cent for SMS subscriber and Facebook related to agriculture. Usage of ICT tools by higher number of the respondents indicates that more number of farmers because familiar with these tools and using them. Jat *et al.* (2021) also found that farmers from Southern Rajasthan were using mobile as an important means of obtaining farm information. Similarly Bhushan *et al.* (2021) also emphasized the role of ICT and stressed upon skill upgradation in this regard.

CONCLUSION

The present was conducted to analyse utilisation pattern of information sources by the potato farmers. The results of the study reveal that higher number of organised farmers seeks advice from PAU scientists and company representatives. However majority of potato farmers found to be rely on informal information sources for obtaining agricultural advice. It was also inferred that newspaper was the most preferred source among farm literature, whereas Mera Pind Mere Khet, a TV telecast

found favour with the respondents. Results indicated that there was significant difference between organised and unorganised farmers in reading the farm literature and more number of organised farmers was reading it. More than half of the farmers were using WhatsApp for seeking farm information, being the most important ICT tool.

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Young Adults Attitude Towards Acid Attacks- A Gender Based Violence

L. Manizia[1]* and Ragini Mishra[2]
[1]M.Sc. Research Scholar, [2]Assistant Professor, Department of Human Development and Family Studies, College of Home science, GBPUAT, Pantnagar, Uttarakhand

ABSTRACT

Acid attack is a violent assault that involves throwing or using of acid intentionally to harm, kill, torture or disfigure a person, usually females. Women in male dominated countries like India faces this vitriol attack. Acid attack in women is a burning issue in the present scenario. Therefore this descriptive research study aimed to understand the attitude of young adults towards acid attacks. A total number of 240 male and female young adults were selected as sample of research through Population Proportion sampling method from two colleges of G.B. Pant University of Agriculture and Technology. To achieve the research objective, a tool namely Attitude Scale on Gender-based violence (A-GBV) was developed and thereafter reliability and validity of the tool was calculated before its application. Suitable statistical methods i.e., frequency, percentage, p value and correlation were applied on collected data to derive the research results. After analysis and comparing the data, the finding of the research reflected strong disagreement towards acid attack. A significant association was found between attitude of young adults towards acid attack and selected independent variable i.e., Age, Gender, College and Family Income.

Keywords: Acid attack, Age, College, Family income, Gender, Young adults

INTRODUCTION

The land disputes, inheritances, dowries, and rejected marriage proposals sometimes elicit jealously, which leads to acid violence, with women being the first victims. Acid attacks are particularly inhumane because the offenders intend to disfigure rather than kill the victims. Acid is also readily available and inexpensive, and it is frequently thrown towards women. They are scarred, often blinded, and profoundly traumatized as a result of these atrocities. Many women's lives have been wrecked as a result of their lack of freedom and independence. Men have attacked women in many parts of India for a variety of reasons, the most common of which is rejection of a proposal. Men seek these women out, confront them, and attack them with acid, leaving them scarred. Physical injuries may heal through arduous and many surgeries, but mental injuries persist for the rest of one's life. Acid violence is the intentional use of acid to harm another person. Acid violence disproportionately affects women and children, and assailants frequently target the head and face to maim, disfigure, and blind them. Acid attack can be viewed to mean "any act of throwing acid or using acid in any form on the victim with the intention of or with knowledge that such person is likely to cause to the other person permanent or partial damage or deformity or disfiguration to any part of the body of such person (National Commission of India, July 2009). It is a horrifying form of assault (Jain, 2018) that women have had to face especially in male dominated societies like India. the attitude existing in Indian society that a man has the right to cause permanent damage to anyone who doesn't agree with what he wants, especially if that person is a woman, needs to be stopped (Jain, 2018). Acid attacks are carried out because of discriminatory attitudes. There is no national database to statically track cases of acid violence. Many cases go unreported. To combat acid violence on a sustained basis, reliable statistics are necessary. Estimates vary from 500 to 1000 cases a year in India, based on research conducted by Acid Survivors Foundation India. In India, there are 28 states and 9 union territories; it gives a figure of about 350 cases per year, excluding unreported incidents. These underlying reasons need to be addressed if acid attack and indeed other forms of violence against women and girls are to be challenged and eradicated (www.acidviolence.org).

*Corresponding author email id: lmanizia23@gmail.com

The Supreme Court has come out heavily on acid attacks on women calling them "worse than murder". The Times of India (2013) reported non-industrial acid is used as a low-cost cleaning agent, so buying acid hardly raises any suspicion. It is sold openly over the country, as cheap as Rupees 30 for 750 ml. In 2019, Law Commission of India stated that even though acid attack is a crime which can be committed against any gender, it has a specific gender dimension in India. Most of the reported acid attacks have been committed on women, particularly young women for spurning suitor for rejecting proposals for marriage, for denying dowry etc. Atiyeh *et al.* (2008) reported that 90 per cent of acid attacks are reported in developing countries such as Colombia, Pakistan, Nepal, Bangladesh, Uganda, and India.

Acid attacks could be cultural, stemming from gender, economic, or class inequalities, the culture of revenge, and to calm misogyny. It could be due to societal factors such as indemnity towards perpetrators, social permissiveness, history of punishment towards women, and male dominated resources. Another reason according to Laura (2013) is situational reasons such as family conflicts, poor family education, geographical situation, emotional state of individuals, peer association and cost of acid. And another cause being personal such as impersonal feelings like male shame, powerlessness, the age of the perpetrator or victim, poor anger management skills, childhood neglect, antisocial behaviour etc. Usually In India, acid survivors who are single when attacked almost certainly become ostracized from society, effectively ruining marriage prospects. The Times of India reported that 72 per cent of reported attacks included at least one female victim. Nguyen (2015) in his study stated that India has the highest number of acid attacks. Out of 1500 total cases reported globally every year, approximately 1000 are committed in India.

Acid attack is an endemic societal problem and an ongoing human rights concern in all communities and cultures on a global, national, and local level. The international literature emphasizes how complicated and cross-generational this topic is. Activists say perpetrators and victims of acid attacks are mostly in the 20-35 age bracket, making engagement programmes with young adults crucial. Most incidents of violence against women are a result of certain discriminatory notions youngsters pick up from their homes or immediate environments. We address these causes by holding no particular gender responsible, but by encouraging free-flowing conversations on important issues such as gender roles, equality, consent and mutual respect between boys and girls (Chakrapani, 2019). This highly sensitive issue can be eliminated from our societies if focus is drawn on the young adults – the future of nation. The kind of attitude they adhere will lead to kind of conduct they perform towards women. Therefore, fundamental need is to assess young people's attitudes toward this shameful conduct towards women so that problem can be cured from its root. It becomes necessary to assess the kind of attitude our young generations have towards heinous crimes like acid- attacks so that necessary efforts can be made to improve the quality of mental health and attitude of the young generation to cure from such social evils from the society.

MATERIALS AND METHODS

A total number of 240 male and female young adults were selected as sample of research through Population Proportion sampling method from three colleges of G.B. Pant University of Agriculture and Technology. To achieve research objective, a tool namely Attitude Scale on Gender-based violence (A-GBV) was utilized. The tool was evaluated by subject experts and thereafter reliability of the tool (Mishra and Gir, 2013; Mishra and Gir, 2014) was calculated (0.74) through pilot study. Due to Covid-19 pandemic situation, researcher collected the data through online mode. Suitable statistical methods i.e., frequency, percentage, p value and standard deviation were applied on collected data to derive the research results. After analysis and comparing the data, the finding of research reflected that high level disagreement attitude towards domestic violence. A significant association was found between attitude of young adults towards acid attacks and selected independent variable i.e., age, gender, college and family income.

RESULT AND DISCUSSION

Acid attack is a worldwide problem affecting all irrespective of age, caste, and religion. It is the most heinous form of gender-based violence. Perpetrator's aim is not to kill the victim but to leave her in a pathetic condition. Injuries on the body heal and leave scars not only on the body but also physically and psychologically the whole personality of the survivor affected (Singh *et al.,* 2019). Therefore, this research focuses on attitude of young adults on this Gender-Based Violence which has become one of the critical topics of discussion in every platform globally.

Table 1: Distribution of Young Adult's Attitude towards Acid Attacks (N=240)

Variables	Analysis		Statements on Acid Attacks					
			If a woman becomes a victim of acid attacks, she is solely responsible for it.	A woman should accept a man's proposal as he can harm her in case of rejection.	Women should hide their beauty to be safe from people with criminal mindset.	Women's behaviour could be an inevitable factor for acid attacks.	Unauthorized acid dealers should be punished equally as the acid attackers.	Easy accessibility to buying of acid should be banned.
Gender	Female	Mean	4.58	4.63	4.59	4.15	4.16	4.47
		SD	0.795	0.709	0.750	0.976	1.181	1.037
	Male	Mean	4.37	4.23	4.05	3.48	3.83	4.01
		SD	0.898	1.041	1.020	1.108	1.169	1.300
		p Value	‹ 0.000*	0.049*	0.001*	‹0.000*	‹0.000*	0.033*
Age	18-21 years old	Mean	4.33	4.31	4.22	3.73	3.85	4.20
		SD	0.929	0.977	0.973	1.122	1.234	1.207
	22-25 years old	Mean	4.83	4.70	4.56	4.03	4.35	4.34
		SD	0.478	0.663	0.788	1.000	0.972	1.170
		p Value	0.001*	0.000*	0.002*	0.009*	0.052	0.002*
College	Agriculture	Mean	4.15	4.09	4.00	3.56	3.80	3.95
		SD	1.105	1.168	1.131	1.118	1.284	1.372
	Home Science	Mean	4.66	4.62	4.50	3.96	4.10	4.40
		SD	0.598	0.659	0.744	1.057	1.113	1.053
		p Value	0.006*	‹0.000*	‹0.000*	0.000*	0.007*	0.059
Family income	High	Mean	4.79	4.63	4.48	4.04	4.13	4.13
		SD	0.459	0.761	0.743	0.944	1.024	1.231
	Middle	Mean	4.52	4.49	4.35	3.90	4.01	4.39
		SD	0.813	0.862	0.896	1.074	1.204	1.061
	Low	Mean	4.17	4.19	4.16	3.51	3.88	4.04
		SD	1.028	1.047	1.093	1.171	1.255	1.366
		p Value	0.000*	0.045*	0.016*	0.289	0.310	0.052

Note: * Stands for significant at p<0.05% level of significance

The values of current data represents that majority of male and female young adults displayed strong disagreement with the statements i.e., *a woman become an acid attack victim, then 'she is solely responsible for it; A woman should accept a man's proposal as he can harm her in case of rejection; Women should hide their beauty to be safe from people with criminal mindset and Easy accessibility to buying of acid should be banned.* On these statements, women level of disagreement was a bit higher among female in comparison to male young adults. Data also reflects that both male and female also portrayed strong disagreement on the statements i.e., *Women's behaviour could be an inevitable factor for acid attacks and Unauthorized acid dealers should be punished equally as the acid attackers* but when values were compared level of disagreement was quite higher among female in comparison to males on these two statements. A significant association was also calculated between gender and attitudinal statements on acid attacks as an gender-based violence.

Table 1 displayed that, young adults belonging to the age group 18-21 and 22-25 years have strong disagreement on statements suggesting women being solely responsible if she becomes an acid attack victim, women accepting men's proposal just to be safe and women hiding their beauty to be safe from people with criminal mindset. While young adults between the age 22-25 years strongly disagreed and young adults between 18-21 years only disagreed to the statement suggesting that women's behaviour could be an inevitable factor for acid attacks. In case of statements suggesting that unauthorized acid dealers to be punished equally as the acid attackers– young

adults between 18-21 years and 22-25 years displayed strong agreement while young adults between 18-21 years displayed agreement and young adults between 22-25 years displayed strong agreement to the statement suggesting banning the easy accessibility to purchasing acid. A significant association was found between the age of young adults and their attitude on the statements suggesting that if a woman becomes a victim of acid attacks, then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her, covering women's beauty to be safe from people with criminal mindset, women's behaviour being an inevitable factor for acid attacks, and banning of easy accessibility for purchasing acid. There was non-significant association between the age of young adults and their attitude the statement suggesting punishing unauthorized acid dealers equally as the acid attacker.

Table 1 suggested that majority of young adults from College of Agriculture and College of Home Science strongly disagreed on the statement stating that if a woman become an acid attack victim, then she is solely responsible for it, a woman should not reject a man's proposal just so that he does not harm her and the statement suggesting that women should hide their beauty to be safe from people with criminal mindset. Young adults from College of Agriculture and College of Home Science disagreed to women's behaviour being an inevitable factor for acid attacks. Similarly, young adults from College of Agriculture have agreement and young adults from College of Home Science have strong agreement on the statements suggesting the punishing of unauthorized acid dealers equally as the acid attackers and the banning of easy accessibility to buying of acid. A significant association was found between college of young adults and their attitude on the statements suggesting that if a women becomes a victim of acid attacks then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her, covering women's beauty to be safe from people with criminal mindset, women's behaviour being an inevitable factor for acid attacks and punishing unauthorized acid dealers equally as the acid attacker. Where there was no significant association between college of young adults and their attitude towards the statement suggesting the banning of easy accessibility for purchasing acid.

It can be explained from table 1 that, young adults belonging to high-, middle- and low-income family displayed strong disagreement on the statements suggesting women being solely responsible if she becomes an acid attack victim, women accepting men's proposal just to be safe and women hiding their beauty to be safe from people with criminal mindset. In case of the statement suggesting women's behaviour being an inevitable factor for acid attacks - young adults from high-income family strongly disagreed and young adults belonging to middle- and low-income family disagreed with the statement. While young adults belonging to high- and middle-income families strongly agreed that unauthorized acid dealers should be punished equally as the acid attacker and young adults from low-income family only agreed to it. Likewise, young adults from high-, middle- and low-income family strongly agreed to ban of easy accessibility to buying acid. A significant association was found between family income of young adults and their attitude on the statements suggesting that if a woman becomes a victim of acid attacks, then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her and covering of women's beauty to be safe from people with criminal mindset. There was no significant association between family income of young adults and their attitude on the statements suggesting women's behaviour being an inevitable factor for acid attacks, punishing unauthorized acid dealers equally as the acid attacker and banning of easy accessibility for purchasing acid.

CONCLUSION

Majority of male and female young adults displayed strong disagreement to conducts related to acid attack. Attitude of female young adults were slightly better. A significant association was found between gender of young adults and their attitude on the statements suggesting that if a women becomes a victim of acid attacks then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her, covering women's beauty to be safe from people with criminal mindset, women's behaviour being an inevitable factor for acid attacks, punishing unauthorized acid dealers equally as the acid attacker and banning of easy accessibility for purchasing acid.

Majority of young adults belonging to the age group 18-21 and 22-25 years displayed strong disagreement to conducts related to acid attack. Attitude of young adults between 22-25 years were better.A significant association was found between the age of young adults and their

attitude on the statements suggesting that if a woman becomes a victim of acid attacks, then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her, covering women's beauty to be safe from people with criminal mindset, women's behaviour being an inevitable factor for acid attacks, and banning of easy accessibility for purchasing acid.

Majority of young adults belonging to College of Agriculture and College of Home Science displayed strong disagreement to conducts related to acid attack. Attitude of young adults from College of Home Science were better. A significant association was found between College of young adults and their attitude on the statements suggesting that if a woman becomes a victim of acid attacks then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her, covering women's beauty to be safe from people with criminal mindset, women's behaviour being an inevitable factor for acid attacks and punishing unauthorized acid dealers equally as the acid attacker.

Majority of young adults belonging to high-, middle- and low-income family displayed strong disagreement to conducts related to acid attack. Attitude of young adults from high-income family was better. A significant association was found between family income of young adults and their attitude on the statements suggesting that if a woman becomes a victim of acid attacks, then she is solely responsible for the cause, that a woman should not reject a man's proposal so that he doesn't harm her and covering of women's beauty to be safe from people with criminal mindset.

The above research study was aimed to study the attitude of young adults towards acid attacks and it can be said that individual attitude and behavior is strongly influenced by the environment in which one live; so efforts to prevent violence must consider how social pressures and expectations influences individual's behavior. The study revealed that majority of male and female young adults belonging to age group of 18-21 and 22-25, various colleges (College of Agriculture and Home Science) and various income groups portrayed strong disagreement towards the conduct of acid attacks. A significant association was found between independent variables and attitude of young adults on various statement statements on acid attack. This level of disagreement of young adults in current research is a positive sign which portrays that young generation are now developing positive attitudes against violence like acid attack and are in favor of removing such evil practices from the society. Therefore, by being aware, prepared, educating staff and students, responding correctly and swiftly and taking the steps to recover campuses can reduce the opportunity for these incidents to occur and lessen the impact when and if tragedy does strike (Richter, 2018). The best way to end acid violence is to prevent it from happening in the first place by addressing its root causes. Education is critical in prevention of acid attacks and other forms of violence against women and girls (ASTI, foundation) and Prevention should start early in life, by educating and working with young boys and girls promoting respectful relationships and gender equality.

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Teacher's Perspectives Towards ICT Integration in Classrooms

Naaz Bano[1]* and Seema Rani[2]
[1]Research Scholar, [2]Professor, Department of Extension Education and Communication Management, CCS HAU, Hisar, Haryana

ABSTRACT

ICTs stand for "Information and communication technologies". It is similar to Information Technology (IT) but focuses mainly on communication technologies. Information communication technologies at present are influencing every facet of human life. They are playing salient roles in education, work places, business and entertainment. Moreover, many people recognize ICTs as catalysts source for change; change in teaching methods, learning approaches, working conditions, handling and exchanging information, scientific research and in accessing information communication technologies. In this digital era, ICT use in the classroom is essential for giving teachers opportunities to learn and apply the vital 21st century skills. ICT improves teaching and learning and its significance for teachers in playing their role of creators of pedagogical environments. The present study was conducted on "Teacher's perspectives towards integration of ICT in classrooms" with a sample size of 100 teachers. The data was collected on attitude of teachers about computer related practices and extent of ICT integration in classrooms by the teachers with the help of the questionnaire. Finding of the study depicts that majority of the teachers were having favorable attitude about ICT and they were inclined towards the integration of ICT in classrooms. Thus it may be concluded that ICT tools and facilities is one the main factors in success of technology-based teaching and learning. For the future studies, there is a need for consideration of other aspects of ICT integration in classrooms especially from management point of view in regard to strategic planning and policy making.

Keywords: ICT, Education, Learning, Teaching, Technology

INTRODUCTION

ICT includes the internet, wireless networks, cell phones and other communication mediums. It means we have more opportunities to use ICT in teaching and learning process now days and improve quality of education. Teachers are the main part of the educational field and works more for the improvement level of our society in the every field. Skilled teachers can formulate the creative students in form of the good social worker, philosopher, politician, poet, etc. for the society. The rapid development of technology has made creatively changes in the way we live. Recognizing the impact of new technologies on the everyday life, today's education institutions try to restructure their education programs and classroom facilities, in order to reduce the teaching and learning technology gap between today and the future. ICTs are making dynamic changes in our society. They are influencing almost all aspects of life. The influences are felt more and more in education sector. Because ICTs provide both teachers and students with more opportunities in adapting teaching and learning to individual needs.

The new information technology tools and techniques can play an enormous role to improve communication especially by way of effective media. Both teachers and students need to keep themselves updated with current happenings to be competent in this globalized era. All these things can be possible through proper facilities. In order to be reflective on the usage of ICTs, there should be examination of the teacher's attitudes about computer-related practices and extent of ICT integration in classrooms by the teachers. Keeping in mind the role of ICTs, the present study was carried out with the following specific objectives:

1. To study the teacher's attitude about computer-related practices
2. To study the extent of ICT integration in classrooms by the teachers

*Corresponding author email id: naazbano1995@gmail.com

Ertmer (2005) found that that employing ICT in the classroom makes the learning environment more dynamic since students participate more when teachers utilize ICT tools in the classroom. The students are actively participating in the conversation. Teachers also stated that incorporating ICT allows students more freedom to learn at their own speed. Students can change the slides to their level of understanding. ICT also gives enough room for students with special needs. A student with a hearing impairment can benefit from audio-based learning materials.

Tooley (2007) the key motive for parents from slum communities to send their children to private institutions for education is the availability of computer education and other ICT tools.

Hermans *et al.* (2008) found three main stages for ICT to be highly valued and effective by the teachers; integration, complementary and enhancement. Integration approach is about implementing right use of ICT in all subject areas that involved complex concepts and skills to improve student's attainment and achievement. For instance, Microsoft PowerPoint can be used to present the topic in a very creative and innovative way that will also lead into discussion and exchanging ideas and thoughts.

Singh *et al.* (2009) analyzed the use of Internet based e-resources at Manipur University. It was shown that 30.7 percent of respondents use the Internet to a limited level, 28.8 per cent to a limited extent, and 13.1 percent to a full level. However, 27.4 per cent of those polled do not use the internet.

Adebayo (2012) found that information and communication technology (ICT) had considerable impact on the administration of polytechnic in Ogun, State Nigeria. The impact were found to be relevant to senior academic & administration officers of polytechnics in ICT offering solutions to specific difficulties of administration. ICT promotes administrators' decision-making abilities in the administration of polytechnic. It also ensures efficient administrative processes for people and material resources, as ICT has the potential to handle equal amounts of data at the fastest possible speed.

Sarkar (2012) reported that organization of ICT in scholastics is developing at a faster rate across the country, according to the findings. One of the most common problems in using ICT in the classroom is separating the need for innovation from the need for instruction. Using ICT to update the nature of training with improved showing technique can open up a variety of learning opportunities. The use of ICT in advanced education has the potential to increase academic performance as well as the country's financial condition.

Bhalla (2013). Teachers in India have been observed using computers for short periods of time and for a limited number of tasks, indicating that computers are not effectively integrated across the curriculum.

Gupta (2015) indicated that education, achievement motivation, and innovativeness were all found to be favourably and significantly connected to the level to which ICTs were used. Richard (2015) observed that the selection and utilization of ICT in instruction positively affect educating, learning, and research. ICT has the potential to change the way instruction is delivered and to enable more widespread access to it. It will also increase adaptability so that students can get training regardless of time or geographical limitations in the twenty-first century. It has the potential to influence how understudies are educated and learn. It would provide a rich environment and inspiration for demonstrating learning processes that appear to have a substantial impact on the way students and instructors learn in class by providing new potential outcomes for students and teachers.

Bakir (2016) with the opening of the gates of liberalization in India in 1991, the educational sector saw an influx of private schools and the presence of multinational schools. These developments underscored the need of instructors being willing to experiment with the use of computers and other ICT resources in the classroom.

MATERIALS AND METHODS

The study was conducted in the purposively selected Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. All the colleges of university including I.C. College of Home Science, College of Basic Sciences, College of Agriculture and College of Agriculture Engineering & Technologies were selected for conducting research on the usage of ICTs by teachers. The proportionate sample of 100 teachers was selected from all the colleges of Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana. Simple random sampling technique was used for selection of the respondents.

Keeping in view the objectives and the variables under study, questionnaire was prepared for teachers and pre-

tested on non-sampled respondents to find any ambiguity in the questions. After pre-testing some modifications were made in the questionnaire by consulting experts and finalized questionnaire was used for data collection. The teachers were asked about attitudes towards computer-related practices and extent of ICT integration in classrooms. The responses offered were summarized on the basis of number and percent of respondents who reported for the respective response.

RESULTS

A cursory look on the data of Table 1 gives us an idea about teachers' skills and knowledge included their online skills under different aspects like browsing, downloading, uploading, use of educational blogs/websites, the use of Open Educational Resources (OERs) and basic programming skills. Majority of the participants' browsing skills were at medium (28.80%) to high (26.70%) levels and 20.40 per cent of them had low and below levels. The graph for downloading skills remained somewhat similar to their browsing skill, 39.90 per cent were at medium and 28.70 per cent were at high levels. In their uploading skills, 20.90 per cent of teachers admitted to having low level, 27.70 per cent were at medium level, 21.40 per cent had high level skills and 29.80 per cent were experts. Forty-one percent of the respondents had medium level skill in the use of educational blogs/websites, 22.00 per cent had low level, and 17.80 per cent had high skill rating. Only 17.80 per cent had low level skill in the use of OERs i.e., using YouTube, Google, etc. whereas 36.10 per cent of them had medium and 25.60 of them had higher level skill. With respect to the basic programming, 47.50 per cent participants reported to have expert level of skill in basic programming, i.e., Logo, Scratch, etc., and 35.50 per cent had low level skill. Teachers' attitudes toward technology were measured according to their experiential and conceptual views. It is clear from the Table 2 that, 40.80 per cent of teachers disagreed 32.50 per cent and strongly disagreed that the technological advancements made them feel tense and uncomfortable whereas 20.90 per cent reported to be holding a neutral opinion and only 5.20 per cent agreed. Similarly, 43.90 per cent of the teachers disagreed and 30.30 per cent strongly disagree that computer-related technologies made their work more difficult whereas 16.80 per cent held a neutral opinion and only 8.40 per cent of them agreed to it.

Table 1: Percentage of teachers in the different online skills category (N=100)

Tool	Category			
	Low (%)	Medium (%)	High (%)	Expert (%)
Browse	20.40	28.8	26.70	24.10
Download	15.20	30.90	28.70	25.20
Upload	20.90	27.70	21.40	29.80
Use of websites	22.00	40.70	17.80	19.30
Use of OERs	17.80	36.10	25.60	20.40
Basic Programming	34.50	11.00	6.80	47.50

Regarding the teacher's views on their colleagues having a positive experience in teaching with technologies. Similarly, 66.40 per cent teachers agreed and 13.50 per cent strongly agreed, whereas 16.20 per cent of them held a neutral opinion and 2.60 per cent disagreed. With respect to the support and encouragement from university to

Table 2: Teacher's Attitudes about Computer-Related Practices (N=100)

Statements	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
Feeling tense and uncomfortable	32.50	40.80	20.90	5.20	0.50
Making professional work more difficult	30.30	43.90	16.80	8.40	0.50
Colleagues having positive experience	1.00	2.60	16.20	66.40	13.60
Support & encouragement from university to integrate technology in teaching	1.60	2.60	23.00	59.60	13.10
Technology as important part of future of education	1.60	0.50	3.70	61.20	32.90
WhatsApp groups as useful resources	2.10	2.60	6.80	62.80	25.60
Technology as necessary tools in both education and work settings	1.60	1.00	7.30	67.50	22.50
Computer as useful educational aids in all subjects	1.60	2.10	9.90	61.20	25.10
More disadvantages than advantages in teaching with technology	24.60	40.80	20.90	12.50	1.00
Traditional chalk and board as the only way to teach effectively	20.40	45.50	16.70	14.70	2.60

integrate technology in teaching 59.60 per cent of them agreed and 13.10 per cent strongly agreed that university supported and encouraged them to integrate technology in teaching whereas 23 per cent remained neutral, and 2.60 per cent disagreed. Teachers' attitude about computer-based technologies slotted under their conceptual view. The results had higher percentage of positive response compared to the ones derived from the experiential view of teachers. More than half of the respondents (61.20%) believed that computer-related technologies played a very important role in improving the quality of education and as important part of future of education and 32.90 per cent strongly agreed on it, whereas 3.70 per cent of them remained neutral.

When respondents were asked if WhatsApp groups were useful resources, more than half of them (62.80%) agreed and 25.60 per cent strongly agreed, whereas only 6.80 per cent held a neutral view and 2.60 per cent of them disagreed. More than half of the teachers (67.50%) teachers agreed and 22.50 per cent strongly agreed that computer-related technologies were necessary tools in both educational and work settings while 7.30 per cent were neutral and 1% disagreed with it. The next statement to analyze teacher's attitude they were asked if computers can be useful educational aids in almost all subject areas. Around eighty-seven percent of the participants responded positively to it (61%.20 agreed, and 25.10% strongly agreed), 9.90 per cent remained neutral, and only 2.10 per cent disagreed. Another statement enquired if there were more disadvantages than advantages in teaching with technology 41.80 per cent teacher disagreed and 24.60 per cent teacher strongly disagreed to it, while 20.90 per cent of them remained neutral and only 12.50 per cent agreed to it. The last statement under the attitude section of the study sought to find out if teaching with the help of traditional chalk and board method was the only way to teach effectively, 45.50 per cent teachers disagreed and 20.40% strongly disagreed to it. Only 14.70 per cent agreed to it.

Table 3 depicts integration of ICT into teaching. The first statement enquired if the participants had tried to determine the usefulness of computers in their teaching career. There was no teacher who disagreed with it. Majority of the teachers (74.30%) were agreed and 8.40 per cent teachers strongly agreed to it, while 17.30 per cent remained neutral. The next statement was to determine if the teacher planned to continue teaching with computer-related technologies and it was found that more than half of the teachers (67.00%) were agreed 13.10 per cent were strongly agreed to it. Not a single respondent strongly disagreed and only 1.60 per cent disagreed, whereas 18.30 per cent of the respondent remained neutral. The third decision-based statement was whether the teacher was interested in increasing the use of computer related technologies in their teaching activity. Again, to this, 64.30 per cent teachers agreed and 14.10 per cent of them strongly agreed, whereas 20.90 per cent of the teachers remained neutral. The next statement had a negative tone as it stated that a teacher used technology in teaching for some time but then decided to stop using it anymore. Forty-six percent of teachers disagreed and 12.60 per cent strongly disagreed to it, while 26.10 per cent remained neutral and only 1.60 per cent of teachers strongly agreed. The last statement was again in a negative tone and enquired if the teacher had never considered the integration of computers technology in their teaching. Regarding this, 22 per cent teachers strongly disagreed and 47.60 per cent disagreed whereas 13.60 per cent of them remained neutral to this question and only 1.60 per cent of them strongly agreed to it.

Table 4 indicates expectations of university to integrate ICT into teaching. When teachers were asked to report on whether university expects from them to have technical

Table 3: Integration of ICT into teaching by the teaches (N=100)

Statements	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
Tried to determine usefulness of ICT	-	-	17.30	74.30	8.40
Plan to continue to use ICT in my teaching	-	1.60	18.30	67.00	13.10
Interested in increasing my use of ICT in teaching	-	0.50	20.90	64.30	14.10
Used ICT then decided to stop it	12.60	46.00	26.10	13.60	1.60
Never considered integration of ICT in my teaching	22.00	47.60	13.60	15.20	1.60

skills to use technology, 67.50 per cent agreed and 8.90 per cent strongly agreed while 16.70 per cent of teachers remained neutral and only 6.80 per cent disagreed with it. The next statement enquired whether or not the university expected the teacher to teach lessons that appropriately combined one's course content, technologies, and teaching approaches, and to this, around seventy per cent (69.50%) teachers responded positively and agreed to it, whereas 17.80 per cent teachers remained neutral and only 3.10 per cent teachers disagreed.

The next statement to which the teachers responded was the question which stated that the university had no expectation from the teacher to use computers in teaching and regarding this 43.40 per cent disagreed and 20.90 per cent strongly disagreed while, 19.50 per cent remained neutral and only 13.60 per cent of them agreed and 2.10 per cent strongly agreed. The last statement under this section stated that the university expected the teacher to continue using computers in teaching. This confirmed whether the ICT integrating program in teaching at university was sustainable or not. More than half of the respondents (50.20%) agreed and 6.70 per cent strongly agreed with it, while 32.40 per cent remained neutral and 9.40 per cent disagreed with it.

The data of Table 5 depicts extent of utilization of ICT by the teachers. A weekly usage of computers was reported by sixty-three percent of teachers for their job/ work and 66.00 per cent of them for using computers for teaching purposes. Thirty-eight percent teachers said to have weekly usage of technologies at home for schoolwork whereas 30.00 per cent said to have used it daily and 28.00 per cent said monthly. Majority of the teachers (72.00%) responded that they use WhatsApp on daily basis to communicate with other teachers. When the respondents were asked about the usage of email to communicate with colleagues, there was a mixed response

Table 4: Expectations of university to integrate ICT into teaching (N=100)

Statements	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
University expects teachers to have technical skills	-	6.80	16.70	67.50	8.90
University expects to teach combining course content, technologies and teaching approaches	-	3.10	17.80	69.50	9.40
University has no expectation to use computers in teaching	20.90	43.40	19.50	13.60	2.10
University expects continuation of use of technology	1.00	9.40	32.40	50.20	6.70

Table 5: Extent of utilization of ICT by the teachers (N=100)

Statements	Once in six months (%)	Monthly (%)	Weekly (%)	Daily (%)
How often do you use a computer for your job?	6.00	24.00	63.00	8.00
How often do you use technologies that you have at home for schoolwork (e.g., smart phone, tablet)?	5.00	28.00	38.00	30.00
How often do you use WhatsApp to communicate with teachers?	3.00	4.00	21.00	72.00
How often do you email to communicate with colleagues?	47.00	31.00	15.00	6.00
How often do you print teaching materials?	11.00	40.00	26.00	24.00
How often do you use computers for teaching?	7.00	21.00	66.00	6.00
How often do you use presentation programs (e.g., PowerPoint) in classes?	7.00	20.00	59.00	15.00
How often do you use video projectors in classes?	16.00	21.00	60.00	3.00
How often do you ask students to consult Internet materials for your classes?	13.00	30.00	43.00	14.00
How often do you use the Internet to prepare your classes?	7.00	30.00	41.00	19.00
How often do you use Web 2.0 tools (e.g., Wiki, Blog, YouTube, Google, FB, Twitter) for your classes?	8.00	27.00	43.00	31.00

by the teachers as 31.00 per cent of teachers said to be using email monthly, 47.00 per cent said to have used it once in six months and 15.00% said to have used it weekly. On how often teachers printed teaching material, 40.00 per cent said monthly, 26.00 per cent said weekly, 24.00 per cent said daily and only 11 per cent said once in six months. More than half of the teachers said to have used presentation programs weekly e.g. PowerPoint and video projectors in classes (59.00% and 60.00% of teachers respectively). There were last three statements based on web usage. Majority of the teachers (43.00%) responded that on a weekly basis they asked their students to consult Internet materials for classes. Forty one per cent teachers responded that they used the Internet themselves to prepare for classes and 43.00 per cent of the teachers, used Web 2.0 tools (e.g. wiki, YouTube, Google, etc.) weekly for their classes (43%).

CONCLUSION

Thus it may be concluded that majority of the teachers had favorable attitude about information and communication technologies. ICT was also reported as a tool to enhance the instruction in clarifying the concepts and challenges. Majority of the respondents were utilizing ICT tools to higher extent and had positive perception. For effectively harness the power of the new information and communication technologies (ICTs) teachers must have adequate access to digital technologies and the internet in the classrooms, teacher education institutions and universities.

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Cost friendly Experimental Designs for Product Mixtures in Agricultural Research

Rahul Banerjee[1], Seema Jaggi[2], Arpan Bhowmik[1]*, Eldho Varghese[3], Cini Varghese[1] and Anindita Datta[1]
[1]ICAR-Indian Agricultural Statistics Research Institute, New Delhi-110012
[2]ICAR Head Quarter, New Delhi-110012
[3]ICAR-Central Marine Fisheries Research Institute, Kochi-682018, Kerala

ABSTRACT

Sustainable agriculture practices are the one that caters for the present without compromising for the future generations and at the same time maintains and enhances environmental quality. With the depletion in the quality environmental conditions and an increase in the global population there is an immense need for ensuring sustainability in agricultural practices. Agricultural research can be thought to be as the backbone for bringing out alternative sustainable agricultural methodologies. Precise formulation of agricultural experiments for research requires the application of appropriate statistical tools particularly accurate situation specific designing and analysis of the experiments. There are several experiments in agricultural research where the response depends only on the proportions of the factors in the experiment. The theory of mixture experiments plays a crucial role in such situations and it has wide applicability in agricultural research. One of the difficulties in Mixture Experiments is the generation of design points specific to situation and model chosen. In this study we have attempted to develop an algorithm to obtain designs for mixture experiments specific to the situation. The algorithm is versatile in terms of the situation, number of runs in the design and other parameters and hence has wider applicability. The application of the algorithmic approach of design generation will also lead to minimization in the computational cost involved in the experiments.

Keywords: Algorithmic approach, Design generation, Mixture design, Mixture experiments, Nonlinear models

INTRODUCTION

Agriculture has predominantly been the most crucial source of subsistence for the mankind since times immemorial. It is the lifeblood to half of the global population even in the present scenario. As per, Food and Agriculture Organisation (FAO), Rome citizens of developing countries with an increasing trend in population size will face acute shortage of food security with a rise in hunger if the global food production does not increase on an average by 50-60% (Harender *et al.*, 2019). Thus, one of the most important contemporary requisites is to sustain natural resources at the same time while protecting environment. Sustainable agriculture is aimed at optimum management of natural resources for agriculture in order to quench the growing human needs at the same time maintaining the environmental quality by conservation of natural resources. Agricultural research is the backbone for ensuring sustainability of agriculture. Precise and planning of agricultural research is a prerequisite for finding valid inferences which would lead to formulation of efficient research policies for ensuring sustainability. Here lies the importance of statistics or specifically design of experiments for correct planning and designing of agricultural experiments according to situations. Situation specific precise designing and formulation of agricultural experiments will lead to accurate and precise inferences. The field of Mixture designs has huge applicability in agricultural research as several of the situations in agricultural experiments are that of mixture experiments. A mixture experiment is one in which the response is depends only upon the proportions of the mixture components and is independent on the amount of the mixture. A mixture is the final product obtained by mixing two or more components, the mixture components are called mixture ingredients. In a mixture experiment the sum total of the mixture component proportions are fixed as

*Corresponding author email id: arpan.stat@gmail.com

the ingredient proportions must add up to one. In case of agricultural experiments, the ingredients maybe several sources of nutrients used in making a fertilizer, it may be several proportions of the chemicals used in the formulation of a pesticide or an herbicide or the ingredients may be inputs at different crop growth stages in splits so that the total quantity of input applied to the crop is fixed. Similarly, in animal husbandry and veterinary feeding trials to study the response of feed to milk yield or body weight the total feed intake supplied to the animal is same and in combinations of different components (Murty and Das, 1968).

{Experimental Situation, Cornell (1981), pp.47} Four chemical pesticides *viz.* Vendex, Omite, Kelthane and Dibrom were sprayed on strawberry plants in an attempt to control mite population and a fixed dose say '*a*' of these four chemicals are applied in fifteen different combinations. Each chemical was applied individually and in combination with each of the others such that total dose of pesticide is same in all the fifteen treatment combinations. The objective of the experiment was to obtain the optimum combination of all the four pesticides to control mite population in strawberry.

In all the above examples the treatments are ingredients of the mixture and their proportions and the response is dependent only on the relative proportions of the ingredients present in the mixture. Thus we can infer that Mixture experiment methodology has wide application in agricultural research. Designing of a mixture experiment generally refers to selection of the proportions of the mixture ingredients in such a fashion such that a mathematical model can be fitted adequately to represent the mathematical relationship between response and ingredients of the mixture and at the same time ensure appropriate estimation of the parameters of the model. The design will also be able to find out combinations of the ingredients that will lead to optimum response. The components of the mixture geometrically represent a simplex. Mixture designs are essentially descriptions or layouts of the design points or mixture components. There are several mixture design available in literature few of which are Simplex Lattice Designs (Scheffé, 1958), Simplex Centroid Designs (Scheffé, 1963), Axial Designs (Chan *et al.,* 1999), Extreme Vertex Designs (McLean and Anderson, 1966) etc.

In agricultural sciences we often come across situations for mixture experiments in which the response exhibited is nonlinear. An experimental situation of the same has been given in (Cornell, 2002). For, situations exhibiting a nonlinear response, nonlinear models would be able to explain the situation in a much more efficient manner as compared to linear models. Besides, nonlinear models also have the advantage of having fewer parameters as compared to linear models. Most of the designs available in literature for Mixture experiments are linear in nature. Thus, there is a need to devise methodologies for obtaining designs for mixture experiments with nonlinear models. Algorithmic approach provides a great alternative for design construction for mixture experiments. Algorithms provide versatility in terms of number of runs of the design, model to be selected as well as the objective function to be chosen. Few Algorithms for Design generation already available in literature include the Detmax algorithm (Mitchell, 1974), KL Exchange algorithm (Atkinson and Donev, 1989), XVERT algorithm (Snee and Marquadt, 1974) and XVERT 1.0 algorithm (Nigam, 1983). There is also a lacunae for simple computer based solutions for design construction in mixture experiments adapting to different choices of models and continuous input variables. Toolkits like GOSSET, OPTEX procedure in SAS, statistical toolbox in MATLAB and AlgDesign package in R are well suited for design generation particularly for linear models with discrete factors however, they are not suitable for Nonlinear models and particularly with continuous factors there's a huge increase in the computational cost. In this study we have modified the Fedorov algorithm (1972) to obtain saturated locally D-optimal designs for mixture experiments with and without restrictions for a wide variety of models. The optimality criteria were satisfied using General Equivalence theorem extended to Nonlinear models by White (1973) and Whittle (1973). Lall *et al.* (2018a and c) have used algorithms to construct D-optimal designs for Exponential and Poisson regression model in Response Surface Experiments. Lall *et al.* (2018b) have also used algorithms to construct D-optimal designs for logistic model in Response Surface Experiments.

MATERIALS AND METHODS

For a mixture design with q components if the proportion of the i^{th} component is represented by x_i, then, the design space is represented by a q-1 dimensional simplex denoted by S_{q-1} and the following conditions hold true:

$$x_i \geq 0, \sum_{i-1}^{q} x_i = 1$$

These restrictions are fundamental for the formulation of any Mixture experiment design. The algorithmic method of design generation can be viewed as an optimization problem. The objective function can be chosen as per the criteria for design generation. In our example the objective function is the determinant of the Fishers Information Matrix fulfilling the D-optimality for obtaining the designs. Initially the *expand. grid* function of the R software is chosen to obtain a uniform candidate set of design points with minimal discrepancy fulfilling the model chosen and the constraints imposed. The objective of the algorithm is to look for the D-optimal design in the vicinity of the candidate set assuming that the optimal design exists in the vicinity. The Fedorov algorithm has been used to search the D-optimal design in the Fedorov algorithm each row of the design is replaced with new design points from the vicinity if there's an improvement in the objective function. This iteration is repeated until there is no improvement in the objective function and then the design obtained is the locally D-optimal design for that particular model. The algorithm also provides a flexibility in terms of the number of runs to be selected for the design for our case we have considered saturated designs. A saturated design has number of runs equal to the number of parameters to be estimated in the model. Saturated designs are advantageous in the sense that they are smaller designs and hence can lead to a significant reduction in computational cost. The step wise algorithmic procedure is mentioned below:

Steps of the Algorithm

1. The model to be fitted is chosen first.
2. In the next step the variables of the model as well as their range is specified.
3. In the third step a candidate set (CS) or a design space is generated consisting of a continuous grid of equidistant discrete points.
4. Then, the initial parameter guesses for the model and the number of runs required for the design is determined.
5. An initial design with a positive Fishers Information Matrix is chosen at random from the candidate set.
6. In the next step exchange of row coordinates of the design is performed iteratively with the coordinates from the vicinity. The coordinates are exchanged in such a fashion such that there is an improvement in the objective function.
7. All the above steps are repeated continuously until there is no such improvement observed in the objective function. At this step the design obtained is locally D-optimal design corresponding to the model selected and the constraints imposed.

The D-optimality criteria of the designs are verified using General Equivalence theorem.

RESULTS AND DISCUSSION

The above methodology has been used to obtain designs for linear as well as Nonlinear models. In all these designs the specific models are chosen, the initial parameter guesses of the parameters of the models are chosen, the number of runs for the design are determined and the algorithm is run. The designs obtained are specific to the model and the initial parameter guesses selected.

Two components mixture and three parameters: The design entails the situation with two mixing component and three parameters in the model considering the interaction term. Thus a saturated design would have 3 runs. The initial parameter guesses are given and the designs are obtained at different increments. The increments considered are 0.01, 0.02, 0.03, 0.04, 0.05, 0.06 and 0.10 respectively. The value of $|\mathbf{M}|$ shown in the table is the value of the Fishers Information Matrix obtained for the D-optimal design corresponding to the model and the particular increment. The designs obtained is mentioned in Table 1.

Here, we can see that the design obtained remains same for the increment size 0.01, 0.02, 0.05, 0.06 and 0.10 however it changes for increment size of 0.03 and 0.05. It is evident from the table that the size of the candidate set is an inverse function of the increment size as the increment is increased the candidate set becomes smaller and smaller.

Mixture designs for a logistic model: There often exist situations in agricultural problems where the response obtained is qualitative in nature, for eg. In baking a cake, the response may be the texture of the cake say firm or soft or in preparing a fruit punch the response maybe the taste of the punch. All the above cases are examples of mixture experiments with a qualitative response variable. In case of qualitative response variables, the relationship is usually Nonlinear in nature and the distribution is often Nonnormal. Here, we have taken such a situation where the response is qualitative. The response has been approximated using a three parameter logistic model for

Table 1: D-optimal Saturated Mixture Designs for Two Components Mixture

Model	$\eta = \beta_1 x_1 + \beta_2 x_2 + \beta_{12} x_1 x_2$; $0 \leq (x_1, x_2) \leq 1$; $x_1 + x_2 = 1$			
Increment	Size of the candidate set	D Optimal design obtained		$\|M\|$
		x_1	x_2	
0.01	101	0.5	0.5	0.002314
		0.0	1.0	
		1.0	0.0	
0.02	51	0.5	0.5	0.002314
		1.0	0.0	
		0.0	1.0	
0.03	34	0.49	0.51	0.002310
		1.0	0.0	
		0.0	1.0	
0.04	26	0.52	0.48	0.002307
		1.0	0.0	
		0.0	1.0	
0.05	21	0.5	0.5	0.002314
		1.0	0.0	
		0.0	1.0	
0.06	17	0.5	0.5	0.002314
		1.0	0.0	
		0.0	1.0	
0.10	11	0.5	0.5	0.002314
		1.0	0.0	
		0.0	1.0	

Table 2: Mixture designs for a logistic model

Model $\eta = e^{-\phi^i} / (1+e^{-\phi_i})^2$, $\phi_i = \theta_1 x_{1i} + \theta_2 x_{2i} + \theta_3 x_{1i} x_{2i}$; $x_1 + x_2 = 1$				
Increment	Size of the candidate set	D Optimal design obtained		$\|M\|$
		x_1	x_2	
0.01	101	0.0	1.0	0.00001097
		0.52	0.48	
		1.0	0.0	
0.02	51	0.52	0.48	0.00001097
		1.0	0.0	
		0.0	1.0	
0.03	34	0.52	0.48	0.00001096
		1.0	0.0	
		0.0	1.0	
0.04	26	0.52	0.48	0.00001096
		1.0	0.0	
		0.0	1.0	
0.05	21	0.5	0.5	0.00001093
		1.0	0.0	
		0.0	1.0	

a mixture model with two mixing component taking into consideration the interaction term. The algorithm has been run for five increments namely, 0.01, 0.02, 0.03, 0.04 and 0.05 with initial parameter guesses and the designs have been obtained in three runs. The D-optimal designs obtained for each of the increments has been mentioned in Table 2. The value of represents the value of the Fishers Information Matrix for the optimal design corresponding to each such increment.

CONCLUSION

The importance of agricultural research in the changing times of environmental conditions and with the importance on sustainability is immense. One of the key factors to ensure achievement of sustainability in agriculture is the correct planning and operation of agricultural research. Thus, the role of statistics and in particular design of experiments is crucial in correct designing of the agricultural experiments so that the inferences obtained from the experiments are valid and accurate. Since, a lot of situations in agricultural research from agronomical experiments to post harvest and food processing trials entail a mixture experiment situation. Thus, the correct application of mixture designs to agricultural situations is crucial to such problems. In this paper we have proposed an algorithmic methodology to obtain designs for mixture experiments under different situations. The algorithmic approach is versatile in the choice of the model, the number of runs of the design, constraints imposed on the model and also in optimality criteria of the designs. Thus the algorithmic methodology can act as an alternative for generation of designs for mixture experiments suiting to different conditions and situations. The application of the proposed algorithm can also help in minimization of the computational cost involved in design generation. All computations presented here were performed by developing suitable R-codes available with the authors.

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Constraints and Suggestions on Technology Dissemination System of State Department of Agriculture (SDA) as Perceived by the Extension Personnel in Kerala

Modem Ravikishore[1]*, B. Seema[2] and P. Supriya[3]
[1]Scientist (Agricultural Extension), Krishi Vigyan Kendra, Reddipalli, Bukkarayasamudramu, Anantapuram-515701, Andhra Pradesh
[2]Professor and Head, Department of Agricultural Extension, College of Agriculture, Vellayani, Trivandrum–695522, Kerala
[3]Scientist, ICAR- National Academy of Agricultural Research Management, Hyderabad–500030, Telangana

ABSTRACT

The paper focuses on the constraints experienced and suggestions proffered by extension professionals in using technology dissemination systems of State Department of Agriculture (SDA) in Kerala, India. The need of modern technology dissemination systems for technical information transfer in SDA can be identified by recognizing the problems in using the traditional system for technical information transfer. However there are some constraints experienced by extension professionals in using technology dissemination systems of SDA which needs to be analysed for effective implementation of the programmes and schemes by extension professionals'. A survey was conducted among Kerala extension professionals using 100 respondents who were actively involved in the fields of agriculture. Based on discussion with scientists, experts in agriculture and also through relevant review of literature, fourteen constraints experienced by extension professionals' were identified. These constraints were ranked based on importance. Results showed that the major constraint faced by Kerala extension personnel was 'lack of training to employees on technology dissemination methods' which was ranked first among fourteen constraints. In order to overcome these constraints so as to enhance the capability of extension professionals in utilizing technology dissemination systems of SDA, regular and relevant training should be provided. For this, SDA has to conduct training need analysis of extension personnel followed by training, involving the experts from State Agricultural Universities (SAUs) and Indian Council of Agricultural Research (ICAR) institutes to inculcate the knowledge on modern technology dissemination approaches.

Keywords: Information, Perception, Schemes, State department of agriculture, Technology dissemination

INTRODUCTION

Agricultural extension has multiple goals, including transferring knowledge from global, national, and local researchers to farmers, helping them clarify their own goals and assessing their opportunities, educating them about decision-making processes, and promoting desirable agricultural development (Msuya *et al.,* 2017). Agricultural extension professionals of State Department of Agriculture (SDA) are personnel who are responsible for meeting the goals of extension system. The effectiveness of extension services is highly dependent on the ability of extension workers who are competent because the entire extension process is dependent on them to transfer information from extension organizations to the farmers (Ravikishore and Seema, 2017). But in the contemporary scenario, agricultural extension organizations face challenges of professional competence among their employees across the world. Capacity, management and advisory services of any organisation are critical components of an effective extension system. But this very much depends upon the role of extension agent is expected to play (Christoplos, 2010). The agricultural extension service is the foundation of any substantial growth in the country's agriculture sector. Extension workers are therefore the main players in serving the agricultural community and are required to transform their expertise, skills and mind-set by disseminating up-to-date information needed to make real-time decisions to

*Corresponding author email id: mravikishore26@gmail.com

improve their livelihoods (Okwoche *et al.,* 2015). Extension functionaries are mainly appointed to enable the transfer of technology from research station to farmers who are the ultimate users (Priyanka and Sajib, 2017). Agricultural technology delivery is the main activity of the State Department of Agriculture (SDA) in Kerala, as in many states of India, is on the brink of major reforms to server the ever changing needs and problems of farming clientele. The problem of extension personnel and indeed technology dissemination systems of SDA became prominent with the growing food demand of burgeoning population in India. Considering that improved and refined technology dissemination systems of SDAs are the veritable means of bringing about improvement in the current performance levels of extension personnel in executing the same at its best for better outreach and utility among the farmers. Human resources are a fundamental bottleneck to effective extension services, given the challenges facing agricultural development. The extension agents of the future or the new extension professionals will have a responsibility that goes beyond providing farmers with technical information. They should require 'soft' or functional skills that enable them to generate and promote innovations; improve the management of farmer organisations and agribusinesses, and build alliances and networks of different groups and individuals along the value chain (Pye-Smith, 2012).

The important constraints expressed by the extension functionaries involved in the Department of Agriculture were, too many schemes and vacancies, less demonstrations on existing farming systems in the state and lack of technological training on different farming systems pertaining to agriculture and allied departments and major suggestions offered were, filling up of existing vacancies and intensifying technological trainings to stakeholders involved in agriculture and allied departments (Kumar *et al.,* 2009). A study on farmers' view on privatization of agricultural extension services revealed that, organizational and functional constraints predominant in any organization includes huge work load of ground level workers, job security issue, lack of proper training, high business orientation, price of products above affordability of farmers and lack of whole family approach (Jiyawan *et al.,* 2009). The major constraints of extension personnel that were facing in their jobs are the usual rejection of production recommendations of department by the farmers, delay or denial of promotion to the extension functionaries, inadequate salaries and allowances and too large areas for coverage by Extensions Agents (EAs) (Olatunji *et al.,* 2015). SDA was expected to play an imperative role in the holistic development of agriculture but failed due to a number of weaknesses and challenges and cannot obtain the desired goals. There are many reasons for not being capable to have a significant impact such as, no incentives for extension personnel's, lack of agricultural planning, weak policies, and communication gaps among the researchers and farming community resulting to low adoption of improved practices (Takenaka, 2006). Planning, training and management of human resources within extension organizations are essential to increase the capabilities and overall effectiveness of extension personnel (Lashgarara *et al.,* 2011). It is obvious that the poor educational background of extension personnel and the rapid changes occurring in the extension environment necessitate regular in-service training to help extension agents develop the knowledge, skills and attitudes in agriculture (Gebrehiwot *et al.,* 2012). Yet, the real and main challenges of extension personnel in technology dissemination of SDA had not been investigated so far and this was the concern of policy makers at all levels of Kerala. Keeping this in view, the present study was conducted to ascertain the constraints of extension functionaries in technology dissemination system of SDA with suitable suggestions in order to enhance the performance effectiveness of technology dissemination system of SDA.

MATERIALS AND METHODS

The State of Kerala, is a tiny strip of land having an area of 38.86 lakh ha (1.185% of the national land area), situated west of Western Ghats of India. It is located in the humid tropics between the latitudes of 8°18' and 12° 48'N and longitudes of 74°28' and 77°37'E. The State of Kerala, named as the "Gateway of monsoon in India" is one of the unique regions in the humid tropical monsoon climates that enjoys high solar radiation and warm temperature round the year. The State has rich bio-diversity and tropical rain forests and is spread in 13 agro-ecological zones under the humid tropics. Out of a total area of 38.86 lakh ha, net sown area is about 56 per cent. Forest occupies about 28 per cent. Agriculture and forest sectors together account for more than 84 per cent of the land area. The food crops comprising of rice, pulses, miner millets and tapioca occupy only 11.86 per cent, out of a gross cropped area of 26.69 lakh ha. Though Kerala is identified as a plantation State, the major staple food crop is rice. Cash crops include

coconut, arecanut, rubber, cashew, tea, coffee and cocoa. Black pepper, cardamom, cinnamon, clove, turmeric, ginger, nutmeg and vanilla are major spice crops in Kerala (Gopakumar, 2011)

A survey was conducted during 2016-2018 among Kerala extension professionals to evaluate constraints experienced by extension professionals in using technology dissemination systems of SDA for the betterment of farming community. The sample of the study constituted 100 respondents with a minimum of 25 extension professionals each from the four National Agricultural Research Project (NARP) zones which includes High Range zone comprising of Wayanad and Idukki, Central Zone comprising of Ernakulum, Thrissur, Palakkad and Malappuram districts, Northern zone comprising the Districts of Kasaragod, Kannur and Kozhikode and Southern zone comprising Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha and Kottayam districts. The purposive random sampling was done in the sampling area in order to arrive at valid conclusions regarding technology dissemination systems of State Department of Agriculture (SDA).

Based on discussion with the senior management of SDA, experts in agriculture and also through relevant review of literature, some of the constraints experienced by the extension personnel on technology dissemination system of SDA were identified. A list containing fourteen such constraints were included in the final questionnaire. The response to each constraint was obtained on a five-point continuum from most important to least important, with the score 'five', 'four', 'three', 'two' and 'one' respectively from the sample of 100 respondents. After which each of the constraint recorded score by all the 100 respondents was summed up wherein the maximum possible score was 500 (Most important score by each respondent for each constraint 5 X Total Sampled respondents i.e. 100) and minimum possible score was 100 (Least important score by each respondent for each constraint 1 X Total Sampled respondents i.e. 100) for each of the constraints with the data range from 100 to 500 and based on the obtained total score for each constraint the mean scores were calculated using the following formula.

$$\text{Mean Score for each constraint} = \frac{\text{Sum of the scores obtained for each constraint}}{\text{Total sampled respondents}}$$

Based on the mean scores the ranking was done and the highest mean score constraint was considered as the first ranked constraint. At the time of interview, the respondents were asked to enumerate the suggestions to overcome the constraints faced by them. Therefore, suggestions with maximum responses could be counted and frequency/percentage was worked out. Hence the statement with maximum frequency was designated as the most important suggestion followed by the others in the decreasing order of importance. The decision rule was administered to categorise the constraints and suggestions from most important to least important. The decision is determined as five + four + three + two + one divided by five = three, which stands as the decision rule. The decision rule for the constraints and suggestions were outlined in Table 1.

RESULTS AND DISCUSSION

The completed and returned questionnaires from our sampled respondents revealed the constraints experienced and suggestions proffered by extension professionals in using technology dissemination systems of State Department of Agriculture (SDA) and ranking of the constraints by respondents.

It was evident from the Table 2 that items 1-14 which included 'lack of training to employees on technology dissemination methods' was a most important constraint which was ranked first by the extension personnel. The other most important constraints as perceived by extension personnel were 'availability of accurate information with respect to technology delivery methods', lack of awareness on new approaches of technology dissemination, technical and infrastructure problems and insufficient financial

Table 1: Categorisation of constraints and suggestions based on Decision rule

S.No.	Constraints (Mean Scores)	Suggestions (Percentages)	Category
1	3.5 – above	70% - above	Most Important (MI)
2	3.0 – 3.49	50% - 69%	Moderately Important (MDI)
3	1.0 – 2.99	1% - 49%	Least Important (LI)

Table 2: Ranking of constraints perceived by the Kerala extension personnel on technology dissemination system of SDA (n=100)

S.No.	Constraints	Extension personnel		
		Mean scores	Rank	Remarks
1	Lack of training to employees on technology dissemination methods	3.79	1	MI
2	Availability of accurate information with respect to technology delivery methods of SDA	3.74	2	MI
3	Lack of awareness on new approaches of technology dissemination	3.58	3	MI
4	Technical and infrastructure problems	3.55	4	MI
5	Insufficient financial assistance	3.45	5	MDI
6	Accessibility to the ICT tools	3.40	6	MDI
7	Insufficient number of technology dissemination tools in the organization	3.37	7	MDI
8	Erratic Internet connectivity	3.33	8	MDI
9	Availability of required inputs to conduct demonstrations	3.25	9	MDI
10	Lack of proper organisational support for technology dissemination	3.14	10	MDI
11	Uncontrollable changes in technology delivery methods	3.10	11	MDI
12	Poor government commitment to implementation of policies and programmes in agriculture for technology dissemination	3.00	12	MDI
13	Lack of political consensus and commitment to policy issues on technology dissemination by government	2.61	13	LI
14	Lack of adequate database with respect to technology dissemination methods of SDA	2.59	14	LI

(MI = Most Important; MDI = Moderately Important; LI = Least Important)

assistance of SDA were the key impediment factors which affect the performance of extension workers. Accessibility to the ICT tools, insufficient number of technology dissemination tools in the organization, erratic internet connectivity, availability of required inputs to conduct demonstrations and lack of proper organisational support for technology dissemination were moderately important constraints. The least important constraints were uncontrollable changes in technology delivery methods, poor government commitment to implementation of policies and programmes in agriculture for technology dissemination, lack of political consensus and commitment to policy issues on technology dissemination by government and lack of adequate database with respect to technology dissemination methods.

The reason behind the findings might be that the delivery of the technology in the right form, place and time by the experts need a better understanding for capacity and confidence building. There is near absence of training and re-training of both the extension workers and farmers on new innovations as the extension workers are not adequate to take care of the teeming population of the farmers (LawalIro, 2014).

Training on technology delivery methods of SDA will help in capacity building to the extension personnel in terms of their knowledge, skill, attitude and understanding and it will contribute to performance back at work.

Authenticity, reliability and credibility of the source of information also plays a vital role in creating rapport with farming community. Therefore continuous monitoring should be there to provide updated, credible and problem specific information for maintaining ample scope and focus on the technology dissemination methods of SDA. The results are in line with the findings of the study entitled farmers and extension personnel view of constraints to effective agricultural extension services delivery in Oyo state, Nigeria where lack of trainings on technology dissemination methods was the major constraint as perceived by extension personnel (Apantaku *et al.,* 2016).

The findings from Table 3 revealed that, the first most important suggestion to overcome the constraints with respect to the technology dissemination system of SDA was the organizing training programmes on latest technology dissemination methods (86%). The other most important suggestions proffered by extension personnel

Table 3: Suggestions given by Kerala extension personnel on the technology dissemination methods of SDA

S.No.	Suggestions	Extension personnel (n=100)		
		Frequency	Percentage	Remarks
1	Organizing training programmes on latest technology dissemination methods	86	86	MI
2	Providing more number of supporting staff	80	80	MI
3	Unnecessary reporting work should be eliminated	74	74	MI
4	Provision of good market and transport facilities to the farmers.	73	73	MI
5	Technology dissemination methods and schemes of SDA should be planned according to the farmers needs	72	72	MI
6	Due importance must be given to agricultural officers in developing technology dissemination methods by SDA	70	70	MI
7	Providing good audio visual aids & infrastructural facilities for technology dissemination	68	68	MDI
8	Coordination and planning among extension personnel should be enhanced	62	62	MDI
9	Encouragement by superiors to their extension professionals	50	50	MDI
10	Provision of more financial assistance to Krishibhavans	43	43	LI
11	Internet connectivity should be better in each Krishibhavan	40	40	LI

(MI = Most Important; MDI = Moderately Important; LI = Least Important)

were providing more number of supporting staff (80%), unnecessary reporting work should be eliminated (74%) and provision of good market and transport facilities to the farmers (73%). Technology dissemination methods and schemes of SDA should be planned according to the farmers' needs (72%), due importance must be given to agricultural officers in developing technology dissemination methods by SDA (70%) and providing good audio visual aids and infrastructural facilities for technology dissemination (68%) were moderately important suggestions. Coordination and planning among extension personnel should be enhanced (62%), encouragement by superiors to their extension professionals (50%), provision of more financial assistance to Krishibhavans (43%) and internet connectivity should be better in each Krishibhavan (40%) scored low percentage by the extension personnel and were least important suggestions.

The other most important constraints as perceived by extension personnel were 'availability of accurate information with respect to technology delivery methods', lack of awareness on new approaches of technology dissemination, technical and infrastructure problems and insufficient financial assistance of SDA were the key impediment factors which affect the performance of extension workers. Accessibility to the ICT tools, insufficient number of technology dissemination tools in the organization, erratic internet connectivity, availability of required inputs to conduct demonstrations and lack of proper organisational support for technology dissemination were moderately important constraints. The least important constraints were uncontrollable changes in technology delivery methods, poor government commitment to implementation of policies and programmes in agriculture for technology dissemination, lack of political consensus and commitment to policy issues on technology dissemination by government and lack of adequate database with respect to technology dissemination methods.

Majority of the respondents suggested that, organizing training programmes on latest technology dissemination methods as the first suggestion. Extension personnel felt the need of latest approaches for technological information dissemination to bridge the information gap between scientific and farming communities. So they suggested for the increased number of training programmes on modern approaches for effective technology dissemination. Most extension staff members, especially those with basic level training, will need intensive in-service training and education (Swanson 2008).

Next suggestion is that majority of the respondents suggested that, providing more number of supporting staff. The extension personnel felt that many of the departmental programmes requires more number of supporting staff for effective implementation, evaluation and reconsideration. Besides technical persons in the Department, providing the supporting staff to handle the administrative matters will enhance the performance of

extension personnel. Extension agents cannot be expected to be experts in every technical and functional field. However, they should know how to broker information needed by their clientele. They also must be backed up by subject matter specialists. Other areas where extension agents may be called upon to work, depending on the local context (Davis and Terblanche, 2016). Unnecessary reporting work should be eliminated was the other suggestion given by the respondents. In the current scenario considering the performance of employees, Department is insisting the extension personnel to report everything to the higher authorities at multiple levels at several times. The time and attention given by the extension personnel for preparing and sending these reports hindering the mandatory work quality of the extension personnel. Hence, extension personnel suggested to reduce the number of reports being asked by the higher authorities.

Provision of good market and transport facilities to the farmers was the other suggestion given by the respondents. Extension personnel opined that, the existed technology dissemination methods were not much focused on the information related to marketing and transporting. Moreover, farmers are facing lot of problems in marketing their produce with respect to the number of middle men, storage and transporting. Hence, they thought that a comprehensive technology dissemination system with market and transport information can bring transformation in the lives of farming community.

'Technology dissemination methods and schemes of SDA should be planned according to the farmers needs' was the other suggestion given by the respondents. The information delivered through SDA programmes and schemes should be specific to their needs, problems and locations. Hence, they thought that a comprehensive bottom-up approach/planning of technology dissemination methods yields greater satisfaction to the farmers. It is important to realise that no single extension methodology is suitable for all situations and for all purposes. A 'one-size-fits-all' approach to sustainable extension and rural development programmes will not work. The need to develop location-specific extension approaches is essential. The best-fit approach embraces both the pluralism of approaches used today and the diversity found within technology dissemination systems (Birner *et al.,* 2009).

Due importance must be given to agricultural officers in developing technology dissemination methods by SDA, providing good audio visual aids and infrastructural facilities for technology dissemination, coordination and planning among extension personnel should be enhanced, encouragement by superiors to their extension professionals, provision of more financial assistance to Krishibhavans (Agricultural Office in Kerala) and internet connectivity should be better in each Krishibhavan was the last suggestion given by the extension personnel. Hence, while planning any programme/scheme the above said constraints should be kept in mind for effective implementation at the grass root level of farming community.

CONCLUSION

The findings of the study reveals that the constraints experienced by extension professionals in using technology dissemination systems of SDA in Kerala. Among the constraints experienced by extension professionals, 'lack of training to employees on technology dissemination methods' was a major constraint which was ranked first followed by availability of accurate information with respect to technology delivery methods'. The reported constraints are needed to be addressed seriously for better and timely dissemination of improved agricultural information and technologies. Based on the findings of the study, more capacity building training programmes has to be organised to extension professionals and extension personnel should be employed and fortified with necessary equipment and facilities to enhance effective technology dissemination for transformation of agriculture in the state and the nation at large.

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Study of Socio-economic Factors and its impact on Cocoon Productivity in Jammu Region

Ravi Kant*, Kamlesh Bali, Rakesh Kumar Gupta, Rakesh Sharma, Permendra Singh, Mohammad Iqbal Jeelani and Aradhana Sharma
Sher-e-Kashmir University of Agricultural Science and Technology of Jammu–180009, J&K

ABSTRACT

Sericulture is an agro-cottage, forest based industry, labor intensive and commercially attractive economic activity falling under the cottage and small-scale sector. The silk is the final product of this industry. It particularly suits to rural population working with agriculture, entrepreneurs and artisans as it requires low investment with potential for relatively higher returns. It provides income and employment to the rural poor especially, farmers with small land-holding and marginalized and weaker sections of the society. An interview schedule was administrated during March-April 2019-20 in three districts viz., Ramban, Doda and Kishtwar of Jammu division to collect preliminary data on socio-economic profile of the silkworm rearers. The survey revealed that the average age was 43.49±0.71 years and family size ranged from 5.52 in Kishtwar to 6.78 in Ramban district. The average schooling of the respondent farmers was 1.61±0.15 years. The average land holding in the three districts was around 0.34±0.02 ha and area under mulberry cultivation was 0.04±0.004 ha with an average of 37.89 trees. The average experience possessed by sericulture farmers was 13 years. Step wise multiple regression analysis was applied to identify the socio-economic factors affecting cocoon productivity and the results revealed that socio-economic factors namely education, total land holdings, area under mulberry plantation and number of mulberry trees have positive and significant while factors namely distance from nearest sericulture office, cocoon market and transportation charges have negative but highly significant effect on cocoon productivity and were found to decrease cocoon production with a unit increase of their value. Other factors namely age, number of family members and experience were recorded non-significant.

Keywords: Cocoon, Mulberry, Multiple regression, Sericulture

INTRODUCTION

Sericulture is an art that deals with the production of silk by rearing silkworm. It stands at a peculiar position in Indian economy and assumes a very high importance in alleviating the problems of rural people. It is highly suitable in the context of diversification of farm enterprises and integration of farming system with other enterprises and has the capacity to generate attractive income (Prakash and Dandin, 2005). It serves as an important tool for rural reconstruction benefiting the weaker sections of the society. The silk cocoon rearing does not only offer periodic income, but also utilizes the untapped family labour for various activities (Lakshmanan *et al.,* 1997).

It is advocated that development of sericulture requires both vertical as well as horizontal growth to achieve the future silk demand in the country (Lakshmanan and Geetha Devi, 2007). However, in view of involvement of marginal farmers having fractured land holdings with sericulture, it may not be possible to go for horizontal expansion as there is already heavy pressure on agricultural land due to increased population coupled with unabated infrastructural development.

With the increased economic needs due to changing social status and unpredictable market trends of different kinds of produce and for doubling the income of the farmers, sericulture has assumed special significance as an important subsidiary occupation. It supplements the income of the farmers, in addition to their returns from other crops (Lyaqet, 2015). Due to favourable climatic conditions for mulberry and silkworm rearing there is huge potential for development of sericulture in temperate,

*Corresponding author email id: ravi309527@gmail.com

intermediate and sub tropical zones of Jammu division. However, changes in the structure of land ownership have affected the incentive structure of agriculture in the state which has reduced the interest of farmers towards silkworm rearing.

Sericulture plays a key role in the upliftment of rural population both socially and economically (Sreenivasa and Hiriyanna, 2014). So, many sericultural technologies have been developed and their recommendations have been made to improve the productivity and quality of cocoon at farmer's level (Kushwaha, 2013). Inspite of well developed extension network to transfer the technologies to the farmers, there is a wide gap in productivity of the cocoon between laboratory to land due to various socio-economic drawbacks and partial or non adoption of improved sericultural technologies. As a consequence farmer's are getting very low returns due to low productivity and poor quality of cocoons as compared to other agriculture crops. Therefore, the present study was conducted to study the major socio-economic factors influencing cocoon productivity in Jammu region.

MATERIALS AND METHODS

The present study was conducted in the three districts namely Ramban, Doda and Kishtwar of Jammu region. An interview in the form of questionnaire was administered for various socio-economic characteristics in each district during March-April, 2019-20. A total of 225 respondents were personally interviewed and various socio-economic parameters of silkworm rearers under study was recorded. Data on cocoon yield was recorded during spring and autumn rearing season. Stepwise multiple regression analysis was applied between average cocoon yield and the socio-economic parameters of each respondent to identify the major factors influencing cocoon productivity.

RESULTS AND DISCUSSION

The data on descriptive statistics of sampled silkworm rearers is shown in Table 1. Maximum average age of respondents was recorded in Ramban (44.92±1.31) followed by Doda (43.48±1.08 years) and minimum was recorded in district Kishtwar (42.06±1.31 years). The average age of silkworm rearers in three districts was observed as 43.49±0.71 years. The average family size ranged between 6.78±0.31 in district Ramban followed by 5.78±0.25 in Doda and minimum number of family members were recorded in district Kishtwar (5.52±0.24). The Overall family size, in all the three districts was 6.01±0.15. Highest average number of educated farmers were recorded in district Doda (1.82±0.36 yrs.) followed by district Ramban (1.64±0.36) years and least of 1.30±0.34 years in district Kishtwar. The overall average formal education in three districts was1.61±0.20 years. The average land holding size of Ramban, Doda and Kishtwar districts was 0.41, 0.41 and 0.28 ha respectively. The overall average land holding in three districts was recorded as 0.34±0.02 ha. Maximum average area under mulberry cultivation was recorded in district Ramban (0.04ha) followed by Doda (0.04 ha) and district Kishtwar (0.03ha). The overall average area under mulberry cultivation in all the three districts stood at 0.04 ha. Mulberry plantation in all the three districts was under rainfed conditions. Average number of trees owned by the respondent was highest in district Doda (47.27) followed by district Ramban (43.06) and lowest in district Kishtwar (23.33). The overall average

Table 1: Descriptive statistics of sampled silkworm rearers

District → / Parameter ↓	Ramban (n=75)	Kishtwar (n=75)	Doda (n=75)	Overall (n=225)
Average age (years)	44.92±1.31	42.06±1.31	43.48±1.08	43.49±0.71
Average family size (no.)	6.78±0.31	5.52±0.24	5.78±0.25	6.01±0.15
Average education (no. of formal years of schooling)	1.64±0.36	1.30±0.34	1.82±0.36	1.61±0.20
Average total land holding (ha)	0.41±0.03	0.28±0.03	0.41±0.09	0.34±0.02
Average area under mulberry cultivation (ha)	0.04±0.005	0.03 ±0.008	0.04±0.004	0.04±0.004
Average no. of mulberry trees (no.)	43.07±5.81	23.33±5.02	47.27±5.75	37.89±3.26
Average experience (years)	17.53±1.08	10.93±0.81	10.72±0.71	13.06±0.55
Average distance of sericulture office (km.)	28.01±2.15	24.50±0.18	19.93±0.48	24.15±0.77
Average distance from cocoon market (km.)	28.01±2.15	3.36±0.19	19.93±0.48	17.09±1.01
Average transportation charges (Rs.)	102.80±7.53	29.33±2.83	52.13±1.42	61.42±3.41
Average annual income (Rs.)	27191.33±2263.25	21719.33±1798.87	20133.73±2014.14	23000.13±1186.34

number of trees owned by the respondents in three districts was recorded as 37.89. Maximum average experience of 17.53±1.08 years was recorded in sericulture from respondents of district Ramban followed by Kishtwar (10.93±0.81) years and minimum in district Doda (10.72±0.71). The overall experience in sericulture enterprise in all the three districts was recorded as 13.06±0.55years. The maximum average distance of respondent's house to nearest sericulture office was recorded as 28.01±2.15 km in district Ramban followed by district Kishtwar (24.50±0.18 km) and 19.93±0.48 km in district Doda. Maximum average distance of 28.01±2.15 Km was calculated from respondent's house to nearest cocoon market in district Ramban followed by Doda (19.93±0.48 km) and minimum distance of 3.36±0.19 km was recorded in district Kishtwar. The overall average distance in all the three districts was 17.09±1.01 km. The average transportation charges paid by respondents as transportation charge was reported by the farmers of Ramban district (Rs. 102.80±7.53) followed by Doda district (Rs. 52.13±1.42) and Kishtwar district (Rs. 29.33±2.83). The overall average transportation charges computed was Rs. 61.42±3.41. Annual income of majority of farmers (82.67%) of district Kishtwar ranges between Rs. 5205.09 and Rs. 40795 followed by District Doda (81.33%) and district Ramban (77.33%). The maximum average annual income of respondents belonged to district Ramban (Rs. 27191.33±2263.25) followed by district Kishtwar (Rs. 21719.33±1798.87) and least in district Doda (Rs. 20133.73±2014.14). The overall average net annual income computed from agriculture was Rs. 23000.13±1186.34.

Qualitative and quantitative production of cocoon depends on various important socio-economic aspects and the adoption of recommended mulberry production and silkworm rearing technologies. In order to study impact of socio-economic parameters on cocoon production, the socio-economic profile of silkworm rearers was analysed. In district Rambana and Kishtwar 70.67 per cent of respondents were middle aged. This shows that middle aged are willing to undertake sericulture as engagements to earn a livelihood. Since sericulture is labour intensive, size of the family has a keen role in influencing manual activity. The average land holding in the three districts was around 0.34±0.02 ha and area under mulberry was 0.04±0.004 with an average of 37.89 number of mulberry trees highlighting insufficient mulberry wealth both quality and quantity wise. The average family size ranged from 5.52 in Kishtwar to 6.78 in Ramban. Insignificant association between districts and family size was recorded. Literacy level in the districts was low. To understand the influence of pathogen load and inoculum contamination source, education level of literacy is very much essential particularly in a short life cycled living organism. The accumulation of different disease causing pathogens due to negligence and illiteracy greatly affects the cocoon crop productivity. The findings are closely in accordance with the findings of Dar *et al.* (2009).

In district Ramban, independent factors namely education, total land holdings, area under mulberry plantation, number of mulberry trees, distance from sericulture office and cocoon market and transportation charges were the major and significant variables influencing adoption. From regression coefficient values it was observed that a unit decrease in total land holdings decreases yield by 2.61 per cent, area under mulberry showed decrease in yield by 5.54 per cent, number of mulberry trees increases yield by 1.30 per cent, a unit increase in distance from sericulture office and cocoon market decreases yield by 3.65 and 3.60 per cent and transportation charges decrease the yield by 0.59 per cent while other socio-economic factors were found non-significant. Independent factors namely education, total land holdings, area under mulberry, distance from sericulture office and cocoon market and transportation charges greatly influenced cocoon yield in district Doda. From regression coefficient values it was observed that a unit increase in education results into an increase of yield by 0.38 per cent, total land holdings increase yield by 6.13, area under mulberry decreased yield by 5.84 per cent, distance from sericulture office and cocoon market decreased the yield by 2.1 and 1.97 per cent respectively transportation charges result into decrease in the yield by 0.39 per cent while other socio-economic factors were recorded non-significant.

In district Kishtwar, education, total land holdings, area under mulberry plantation, experience and distance from sericulture office greatly influenced cocoon yield. From regression coefficient values it was observed that a unit increase in education increase yield by 1.09 per cent, a unit decrease in total land holdings results into decline in yield by 2.19 per cent, area under mulberry decreases yield by 2.24 per cent, experience increases yield by 0.53 per cent, unit increase in distance from sericulture office decreases yield by 2.36 per cent while other factors were found to be insignificant. Overall the independent factors together explained 47% variation (R^2=0.47) in cocoon yield in district

Table 2: Impact of socio-economic factors on cocoon yield

Districts →	Ramban (n=75)			Kishtwar (n=75)			Doda (n=75)		
Independent variables →	**R.C.**	**S.E.**	**P-value**	**R.C.**	**S.E.**	**P-value**	**R.C.**	**S.E.**	**P-value**
Constant	38.60	5.30	0.00	8.91	15.97	0.58	16.97	6.57	0.01
Age	-0.08	0.14	0.57	0.19	0.10	0.07	0.10	0.14	0.49
Family members	0.01	0.31	0.97	-0.28	0.39	0.47	-0.53	0.48	0.27
Education	0.20	0.28	0.48	1.09	0.30	0.05*	0.38	0.26	0.04*
Total land holdings	-2.61	4.49	0.04*	-2.19	1.33	0.01**	-6.19	5.18	0.04*
Area under mulberry	-5.54	32.90	0.01**	-2.24	1.92	0.04*	-5.84	46.02	0.02*
No. of mulberry trees	1.30	0.03	0.05*	0.03	0.02	0.21	-0.04	0.03	0.21
Experience	1.04	0.19	0.03*	0.53	0.16	0.00**	-0.10	0.21	0.64
Distance from sericulture office	-3.65	1.01	0.03*	-2.36	0.90	0.01**	-2.01	0.00	0.05*
Distance from cocoon market	-3.60	1.12	0.02*	-0.36	0.57	0.08	-1.97	0.80	0.01**
Transportation charges	-0.59	0.32	0.02*	-0.07	0.06	0.28	-0.39	0.25	0.02*
Annual income	-0.78	0.06	0.11	-0.81	0.05	0.18	-0.64	0.04	0.15
R^2 value	0.45			0.43			0.47		
F-value	5.39**			2.82**			2.46**		

R.C =Regression coefficient, S.E.= Standard error of mean, * significant at 0.05% and ** highly significant at 0.1%

Doda followed by district Ramban (45%, R^2=0.45) and Kishtwar (43%, R^2=0.43).

With respect to socio-economic profile of the respondents; eleven major socio-economic factors (Table 2) were studied through stepwise multivariate regression analysis model to find out their influence on cocoon production at the farmers' level. On the basis of p-values and regression coefficients, it was observed that overall, socio-economic factors namely education, total land holdings, area under mulberry plantation and number of mulberry trees were recorded significant and positive and the important factors in increasing cocoon production and the factors namely distance from nearest sericulture office, cocoon market and transportation charges were recorded negative but highly significant and were found to decrease cocoon production. Factors namely age, number of family members and experience were recorded non-significant

CONCLUSION

Socio-economic factors namely education, total land holdings, area under mulberry plantation and number of mulberry trees were recorded significant and positive and the important factors in increasing cocoon production and the factors namely distance from nearest sericulture office, cocoon market and transportation charges were recorded negative but highly significant and were found to decrease cocoon production. Factors namely age, number of family members and experience were recorded non-significant.

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Necessity of Establishment of Community Radio Stations in Indian Agriculture Universities for Doubling Farmers Income

Arpita Sharma
Assistant Professor, Department of Agricultural Communication, College of Agriculture, GBPUA&T, Pantnagar, Uttarakhand

ABSTRACT

Community radio is participatory medium used to disseminate the information among the community. It plays a vital role in building vibrant communities, in mobilizing groups to action by informing and empowering citizen, in giving voice to the marginalized groups of society and in bringing community needs to the attention of local and even National Government as are the challenges with community radio development. Community Radio programmes empowers the farming society. Universities are innovating various technologies and high yielding verities. There is an urgent need to disseminate this knowledge among the farming society. Present paper aim is to discuss the need of establishment of community radio station in Agriculture Universities.

Keyword: Agriculture university, Community radio station

INTRODUCTION

Community radio can be regarded as most appropriate medium of mass communication in developing countries with very low literacy rates, poor transportation systems and very low purchasing power. It is a new concept to ensure People Participation at grass root level for their local development. It provides the platform to the rural people to take part in each and every step like programme designing, recording, broadcasting and evaluation. It is a medium of empowerment. Among all Communication tools community radio is at heart of the possibilities of an emerging "Information Society" that is people centered, inclusive and development oriented; where everyone can create, access, utilize, share information and knowledge, enabling individuals, communities and people to achieve their full potential in promoting and improving their quality of life. In India total 251 community radio stations are in working conditions. Data revealed that maximum CRS are operational in Educational Institutes.

Community Radio as a concept gathered prominence in social literature mainly through the writings of Girard (1992), who has provided one of the best descriptions of community radio: Community radio is a type of radio made to serve people; encourages expression, participation and that values local culture. Its purpose is to give a voice to those without voices, to marginalized groups and to communities far from large urban centers, where the population is too small to attract commercial or large-scale radio station. Community radio is a radio station owned, run and maintained by a community. According to Michael Delorme, World Association of Community Broadcasters [AMARC]-"It is called as popular or educational radio in Latin America, rural or local radio in Africa, public radio in Australia and free or associative radio in Europe. All these describe the same phenomenon - gaining voices and democratizing communication on a community scale. Community radio, although taking on diverse forms depending on its surroundings, remains a type of radio made to serve people; radio that encourages expression and participation and that values local culture. Lewis (1995) stated that community radio is a form of local radio which defines itself as an autonomous entity and relies on the community for its survival without any commercial aims or objects. Community radio is 'a medium that gives voice to the voiceless, that serves as the mouthpiece of the marginalised and is at the heart of communication and democratic processes within societies. According to CEMCA (2011) community radio is a type of radio service that caters to the interests of a certain

Email id: sharmaarpita615@gmail.com

area, broadcasting content that is popular to a local audience but which may often be overlooked by commercial or mass-media broadcasters.

Nair (2011) reported that community radio is a whole new world providing communication development support to the people residing in far flung areas of India. Reviewing the present India scenario regarding community radio one can say that priority needs to be given to the issuing of community broadcasting licenses to rural areas and other regions and communities that are at least developed in terms of various socio-economic indicators. Pradhan (2011) reported that community radio conjures up a mix of reaction in the minds of Indian people. Sometimes the responses are optimistic as it recalls community radio stations, which have achieved spectacular success. But the responses are depressing when the dozens of unpopular and neglected community radio stations comes to ones notice. Community radio can find tremendous opportunities in the socio-cultural and linguistic diversities in India to evolve into a powerful alternative tier of broadcasting. Catering to the popular expectations, community radio has evolved as an excellent tool for facilitating participation, empowerment, and positive development through widening of horizons of listeners.

Singh (2011) examines about community radio broadcasting which is a non-profit service and how it is owned and managed by a particular community, usually through a trust, foundation or association. Its aim is to serve and benefit that community. It is, in effect, a form of public-service broadcasting, but it serves a community rather than the whole nation, as is the usual form of public broadcasting. The liberal governments in many Asian countries have promoted freedom of speech and information communication flow in varieties of methods for national and social developments. The fight for expansion of community radio is very much a part of larger debates around spectrum reform, media democracy and the right to communicate.

Community Radio applies participatory communication approaches. The nature and extent of community participation in a community radio station varies from minimal participation when outsiders make the decisions to full involvement of the community members in the decision-making process beginning from the initiation to the establishment, management, financing, administration, program production and evaluation. Participatory communication approaches place decision-making in the hands of ordinary people. It can democratize communication and empower the marginalized people. It tends to stress the importance of the cultural identity of local communities and participation at all levels-international, national, local and individual (Dagron, 2001). Some people favor community participation as a means of reaching certain goals since it makes projects and programs more humane, effective and sustainable. However, others see participation as an end in itself. For them, participation is a set of desired processes and relationships (Chambers, 2009). Public participation is important for preventing the monopolization of communication. It fosters a fair balance between different parties involved in the communication process. Public participation enhances media autonomy and promotes a plurality of opinions. Thus, communication facilities may serve not just those in power but society as a whole (MacBride, 1980).

In India farmers are facing many problems in the field. Community Radio is a easily reachable and information providers for the farmers. Onkargouda Kakade (2013) concludes that majority of farmers opined that the information which broadcast through Community radio stations as practically applicable and reliable. According to Satterthwaite (2003), in Africa, Asia and India, most of the poorest of the poor people still live in rural areas. In remote areas, Community radio is often the only medium available that is pervasive, accessible and affordable. Community radio can be regarded as most appropriate medium of mass communication in developing countries with very low literacy rates, poor transportation systems and very low purchasing power. Deshmukh, (2009) reported that most of the farmers felt that the information provided in Kisanvani (community radio) could be actually practices and adopted by the farmers but the degree of adoption varied from year to year. Kothari (2015) reported that Sangham Radio (community radio) provides a lot of information on the dangers of chemicals, fertilizers, hybrid and genetically modified seeds. It also helps the women and other farmer members in marketing of their organic produce.

Pattanashetti and Shree (2012) concludes that Krishi Community Radio provides useful information on farming related aspects and helps in adopting new agricultural technologies by farmers and create awareness about new varieties and increases knowledge. It also helps the listeners in gaining knowledge about improved varieties of seeds,

seed treatment, seed selection, storage, better methods of agricultural practices, control of pesticides and diseases and harvesting techniques etc. Agricultural Universities are mostly public Universities or Government Universities in India Universities have three mandates viz; teaching, research and extension. Universities are doing research in their lab and extension functionaries are disseminating this information among the farmers. Third mandate "Extension" is very important as this is related to dissemination of information about Agricultural technologies among the farmers. Generally Universities are doing many invention and innovation to empower the rural people. But unfortunately these technologies are not reaching among the farming community. There is big gap between innovation and its reach among the farming community. Community radio can be a powerful medium to fulfill this gap. In this way, community radio is cheaper and low cost medium to reach among the farmers in less time. Community radio is low cost and cheap medium to disseminate the information among the farmers.

Presently Director Education had circulated the letter regarding establishment of CRS in every Agriculture Universities. Thus, now this is compulsory that every educational institute should have their own radio station. This will be helpful to disseminate the information among the farming community.

To reach the wide range of farmer's mass media can play a very important role. Community Radio is one of the powerful Information Communication tool for disseminating the information among the society. Pattanashetti (2012) reported that majority of the farmers (67%) preferred agricultural success story programme followed by live interactive program (62%) and phone in programme (57.50%). A majority of the farmers were interested in programme like rainfall prediction, agricultural news, disease and pest predictions and inputs availability

RESULTS AND DISCUSSION

Table 1 represents that total 251 community radio stations are working in India. Among 251 CRS total 120 are working in Educational Institute followed by 116 are working in NGOs. Total 15 CRS are operational condition in KVKs.

In the hills of Uttarakhand, seven community radio stations have come together to create a multi-level network that reaches the remotest villages to tackle misinformation about covid-19. During Covid period Community radio

Table 1: Analysis of Community Radio Station in India

S. No.	State	Category	No. of operational radio stations
1.	Andhra Pradesh	NGO	2
		EDU	4
2.	Arunachal Pradesh	NGO	1
3.	Assam	EDU	2
		NGO	1
4.	Bihar	NGO	7
		KVK	1
		EDU	1
5.	Chandigarh	EDU	5
		NGO	1
		KVK	1
6.	Delhi	EDU	5
		NGO	1
7.	Gujarat	EDU	3
		NGO	2
		KVK	2
8.	Haryana	EDU	2
		NGO	7
		KVK	1
9.	Himachal Pradesh	EDU	2
		NGO	1
10.	J&K	NGO	1
11.	Jharkhand	NGO	2
12.	Karnataka	NGO	5
		EDU	12
		KVK	1
13.	Kerala	EDU	5
		NGO	6
14.	Madhya Pradesh	EDU	7
		NGO	11
15.	Maharashtra	EDU	7
		NGO	11
		KVK	4
16.	Manipur	NGO	2
17.	Odisha	NGO	10
		EDU	2
18.	Puducherry	EDU	3
		NGO	1
19.	Punjab	EDU	4
		NGO	1
20.	Rajasthan	NGO	5
		EDU	5

Table 1 contd...

S. No.	State	Category	No. of operational radio stations
21.	Tamil Nadu	EDU	25
		NGO	8
		KVK	2
22.	Telangana	NGO	7
		EDU	3
23.	Tripura	NGO	1
24.	Uttar Pradesh	EDU	14
		NGO	13
		KVK	2
25.	Uttarakhand	EDU	5
		NGO	5
26.	West Bengal	EDU	3
		NGO	3

in Uttarakhand come together to create a multi-level network to disseminate the information on covid as well as related to farming also. Mandakini ki Awaaz, Kumaon Vaani, Pantnagar Janvani, Radio Zindagee, Himgiri ki Awaaz, Heval Vani and Radio Khushi are working for empowering the farming belt. The main purpose of all these CRS is to inform, educate and reassure the community. They are leveraging the strengths and networks of the stations, creating information-based communication. In Uttarakhand CRS are providing information on Garhwali, Kumaoni, Hindi and local dialects. This will be easier among community to understand the topic easily. Uttarakhand is disaster prone area. Community Radio plays a very important role to dissiminate the information among the hill society about disaster. CRS also inculcate awareness about climate change and its impact in natural disasters. These community radio stations are picking up local issues, producing content on how unplanned development in adversely affecting the flora, fauna, weather pattern and lifestyle of hills. These radio stations in collaboration with various state and national agencies started producing programs based on the effects of climate change, disaster management, and related issues.

Mobile Vaani is a voice-based social platform where users can call and access, share or comment on content. Gram Vaani has set up free Mobile Vaani for each of the three community radio stations (CRS)- Kumaon Vani (Mukteshwar), Mandakini Ki Awaz (Rudraprayag) and Henvalvani (Chamba Valley) in the flood affected region.

Kumaon Vani has set-up a system for Uttarakhand flood victims where they can just give a miss call for help. As soon as people give miss call on the particular given numbers, they get a call back where they can record their messages. To use these services, there are three phone numbers:-011-66030073: Line to be used by Kumaon Vani (Mukteshwar)).011-66030074: Line to be used by Henvalvani (Chamba Valley). 011-66030075: Line for the Mandakini Ki Awaz (Rudraprayag). The facility can be used by victims to inform people of their situation. This also allows people to call and listen to the recorded messages and other audio 'uploaded' by the CRS. This facility can be used to provide information to others at a time of convenience to the callers. The caller incurs no cost. Mobile Vaani is essentially a social media platform that runs over phone calls. Using simple technologies and social context, Gram Vaani has been able to impact communities. The company manages 30 rural radio stations and shares content over mobile and the web.

Kumaon Vani community radio station was set up by TERI in March 2010 in Nainital district of Uttarakhand. The aim of CRS is to bring together communities across several villages in the Kumaon region and to promote sustainable development among the local farming community. The radio station is a not-for-profit entity operated, owned, and driven by a creative team of reporters and technicians.

Uttarakhand Government has introduced a system of community radios in all disaster-prone districts for alerting the people in advance about natural calamities and for providing assistance in post disaster relief and rescue operations. It would be easier to communicate about relief and rescue operations, or, about areas where relief supplies could be accessed. Community radios would also be crucial in helping farmers enhance their incomes by informing them about the best agricultural practices.

Tabing (2002) defined community radio Station as one which operates in the community for the community, about the community and by the community. The community can be territorial or geographical. It can also be a group of people with common interests, which are not necessary living in one defined territory. Ullah (2006) stated that Community Radio is the best way to meet the needs of communication at local level because Community Radio helps to create a place where various people in the community including seniors, youths, mothers with small

children, students, religious leaders, people with disabilities meet. Thangaraj (2007) enlisted advantages of Community Radio as follows: (1) Can cater to the welfare of the common man (2) can help to improve health, nutrition, child care, women development, environment, eco-balance and others (3) can expose community to outside world (4) can provide opportunities for progress. Bhatnagar (2008) reported that Government of India announced its Community Radio Policy in December 2002, which was later liberalised in 2006. Community radio gives the people a medium to express themselves, a platform to air their concerns, to be heard, considered and acted upon, thus increasing their dignity and self confidence. People generally come forward to gain skills, to be part of the community group, to share their interest in music, anchoring or to increase their social circle. A carefully planned orientation process is very important to map the potential of individuals and to filter-out committed volunteers to form the core team.

Bhatia (2008) reported that Gyan Vani CR network acts as a cooperative devoted exclusively to education and community development. The programmes include information relevant to students of pre-primary, primary, secondary and higher secondary as well as enrichment programmes for environment awareness, women's empowerment, legal literacy, professional education and science education. Besides education there are lot of subject, which are sought to be covered with adequate attention like Career Counseling, Employment news, Health Care, Mother and Child care etc. Singh (2009) reported that teleconferencing, Community radio, paging, Satellite Communication and Group telephone tutorials are new watchwords for interactive communication. Walfer and Dhanarajan (2009) stated that community radio is an immensely powerful technology for the delivery of education with enormous global potential reach. They added that strength of radio include the following: (1) Community Radio reaches a wider audience than any other medium. (2) It can motivate people by building audio/ oral traditions and stimulate the imagination better than video or television. (3) Community Radio programnme are cheaper to make as compared to television and video. Balit (2009) concluded that Community radio is a practical and creative medium for facilitating the education and empowerment of the poor including women and youth.

Press Information Bureau (2009) reported that Community Radio Station is expected to serve particularly, the women, farmers, fishermen to empower them with information and communication critical for disaster preparedness and management. The community management committee has made linkages with the local government institutions like panchayats, health centers, schools and disaster management related Government institutions to establish a disaster management mechanism to face natural calamities. Shively (2009) reported that for a highly populated and predominantly rural country like India the edutainment of the masses is essential. This can be achieved by utilizing the concept of a Community Radio more effectively. Community radio tells the story of the people and helps communities striving to speak out and be heard. It has provided means of empowerment to the community. Sharma (2010) stated that the smallest and most precarious community radio station make a difference for a community. The presence of a community radio station, even if it is not highly participatory, has an immediate effect on the population. Small stations usually start airing music for most of the day, thus making an impact on cultural identity and community pride. The next step, closely associated with music programming, is carrying announcements and dedications which contribute to the strengthening of the local social networks. When the station grows in experience and skill, local production of health or education-related programme starts. These contribute to share information on important issues that affect the community.

Community Radio seems to have proven itself as a developmental tool, particularly with the rise of community and local radios, which have facilitated a far more participatory and horizontal type of communication. Radio can also help bridge the digital divide by providing a powerful tool for information dissemination and access, especially for hard-to-reach rural audiences. Sharma and Kumar (2009) opined that community radio can play an effective role in accelerating social change. Community radio, in essence is a type of radio service that caters to the interests of a certain area, broadcasting material that is popular to a local audience through participatory based knowledge sharing. In a pluralistic society like India, it encourages the specific community's social, cultural and political identity by operating with the community and for the community's welfare. The basic technical know how including transmitter and signaling system should be demonstrated carefully to the community people. There is a limit to transmit demonstrative knowledge through the radio medium. But the highest impact which can be

obtained through the community radio broadcasting is an awareness and understanding of problems and encouraging possible stimulation and motivation to take action against it.

Sharma and Kumar (2010) reported that most of the community radio programmes in the developing countries have started with the support from some outside donor either national or international. India is a country of daunting socio-economic divides accompanied by a formidable diversity of languages, dialects and cultures. The potential for community media have assumed paramount significance in past several years in India. However, judging media trends it is observed that there is still a wide gap between the potential and practices of community media in India. Community voices are struggling at the periphery of a contrasting and often iniquitous media landscape. Moreover, limited persons can only get the benefits of the development those who can afford to have the required information. In this way the nature of the development will be exclusive rather than inclusive. Here only free media can bridge the gap. Free media is a leading force in informing and educating citizens, monitoring government and exposing misconduct. 'Medium is the Message' the historical statement by Marshal McLuhan, actually revealed a technocentric concept on information flow. No doubt technology adds some value or even makes the information flow quite faster, but content is the nucleus in the massage, not the medium. So, for the development in the rural community content should be disseminated to the receiver in the right time and at the right place in easy and accessible format and that role can be significantly played by community media only.

Barl (2009) stated that the successful airing of programmes spanning across disaster preparedness, marine education and safety measures in the sea that saw tremendous participation from the residents and helped in creating a close knit fishermen community by the Kalanjian Community Radio in Tamil Nadu, in the post Tsunami scenario demonstrates the development role of community radio. However, despite all success stories, setting up and running an effective community radio faces a lot of challenges, the biggest issue being that of sustainability. Among the major reasons observed is lack of community interest, insufficient content, sporadic financial assistance. All these, combined with the bureaucratic problems of getting a license hinder the process of growth of community radios in India. Financial constraints hurt the community radio movement in India. There is neither central assistance nor adequate source of income for community radio stations. A possible way out for addressing the financial constraints could be to link them with industries as a part of their CSR activities.

According to Das (2011) the base line objective of the expansion of community radio in rural India is to encourage a sustainable agricultural communication. In order to enhance communication activities and for the farmers to be fully involved, it is necessary to train the farmers themselves in communication skills so that they can actively participate in the transfer of knowledge and technologies. It's a techno-based audio medium where important local issues are broadcasted with the local people's ideas and opinion. Since the total process lies on a horizontal mechanism, then the participation must be ensured at every level in production and management of their packages. Community radio is a whole new world providing communication development support to the people residing in far flung areas of India. Reviewing the present Indian scenario regarding community radio one can say that priority needs to be given to the issuing of community broadcasting licenses to rural areas and other regions and communities that are at least developed in terms of various socio-economic indicators. Community radio has given a new meaning to the word democracy. It leads to peoples' democratic communication and empowerment in a real sense. It makes local officials to be subtly mindful of their actions and decisions. It is important that a culture of genuine democratic communication is developed among the Asian countries, which make the leaders accountable irrespective of the regulatory systems.

Community radio has the potential of becoming the voice of the voiceless. However, it is observed that community radio stations are distinguished from government owned radio stations in terms of audiences, ownership, control, content and the degree of participation in media through such outlets. Community radio stations throughout the world are known for their role of providing a platform for participation in media for those neglected or marginalized by the mainstream media. Community members are those living in the area served by the community radio station. This includes the local leaders, including elected representatives. The community of a station also includes community structures, such as civic

or religious groups and sports clubs, non-governmental organizations (NGOs), and government officials, who could play a role in promoting or obstructing the work of the station. Outsiders, including donor organizations, volunteer organizations, consultants and experts are also parts of the community. Community radio is a local radio and participatory in nature, owned and run by the community, to serve the needs of the people. Community radio aims to change social conditions and improve the quality of cultural life through meaningful and relevant programmes. People actively take part in formulating the station's policy, strategy and programme content. For present research investigation community radio is conceptualized as a participatory medium of communication through which Information, Education and Knowledge on women empowerment related aspects were given to rural women.

Dhawan (2010) gave the five step model on the community radio: (1) Participatory Development as a vital concept in local development: Participatory development implies the active participation of individual, group and communities in shaping their environment and the quality of their living condition. Participatory development is seen as a vehicle to help people to challenge such exclusion by encouraging them to participate in collective action in pursuit of common interests and goals. Development process must: (a) Involve local people in using their own experience as a basis to identify their own needs and resources and to devise potentials solutions. (b) Enable local people to develop appropriate skills, knowledge and confidence. (c) Empower local people to take initiatives. Again, this can involve the development of appropriate skill, knowledge. The basis of participatory local development is to link needs identification with the location solutions and the generation of remedial action. In order to do this it is often necessary to work with the target group. (a) To understand the problem as completely as possible. (b) To identify the scale of the problem. (c) To identify and locate the target group. (d) To implement solution. (2) Group: What are they and how do they work: The second step is to examine what a group is and the various kinds of group which exist. One can also explore the importance of group to locally based development. Factors that affect the dynamics with in a group in the context of different needs that exist with in group. Group undertaken work in areas such as community enterprise, community arts, social services, community education. (3) Working in Group: A Key Skill in Rural Development: People behave differently in a group context. In addition individuals may behave differently in various groups, a person may feel very confident in one situation but may feel totally initiated in another. (4) The process of Group: A key of skill in Rural Development: Role of facilitator is to enable people in a group to formulate and express their views/ decisions on whatever issues are before them. A key role of the facilitator is to create the condition for balanced challenging discussion, equality of participation and strategic. (5) Leadership in Local development: Group and staff working together: Group leader gives and receives information and opinions and offers facts, ideas and suggestions. The leader tries to draw out what facts group members have to contribute to the overall tasks.

CONCLUSION

On the basis of above, this can be concluded that community radio is need of present era. There is an urgent need to establish community radio stations in each and every University. Community radio stations serve as the most trusted agent in village that brings change. It plays a vital role in building vibrant communities, in mobilizing groups to action by informing and empowering citizen, in giving voice to the marginalized groups of society and in bringing community needs to the attention of local and even national Government as are the challenges with community radio development. Community radio involves community organization joint thinking and decision making all of which entail great potential for empowering communities and building a democratic society. Community radio stations are operated, owned and driven by the communities they serve. It is not for profit and provides a mechanism for facilitating individuals, groups and communities to tell their own diverse stories to share experiences and in a media rich world community radio acts as a vehicle for the community and voluntary sector, civil society, agencies, NGOs and citizen to work in partnership to further community development as well as broadcasting aims.

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Extent of Utilization of Information and Communication Technology (ICT) in the Agricultural Marketing by Farmers and Traders in Tonk and Dausa Districts of Rajasthan

Sushmita Saini[1]* and Basavaprabhu Jirli[2]
[1]Research Scholar, Department of Agriculture Extension, ICAR-Indian Agriculture Research Institute, New Delhi
[2]Professor and Head, Department of Extension Education, Institute of Agricultural Science, Banaras Hindu University, Varanasi, UP

ABSTRACT

e-Mediated extension services helps the farmers to be e-ready and exploits the potential of ICT tools. National Agriculture Market (e-NAM) created an opportunity for the integration of physical Agricultural Produce Market Committees (APMCs) that can be accessible across the country through common digital platform to facilitate trade of agriculture commodities. The objective of the study was to determine Extent of Utilization of Information and Communication Technology (ICT) in Agricultural Marketing by Farmers & Traders in Dausa and Tonk districts of Rajasthan. The study adopted ex post facto research design and collected data from 100 respondents and was analyzed by using descriptive statistic and Mann Whitney U. The study found high to moderate utilization of provisions of e-NAM platform in the APMCs of Rajasthan and better prices in wheat and mustard on e-NAM platform than traditional markets.

Keywords: APMCs, e-mediated, e-NAM, e-ready, Digital platform, ICT

INTRODUCTION

The ubiquitous adoption of information and telecommunications technologies (ICTs) in country paves the way to provide farmers with more timely and low-cost information services, as well as to assist in the coordination of agricultural agents (Aker *et al.,* 2016). Appropriate utilization of ICT in agriculture leads to empower the stakeholders with the modern techniques to enhance productivity and profitability of agriculture. The dissemination of necessary information through ICT tools are in a user-friendly format, simple to access, and cost effective methods at the appropriate time. (Anonymous. 2011a). Agricultural marketing encompasses a wide range of operations and activities that involves movement of fresh produce and raw materials from the cultivated farm to the ultimate user. The Twelfth Plan working group on agriculture market outline the issues in existing markets like: too many intermediaries which hikes the cost of goods and services; inadequate infrastructure for storage, sorting, grading, and post-harvest management of produce; restriction of private players to invest in logistics or infrastructure; price discovery mechanism were not transparent; ill-equipped and untrained mandi staff; market information not easily accessible; and essential Commodities Act 1955 hampers free movement, storage and transport of produce (Chand, 2012). Integration of ICT in Agriculture Marketing provides a great opportunity to overcome from loop holes of Agricultural Produce Marketing Committee (APMCs) in the conventional markets. Government realize the importance of e-mediated agriculture markets in India and launched electronic National Agriculture Market (e-NAM) on 14th April 2016. National Agriculture Market (NAM) is a pan-India electronic trading portal completely funded by Union Government and implemented by Small Farmers Agribusiness Consortium (SFAC). e-NAM portal networks the existing APMC (Agriculture Produce Marketing Committee)/ Regulated Marketing Committee (RMC) market yards, sub-market yards, private markets and other unregulated markets to unify all the nationwide agricultural markets by creating a central online platform for agricultural commodity price discovery (Anonymous,

*Corresponding author email id: sushmitasaini0117@gmail.com

2017c). The research question was to what extent beneficiaries of e-NAM exploits the facilities of digital mandi? The objective of study was to understand the extent of utilization of provisions of e-NAM by the farmers and traders of Tonk and Dausa districts of Rajasthan.

MATERIALS AND METHODS

The study was conducted in Rajasthan where maximum number of APMCs connected to e-NAM. Out of 1000 e-NAM markets in 18 states and 3 union territories of the country, 144 e-mandis are operational in Rajasthan. For the purpose of sampling, names of two e-mandis of Rajasthan were randomly chosen. Mandawari mandi (APMC) of Dausa district and Niwai mandi (APMC) of Tonk district were sampled for study. The cross sectional data was collected during 2019-2020 rabi season through semi-structured interview schedule. Twenty-five farmers and twenty-five traders from each APMCs were randomly interviewed who sell their produce through e-NAM digital platform. The total sample size was 100.

The data collected on the available facilities with the help of focus group discussion. The focus was on crop were wheat, mustard, bajra, gram and sesamum.

Data was analyzed by using descriptive statistics and Mann Whitney U test. The purpose of running this test was, the observations from the traditional market and e-NAM markets were independent, continuous and ordinal (in rupees). The null hypothesis (H_0) was the two independent groups (traditional market and e-NAM market) are homogeneous and have the same distribution of price of crops (wheat/mustard/ bajra/ gram/ sesamum). The alterative hypothesis (H_1) was the first group data distribution (e-NAM) of price differs from the second group data distribution (traditional market) of price of crops (wheat/ mustard/ bajra/ gram/ sesamum).

The score obtained by two independent groups were ranked together, giving rank 1 to the lowest score. The ranks received by the two sets of scores are then separately summed up. To determine the value of U, using the formula:

$$U_1 = N_1 N_2 + N_1 (N_1 + 1) - SR_1 / 2$$
$$U_2 = N_2 N_1 + N_2 (N_2 + 1) - SR_2 / 2$$

Where, U_1 = the total number of first group (e-NAM market) observations preceding second group (traditional market) observations,

U_2 = the total count of second group (traditional market) observations preceding first group's (e-NAM market)

N_1= number of items in the first group (e-NAM market)

N_2= number of items in the second group (traditional market);

R_1= sum of the ranks of the first group (e-NAM market)

R_2 = sum of the ranks of the second group (traditional market). Microsoft excel and IBM SPSS statistics software (23.0 version) were used for analysis of data.

RESULTS AND DISCUSSION

The results of Extent of utilization of provisions of e-NAM by respondents are presented in the Table 1 and Figure 1. Mean score values of extent of utilization of provisions of e-NAM in Mandawari and Niwai APMCs show which facility was used by respondents (farmers and trader).

From the Table 1, items with mean score values less than 1.83 were taken as less utilized facilities by respondents, items with mean score values of 1.89–2.72 were taken as moderately used facilities and items with mean score values more than 2.73 were taken as highly used facilities. The standard deviation (S.D.) was also presented to show how the individual raw scores of items was dispersed or scattered about the mean score. Items of extent of utilization of e-NAM also arranged in ranked order on the basis of mean score values from highly used to less used provisions.

The results reveals that getting sale agreement and e-invoices generated with each sale of e-NAM lot and assaying (quality check) of produce on e- NAM platform was highly used facility with rank I and II respectively. Nagarjuna Fertilizer and Chemicals Limited is a strategic partner of e-NAM and responsible for design, develop, test, implement, maintain, manage, enhance and modify the set of applications and modules of e-NAM platform. The sale agreement and sale invoices generation and quality assaying management done by strategic partner (Anonymous, 2016c).

Followed by pay via online mode; attending training programmes at APMCs regarding e-NAM facilities; visit e-NAM mandi daily; visit mandi via online mode; access e-NAM portal through Mobile app; sale of produce via online mode; price information before selling/trading of produce; get payment immediately in banking account with ranks III to X respectively. e-NAM integrates the physically

Table 1: Extent of utilization of e-NAM with mean scores and rand order

Code	Items	F	R	N	S.D.	Mean score	Rank order	Facility utilized
E07	Sales agreement & e-invoices generated with each sale of e-NAM lot	87	13	0	0.33	2.87	I	Highly
E06	Assaying of produces which farmer brought for selling and trader brought for trading on e-NAM platform	76	23	1	0.45	2.75	II	Highly
E11	Pay via online mode	64	33	3	0.54	2.61	III	Moderately
E09	Attend training programmes at APMCs regarding e-NAM facilities.	65	29	6	0.60	2.59	IV	Moderately
E05	Visit e-NAM mandi daily	60	34	6	0.61	2.54	V	Moderately
E03	Visit mandi via online mode	56	38	6	0.61	2.50	VI	Moderately
E02	Access e-NAM portal through Mobile app	43	42	15	0.71	2.28	VII	Moderately
E01	Sale of produce via online mode	44	29	27	0.82	2.17	VIII	Moderately
E04	Price information before selling/trading of produce (commodity wise)	36	34	30	0.81	2.06	IX	Moderately
E12	Get payment immediately in banking account	21	55	24	0.67	1.97	X	Moderately
E10	Tracked their produces with unique Lot id generated/ check live status of APMCs before trading	13	28	59	0.71	1.54	XI	Less
E08	Under gone any learning e- modules tutorials videos on e-NAM portal	11	26	63	0.68	1.48	XII	Less

F= Frequently; R= Rarely; N= Never

integrated markets, the universe of players increases, and traders begin to transparently bid for the lots of produce. With e-NAM, cartelization has begun to break down. As a metric of success, the number of bids per lot has increased from 1.8 to 4.8. With the competition among buyers and sellers, price discovery is better and to the advantage of the farmer (Boettiger and Sanghvi, 2019). There are many provisions of digital mandi e-NAM that facilitates conveniently buying and selling of crops to the farmers and traders to across the country via a common

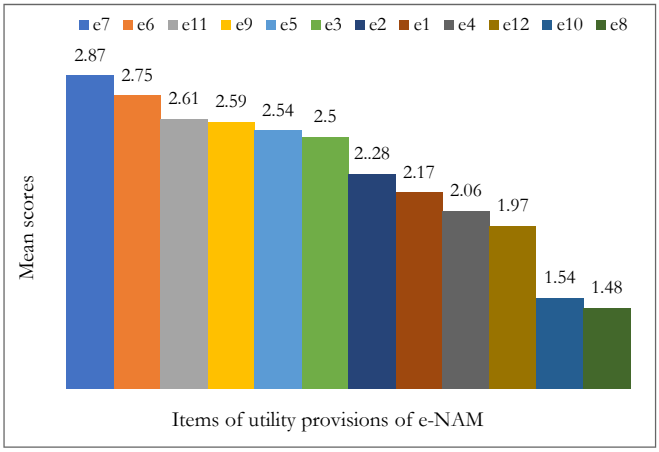

Figure 1: Distribution of provisions of e-NAM utilized by respondent

platform. e-tendering or e-NAM will advocate increased marketing efficiency, increased competitiveness, infrastructural, social and technological improvisation of markets, increased market driven diversification, improved transparency in marketing system, increased financial literacy of farmers (Kalamkar *et al.,* 2019).

Followed by tracked their produces with unique Lot id generated/check live status of APMCs before trading and learning e- modules tutorials videos on e-NAM portal was least used facilities with rank XI and XII respectively.

Table 2 depicts the results for famers. Null hypothesis was accepted for wheat, bajra, gram and sesamum with the p-value more than 0.05 that explains the two

Table 2: Testing statistical significance of different crops selling on two different platforms by the farmers (n=100)

Crops	U (Test Statistic)	p-value
Wheat	1267.50	0.84
Mustard	1512.50	0.49*
Bajra	1327.00	0.52
Gram	1239.00	0.88
Sesamum	1254.50	0.94

*Sig = 0.05

Table 3: Testing statistical significance of different crops selling on two different platform's by the traders (n=100)

Crops	U (Test Statistic)	p-value
Wheat	1545.50	0.03*
Mustard	1462.00	0.10
Bajra	1320.50	0.51
Gram	1254.50	0.94
Sesamum	1252.00	0.96

*Sig = 0.05

independent groups (traditional market and e-NAM market) are homogeneous and have the same distribution of price of crops. The null hypothesis was rejected only for mustard crop that explains significant difference in selling price on e-NAM mandi than traditional market with p-value 0.49 at 5% level of significance. The price advantage of 3.75 per cent received by the farmers for the same crop before and after eNAM situations. Though this gives the price difference realized by the same person for the same agricultural produce, it needs to be noted that there is a difference in the time horizon (Nuthalapati *et al.,* 2020)

Table 3 heralds the results for traders. Null hypothesis was accepted for mustard, bajra, gram and sesamum with the p-value more than 0.05 that explains the two independent groups (traditional market and e-NAM market) are homogeneous and have the same distribution of price of crops. The null hypothesis was rejected only for wheat crop that explains significant difference in selling price on e-NAM mandi than traditional market with p-value 0.03 at 5% level of significance. Rajasthan, Telangana and Uttarakhand are top three states in India for issuing maximum licenses by authorities with 43.58 per cent, 19.81 per cent and 16.97 per cent, respectively (Meena *et al.,* 2019).

CONCLUSION

The appropriate use of ICT would be stepping stone in revolutionizing agricultural practices. ICT in agriculture markets created the opportunity to enhance the accessibility of existing markets and creation of new digital markets. National Agriculture market (e-NAM) was launched with the vision to promote homogeneity in agricultural marketing by optimizing procedures across integrated markets in pan India, eliminating information asymmetry between buyers and sellers, and encouraging real-time price discovery based on actual demand and supply. Provisions of e-NAM were not utilized in the same degree. There is need to adopt promotion strategies to make farmers and traders aware about the benefits of buying and selling of crops via a common digital platform with a single license valid across the country. Rajasthan is leading state in wheat and mustard production, from the study it was found that respondents got remunerative price on e-NAM platform.

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Utilization Patterns of Sugarcane Production Technologies and Factors Affecting the Same Under Sugarcane Based Farming System in Indo-Gangetic Plains of India

Kamta Prasad, Gopal Sankhala[1], Rakesh Kumar Singh[3], Y.P. Singh[4]*, Barsati Lal[2], R.S. Dohare[2] and Rajesh Kumar[2]

[1]Principal Scientist, ICAR-National Dairy Research Institute, Karnal-132001, Haryana
[2]Principal Scientists, ICAR- Indian Institute of Spices Research, Dilkusha, Lucknow-226002, Uttar Pradesh
[3]SMS (Animal Science), KVK, ICAR-Indian Institute of Spices Research, Lucknow-226002, India
[4]STO, ATIC, ICAR-Indian Agricultural Research Institute, New Delhi-110012

ABSTRACT

Utilisation of technologies by the farming community is of utmost importance from economic wellbeing of farmers, the enterprise as well as environment point of views. However, the technology utilization may be affected by 'their sources and access. Here an attempt has been made to investigate actual level of technology utilization at farmers' level along with factors affecting the same. The study was conducted in purposively selected the state of Uttar Pradesh among the five states viz., Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal of the Indo-Gangetic Plains (IGP) of India mainly as it has highest area under sugarcane and area wise was also the largest. The study was conducted in major sugarcane growing regions *viz*., Eastern, Central and Western U. P. and 3 regions, 3 districts, 6 *tehsils,* 12 villages and 240 farmers constituted the sample size. The data collection was done with the help of semi-structured interview schedule through personal interview and observation methods. Most of the farmers (40.00%) were of old age, had education up to high school (25.83%), medium family educational status (40.42%), maintained small families (42.50%), have joint families (57.42%), had medium level of social participation (51.25%), decisions were taken by the family head on the basis of economic factors (56.25%), average land holding was 1.78 ha, belonged to the marginal category (40.42%) of farmers, 49.17 per cent had low level of annual income (<Rs. 2.17 lakh), small herd size (59.58%) of less than 3.16 standard animal unit dominated by non-descript animals, medium mass media exposure (42.50%) and medium extension contact (41.25%). Sugarcane was found to be the major crop which covered 32.95 per cent of total cropped area with average yield of the 708.58 q ha^{-1}. It was observed that majority (43.33%) of the farmers could utilize technologies to medium extent with index value of 48.80-62.45. It was followed by the farmers (31.25%) who utilized the technologies to high extent with index value of greater than 62.45. It was observed that education of family head, family educational status, family size, income from sugarcane, income from other sources, extension contact and mass media exposure were found to be the major contributory factors in utilization of sugarcane production technology in Uttar Pradesh.

Keywords: Sugarcane, Technology, Utilization and factors

INTRODUCTION

Sugarcane is more profitable crop relative to other crops in the area where it is planted (National Commission on Farmers, 2005) also improves the soil health by fixing the nitrogen ranging between 50-60 per cent of the total plant nitrogen requirement which is equivalent to about 100 - 175 kg N ha^{-1}. This indicates that sugarcane is a unique non-legume C-4 crop, which has potential equivalent to even some of the leguminous crops for the fixing of atmospheric nitrogen in the natural conditions (Lima *et al.*, 1987). In this direction among the various crops, sugarcane also offers an excellent opportunity for dairy farming as sugarcane contributes a lot in the form of fodder, fuel, litter and housing material. Kung (1978); Kevelenge *et al.* (1983); Nasseven (1986) and Wanapat (1990) reported that

*Corresponding author email id: ypicar2016@gmail.com

among the many food crops cultivated by farmers, sugarcane represents an example whose by-products can maximally be utilized.

Sugarcane and its by-products (bagasse, molasses, leaves, tops and stalks) have successfully been used as cattle feed in intensive production systems. In low-producing dairy cows in India, feeding sugarcane tops (51% dietary level) twice daily was the most efficient practice for optimal nutrient utilization (Bandeswaran *et al*., 2012).

The sugarcane also plays a vital role towards socio-economic development by providing employment to the 45 million sugarcane farmers and agricultural labourers (7.5% of the rural population). About half a million skilled and semi-skilled workers, mostly from the rural areas are also engaged in the sugar industry. (Anonymous, 2006 and Murthy, 2010). It contributes about 4.4 per cent of the value of output from crop sector, occupies about 2.4 per cent of India's gross cropped area, cultivated in about 5 million hectares and India holds the second position in production of sugarcane after Brazil. It is mainly grown under the highly fertile irrigated agri-ecosystem of the country of which Indo-gangetic plain region is the major contributor to the ara and production of sugarcane crop. Under the indo-gangetic plain region, Uttar Pradesh is main constituent as it has highest area, 2151 thousand ha under sugarcane crop in the year 2019-20 with a production and productivity of 173816 thousand tonnes and 80.81 tonnes ha^{-1}, respectively (Anonymous, 2020). Furthermore, barring Bihar ($294), U. P. is one of the poor State as average annual/capita income was just $ 436 in 2011 as compared to $1,410 for India as a whole (World Bank, 2014). Thus, increasing the per capita income is the need of the hour for improving the standard of living but it cannot be achieved without increasing the productivity of sugarcane farming which is prevalent in 59 out of the 75 districts. It may further contributes towards the increasing the income of farmers by effective utilization of technologies. Utilisation of technologies by the farming community is of utmost importance from economic wellbeing of the enterprise as well as environment point of views. However, the technology utilization may be affected by 'their sources and access. Here an attempt has been made to investigate actual level of technology utilization at farmers' level along with factors affecting the same.

MATERIALS AND METHODS

The Indo-Gangetic Plains (IGP) in India mainly comprises of five states viz., Punjab, Haryana, Uttar Pradesh, Bihar and West Bengal. Among these state the state of Uttar was selected in purposively to conduct the study as area wise it is the fifth largest, the most populous, it has highest area, 2151 thousand ha under sugarcane crop in the year 2019-20 with a production and productivity of 173816 thousand tonnes and 80.81 tonnes ha^{-1}, respectively (Anonymous, 2020). In the state sugarcane cultivation is mainly concentrated in 3 Regions; hence these Regions were selected purposively for conducting the study. Faizabad, Sitapur and Muzaffarnagar districts from Eastern, Central and Western U.P. were randomly selected, respectively. From each selected district, two tehsils and from each selected *tehsil*, 2 villages were selected randomly. For selection of the respondents, a pilot survey of the selected villages was carried out and a list of farmers practicing sugarcane farming from 5 years, generating substantial part of agricultural income from sugarcane crop related activities either through its cultivation or doing related activities such as share cropping, labour, running crushers, transportation of sugarcane, etc. were shortlisted irrespective of whether they were having their own land or not. Farmers were categorised on the basis of land holdings i.e., landless, marginal, small, semi-medium, medium and large categories as per government of India classification. On the basis of proportionate random sampling method, from each selected village, a total of 20 farmers were selected subject to condition that at least one farmer must be included in each category. Thus, a total of 240 such farmers constituted the sample size. The data collection was done through personal interview and observation methods during the year 2016.

RESULTS AND DISCUSSION

Profile of farmers consist of social, personal, psychological, economical and communicational traits which deals with their technological use pattern, relationship with other members of the social system as well as their social and economical status in the society (Table 1).

Most of the farmers (40.00%) were of old age, had education up to high school (25.83%), medium family educational status (40.42%), maintained small families (42.50%), have joint families (57.42%), had medium level of social participation (51.25%), decisions were taken by the family head on the basis of economic factors (56.25%), practicing agriculture as primary along with dairy as secondary occupation (63.33%), average land holding was 1.78 ha, belonged to the marginal category (40.42%) of farmers, 49.17 per cent had low level of annual income

Table 1: Profile of farmers (n = 240)

S.No.	Category	Frequency	Percentage
A.	**Socio-personal variables**		
1.	**Age (in years)** (Mean-48.12 and range-18 to 78)		
	Young (Up to 35)	50	20.83
	Middle (36-50)	94	39.17
	Old (Above 50)	96	40.00
2.	**Education of family head**		
	Illiterate	37	15.42
	Primary	34	14.17
	Middle	42	17.50
	High School	62	25.83
	Intermediate	37	15.42
	Graduate	22	9.16
	Post Graduate & above	6	2.50
3.	**Family educational status** (Mean- 342.19 and range- 100 to 583.33)		
	Low (< 293.33)	70	29.16
	Medium (293.34-391.07)	97	40.42
	High (>391.07)	73	30.42
4.	**Family size** (Mean- 6.97 and range- 1 to 29)		
	Small (< 6)	102	42.50
	Medium (6 to 9)	86	35.83
	Large (>9)	52	21.67
5.	**Family type**		
	Nuclear	101	42.08
	Joint	139	57.42
6.	**Social participation** (Mean –17.10 and range- 7 to 56)		
	Low (<15.48)	90	37.50
	Medium (15.48 to 27.16)	123	51.25
	High (>27.16)	27	11.25
7.	**Decision making pattern**		
7.1	**Style of decision making**		
	By the family head	135	56.25
	Jointly by adult male members	2	0.83
	Jointly by adult female members	11	4.58
	Jointly by all members of the family	56	23.33
	By the family head+ other adult male members	7	2.92
	By the family head+ adult female members	28	11.67
	Jointly by adult male members + adult female members	1	0.42
7.2	**Basis of decision making**		
	Economic considerations	135	56.25
	Social and psychological consideration	4	1.67
	Situational factors	11	4.58
	Economic considerations + social and psychological consideration	7	2.92
	Economic considerations + situational factors	27	11.25
	Economic considerations + social and psychological consideration +situational factors	56	23.33
B.	**Socio-economic variables**		
1.	**Occupation (Main + Secondary)**		
	Agriculture + dairy	152	63.33
	Labour + dairy	25	10.42

Table 1 contd...

S.No.	Category	Frequency	Percentage
	Agriculture + dairy + service	10	4.17
	Labour + dairy + business	6	2.50
	Agriculture + dairy + labour	25	10.42
	Agriculture + dairy + business	14	5.83
	Agriculture + dairy+ service + business	2	0.83
	Agriculture + dairy + business + labour	5	2.08
	Agriculture + dairy+ service + labour	1	0.42
2.	**Operational land holding** (Mean -1.78 and range -0 to 14 ha)		
	Landless (0)	31	12.92
	Marginal (<1 ha)	97	40.42
	Small (1-2 ha)	56	23.33
	Semi-medium (2-4 ha)	30	12.50
	Medium (4-10 ha)	14	5.83
	Large (>10 ha)	12	5.00

	Crops/Total area (In ha)	Average Area/ household (ha)	Percentage to total cropped area	Average yield (q ha^{-1})
3.	**Cropping pattern**			
a.	**Cereal, pulses, oilseeds and other crops**			
i)	***Kharif***			
	Paddy (204.23)	0.85	22.67	41.68
	Black gram (33.25)	0.14	3.69	13.21
	Sesame (39.45)	0.16	4.38	11.14
	Cow pea (0.95)	0.004	0.11	37.50
	Maize (11.30)	0.05	1.25	40.00
	Bajra (9.90)	0.04	1.10	20.31
ii)	***Rabi***			
	Wheat (165.85)	0.69	18.41	35.74
	Mustard (42.50)	0.18	4.72	21.43
	Lentil (5.90)	0.02	0.65	20.00
	Potato (9.85)	0.04	1.09	268.53
iii)	***Zaid***			
	Mentha (17.30)	0.07	1.92	110.40 (l/ha)
	Okra (4.20)	0.02	0.47	65.00
	Maize (1.70)	0.01	0.19	30.00
b.	**Fruit crops**			
	Mango (8.90)	0.04	0.99	82.86
c.	**Fodder crops**			
i)	***Kharif***			
	Chari (13.24)	0.06	1.47	428.77
ii)	***Rabi***			
	Berseem (11.73)	0.05	1.30	453.11
	Oat (4.68)	0.02	0.52	250.60
iii)	***Zaid***			
	Chari (19.13)	0.08	2.12	372.22
	Overall fodder	**0.21**	**5.41**	**418.53**

Table 1 contd...

	Crops/Total area (In ha)	Average Area/ household (ha)	Percentage to total cropped area	Average yield (q ha^{-1})
d.	**Cash crop-sugarcane**			
	Autumn (40.00)	0.17	4.44	775.24
	Spring (73.20)	0.31	8.12	751.47
	Late (84.85)	0.35	9.42	675.00
	Ratoon (98.80)	0.41	10.97	632.60
	Overall	**1.24**	**32.95**	**708.58**
4.	**Annual income** (Mean – Rs. 269287 and range- Rs. 52705 to 1231441)			
	Low (< Rs. 216617.00)		118	49.17
	Medium (Rs. 216617 to 431129)		90	37.50
	High (> Rs. 431129)		32	13.33
5.	**Herd size** (Mean- 3.22 and range- 1.3 to 10.39 standard animal units)			
	Small (<3.16)		143	59.58
	Medium (3.16-5.40)		67	27.92
	Large (>5.40)		30	12.50
C.	**Communication variables**			
1.	**Mass media exposure** (Mean-5.91 and range- 1 to18)			
	Low (< 4.34)		96	40.00
	Medium (4.34-9.00)		102	42.50
	High (> 9.00)		42	17.50
2.	**Extension contact** (Mean-8.91and range- 2 to 21)			
	Low (< 7.55)		96	40.00
	Medium (7.55-11.54)		99	41.25
	High (>11.54)		45	18.75

(<Rs. 2.17 lakh), small herd size (59.58 %) of less than 3.16 standard animal unit dominated by non-descript animals, medium mass media exposure (42.50%) and medium extension contact (41.25 %). Most utilized mass medium was found to be the mobile phone and most contacted source for acquisition of information was fellow farmers/progressive farmers. Sugarcane was found to be the major crop which covered 32.95 per cent of total cropped area with average yield of the 708.58 q ha^{-1}. Paddy, wheat and mentha were the other major crops of *Kharif, Rabi* and *Zaid* seasons', respectively. Chari was grown by the farmers in Kharif and Zaid seasons while berseem and oat were in *Rabi* season. These fodder crops occupied 5.41 per cent of total cropped area.

The technology utilization affect the productivity consequently levels of income and standard of living thereby, optimum use of technology should be ensured. For devising policies of technology transfer, utilization pattern of technologies at the farmers level to be determined to direct the efforts in the right directions. Utilisation of farming technologies is necessary to increase the production and productivity of agriculture for feeding the ever increasing population of our country. Use of the technologies is also necessary for sustainability of agriculture.

Results presented in Table 2 depict that a sizeable proportion of the farmers (41.25%) had medium level of utilization followed by 30.83 and 27.92 were having high and low levels of technology utilisation in respect of varieties, planting materials and methods. It can be inferred that most of the farmers had medium level of technology utilization. It might be due to the fact that most of the farmers are either marginal or small who do not have much resources with them to make use of costly technologies. Average utilization was found to be the 47.96 depict a gap of nearly 52 per cent that need to be abridged for increasing the productivity of crop and in turn income of the farmers.

The mean utilization index was found to be 51.88. Most of the farmers (41.67%) fell in the category of medium utilization of technologies in the major area of fertilizer and irrigation management followed by 39.58 and

Table 2: Distribution of farmers according to the major area wise utilisation of sugarcane farming technologies (n=240)

S.No.	Major areas	Categories	Frequency	Percentage
1.	Varieties, planting materials and methods (Mean- 47.96)	Low (<46.60)	67	27.92
		Medium (46.60-58.99)	99	41.25
		High (>58.99)	74	30.83
2.	Fertilizer & irrigation management (Mean- 51.88)	Low (<55.61)	95	39.58
		Medium (55.61-68.75)	100	41.67
		High (>68.75)	45	18.75
3.	Weed management, intercultural operations and intercropping (Mean- 39.67)	Low (<31.97)	91	37.92
		Medium (31.97-53.49)	94	39.17
		High (>53.49)	55	22.92
4.	Plant Protection (Mean- 43.00)	Low (<40.99)	79	32.92
		Medium (40.99-70.36)	153	63.75
		High (>70.36)	8	3.33
5.	Ratoon management (Mean- 51.74)	Low (<47.76)	85	36.17
		Medium (47.76-71.67)	97	41.28
		High (>71.67)	53	22.55
6.	Post-harvest management and mechanization (Mean- 65.14)	Low (<50.20)	56	23.33
		Medium (50.20 -83.79)	143	59.58
		High (>83.79)	41	17.08
7.	Overall technology utilization (Mean- 48.79)	Low (<48.80)	61	25.42
		Medium (48.80-62.45)	104	43.33
		High (>62.45)	75	31.25

18.75 per cent of them fell in the categories of low and high, respectively.

Medium level of utilization may be attributed to the availability crises, lack of how to knowledge among the farmers and increasing input cost. Since the matter is related to very basic requirement of cultivation i.e., soil hence it is of utmost importance and need to be relooked by the various agencies working in the sugarcane dominated areas. The farmers must be made aware about balanced use of fertilizers and water, input saving technologies, green manuring and use of organic manures for proper soil health management (Table 2).

Average utilization index of this group of technologies was 39.67 out of maximum possible index i.e., 100. This indicates a gap of nearly 60 per cent. This was observed that 39.17, 37.92 and 22.92 per cent of the farmers had medium, low and high utilization of technologies, respectively. It shows that most of the farmers had medium level of utilization which might be due to the complexity of weed management technologies, operational difficulties of intercropping and lack of funds with the farmers (Table 2).

A cursory look at the Table 2 shows that majority of the farmers (63.75%) had medium level of utilization followed by 32.92 and 3.33 per cent of them had low and high levels of utilization of plant protection technologies, respectively. The mean utilization was 43.00 per cent. It is evident that majority of the farmers had medium level of utilization of technologies which may be attributed to the more cost and complexity involved with the plant protection technologies.

A glance at Table 2 shows that under ratoon management, nearly two fifth (41.28%) of the farmers utilized technologies to medium level and 22.55 per cent of them utilized to high level while, a large (36.17%) proportion of them utilized the technologies to low level. The average utilization of the ratoon management technologies was 51.74 per cent. In a nutshell, it may be said that most of the farmers utilized technology to the medium level. This may be because of that farmers consider ratoon as a bonus crop, ignorance about the technologies, lack of resources with the farmers, etc. Ratoon covers almost 40 to 50 per cent of total sugarcane area, cost of cultivation is also comparatively less than the plant crop, early ripening facilitate timely start of sugar mill and early availability of fodder to the animals, therefore, utilization of ratoon management technologies must be improved by sensitizing the farmers for utilization of ratoon management technologies.

Results presented in Table 2 indicate that majority (59.58%) of the farmers had medium level of utilization i.e., 50.20 to 83.79 per cent. A sizeable proportion (23.33%) of them fell in the category of low level (<50.20) followed by 17.08 per cent of them who had high level (>83.79) of utilization. The average utilization was found to be the 65.14 per cent. It can be visualized that majority of the farmers had utilized the technologies to an extent of medium level which might be due to the inadequate resources, poverty and poor educational status of the farm families.

Results presented in Table 3 indicate that the technologies related to post-harvest management and mechanization were found to be most utilized with an index value of 62.29 followed by fertilizer & irrigation management (53.85), Varieties, planting materials and methods (51.01), ratoon management (48.85), plant protection (40.63) and weed management, intercultural operations and intercropping (36.13). The overall technology utilization was found to be the 48.68 depicting a gap of 51.32. The results shows that technologies related to post-harvest management and mechanization were most utilized and it might be due to the direct implication of these technologies on cash earning, shortage of manpower for agricultural work and efforts to minimize the cost of cultivation. The group of technologies under weed management, intercultural operations and intercropping as well as plant protection was the least utilized with a gap of 63.88 and 59.38, respectively. Reasons behind this state of affairs may be the complexity associated with technologies, lack of knowledge among the farmers and difficulties perceived by the farmers particularly for use of intercropping related techniques in face of the unavailability of broad spectrum agro-chemicals for plant protection. On the basis of the results it can be suggested that the farmers of Eastern UP may be provided with skill oriented training on intercropping, weed management, plant protection both bio as well as chemical and handling of agro-chemicals for best use of major production resource, i.e. land.

Results presented in Table 3 indicate that the technologies related to post-harvest management and mechanization were found to be most utilized with an index value of 62.71 followed by fertilizer & irrigation management (51.25), varieties, planting materials and methods (48.03), ratoon management (48.02), plant protection (45.00) and Weed management, intercultural operations and intercropping (41.13). The overall technology utilization was found to be the 48.39 depicting a gap of 51.61. The results shows that technologies related to post-harvest management and mechanization were most utilized however, still a gap of 37.29 exist. The least utilized technologies were the weed management, intercultural operations and intercropping with a gap of 58.88. This indicates that the farmers need to motivated for utilization of technologies through use of modern communication media, practical training, tours and kisan gosthis.

It was observed that the most utilized technologies were post-harvest management and mechanization with a index value of 70.42 followed by ratoon management (58.33), fertilizer & irrigation management (50.52), varieties, planting materials and methods (44.86), plant Protection (43.38) and weed management, intercultural operations and intercropping (41.75). The overall technology utilization was found to be the 49.29 depicting a gap of 50.71. The results shows that technologies related to post-harvest management and mechanization were most utilized and it might be due to the direct implication of these technologies

Table 3: Region wise technology utilsation and technological utilisation gap of sugarcane production technologies

S. No.	Major areas	Average Tech. utilization index				Technology utilization gap			
		Eastern UP	Central UP	Western UP	Overall UP	Eastern UP	Central UP	Western UP	Overall UP
1	Varieties, planting materials and methods	51.01	48.03	44.86	47.96	48.99	51.97	55.14	52.04
2	Fertilizer & irrigation management	53.85	51.25	50.52	51.88	46.15	48.75	49.48	48.12
3	Weed management, intercultural operations and intercropping	36.13	41.13	41.75	39.67	63.88	58.88	58.25	60.33
4	Plant Protection	40.63	45.00	43.38	43.00	59.38	55.00	56.63	57.00
5	Ratoon management	48.85	48.02	58.33	51.74	51.15	51.98	41.67	48.26
6	Post-harvest management and mechanization	62.29	62.71	70.42	65.14	37.71	37.29	29.58	34.86
7	Overall technology utilization	48.68	48.39	49.29	48.79	51.32	51.61	50.71	51.21

on cash earning, shortage of manpower for agricultural work and efforts to minimize the cost of cultivation. The technologies related to ratoon management were the second most utilized. This might be due to delayed planting resulting in low yield of plant crop but the farmers want to realize the more earning from sugarcane thereby they were giving more attention to ratoon crop, to maximize profitability as ratoon does not include the cost of seed as well as land preparation, early harvest provide fodder for animals during fodder scarcity period of mid October to mid November and also provide chance of early cane supply to mill when labour scarcity is less. The group of technologies under weed management, intercultural operations and intercropping as well as plant protection was the least utilized with a gap of 58.25 and 56.63, respectively.

Further, it was observed that there were no significant difference was observed among the different regions of UP as for as technology utilization was concerned. It may be attributed to the concentrated efforts of research organizations, cane department and sugar mills across the state. On the basis of all the sugarcane farming technologies and considering the whole state as unit, it was observed that majority (43.33%) of the farmers could utilize technologies to medium extent with index value of 48.80-62.45. It was followed by the farmers (31.25%) who utilized the technologies to high extent with index value of greater than 62.45, however, about a quarter (25.42%) of farmers were utilizing the technologies to low extent with index value of less than 48.80. The mean utilistion of technologies was found to be the 48.79 per cent with a gap of 51.21. A highest gap in utilization was observed in case of weed management, intercultural operations and intercropping though utilization of these technologies are the need of the hour for increasing productivity per unit time and land as there is a serious competition for land among the different activities like, other crops, industry, housing, transportation, etc. Most important aspect of sugarcane production *viz.* plant protection also posed a dismal show, in increasing the productivity plant protection has a major role.

It is concluded that majority of the farmers had medium level of utilisation of sugarcane farming technologies hence hypothesis that utilisation pattern of farming technologies by the farmers will not be low is accepted. Though the level of utilization is medium, however, except one or two aspects, the utilization remains under 50 per cent. It poses a serious threat in improving the productivity further to meet out the futuristic demand. This might be due to the lack of resources with the farmers, fragmentation of land, unexpected results of technologies, technology dissemination bias skewed

Table 4: Relationship between profile variables of farmers and utilization of sugarcane production technologies (n=240)

S.No.	Variables	Correlation coefficient (r value)			
		Eastern UP	Central UP	Western UP	Overall UP
1	Age	0.098	0.348**	0.205	0.212**
2	Education of family head	0.379**	0.275*	0.337**	0.328**
3	Family education status	0.507**	0.433**	0.374**	0.424**
4	Family size	0.321**	0.371**	0.113	0.259**
5	Social participation	0.568**	0.605**	0.481**	0.543**
6	Land Holding	0.442**	0.571**	0.453**	0.485**
7	Total area under sugarcane	0.443**	0.544**	0.446**	0.461**
8	Total cropped area	0.428**	0.551**	0.436**	0.465**
9	Annual income from Sugarcane	0.546**	0.635**	0.683**	0.614**
10	Annual income from other crops	0.527**	0.551**	0.450**	0.503**
11	Annual income from dairy	0.026	0.216	0.087	0.104
12	Annual income from other sources	-0.418**	-0.679**	-0.411**	-0.426**
13	Gross annual income	0.458**	0.559**	0.466**	0.488**
14	Herd size (Anim. Unit)	0.230*	0.225*	0.334**	0.256**
15	Mass media exposure	0.642**	.613**	.657**	.624**
16	Extension contact	0.664**	.623**	.534**	.601**

*<p=0.05 and **<p=0.01

towards the large farmers, factionalism in rural areas arising out of inherent lacuna of Indian society, unavailability of technologies, lack of proper knowledge and complexity of the technologies (Table 2 & 3).

Results given in Table 4 reveal that education of the family head, family educational status, family size, social participation, land holding, total area under sugarcane, total cropped area, annual income from Sugarcane, annual income from dairy, gross annual income, herd size, mass media exposure and extension contact were highly significantly positively correlated with utilization of technologies irrespective of the regions indicating that these variables may be given priority to improve the technology utilization. Annual income from other sources was found to be highly significantly but negatively correlated with utilization of sugarcane production technologies which provide an insight that the farmers those who have their earning from other sources are not much bothered about the sugarcane cultivation as their financial needs were met, however, they were sensitize to earn more by giving proper attention to sugarcane also.

After determining the simple regression, stepwise regression was carried out with the use of SPSS software to single out the important contributory variables and their overall contribution in explaining the variation in coefficient of determination. The equation of best fit is as follows:

$Y= 26.377+0.254* X_5+0.218*X_9+ (-0.318*X_{11}) + (-0.208*X_{12)} + 0.437*X_{16} +e$

It was observed that social participation (X_5), income from sugarcane (X_9), income from dairy (X_{11}), income from other sources (X_{12}) and extension contact (X_{16}) found to be the major contributory factors in explaining the variation in utilization of sugarcane production technology in Eastern Uttar Pradesh with a contribution of 60.80 per cent (R^2=0.608). It might be due to that social participation as well as extension contact may contribute in quality of decisions, improve participation in development programmes, income helps in purchasing of good inputs. However, income from dairy and other sources had negative impact shows less interest of farmers on sugarcane cultivation as their financial needs were met but the farmers should be sensitized to give proper attention to the sugarcane also so that they should earn more (Table 5).

In light of the results it is suggested that for improving the technology utilisation, social participation, income from sugarcane, income from dairy, income from other sources and extension contact should be given more emphasis in the Eastern Uttar Pradesh. The equation of best fit is as follows:

$Y= 33.358+0.173* X_4+ (-0.538*X_{12}) +0.185*X_{13}+ 0.306*X_{15} + e$

It was observed that family size, income from other sources, total annual income and mass media exposure found to be the major contributory factors in explaining the variation in utilization of sugarcane production technology in Central Uttar Pradesh with a contribution of 70.60 per cent (R^2=0.706). It might be due to that mass media exposure helps in receiving the information regarding technologies and different development programmes in turn improve the harnessing the accrued benefits, income helps in purchasing of quality inputs at right time. Family size also showed positive impact explains that the farmers could meet the labour requirement and succeeded in utilization of technologies. However, income from other sources had negative impact shows less interest of farmers on sugarcane cultivation as their financial needs were met but the farmers should be sensitized to give proper attention to the sugarcane also so that they should earn more (Table 6).

Results suggest that in Eastern Uttar Pradesh media management and cash flow are the important factors could positively contribute in utilization of technologies hence

Table 5: Impact of profile variables on utilization of sugarcane production technology in Eastern Uttar Pradesh region (Stepwise regression analysis) (n=80)

S. No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Social participation (X_5)	0. 254	2.541**	0.265
2.	Income from sugarcane (X_9)	0.218	2.161**	0.000
3.	Income from dairy (X_{11})	-0.318	-4.064***	0.000
4.	Income from other sources (X_{12})	-0.208	-2.784***	0.000
5.	Extension contact (X_{16})	0. 437	4.726***	0.521

Adjusted R^2 = 0.608, Constant= 26.377, F=4.3155**, p<0.01 ($t_{Tab.}$ two tailed = 2.639)

Table 6: Impact of profile variables on utilization of sugarcane production technology in Central Uttar Pradesh region (Stepwise regression analysis) (n=80)

S.No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Family size (X_4)	0.173	2.470***	0. 438
2.	Income from other sources (X_{12})	-0.538	-8.405***	0.000
3.	Total annual income (X_{13})	0.185	2.053**	0.000
4.	Mass media exposure (X_{15})	0.306	3.671***	0.692

Adjusted R^2 = 0.706, Constant= 33.358, F=5.7236**, p<0.01 ($t_{Tab.}$ two tailed = 2.639)

technologies should be given wide publicity and farmers should be provided with easy credit facilities. The equation of best fit is as follows:

$Y= 7.677+0.143* X_3+ (-0.391*X_6) +0.670*X_9+ (-0.227 *X_{12}) +0.329*X_{15}+ e$

It was observed that family education status, land holding, annual income from sugarcane, annual income from other sources and mass media exposure found to be the major contributory factors in explaining the variation in utilization of sugarcane production technology in Central Uttar Pradesh with a contribution of 61.90 per cent (R^2=0.619). It might be due to that education, mass media exposure helps in receiving the information regarding technologies and different development programmes in turn improve the harnessing the accrued benefits, income helps in purchasing of quality inputs at right time. However, land holding and income from other sources had negative impact show less interest of farmers on sugarcane cultivation as their financial needs were met but the farmers should be sensitized to utilize available technologies and give proper attention to the sugarcane also so that they should earn more (Table 7).

For improving the technology utilization education, land holding, annual income from sugarcane, annual income from other sources and mass media exposure to be given the priority while framing the policies for sugarcane development in Western Uttar Pradesh.

Considering the whole of Uttar Pradesh as a unit at the first stage the simple regression analysis was carried out and afterward stepwise regression was carried out with the use of SPSS software to single out the important contributory variables and their overall contribution in explaining the variation in coefficient of determination. The equation of best fit is as follows:

$Y= 17.893+0.163* X_3+ 0.150*X_4+0.224*X_9+ (-0.347*X_{12}) + 0. 302*X_{15} +e$

It was observed that family educational status, family size, income from sugarcane, income from other sources and mass media exposure were found to be the major contributory factors in explaining the variation in utilization of sugarcane production technology in Uttar Pradesh with a contribution of 57.20 per cent (R^2=0.572). It might be due to that family educational status may contribute in quality of decisions; mass media exposure improves participation in development programmes as well as receiving the information, income helps in purchasing of good inputs. These are the possible reasons for positive contribution to the utilization of sugarcane production technologies. However, income from other sources had negative impact show negligence of farmers on sugarcane cultivation as their financial needs were met but the farmers should be sensitized to utilize available technologies and give proper attention to the sugarcane also so that they should earn more (Table 8).

Table 7:Impact of profile variables on utilization of sugarcane production technology in Western Uttar Pradesh region (Stepwise regression analysis) (n=80)

S.No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Family education status (X_3)	0.143	1.905*	0.021
2.	Land holding (X_6)	-0.391	-2.727**	1.322
3.	Annual income from sugarcane (X_9)	0. 670	4.201***	0.000
4.	Annual income from other sources (X_{12})	-0.227	-3.030***	0.000
5.	Mass media exposure (X_{15})	0.329	2.737***	1.072

Adjusted R^2 = 0.619, Constant= 7.677, F=4.0669**, p<0.01 ($t_{Tab.}$ two tailed = 2.639)

Table 8:Impact of profile variables on utilization of sugarcane production technology in Uttar Pradesh (Stepwise regression analysis) (n=240)

S.No.	Profile characteristics of the farmers	Beta coefficient	't' value	Standard error
1.	Family educational status (X_3)	0.163	3.315***	0.012
2.	Family size (X_4)	0.150	2.991***	0.318
3.	Income from sugarcane (X_9)	0.224	3.581***	0.000
4.	Income from other sources (X_{12})	-0.347	-7.632***	0.000
5.	Mass media exposure (X_{15})	0.302	5.064***	0.442

Adjusted R^2 = 0.572, Constant= 17.893, F=3.7656**, p<0.01 ($t_{Tab.}$ two tailed = 2.576)

In light of the results it is suggested that for improving the technology utilization, family educational status, family size, income from sugarcane, income from other sources and mass media exposure should be given more emphasis.

CONCLUSION

It is concluded that majority of the farmers had medium level of utilisation of sugarcane farming technologies. Though the level of utilization is medium, however, except one or two aspects, the utilization remains under 50 per cent and there is no significant difference in utilization among the three sugarcane growing regions of Uttar Pradesh. It poses a serious threat in improving the productivity further to meet out the futuristic demand. Need based, cost effective and feasible technologies to be disseminated to the farmers through most effective channels in the manner so that these could be understood properly and utilized. Use of technical words like a. i. to be avoided while preparing the literature for farmers. It was also observed that education of family head, family educational status, income from sugarcane, income from other sources, social participation, extension contact and mass media exposure were found to be the major contributory factors in utilization of sugarcane production technology in Uttar Pradesh.

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Exploring the Vertical Impact of Farmer's Footfall at Krishi Vigyan Kendra to fulfill Farmer's Agricultural based Technical Information Thrust

Sarvesh Kumar[1]*, M.K. Bankoliya[2], Pushpa Jharia[3] and R.C. Sharma[4]
[1]Scientist (Agricultural Extension and Rural Sociology), [2]PA (Plant Protection), [3]PA (Plant Breeding & Genetics), [4]Senior Scientist & Head, JNKVV, Krishi Vigyan Kendra-Harda-461331, Madhya Pradesh

ABSTRACT

The agricultural development is backbone of rural development that is possible through strong interventions of transfer of agricultural technologies imparting both extension personnel and farmers as well. The most of the farmers visited KVK for seeking the technical knowledge related to field crops (1458, rank I) this was prominently depends upon the cropping pattern (soybean-wheat/gram) of the district followed by horticultural crops. The maximum footfall was made by farmers in the year 2020 (807, rank I), the productivity of major crops get enhanced during study period like Wheat by 500 kg/ha, Chickpea by 869 kg/ha, Soybean by 100 kg/ha, Pigeonpea by 665 kg/ha and Summer greengram by 325 kg/ha respectively. Hence it my briefed that farmer's footfall at KVK and its technical intervention had positive vertical impact on the profitability and productivity of growing crops in the Harda district of Madhya Pradesh.

Keywords: Agriculture, Footfall pattern, Horizontal impact, Information need, Productivity, Profitability, Vertical

INTRODUCTION

The Indian agriculture sector provides employment to about 65 per cent of the labour force, accounts for 27 per cent of the GDP and contributes 21 per cent of total exports and provides raw material to several industries. Therefore information is a powerful tool in addressing the agricultural needs and if it is used properly the economics nation can be changed Malhan and Rao (2007).

Inappropriate or poor quality information could be a hindrance to farmers' in use of information sources. The major constraints to information access are poor availability, poor reliability and a lack of awareness of information sources available and untimely provision of information. Awareness creation, through newspapers and television about the various sources of information for farmers would also be helpful in transformation of agricultural situation. Access to current information and its use is critical, not only for the financial success of farmers but to support sustainable agricultural systems also Callander (2011).

The agriculture sector in developing countries is becoming increasingly knowledge intensive. Researchers at the global, regional and national levels continue to generate new information. As agriculture systems become more complex, farmers' access to reliable, timely and relevant information sources becomes more critical to their competitiveness. Information must be relevant and meaningful to farmers, in addition to being packaged and delivered in a way preferred by them Diekmann and Batte (2009).

Context specific information could have a greater impact on the adoption of technologies and increase farm productivity for marginal and small agricultural landholders. Understanding farmers' information needs helps in designing appropriate policies, programs and organizational innovations Sammadar (2006).

Visiting pattern is a good indicator of agricultural extension services because the frequency and reasons of farmer's visit at Krishi Vigyan Kendra for agricultural technical information indicates the likely pathway for good

*Corresponding author email id: sarveshkvkharda@gmail.com

need based agricultural knowledge and extension services. The Krishi Vigyan Kendra (Farm Science Center) is district level agricultural extension center working with mandate of technologies assessment, refinement and transfer to farmers fields. Simultaneously, it provide training to unemployed rural youth, extension workers of district, in-service training, breeder seed productions presently also harnessing the indigenous technologies and maintain records of ITKs at district level. There are 722 KVKs working in 11 zones of the country. KVKs provide training and technical guidance in major fields, agronomy, horticulture, animal husbandry, plant protection, home science and agricultural extension. KVKs play an important role in connecting the rural community to outside world for exchange of information. The ultimate progress can only take place when people know new technology, understand it and work upon it. This requires access to reliable source of information Rathore and Karki (2010).

The agricultural development is backbone of rural development that is possible through strong interventions of transfer of agricultural technologies imparting both extension personnel and farmers as well. It is need of hour to carry out such vital studies to evaluate the performance of extension systems running to solve the agricultural technical problems and the farmers visiting pattern towards the extension systems and agricultural information sources present around us. With this background present study "assessing the visiting pattern of farmers at KVK for fulfilling their information needs for their profitable farming- A Meta Analysis" was undertaken and completed recently.

MATERIALS AND METHODS

The present study was completed at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Krishi Vigyan Kendra district-Harda, Madhya Pradesh during 2016-2020. Five years farmers' footfall record continuously was maintained at Krishi Vigyan Kendra with farmers' specific purpose of visits. The registered farmer's data at Krishi Vigyan Kendra-Harda from year 2016 to 2020 was used for this study. The collected data was categorized according to broad category of problems faced by farmers in the district. The desired technical information were written by visiting farmers at KVK record book themselves pertaining to different fields of agriculture. Hence, recorded data was tabulated, analyzed and presented in the result and discussion for knowing the footfall of farmers and their need of agricultural based technical information for making agriculture as profitable venture. Results of this study were inferred after tabulation, analyzing by using statistical tools like, percentage, rank and correlation-coefficient etc. for validation of the study.

RESULTS AND DISCUSSION

The farmer under this study constituted a particular group of users whose information needs was very specific. In recent decades, the value of information has increased considerably in developing countries but, farmers are rarely consulted about their needs and preferences before the extension systems present around them. So, by understanding how farmer's access and use agricultural information, their agricultural information needs and the factors that influence their information search behavior is very important hence, the correlation coefficient (r) sowing nature and extent of relationship between visitors (farmers) and independent variables was also analyzed as under.

The above Table 1 reflects the nature and extent of relationship between visitors (farmers) and independent variables under study in accordance with the visitors came to visit at KVK Harda for agricultural technical information the correlation value of the variable age was found highest i.e. 1.3144. It is highly significant indication the strong association of the age component. The next associated variable was regarded as occupation 12808. This reveals that occupation is the main area of the association related with the dependent variable. The visitors who were having the agriculture as the main occupation they were having positive attitude towards the KVK visit seeking technical knowhow. After occupation education, knowledge about of KVK, land holding, credit orientation and caste also were having consistent association with depend variable indicating with calculated 'r' value 1.2676, 1.2331, 1.1934,

Table 1: Correlation coefficient (r) sowing nature and extent of relationship between farmers and independent variables

Independent variables	Correlation coefficient 'r' value
Age (X_1)	1.3144**
Education (X_2)	1.2676**
Caste (X_3)	1.0158**
Occupation (X_4)	1.2808**
Land holding (X_5)	1.1934**
Credit orientation (X_6)	1.1376**
Knowledge about KVK (X_7)	1.2331**

**Significant at 0.01 per cent level of probability

Table 2: Classification of Footfall of Farmers to KVK for Agricultural based Technical Information Thrust

S. No.	Different Categories of Technical Information	Footfall of Farmers at KVK						
		2016	2017	2018	2019	2020	Category wise farmer's footfall	Rank
1	Field crops cultivation	207	229	311	327	384	1458	I
2	Horticultural cultivation	98	174	165	213	221	871	II
3	Animal husbandry	49	51	57	65	97	319	III
4	Small enterprises/cottage industry	16	27	24	33	52	152	IV
5	Other important agricultural information	32	45	38	40	53	208	V
	Year wise farmer's footfall	402	526	595	678	807		
	Rank	V	IV	III	II	I		

1.1376 and 1.0158 respectively. The age component showed the strong association with dependent variable also in the study made by Mandal *et al.* (2010).

It is exposed from Table 2 (Year wise farmer's footfall) that the maximum farmer's footfall (807) were recorded at KVK- Harda seeking technical information regarding agriculture in the year 2020, hence got Rank I followed by year 2019 (footfall-678, rank II), year 2018 (footfall-595, rank III), year 2017 (footfall-526, rank IV) and year 2016 (footfall-402, rank V) as per record at KVK- Harda. The figure of year 2020 visits of farmers at KVK- Harda revealed that the visits of farmers may increase due to awareness and reach of KVK up to grass root level or vice–versa, for technical information regarding agriculture is one of the reasons for increasing farmer's footfall year by year. The approach of farmers to the KVK increased in ascending order year by year that means KVK is approaching well and able to motivate farming community of the district to have technical knowledge and to be part of transfer of technology system. In connection to this study Mishra *et al.* (2010) also reported that 52.12 per cent farmers visited personally to ATIC 4-6 times in year for seeking agricultural technical information.

It is again reflected form values given in the Table 2 (Category wise farmer's footfall) that the maximum farmers footfall at KVK were found related to field crops cultivation (farmer's footfall-1458, rank I) in total five years cumulatively followed by Horticultural (farmer's footfall-871, Rank II), Animal husbandry (farmer's footfall-319, rank III) for Small enterprises/cottage industry (farmer's footfall-152, rank IV) and other important agricultural information (farmer's footfall-208, rank V), etc. The maximum visits of farmers at KVK- Harda were found for the technical agricultural information related to the field crops cultivation in past five years, that was again indicator of major cropping pattern of the district that was Soybean-Wheat-Greengram or Soybean-Chickpea-Greengram or Soybean-Maize-Greengram, hence such studies keep much importance to make strategies for promotion of new field crops, horticultural advancement and other so many resource generating policy implementation in the different districts of the country to minimize the technical knowledge gap among farm practitioners.

The values mentioned under Table 3 are the season and year category wise footfall of the farmers at KVK for seeking their information need. The impression of the table values shows that the foot fall of framers at KVK was increased by year to year since 2019 to 2020 which also been represented by respective ranks as I, II, III, IV & V respectively. It shows that the value of information and advisory given to famers by KVK is fulfilling their critical need.

The value shown in Table 4 reflects that during last five years the maximum footfall of farmers for getting scientific solution of their problems and anther advisory and information was seen during Kharif season may due to harsh weather situations and maximum insect pests attach in their crops hence received Rank I followed by Rabi season and Zaid season and vice versa. The highest farmer's foot fall also was seen at Krishi Vigyan Kendra, Khokhar Khurd, Mansa, Punjab for insect-pest and disease management by Singh *et al.* (2019). This again helps to justify the present study done at KVK, Harda-MP during 2020.

Table 5 evident that out of the selected respondents who visited more than once at KVK, majority (37.34%, rank I) visited 2-3 times yearly before the starting of the season and during the season as per need, followed by the

Table 3: Season and year wise footfall of the farmers at KVK

Different categories of technical information		Field crops cultivation	Horticultural cultivation	Animal husbandry	Small enterprises/ cottage industry	Other important agricultural information	Year wise total visits	Year wise ranks
2016	Rabi	97	38	23	9	10	177	
	Kharif	93	46	19	4	14	176	
	Zaid	17	14	7	3	8	49	
	Total	207	98	49	16	32	402	V
2017	Rabi	91	75	15	11	16	208	
	Kharif	104	69	18	9	21	221	
	Zaid	34	30	17	7	8	96	
	Total	229	174	50	27	45	525	IV
2018	Rabi	118	53	18	11	14	214	
	Kharif	139	68	27	8	16	258	
	Zaid	54	44	12	5	8	123	
	Total	311	165	57	24	38	595	III
2019	Rabi	121	88	19	11	14	253	
	Kharif	137	69	26	13	17	262	
	Zaid	69	56	20	9	9	163	
	Total	327	213	65	33	40	678	II
2020	Rabi	138	79	32	24	19	292	
	Kharif	141	85	37	18	25	306	
	Zaid	105	57	28	10	9	209	
	Total	384	221	97	52	53	807	I

Table 4: Overall season wise footfall of farmers during last five years at KVK

Year	Rabi	Kharif	Zaid
2016	177	176	49
2017	208	221	96
2018	214	258	123
2019	253	262	163
2020	292	306	209
Overall footfall	1144	1223	640
Rank	II	I	III

Table 5: Frequency distribution of the farmer's footfall at KVK according to periodicity (N=300)

Periodicity	Frequency	Percentage	Rank
Weekly	13	4.33	V
Fortnightly	59	19.67	III
half yearly	73	24.33	II
2-3 time in year	112	37.34	I
>3 time in a year	43	14.33	IV
Total	300	100	

half yearly means at least twice a year i.e. 24.33 per cent, rank II, whereas 19.67 per cent, 14.33 per cent and 4.33 per cent of the farmers fortnightly, more than 3 times in the year and weekly respectively were noticed under study. The frequency of farmers visit at KVK referred to farmer's interest and innovativeness in crop cultivation for enhancing their income. This study is also confirms by the finding as revealed by Laharia (2002) and Mishra *et al.* (2010).

In the present study the impact of farmer's footfall was also evaluated through secondary data availed by department of agriculture are part of their production statistics of the district for both the years 2016-17 and 2020-21 (Table 6). The word vertical impact is associated with the increase in production and productivity in last five years of major crops in the district, which may reflect the contribution of technical guidance given to farmers by Krishi Vigyan Kendra hard to boot self confidence and motivation of farmers visited to KVK in the study.

It is very clear from statics given in the Table 7 that we have received a notable vertical impact in form of product and productivity improvement since 2016-17 to 2020-21 due to KVK interventions and farmers footfall at KVK

Table 6: Production Statistics of District Harda during 2016-17 and 2020-21

Name of Crop	Season	2016-17			2020-21		
		Area (1000 ha)	Production (metric tonne)	Productivity (kg/ha)	Area (1000 ha)	Production (metric tonne)	Productivity (kg/ha)
Wheat	Rabi	141.5	608.450	4300	132.200	633.600	4800
Chickpea	Rabi	41.00	71.960	1755	58.20	152.720	2624
Soybean	Kharif	133.0	199.500	1500	167.00	267.200	1600
Pigeon pea	Kharif	4.33	5.850	1350	2.00	4.030	2015
Summer greengram	Zaid	11.85	142.200	1200	82.50	1258.12	1525

Source: DDA, Department of Agricultural Development and Farmer's Welfare, Harda, 2020-21

Table 7: Comparative Statistics of Productivity Enhancement from 2016-17 to 2020-21

Name of crop	Season	Productivity (kg/ha) 2016-17	Productivity (kg/ha) 2020-21	Difference (+ or -) kg/ha
Wheat	Rabi	4300	4800	500 (+)
Chickpea	Rabi	1755	2624	869 (+)
Soybean	Kharif	1500	1600	100 (+)
Pigeon pea	Kharif	1350	2015	665 (+)
Summer greengram	Zaid	1200	1525	325 (+)

Source: DDA, Department of Agricultural Development and Farmer's Welfare, Harda 2020-21

Harda. Farmer could get improved their productivity in all major crops like Wheat by 500 kg/ha, Chickpea by 869 kg/ha, Soybean by 100 kg/ha, Pigeon pea by 665 kg/ha and Summer greengram by 325 kg/ha respectively.

CONCLUSION

This study realized that the awareness and importance of agricultural information and its use among the farming community is increasing day by day to minimize the technical knowledge gap. Farmers also must be able to get reliable information delivered to them at proper time and place through KVKs and other extension systems. It will be beneficial to farmer's to make their farming profitable enterprise through realizing productivity gains from the adoption of new farming practices and actions to mitigate crop losses. Study also concludes that the most of the farmers visited KVK for seeking the technical knowledge related to field crops (1458, rank I) this was prominently depends upon the cropping pattern (soybean-wheat/gram) of the district followed by horticultural crops. The maximum visits were made by farmers in the year 2020 (807, rank I), which depicts the awareness of farmers towards the KVK as the technical knowledge source for the farmers. The majority of farmers (37.34%, rank I) visited KVK 2-3 times yearly before the starting of the season and during the season as per need, which reflects the curiosity of doing something new, interest, faithfulness of the frames for quenching thrust of new technologies, knowledge and innovations for agricultural profitability among farming community through improvement in the productivity in all major crops like Wheat by 500 kg/ha, Chickpea by 869 kg/ha, Soybean by 100 kg/ha, Pigeonpea by 665 kg/ha and Summer greengram by 325 kg/ha respectively. Hence it my briefed that farmer footfall at KVK and its technical intervention had positive vertical impact on the profitability and productivity of growing crops in the Harda district of Madhya Pradesh.

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Shelf life and Sensorial Quality Study of Pickle Prepared from Local Chicken

Y. Prabhabati Devi[1], Kumari Sunita[2], K. Bhagya Lakshmi[3], Ingudam Bhupenchandra[4] and Y. Jamuna Devi[5]
[1]Krishi Vigyan Kendra, Chandel, ICAR-Manipur Centre, Manipur
[2]Krishi Vigyan Kendra, Madhopur, West Champaran, Bihar
[3]KVK, Amadalavalasa, ANGRAU, Andhra Pradesh
[4]KVK, Tamenglong, ICAR-RC for NEH Region, Manipur Centre, Manipur
[5]Standard College, Kongba, Imphal, Manipur

ABSTRACT

The main aim of the study is the formulation of organoleptic accepted pickle prepared from local chicken by using preservatives like vinegar, sodium benzoate, salt at different ratios and also to study the shelf life for a period of180 days by observing any changes in colour, flavor, texture and appearance of fungus. The results showed that chicken pickle stored successfully for 180 days at ambient temperature (26±4°C) without any significant change in the quality attribute after incorporation of vinegar and sodium benzoate as a common preservative. The result showed that the preservation of local chicken pickle with vinegar and sodium benzoate was the best method for extending the shelf life and to retard the growth of microbial load. From the study, it was also found that T5 got the highest sensorial score in terms of colour, flavour, texture, taste, appearance and overall acceptability than the other four treatments.

Keywords: Local chicken, Preservatives, Microbial, Sensory, Shelf life

INTRODUCTION

Chicken is a major food item consumed in most part of the world since time immemorial. It is also an important source of animal protein which is very important for the normal functioning of the human body. Chicken is highly perishable, having a shorter shelf life, spoilage commences immediately after slaughtered and a vast array of biochemical and physiological changes take place from the time chicken is slaughtered until it is consumed. Effective utilization of these by-products for the production of value-added meat products is one way to realize maximum returns from the poultry sector. Pickling of meat is an alternative method to develop a low-cost shelf-stable meat product in the market (Gadekar *et al.,* 2010). Pickling help to improve desirable characteristic like taste, flavor and texture along with the preservative effect. For pickling, proper concentration of salt is very important for better shelf life and also to reduce the infestation of mold, yeast and bacteria. If the salt concentration is less, the product gets slimy, soft and holds lots of water. Therefore, the average salt concentration should not be less than 5.3 per cent (Rajablou *et al*., 2012). The texture is also one of the most important sensorial quantitative characteristics of pickle and its effects on products acceptance is crucial (Sadeghizadeh *et al.,* 2018). Application of suitable and acceptable processing technology leading to the value addition of spent chicken meat would be a suitable remedy to its disposal problem besides enhancing its acceptability as it will suit the taste buds of local consumers. It has been widely recognized that pickling of meat with edible oil, salt, spices, condiments and vinegar not only enhances its acceptability but also provides better storage life even at ambient temperature (Nayak *et at.,* 2011). These ready-to-eat meat products can be used as a side dish to roti, chapatti, paratha, rice etc. The problem of shelf life of chicken pickle is higher in Manipur, and hence an attempt is made to minimize the spoilage by the proper use of technology and also to select good quality local chicken. The present study was undertaken to prepare chicken pickle by use of different technologies in order to see the fungal growth at

*Corresponding author email id: prabhayumnam@rediffmail.com

different storage periods and also to assess the quality and overall acceptability of chicken pickle by sensory evaluation.

MATERIALS AND METHODS

Matured, fresh and good quality local chicken were collected from Chandel village, Manipur. Established brands of red chilli powder, turmeric powder, cumin seed powder, white mustard seed powder for spices, salt and mustard oil, vinegar and acetic acid were purchased from the local market.

Select healthy local chicken, slaughtered and dressed. The dressed carcases were manually deboned and cut the chicken meat into small cubes. Mix the chicken piece thoroughly with 3 per cent salt and keep for two hours. Fry the meat in a minimum quantity of oil and keep it separately. Fry mustard seed, green chilli, garlic and ginger paste in the remaining oil till it cooks properly. Add chilli powder, pepper and turmeric powder and mix well over low flame for a few minutes. Then add fried chicken pieces and cook for a few minutes, then add salt, garam masala powder and mix well. When cooled, fill in the sterilized bottles and seal properly. In some treatments like T_4 sodium benzoate was added when it removes from fire. In the case of T_5 fried chicken was cured in vinegar for 12 hours and other processes remain the same with T_4.

Sensory evaluation was carried out for all the differently treated pickles after 7 days maturation period. 30 semi-trained panellists evaluated the sensory attributes of pickles. Panellists were familiar with product sensory evaluation; most having trained on pickle preparation. The attributes evaluated were colour, aroma, taste, texture, appearance and overall acceptability. For each sample, panellists scored their liking of these characteristics using the nine points

Table 1: Different treatments for pickling of local chicken

Sample	Treatment
T_1	Fried chicken cube + 2.5 % salt + spice + 15% Mustard oil
T_2	Fried chicken cube + 3.5 % salt + spice + 20% Mustard oil
T_3	Fried chicken cube + 4.5 % salt + spice + 25% Mustard oil
T_4	Fried chicken cube + 5% salt + spice + 30% Mustard oil +10% vinegar + 0.2% sodium benzoate
T_5	Vinegar cured chicken + 5.5% salt + spice + 35% Mustard oil + 0.2% sodium benzoate

Table 2: Recipe of local chicken pickle

Ingredient	Treatments				
	T1	T2	T3	T4	T5
Fried chicken cube (kg)	1	1	1	1	1
Mustard Oil (ml)	150	200	250	300	350
Salt (g)	25	35	45	50	50
Chilli Powder (g)	20	30	35	40	50
Jira Powder (g)	5	10	15	20	20
White Mustard Seed Powder (g)	10	20	20	20	20
Garam masala powder (g)	5	10	10	10	10
Fenugreek powder (g)	5	10	10	10	10
Coriander powder (g)	5	10	10	10	10
Turmeric Powder (g)	10	10	10	10	10
Garlic paste (g)	-	50	100	150	150
Ginger paste (g)	-	30	50	70	100
Green chilli paste (g)	-	20	55	50	50
Vinegar	-	-	-	100 ml	1 lt
Sodium benzoate	-	-	-	2.0gm	2.0gm

Hedonic scale as described by Joshi, 2006. Average scores for each parameter is reported. The scores represented 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much and 9 = like extremely.

Shelf-life study for pickle prepared from local chicken stored at room temperature was conducted for a period of 6 months. Observations for any change in colour, flavour, texture and appearance of fungus were done for 15 days interval from 15 up to 60 days and 30 days intervals for the rest of the period.

Means of three replicates and standard deviations of the means were calculated for all the sensory parameters. Statistical analysis was performed by Windows-based SPSS version 22.0. Differences were separated using post-hoc tests with multiple comparisons of means of sensory parameters using Duncan's Multiple Range Test. Pearson's correlation coefficient analysis was performed to evaluate relationships between the sensory parameters under investigations using the same statistical package. The 5% probability level is regarded as statistically significant. Pearson's correlation coefficient analysis, cluster analysis and regression were computed to identify the relationship between the sensory parameters. Cluster analysis (CA) helps in grouping objects (cases) into classes (clusters) on the basis of similarities within a class and dissimilarities between different classes. The results of CA help in interpreting the data and indicate patterns of clustering.

RESULTS AND DISCUSSION

The mean sensory scores of a chicken pickle as evaluated by the testing panel are presented in Table 3 and presented in Figure 1. It is seen that T5 scored the highest for colour (8.0), flavour (7.6), taste (8.2), texture (7.8), appearance (8.3) and overall acceptability (8.1), while T_1 scored the lowest for all the attributes. It was observed that sensory scores improved with the increase in concentrations of salt, spices, mustard oil, and vinegar.

Observations for change in color, flavour, texture and visual observation for growth of fungus in chicken pickles stored at room temperature (27-33°C) for a period of 180 days is given in Table 4. Differently treated chicken pickles were in good condition in the first week of storage but a slight change in texture started in T1 treatment which may be due to deep fry in high temperature. This finding is in line with the finding of Nasution (2013) that texture gets affected by storage conditions as fermentation of sample was seen decrease after ten days of pickling process. Fungal growth is undesirable in pickling and fermentation (Zhao and Ding, 2008). In the 15 days of storage, slight fungal growth was seen in T_1 sample, with a slight change in colour, appearance and flavour but no changes were

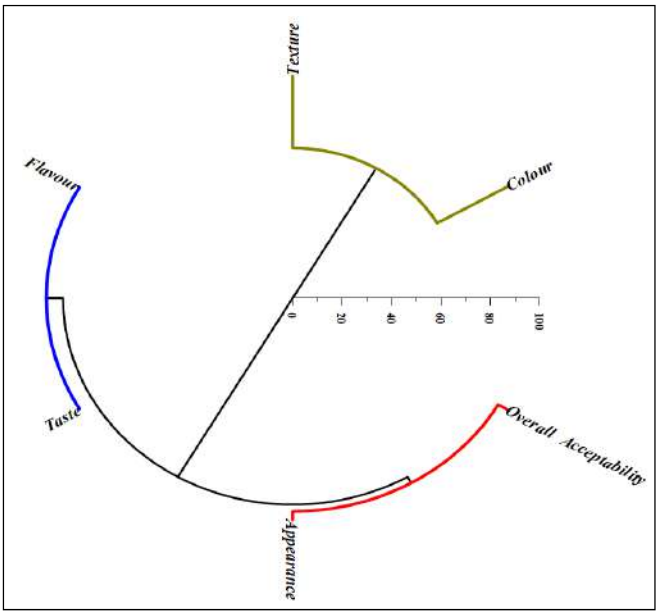

Figure 2: Results of cluster analysis depicting the clustering of visual parameters via dendrogram

Table 3: Mean score for performance of colour, flavour, texture, taste and overall acceptability of various sample of chicken pickle

Sample Code	Colour	Flavour	Taste	Appearance	Texture	Overall Acceptability
S_1	6.5c	6.8b	6.7d	6.9d	6.6c	6.8bc
S_2	7.2ab	7.0a	7.1bc	7.3bc	7.2ab	7.1bc
S_3	7.4ab	7. 2a	7.3b	7.5bc	7.4ab	7.3bc
S_4	7.6a	7. 4a	7.5b	7.8b	7.7a	7.6b
S_5	8.0a	7.6a	8.2a	8.3a	7.8a	8.1a

Values in the same column followed by different letters are significantly different at $p < 0.05$ according to Duncan's multiple-range test for separation of means (Values are means of three replicates)

Table 4: Shelf life study of a chicken pickle

Shelf life (Days)	Sample	Fungal Growth	Colour	Flavour	Texture	Remark
15	S1	Slightly Growth	Slight Change	No off flavour	Firm	Good
	S2	No Growth	No Change	No off flavour	Firm	Good
	S3	No Growth	No Change	No off flavour	Firm	Good
	S4	No Growth	No Change	No off flavour	Firm	Good
	S5	No Growth	No Change	No off flavour	Firm	Good
30	S1	Growth	Change	Slightly off flavour	Slightly Soft	Good
	S2	Slightly Growth	Slightly Change	No off flavour	Firm	Good
	S3	No Growth	No Change	No off flavour	Firm	Good
	S4	No Growth	No Change	No off flavour	Firm	Good
	S5	No Growth	No Change	No off flavour	Firm	Good
45	S1	Severely growth	Change	Off flavour	Soft	Slightly spoiled
	S2	Slight Growth	Slight Change	Slightly off Flavour	Slightly soft	Fair
	S3	No Growth	No Change	No off flavour	Firm	Good
	S4	No Growth	No Change	No off flavour	Firm	Good
	S5	No Growth	No Change	No off flavour	Firm	Good
60	S1	Excessive Growth	Change	Off flavour	Extremely soft	Spoiled
	S2	Excessive Growth	Change	Off flavour	Soft	Slightly spoiled
	S3	Severely Growth	Slightly Change	Slightly off Flavour	Slightly soft	Fair
	S4	No Growth	No Change	No off flavour	Firm	Good
	S5	No Growth	No Change	No off flavour	Firm	Good
90	S1	Excessive Growth	Change	Off flavour	Extremely soft	Completely spoiled
	S2	Excessive Growth	Change	Off flavour	Extremely soft	Spoiled
	S3	Severely Growth	Change	Off flavour	Soft	Slightly spoiled
	S4	No Growth	No Change	No off flavour	Firm	Good
	S5	No Growth	No Change	No off flavour	Firm	Good
120	S1	Excessive Growth	Change	Off flavour	Extremely soft	Completely spoiled
	S2	Excessive Growth	Change	Off flavour	Extremely soft	Spoiled
	S3	Excessive Growth	Change	Off flavour	Extremely soft	Spoiled
	S4	No Growth	Slight Change	Slight off flavour	Soft	Slightly spoiled
	S5	No Growth	No Change	No off flavour	Firm	Good
150	S1	Excessive Growth	Change	off flavour	Extremely soft	Completely spoiled
	S2	Excessive Growth	Change	off flavour	Extremely soft	Completely spoiled
	S3	Slightly Growth	Change	off flavour	Extremely soft	Spoiled
	S4	No Growth	Change	off flavour	Soft	Slightly spoiled
	S5	No Growth	No Change	No off flavour	Firm	Good
180	S1	Excessive Growth	Change	off flavour	Extremely soft	Completely spoiled
	S2	Excessive Growth	Change	off flavour	Extremely soft	Completely spoiled
	S3	Severely Growth	Change	off flavour	Extremely soft	Spoiled
	S4	Slightly Growth	Change	off flavour	Soft	Slightly spoiled
	S5	No Growth	No Change	No off flavour	Firm	Good

observed in the other samples. It may be due to a low concentration of salt and mustard oil. In the 30 days of storage, T_2 pickles also showed slight fungal growth on the surface of the pickle rendering it not suitable for consumption, while T_3, T_4 and T_5 pickles showed no fungal growth, no change in colour, flavour and texture. After the 45 days of storage, T_3 sample showed a slight change in colour, flavour, texture and slight fungal growth. Change in colour and flavour on storage has also been reported in bell pepper-based chutney (Sharma and Joshi, 2014), tomato pickle mix (Rao *et al.,* 2011) and stem amaranthus pickle (Shanta *et al.,* 2014). This may be due to the binding of pigment with the other spice components. Even after of storage of 150 days of storage, T_4 and T_5 pickles were in good condition, showing no fungal growth, and no change in other physical characteristics. On the 120 days of storage, T_4 pickle showed a slight change in flavour, colour and texture. However, no fungal growth was visually observed till 150 days of storage in T_4 pickle. On the 180 days of storage, it was observed that there was slight growth of fungus in T_4 pickle which resulted in a change in colour, flavour, texture and was not suitable for consumption. On storage of chicken pickles for 180 days, it was observed that T_5 pickle had the best shelf life and adjudged the best treatment with no change in the physical characteristics and no appearance of fungal growth. It was seen that with the appearance of fungus, the texture of the pickle softens. The change in texture is due to the production of pectinase by fungi which softened meat and thereby leading to the deterioration in flavor (Xiong *et al.,* 2016). There was no appearance of fungus on the surface of the pickle with T_5 treatments due to the higher concentration of salt and mustard oil and vinegar. The use of salt, as a preservative has been well known (Mishra *et al.,* 2011). The covering of mustard oil, as well as proper concentration of salt and vinegar, also helped to prevent microbial development in chicken pickle results in agreement with the study on the germination of Bengal gram pickle (Mishra *et al.,* 2010) and Auricularia auricula pickle (Shazor *et al.,* 2015). Vinegar also helped to maintain the proper pH of the pickle. The excellent shelf life of the treatment T_5 pickle may be due to the presence of a high quantity of oil on the top layer of pickle and also with a high concentration of salt.

Results of the Pearson's correlation coefficient analysis (Table 5) revealed the existence of highly significant positive correlation between colour with flavour ($p < 0.01$ and $r = 0.975$), taste ($r = 0.979$), texture ($r = 0.975$), appearance ($r = 0.991$), and overall acceptability, ($r = 0.982$). Similarly, flavour a significant positive correlation with taste ($p < 0.05$ and $r = 0.915$), while it had highly significant positive correlation ($p < 0.01$) with texture ($r = 0.946$), appearance ($r = 0.958$), and overall acceptability, ($r = 0.975$). Taste was found to correlate significantly $p < 0.01$) with texture ($r = 0.994$), appearance ($r = 0.980$), and overall acceptability, ($r = 0.926$). Likewise, texture also exhibited a significant positive correlation with ($p < 0.01$) appearance ($r = 0.995$), and overall acceptability, ($r = 0.960$). Appearance and overall acceptability observed a significant positive correlation ($p < 0.01$ and $r = 0.971$). The overall results of correlation analysis (Table 6) indicates that all the sensory parameters are correlated to each other and this implies that the increment in one of the sensory parameters improved the other parameters and vice-versa; and they are dependent on each other. Similar finding was reported by Shanta *et al.* (2014) who also found correlation between colour, flavour, texture and overall acceptability as if any one of the parameters increases the other parameters also increases and overall acceptability of the product also increases.

To validate the results of correlation analysis cluster analysis was performed to see the affinity and extent of the relationship between the visual parameters. The results

Table 5: Pearson's correlation coefficient (r) matrix between the sensory parameters

	Colour	Flavour	Taste	Appearance	Texture	Overall acceptability
Colour	1.000	-0.193	0.956	0.972	0.983	0.955
Flavour	-0.193	1.000	0.009	-0.083	-0.336	-0.055
Taste	0.956	0.009	1.000	0.993	0.904	0.993
Appearance	0.972	-0.083	0.993	1.000	0.941	0.998
Texture	0.983	-0.336	0.904	0.941	1.000	0.921
Overall acceptability	0.955	-0.055	0.993	0.998	0.921	1.000

The correlation coefficient (r) values are significantly positive at $p < 0.01$ (Boldfaced italics) and $p < 0.05$ (Bold) levels of probability (2-tailed)

Table 6: Variance analysis of sensory parameters

Source	df	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Regression	1	0.988	99.99%	0.988	0.494	15424.2	0.000
Colour	1	0.902	91.27%	0.004	0.004	125.5	0.008
Error	3	0.086	8.73%	0.086	0.086	2692.2	0.000
Total	4	0.000	0.01%	0.000	0.000		

Stepwise selection of terms: α *to enter = 0.15,* α *to remove = 0.15*
Where, Seq SS = Sequential sums of squares, Adj SS = Adjusted sum of squares, Adj MS = Adjusted mean of squares

of cluster analysis were visualized and depicted through the dendrogram wherein, the visual parameters showed the formation of two dominant clusters viz., cluster I comprising of taste, appearance and texture and cluster II consisting of colour and acceptability. The most likely reason for the formation of similar clusters in respect of visual parameters is due to the existence of a highly positive and significant correlation between them as evident in correlation.

To screen the magnitude of attribution of differential sensory parameters to overall acceptability simple linear regression with each sensory parameter and multiple stepwise regression was computed (Table 6). To work out the regression the sensory parameters were assigned as independent attributes while overall acceptability as a dependent attribute. Upon iteration, the linear regression response curve for all the sensory parameters was laid in a single graph. From, the graph it can be concluded that colour (r = 96.5%) was the most dominant sensory parameter attributed to the overall acceptability. Further, the sensory parameters can be ranked based on the response curve as colour (r = 96.5%) > flavour (r = 95.0%) > texture (r = 92.2%) > appearance (r =94.3%) > taste (r = 85.7%). To further validate this claim, stepwise multiple regression was computed and the following equation I was generated after selecting the most dominant attributes among the sensory parameters. Again, upon iteration, the sensory parameter was realized to be the most significant and dominant parameter attributed to overall acceptability, attributing to the extent of 96.49% (Table 6).

CONCLUSION

Chicken meat is highly perishable so preserving in the form of pickle can extend the shelf life and can also made available throughout the year. So, proper preservatives like salt, mustard oil and vinegar should be used in proper concentration to reduce the microbial growth and also to extend the shelf life of the pickle. From this study, it was found that fungal growth was a great problem of pickle. If we add a proper concentration of preservatives, the fungal growth becomes very low. The panellists also tested the product and gave the score for color, aroma, texture, taste and overall acceptability. The score of the panel test indicated that among the five treatments, the pickle which was prepared with vinegar cured (T_5) was the most acceptable. In the case of shelf life, T_5 have better shelf life than the other 4 treatment. It was proved that T_5 is the best method for extending the shelf life and also for improving the quality of the chicken pickle. This study gives a good prospect on the processing of meat This technology may be adopted on large scale by the rural youth, women entrepreneurs and farm women in order to generate income and also for increasing employment opportunities for sustaining livelihood.

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Adoption and Efficacy Measurement of Improved Sugarcane Varieties in Livelihood Security of Lower Shivalik hills of Uttarakhand

Pinaki Roy[1]*, B.S. Hansra[2] and R. Roy Burman[3]
[1]Research Associate, Indian Council of Agricultural Research, New Delhi
[2]Professor, Amity University, Noida, Uttar Pradesh
[3]Principal Scientist, ICAR-Indian Agricultural Research institute, New Delhi

ABSTRACT

Sugarcane farming is the largest source of livelihood in plains of Uttarakhand but its productivity is lower (60.5 and 64.6 mt/ha) than the national average (70.0 & 68.2 mt/ha during 2016-17 & 2017-18) as well as amongst other states of lower Shivalik Hills. Hence, a study was undertaken to measure the impact and efficiency of improved sugarcane varieties. CO 0238 was the most popular improved variety of sugarcane and had the highest BCR (3.15:1). Among the local varieties, Pant 97222 showed the highest BCR (1.29:1). Among the sugarcane varieties, net return was maximum in case of CO 0238 (Rs. 212056.08) than all other selected varieties. Box Plot technique implied to find out the yield variations between improved and local varieties. CO 0238 gave average yield of 950-975q/ha whereas, returns from C0 0239 and CO 0124 were 845-890 q/ha respectively. In case of local sugarcane varieties, it was observed that average yield were 665-685 q/ha, 660-675 q/ha and 630-710 q/ha for Pant 97222, COH 119 and COS 94270 respectively. To measure sustaining productivity (economic efficiency) of varieties and to recognise best suited variety for particular region, multivariate regression analysis has been used. The results showed that CO-0238 yielded 170q/ha more than that of CO-0124. Similarly, CO-0139 has produced 81q more yield per ha compared to CO-0124. Results indicate that CO-0238 was the best suitable variety in terms of yield in that region.

Keywords: Extent of adoption, Economic analysis, Box plot techniques, Yield variation

INTRODUCTION

One of the overarching goals of Indian agriculture development programs and approaches is to increase agricultural productivity to fasten economic growth. Notably, 70 per cent of the residents rely upon farming for survival. Thus, the agriculture sector is imperative for encouraging growth, overcoming poverty, and upgrading food security. Productivity increase in agriculture will scale up financial conditions by increasing farmers' financial gain, reducing food costs thereby improving utilization (Diagne *et al.*, 2009). The gains from improved agricultural technologies has a direct impact on poor farmers through the rise in farm household incomes, and indirectly by the raise of jobs and the emolument rates of landless workers in function as well as reduction of food prices (Winters *et al.*, 1998a,b); De Janvry and Sadoulet, 1988, 2002).

Uttarakhand is an agrarian state. The agriculture sector of Uttarakhand is a vital sector that employs about 70 per cent of the state's population even though it contributes only 17 per cent to the state's gross domestic product (Watershed Management Directorate, Dehradun, 2008). Since nearly 90 per cent of the terrain of Uttarakhand is hilly, yield per ha isn't high. There is vital inequality within the gross cropped space between hills and plains. Hills area occupies only 14 per cent of the gross cropped whereas the plains comprise the rest area. It is necessary to point out that Uttarakhand grain production has not shown any significant increase throughout the last decade.

Uttarakhand consists of thirteen districts and spreads over plains, terrain, and sub mountainous and alpine zones. The growth of grain production is pretty variable in different areas. In the hills, the principal crops grown include fruits, vegetables paddy, mandua, ramdana and potato whereas in the plains the main crops are wheat, paddy, pulses, sugarcane, and mustard (Present Scenario of Agriculture in Uttarakhand, 2019). The Shivalik area is

*Corresponding author email id: roypinaki51@gmail.com

nestled between the Himalayan ecosystem and the Indo-Gangetic plains of North-West India. Despite that, the region described to range from 2.14 mha to 8.00 mha in North-West India by various researchers. Based on topography and geography, it demarcates the Shivalik region (3.33 mha), covering the hills (1.79 mha) and its foothills or plains (1.54 mha) in the states of Jammu and Kashmir (J&K), Himachal Pradesh, Uttarakhand, Punjab, Haryana, Uttar Pradesh and the union territory of Chandigarh at altitudes ranging from 217 m to 2332 m above MSL. The portrayed map shows i.e., Jammu region of J&K, Malwa region of Punjab, Haridwar, Udham Singh Nagar, and southern plains of Nainital of Uttarakhand comes under lower Shivalik hills (Yadav *et al.*, 2015, Sati and Wei, 2018). Sugarcane farming is the largest source of livelihood in plains of Uttarakhand but its productivity is lower (60.5 and 64.6 mt/ha) than the national average (70.0 & 68.2 mt/ha during 2016-17 & 2017-18) as well as amongst other states of lower Shivalik Hills. Therefore, the study has been undertaken to access the extent of adoption of improved sugarcane varieties as well as to ascertain the economic impact in terms of B:C ration and Net return.

MATERIAL AND METHODS

A multistage random sampling was used to select the area and the sample for the study. Initially, three districts (Haridwar, Udham Singh Nagar, and Nainital districts were identified. Here the criterion used was the presence of plains and adequate irrigation facilities. In the second stage, blocks from three districts were enlisted. Among the enlisted blocks, all five blocks of Haridwar, all seven blocks of Udham Singh Nagar, and only two blocks in the southern part of Nainital had irrigation facilities has been selected. In the third stage, fifty percent blocks had been selected by adopting fisher randomization technique. Hence, three blocks from Haridwar, four blocks from Udham Singh Nagar, and one southern block from Nainital district were chosen for the study. In fourth stage, three villages from each of the eight selected blocks with more probability value were selected. A total of twenty four villages from eight blocks of three districts have been

Table 1: Distribution of farmers for the study (N = 360)

Lower Shivalik Region of Uttarakhand					
Udham Singh Nagar		**Haridwar**		**Nainital**	
Block Jaspur		**Block Laksar**		**Block Haldwani**	
Village	**Respondents**	**Village**	**Respondents**	**Village**	**Respondents**
Amritpura	15	Dhadhekidhana	15	Abdipur	15
Bagwara	15	Nehandpur	15	Ibrahimpur	15
Baheri	15	Musahibpur Majri	15	Alampur	15
Block Khatima		**Block Narsan**			
Village	**Respondents**	**Village**	**Respondents**		
Radhuliya	15	Aamkheri	15		
Shamthana	15	Talhedi	15		
Diyan	15	Thoi	15		
Block Bajnor		**Block Khanpur**			
Village	**Respondents**	**Village**	**Respondents**		
Santoshpur	15	Abdipur	15		
Mundia Kalan	15	Ibrahimpur	15		
Hulsanganj	15	Alampur	15		
Block Kichha					
Village	**Respondents**				
Danpur	15				
Kolaria	15				
Chhinaki	15				
Total	**180**		**135**		**45**

selected for the final study. A total of 360 farmers were served as respondents for this study. Details of study area was given Table 1.

Numbers of farmers chosen from each village were fifteen, thus making a total of 360 farmers from 24 villages as sample for the study.

From review of literature and secondary sources of information, it was found that sugarcane is the one of the major crop in the Lower Shivalik Hills (DAC&FW, 2019). Technologies (*i.e.,* varieties and farm machinery) which were demonstrated and popularized for the last 10 years were considered as improved technologies (National Food Security Mission, 2019). A list of improved varieties which was the most prevalent and adopted after 2010 were enlisted with discussion with KVK staff and State Department of Agriculture. Among the listed varieties, six varieties (*i.e.*, three improved varieties and three local varieties) were selected randomly without replacement method by employing lottery method to measure extent of adoption. Net return was attained by subtracting the total costs endured from the gross returns obtained. Benefit cost ratio was obtained by dividing the Gross Income by total cost. T-test has been adopted to find out significance difference of improved and local varieties, if any. Multivariate regression model has been used to estimate farm level economic efficacy for improved varieties.

RESULTS AND DISCUSSION

The data in Table 2 presented the level of adoption of sugarcane varieties. Ardent adopter and mild adopter categories have been developed based on mean score of total number of varieties adopted by them from the selected improved varieties. It was found a bulk of farmers had medium adoption rate within the ardent adopters (71.58%) as well as within the mild adopter (88.70%) category. Variety wise categorization was also presented for both the adopter category. Maximum adoption was found for CO-0238 variety of sugarcane. It was found that 98.91 per cent and 94.92 per cent adoption level occurred respectively in CO-0238 in case of ardent adopter and mild-adopter farmers.

A significant and unrecognized characteristic of farmers' acquisition of upgraded varieties was that of adoption and ensuing practice of new technology by farmers were entirely based on the supremacy over existing varieties in respect of productivity, quality, cost-saving and

Table 2: Extent of Adoption of improved varieties (N=360)

Based on Mean Score							
Sugarcane area in acre							
Low	2-2.58	19	10.38	Low	1-1.76	3	1.69
Medium	2.58-4.43	131	71.58	Medium	1.76-3.29	157	88.70
High	4.43-6.00	33	18.03	High	3.29-6.00	17	9.60
	Within ardent adopter variety wise adoption in sugarcane				**Within mild adopter variety wise adoption in sugarcane**		
	CO 0238 (n=181) (98.91%)				**CO 0238 (n=168) (94.92%)**		
Low	1-1.58	21	11.60	Low	< 0.92	Nil	-
Medium	1.58-3.58	133	73.48	Medium	0.92-2.59	143	85.11
High	3.58-5.00	27	14.91	High	2.59-6.00	25	14.88
	CO 0239 (n=74) (40.44%)				**CO 0239 (n=21) (11.86%)**		
Low	<0.45	NIL	NIL	Low	< 0.66	NIL	NIL
Medium	0.45- 1.96	63	85.13	Medium	0.66-1.62	19	90.47619
High	1.96- 5.00	11	14.86	High	1.62-3	2	9.52381
	CO 0124 (n=70) (38.25%)				**CO 0124 (n=28) (15.82%)**		
Low	0.17- 0.62	5	7.14	Low	0.5- 0.71	2	7.14
Medium	0.62-1.54	58	82.85	Medium	0.71-1.57	21	75
High	1.54-3.00	7	10	High	1.57-2	5	17.85

F indicates *frequency*

price. The only thing was that farmers' must be made aware and persuaded via different extension activities like field day, FLD, training, participatory approaches, *etc.*, conducted by institution, Govt., extension agency, NGOs or even by private entrepreneurs. Besides, provision of basic/critical inputs like seed, *etc.*, may be made for easy access to this technology which eventually would be an intrinsic part of local seed delivery system for uninterrupted supply. Nonetheless, adoption level might be assorted because the varieties did not suffice ranchers' desires, or owing farmers' dearth of access to seed or details on new varieties. Frequently, varieties that roll out hastily from farmer to farmer were those with extremely flattering quality traits. Sometimes, new varieties were somewhat high ranking compared to existing ones; the eminence of the upgraded variety might be observable in a repeated experiment, but it might not be clearly evident in the field of any farmer. In such circumstances, farmers were very likely to accept more of the high yielding variety deprived of persuasion and stimulus. Although institutions frequently see the transmission of knowledge on new varieties as an extension feature, they may need to actively persuade and assist the extension service by assembling information packages for new issues, leading collegial variety selection and front-line demonstration programmes, certifying that ample quantities of seed were available for on-farm testing, field day organizing and engaging in agri-fair which might enhance adoption of improved varieties. Paucity of access to seed could also be one of the grounds for varying adoption level of improved varieties amidst the growers.

It was measured in terms of yield of particular improved variety and yield variation of the variety. The Box Plot technique has been adopted to find out the yield variations among improved and local varieties (Figure 1). The same procedure had been adopted in the study conducted by Arora *et al.* (2019) for evaluation of recommended maize production technology in khadi area in Farmer FIRST Programme. It shows the yield variation of sugarcane. CO-0238 gave average yield of 950-975q/ha whereas, returns from CO-0239 and CO-0124 were in ranges 845-890 q/ha. The end of Whiskers range indicates that minimum and maximum yield of CO-0238 were 890 q/ha and 1040 q/ha respectively, whereas, it was at 830-930 q/ha and 690-900q/ha, respectively for CO-0239 and CO-0124. In case of local sugarcane varieties, it was found that average yield were 665-685 q/ha, 660-675 q/ha and 630-710 q/ha for Pant 97222, COH 119 and COS 94270,

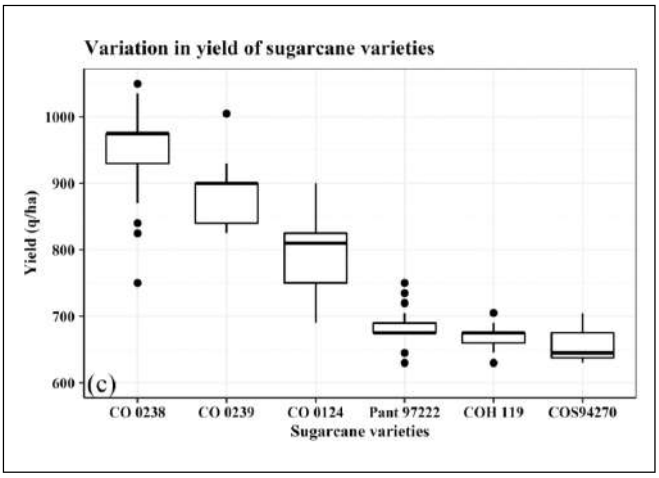

Figure 1: Yield estimation of sugarcane varieties

respectively. Maximum and Minimum yields varied within the range of 650-690 q/ha in case of COH 119.

Kernel density represented the dispersion of yield among the farmers. The peak of density plot helped to display where values were concentrated. Band width represented the density of values among the farmers for particular variety. From the Figure 2, it was observed that for CO-0238, dispersion of yield from 830q/ha to 1200q/ha and maximum yield concentrated on 950-1000q/ha. Similarly, for CO-0239 and CO-0124, maximum yield concentrated on 850-900 q/ha and 800-850 q/ha. From the Figure 3, it was established that for CO-Pant 97222, dispersion of yield from 650q/ha to 750q/ha and maximum yield concentrated on 680-700 q/ha. Similarly, for COH119 and COS 94270, maximum yield concentrated on 630-650 q/ha and 620-630 q/ha.

Economic impact was measured in terms of Cost-Benefit Ratio, Net return for each improved variety. Table 3 illustrated the comparative analysis of BCR in case of sugarcane varieties. CO 0238 was the most admired and had the highest BCR (3.15:1). Two other improved varieties (CO 0239 and C0 0124) had afforded quite low BCR (1.85:1 and 1.47:1) compared to CO 0238. BCR was found to be more (2.31:1) for small farmers, farmers who had low operational land holdings could adopt better management practices which lead them to have auxiliary benefits. Among the local varieties, Pant 97222 represented the highest BCR (1.29:1). No small farmers were found to cultivate COH 119 and COS 94270 in that area. Estimates of t-test specified positive and significant differences among the farmers who adopted improved

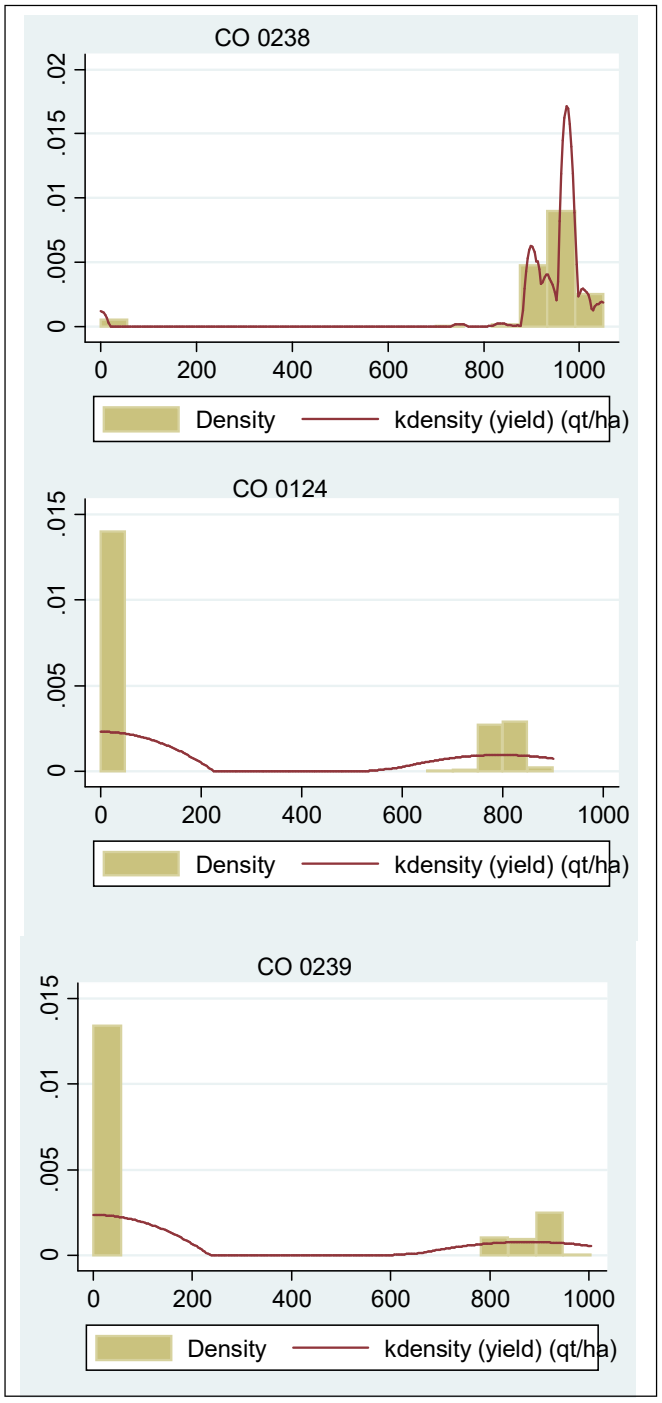

Figure 2: Kernel density estimation of improved varieties

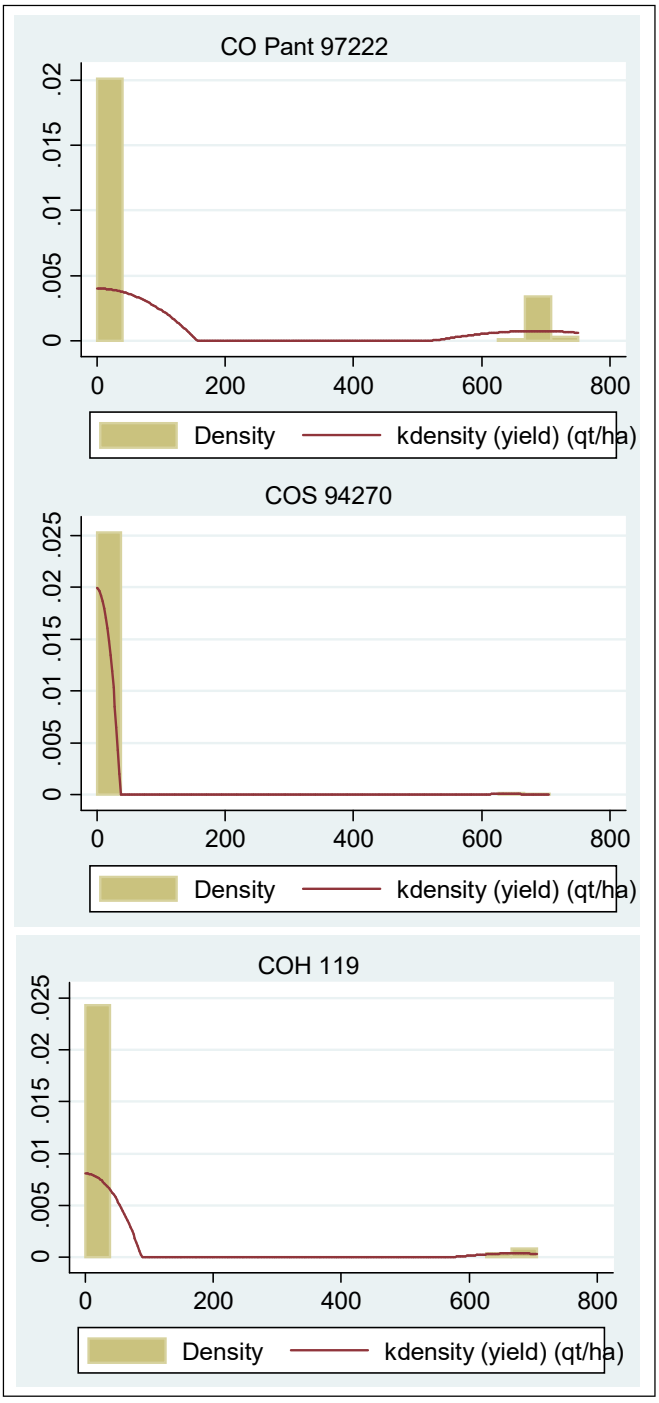

Figure 3: Kernel density estimation of local varieties

and local varieties. The t-test values of 34.98 and 13.15 among the medium and semi-medium farmers revealed that there were more revenue can be procured in case of adoption of improved varieties. Similar finding has been outlined by Kant *et al*, 2015.

Among the sugarcane varieties, net return was maximum in case of CO-0238 (Rs. 212056.08) than all other selected varieties (Table 4). 't' test results displayed that there was substantial difference in net return in absolute term between improved and local varieties. Similar result was obtained by Kumar *et al.* (2014).

Efforts were made to pick out the various factors influencing the yield variation among improved sugarcane varieties and try to quantify the repercussion of input use and socio-economic factors on overall yield. Various factors that is likely to affect the variation of yield among

Table 3: Comparative Benefit-Cost (BCR) Analysis of Crop Varieties (N=360)

Sugarcane varieties		Farmers' category				
		Small (1-2 ha)	Medium (2-4 ha)	Semi medium (4-10 ha)	Average	Total average
Improved	CO 0238	3.21	3.12	3.11	3.15	2.16
	CO 0239	2.24	1.67	1.66	1.85	
	CO 0124	1.49	1.47	1.45	1.47	
	Total Avg	2.31	2.08	2.07		2.16
Local	Pant 97222	1.26	1.28	1.32	1.29	
	COH 119	-	1.23	1.31	1.27	1.25
	COS 94270	-	1.20	-	1.20	
	Total Avg	1.26	1.24	1.31		1.26
t-statistic		-	34.94**	13.15**	**Significance 1%	
P(T<=t) two-tail		**-**	**0.00**	**0.00**		

Table 4: Comparative analysis of net return of crop varieties

Sugarcane varieties		Farmers' category				
		Small (1-2 ha)	Medium (2-4 ha)	Semi medium (4-10 ha)	Average	Total average
Improved	CO 0238	212509.47	212234.77	211424.01	212056.08	142545
	CO 0239	167545.47	112925.15	113968.43	131479.68	
	CO 0124	88855.9	82866.89	80578.46	84100.41	
	Total Avg	156303.61	136008.94	135323.63		142545.4
Local	Pant 97222	46367.71	49168.94	56507.06	50681.23	44546.15
	COH 119	NIL	41723.96	51979.47	46851.71	
	COS 94270	NIL	36105.496	NIL	36105.49	
	Total Avg	46367.71	42332.8	54243.27		47647.93
t-statistic		4.86**	39.26*	19.04*	**Significance 5%	
P(T<=t) two-tail		0.03	0.00	0.00	*Significance 1%	

the improved sugarcane varieties by using the multivariate regression model. The assumption of normality and hetero scedasticity of residuals were tested and no significant results on variations were found. By-product of sugarcane has very little economic use in the farm community that inspired to use multivariate regression model instead of using SUR model. The results of the above analysis implies that CO-0238 has afforded about 170q more yield per ha than that of CO-0124. Similarly, CO-0139 has produced 81q more yield per ha compared to CO-0124. Thus, results of this measure depict that CO-0238 was the best suitable variety in terms of yield in that region. In addition to this, it was also found that with increase of extension contact, overall yield of sugarcane can be increased significantly.

CONCLUSION

Sugarcane farming is the one of the largest source of livelihood in plains of Uttarakhand. It was found a bulk of farmers had medium adoption rate within the ardent adopters (71.58%) as well as within the mild adopter (88.70%) category. This study revealed CO 0238 was the most popular improved variety of sugarcane which had the highest BCR (3.15:1) and highest net return (Rs. 212056.08) than all other selected varieties. The result of multivariate analysis showed that CO-0238 yielded 170q/ha more than that of CO-0124. Similarly, CO-0139 has produced 81q more yield per ha compared to CO-0124. Results indicate that CO-0238 was the best suitable variety in terms of yield in that region.

Table 5: Farm level economic efficiency improved sugarcane varieties (Multivariate Regression model)

Source	SS	df	MS	Number of obs		547
				F(11, 535)		146.28
Model	2532768	11	230251.6	Prob> F		0
Residual	842087.9	535	1573.996	R-squared		0.7505
				Adj R-squared		0.7454
Total	3374856	546	6181.055	Root MSE		39.674
Yield	**Coef.**	**Std. Err.**	**T**	**P>|t|**	**[95% Conf.**	**Interval]**
CO-0124						
Co 0238	169.57	4.515	37.55	**0.000**	160.70	178.44
Co 0239	81.10	5.738	14.13	**0.000**	69.827	92.37
Operational land holding	10.52	4.578	2.3	0.022	1.527	19.517
Seed rate (q/ha)	-0.67	0.521	-1.29	0.197	-1.699	0.351
N use (kg/ha)	-0.07	0.067	-1.17	0.242	-0.210	0.053
P use (kg/ha)	-0.42	0.264	-1.61	0.108	-0.945	0.0937
K use (kg/ha)	0.45	0.240	1.91	0.057	-0.014	0.931
Irrigation charge (Rs/ha)	0.01	0.008	1.68	0.094	-0.002	0.029
Innovativeness	2.085	2.129	0.98	0.328	-2.097	6.267
Educational status	1.41	1.711	0.83	0.410	-1.949	4.773
Extension contact	3.50	0.507	6.91	**0.000**	2.510	4.502
_cons	606.91	85.667	7.08	0.000	438.624	775.19

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Decadal Analysis of Cereal Production in Bundelkhand Region of Uttar Pradesh

Uma Sah, G.P. Dixit, Hemant Kumar, Jitendra Ojha, Mohit Katiyar, Vikrant Singh, and S.K. Dubey[1]*
ICAR-Indian Institute of Pulses Research, Kalyanpur, Kanpur-208024, Uttar Pradesh
[1]ICAR-Agricultural Technology Application Research Institute, Kanpur-208001, Uttar Pradesh

ABSTRACT

The study analyses the growth and stability of major cereal crops in Bundelkhand region of UP state during last two decades (2000-20). Secondary data on area, production and productivity collected from published reports was utilized for the purpose. The whole study period was divided into two periods, period-I (2000-10), period-II (2010-20) and over all period (2000-20). The CAGR and CDVI were computed for ascertaining the growth and stability respectively for area, production and yields of the major cereals over the given period of time. Results showed that wheat alone accounted for 86.57 per cent and 91 per cent of total area and production of cereals in the region, whereas about 27.50 per cent of total area was found under barley which contributed 27 per cent to total barley production of the state. Lalitpur district contributed highest area (21.03%) under total cereals in the region (1.06 million ha), closely followed by Banda (20.01%) and Jhansi (19.03%). The temporal analysis revealed that there was positive growth rate in overall area (1.61%), production (3.59%) and productivity (2.77%) of cereal crops during the overall study period (2000-20) with low to medium instability of overall area (10.45%), production (26.01%) and productivity (16.79%) in the region. Among all the cereal crops, barley recorded highest annual increase in area (2.18%), production (6.15%) during the overall study period. In contrast, maize recorded highest decline in area (-1.80%), production (-2.24%) and productivity (0.40%) in the region during 2000-20.

Keywords: Bundelkhand region, Cereals, Production, Productivity, Uttar Pradesh

INTRODUCTION

Bundelkhand region of Uttar Pradesh is the central semi-arid plateau region of India covering about 2.94 million hectare, which is about 12.21 per cent of that state (Shakeel, A. *et al.,* 2012). The region is spread across seven districts namely, Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda and Chitrakoot. The region is characterized by acute shortages of water due to recurrent failures of the monsoon (Chand *et al.,* 2020) resulting into the average irrigation intensity of approximately 108 per cent with gross irrigated area accounting to 48 per cent of gross sown area. The region also witnesses temperature variation ranging between 3°C to 47.8°C with 867 mm of average annual rainfall. Bundelkhand region is particularly vulnerable to climate changes and variable climatic conditions. Changes in the climatic phenomenon being witnessed in the region have a horde of impacts on livelihood and biodiversity of the region (Prasad *et al.,* 2012). The region is characterized by undulating topography and has high physical vulnerability (Prakash and Mishra, 2020). Agriculture is the main occupation of the peoples in Bundelkhand region. About 32 per cent of the total population (18.3 million) of the region fall below the poverty line (Census, 2011).

Chick pea, wheat, sorghum, paddy, maize, barley, lentil, sesame, mustard, groundnut, soybean, peas, urd, mung bean, vegetables and fruits are important crops of the region (Samra, 2008). Thus cereals like wheat, paddy, barley and maize are important components of the cropping system and together cereals contribute about 56 per cent of the total agriculture production in the region (Samra, 2008). As staple foods, cereal grains provide a good amount of carbohydrate, dietary fiber and protein. In addition, they are notably rich sources of vitamin B, vitamin

*Corresponding author email id: skumar710@gmail.com

E, and a number of minerals, such as iron, zinc, magnesium, and phosphorus (Shahidi and Chandrasekara, 2015) The cereals also cater to requirement of fodder and fuel for the farm families in the region. The cropping system of the region has witnessed tremendous shift and changes over the period of time. The area, production and productivity of major cereals have undergone a lot of variations over time. It was therefore attempt in this paper to analyse the temporal dynamics in area, production and productivity of major cereal crops of Bundelkhand region during last two decades i.e. 2000-2010 and 2010-20 as well as the overall period of 2000-20.

MATERIALS AND METHODS

Time series data on Cereals of seven districts of Bundelkhand region of Uttar Pradesh for the past twenty years was procured from published reports of Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of India and Directorate of Economics and Statistics, Government of Uttar Pradesh. To smoothen the fluctuation of data on Cereals from year to year, Triennium data (TE) on area, production and productivity of cereals crops was computed for analysis.

Twenty year time series data from 2000-01 to 2019-20 on area, production and productivity of major cereals crops namely paddy, wheat, barley and maize were worked out. Data for all four major cereal crops were analysed and presented for all seven districts of UP namely Banda, Hamirpur, Chitrakoot, Jalaun, Mahoba, Jhansi and Lalitpur. In addition, the combined data for the period of 2000-2020 was also processed adequately. The study period (2000-01 to 2019-20) was mainly divided into two major periods viz. period-I (2000-01 to 2009-10), period II (2010-11 to 2019-20) besides the overall period (2000-2001 to 2019-20). The data was subjected to descriptive statistics to ascertain the cereals production scenario in the region. Compound Annual Growth Rate (CAGR) was computed to inspect the trend in area, production and productivity of the cultivated cereals crops taken in the study. The compound growth rate has been determined by using the following exponential function (Maurya, 2016; Kumar and Devraj, 2010). Stability was measured by CDVI (Cuddy and Della Valle, 1978).

RESULTS AND DISCUSSION

Wheat, paddy, barley and maize are the major cereals cultivated in Bundelkhand region of Uttar Pradesh state. These crops collectively occupy about 1062.54 thousand hectare in the region. Individually wheat, barley, paddy and maize crops contribute about 9.13, 26.93 0.97 and 1.7 per cent of total production in UP state respectively (Table 1). However, the productivity of most of cereal crop is recorded to be low in the region as compared to UP state (3.0 t/ha) and National average (2.8 t/ha) except for Barley crop (3.01 t/ha) (Table 1).

Crop wise area allocation shows that among the cereal crops, wheat occupied highest area i.e., 919.88 thousand ha and contributed 2991.26 thousand tonnes of production in the region. This crop thus singly accounted for 86.57 per cent of total area and 91per cent of the total production under cereals in the region. The region accounted for 9.64 (919.88 thousand hectare) and 9.13 (2991.26 thousand tonnes) percent of total area and production of wheat in the UP state, respectively. Similarly, this region shared about 27.50 per cent (41.20 thousand ha) of total barley area contributing 27 per cent (123.91 thousand tonnes) of total barley production in UP state. The average productivity level of barley in the region was observed to be higher (3.01 t/ha) in comparison to productivity of UP state (3.0 t/ha) as well as country level

Table 1: Cereal area, production and productivity scenario (2018-19)

Crop	India			Uttar Pradesh			Bundelkhand		
	Area (000 ha)	Prod. (000 tonnes)	Yield (t/ha)	Area (000 ha)	Prod. (000 tonnes)	Yield (t/ha)	Area (000 ha)	Prod. (000 tonnes)	Yield (t/ha)
Paddy	43790	116420	2.6	5750(13.13)	15540 (13.35)	2.7	75.52 (1.30)	151.81 (0.97)	2.01
Wheat	29140	102190	3.5	9540 (32.74)	32750(32.05)	3.4	919.88(9.64)	2991.26 (9.13)	3.1
Barely	580	1630	2.8	150 (25.86)	460(28.22)	3.0	41.20 (27.46)	123.91 (26.93)	3.01
Maize	9180	27230	2.9	730(7.9)	1530(5.6)	2.0	25.94 (3.4)	22.72 (1.7)	0.88
Total/Average	82690	247470	2.95	16170 (19.55)	50280 (20.31)	2.77	1062.54(6.57)	3289.7 (6.5)	2.25

Source: Authors calculation from secondary data

(2.8 t/ha). Maize accounted for 3.4 per cent (25.94 thousand ha) of the total maize area and contributed 1.7 per cent (22.72 thousand tonnes) to the total maize production in the UP state.

Thus, wheat and barley emerged as the major cereal crops of the region which are sharing sizeable to the total area and production in the state as a whole.

Inter-district variations in area and production: The district-wise analysis as contained in Table 2 show that among all the seven districts of Bundelkhand region, Lalitpur contributed highest to the area i.e., 223.4 thousand ha (21.03%) of the total cereal area (1062.5 thousand ha) in the region, closely followed by Banda (20.01%) and Jhansi (19.03%) districts during 2018-19. In contrast, Chitrakoot district contributed least (5.94%) of the total area and production (4.97%) under cereals in the region. The highest production of cereals was contributed by Lalitpur (21.25%), followed by Jhansi (19.08%) and Banda (18.36%) districts in the region (Table 2).

Distinct preferences for cultivation of different cereal crops were observed within the districts of Bundelkhand region. Banda district distinctively contributed about 68.67 per cent (51.86 thousand ha) of the total Paddy area in the region. Correspondingly, the district contributed about 78.4 per cent (109 thousand tonnes) of total paddy production. Lalitpur district on the other hand accounted for 93.3% (24.2 thousand ha) of total maize area and added 20.57 thousand tonnes (92.70%) of total maize production in UP Bundelkhand region. Lalitpur district also accounted for highest area coverage under barley (23.8%) and wheat (20%) and contributed about 26.25 per cent and 21.47 per cent of total barley and wheat production in the region (Table 2).

Decadal variation in area, production and productivity of cereal crops: Decadal variation of area coverage, production and productivity of major cereal crops in Bundelkhand region of UP were analysed for the period of 2000-2020. The overall area under cereal crops was observed to fluctuate between 779 thousand ha at TE 2010 and 1011 thousand ha at TE 2020 with an increase by 30 per cent from TE 2010 to TE2020. The region witnessed a considerable decline in area by 6.8 per cent from TE 2000 to TE 2010, while it registered an impressive

Table 2: District Wise area (000' ha) and production (000' tones) under cereals in Bundelkhand region of UP state (2018-19)

Crops	Banda	Chitrakoot	Hamirpur	Jalaun	Jhansi	Lalitpur	Mahoba	Total
Area								
Maize	2	48	200	2	1484	24202	5	25943
	(0.01)	(0.19)	(0.77)	(0.01)	(5.72)	(93.29)	(0.02)	(100)
Barley	937	4133	3791	8737	5507	9798	8302	41205
	(2.27)	(10.03)	(9.20)	(21.20)	(13.36)	(23.78)	(20.15)	(100)
Paddy	51864	9109	177	682	12335	1255	105	75527
	(68.67)	(12.06)	(0.23)	(0.90)	(16.33)	(1.66)	(0.14)	(100)
Wheat	159768	49808	113456	143818	182907	188237	81227	919881
	(19.37)	(5.41)	(12.33)	(15.63)	(19.88)	(20.46)	(8.90)	(100)
Total	212571	63098	117624	153239	202233	223492	90299	1062556
	(20.01)	(5.94)	(11.07)	(14.42)	(19.03)	(21.03)	(8.50)	(100)
Production								
Maize	4.0	12.9	4.14	2.0	1591	20572	5.0	22191.04
	(0.018)	(0.05)	(0.018)	(0.009)	(7.16)	(92.70)	(0.02)	(100)
Barley	2724	13049	11024	25120	15328	32529	24141	123915
	(2.20)	(10.53)	(8.90)	(20.27)	(12.37)	(26.25)	(19.48)	(100)
Paddy	109589	14665	367	1471	12335	1255	105	139787
	(78.40)	(10.49)	(0.26)	(1.05)	(8.82)	(0.90)	(0.08)	(100)
Wheat	489299	135073	364235	534094	595918	642076	230571	2991266
	(16.36)	(4.52)	(12.18)	(17.86)	(19.92)	(21.47)	(7.71)	(100)
Total	601616	162799.9	375690.14	560687	625172	696432	254822	3277159.04
	(18.36)	(4.97)	(11.46)	(17.11)	(19.08)	(21.25)	(7.78)	(100)

Figures parenthesis indicate the percentage of total area & production of cereals in Bundelkhand region of UP state

enhancement of about 21 per cent gain of area from TE 2000 to TE2020. In tandem with the area enhancement, the cereal production witnessed enhancement of 85 per cent from TE 2000 to TE 2020 in the region. In similar line the productivity of overall cereals witnessed enhancement of 52 per cent during the overall study period in Bundelkhand region of UP state (Table 3).

The region witnessed positive growth rate in overall area (1.61%), production (3.59%) and productivity (2.77%) of cereal crops during the overall study period (2000-20). The instability of overall area (10.45%) under cereals was observed to be low, while it was medium for total cereal production (26%) and productivity (17%). The growth under area coverage under wheat and barley was statistically significant (P<0.01). In contrast the area decline rate under maize crop was also observed to be statistically significant (P<0.05). The growth under all the cereals crops as well as overall cereal productivity in the region was found also to be statistically significant (P<0.01).

Crop wise analysis indicates that among all the cereal crops, paddy recorded highest growth in area coverage (130%), production (25%) and productivity (75%) in the region from TE 2000 to TE 2020. Paddy is monsoon dependent crop that need more water for good harvest. The area under paddy in the region witnessed a decline in all the three periods with highest decline in period 1(-7.60%). Corresponding to the area, CAGR for production and productivity reported decline by 9.2 per cent and 0.4 per cent, respectively. In overall period, the area under paddy registered a decline by 0.43 per cent; however, the production and productivity registered growth at 3.79 and 4.8 per cent, respectively. The instability index was recorded medium for area, production and productivity (23.43, 28.43, and 20.08) in the region during 2000-20.

Barley recorded 35.4 per cent increase in area coverage and 138 per cent enhancement in production with 82 per cent rise in productivity levels from TE 2000 to TE 2020. Further, the rate of growth of area and production of Barley was observed to be higher during period II (2.38% and 4.53%) than period I (1.78%, 3.19%). The instability index for area coverage under barley was observed to be low whereas it was medium with respect to production and productivity during overall study period.

The area enhancement under barley crop in Bundelkhand region of UP state could be attributed to the decreasing and erratic rainfall pattern in the region that

Table 3: Decadal variation in area, production and productivity of cereal crops

	TE			CAGR			Instability		
	2000	**2010**	**2020**	**2000-10**	**2010-20**	**2000-20**	**2000-10**	**2010-20**	**2000-20**
Area (H)									
Maize	23905.67	41087.4	23520.2	5.85	-4.86	-1.80*	16.98	19.49	24.45
Barley	28299.00	32629.7	38306	1.78	2.38	2.18**	9.68	11.75	11.80
Paddy	31091.00	55084	71554.3	-7.60	-2.41	-0.43	23.06	9.52	23.43
Wheat	680920.00	650209	877770.7	0.27	1.11	1.94**	9.74	9.12	10.79
Total	836417	779010.0	1011151.2	-0.57	0.93	1.61**	9.41	8.86	10.45
Production (T)									
Maize	25742.00	48081	19417.33	7.12	-10.01	-2.24	46.62	39.52	52.40
Barley	43621.33	50717	103825	3.19	4.53	6.15*	21.25	21.23	17.46
Paddy	113436	55221	141719	-9.20	6.49	3.79	38.14	16.78	28.43
Wheat	1434574.33	1388176.67	2717119	-0.59	4.50	3.61	19.47	26.08	20.66
Total	1609382.67	1542195.67	2982081.33	-0.74	4.36	3.59	19.80	25.00	26.01
Productivity (T/H)									
Maize	0.94	1.30	1.19	0.38	1.78	0.40 *	27.19	17.80	23.37
Barley	1.49	1.27	2.71	1.07	1.93	4.76*	17.98	21.28	23.82
Paddy	1.06	0.90	1.86	-0.40	4.01	4.80*	23.97	12.89	20.08
Wheat	2.08	1.97	3.00	-0.53	3.50	1.64*	12.86	23.83	21.35
Total	1.44	1.36	2.19	-0.14	2.82	2.77*	13.21	16.11	16.79

is leading farmers to opt for low resource requiring crops like barley as compared to wheat. The market price of barley is also reasonable in the region.

The area coverage under wheat crop continued to increase by 29 per cent from TE 2000 (680.92 thousand ha) to TE 2020 (877.77 thousand ha). In similar lines, the production of Wheat was recorded to enhance by 89.40 per cent during the same period. A steady positive growth was observed in area coverage during the period I (0.27%) and period II (1.11%) and overall period (1.94%), while during the overall period (2000-20), wheat witnessed an increase in area coverage by 1.94 per cent, production by 3.61 per cent and productivity by 1.64 per cent in the region. Though the crop registered a positive growth rate in area coverage by 0.27 per cent, the production (-0.59%) and productivity (-0.53%) recorded negative growth rate during period I. Interestingly, the instability index of area coverage under wheat was low while for wheat production and productivity, the index was medium. This reflects on lower fluctuations in wheat area in the region. This could be attributed to the fact that wheat being the staple food crop of people of the region, the existing consumption demands provided sufficient markets demands for wheat in the region.

The overall area and production of maize crop registered decline by 1.6 per cent and 25 per cent, respectively during whole study period (TE 2000-20). The rate of decline was witnessed to be 1.80 per cent and 2.24 per cent in area coverage and production under maize during overall study period, respectively. In contrast, the growth rate of area and production of maize was recorded positive for period I (5.85% and 7.12%). The instability index for area coverage and productivity recorded medium for all study period while it recorded high for production for the same period.

A closer look at the Table 4 indicates that during period I among all the cereal maize recorded highest growth rate in area (5.85%) and production (7.12%), while paddy recorded highest decline in area (-7.60%) and production (-9.20%). In contrast, during period II maize recorded highest decline in area (-4.86%) and production (-10.01%). Though paddy continued to witness a decline in area by 2.41 per cent during period II, it registered highest gain in production by 6.49% among all the cereal. Barley recorded highest growth in area (2.18%) and production (6.15%) during the overall study period while paddy registered highest growth in productivity (4.80%) followed by barley (4.76%).

Yearly variation in area and production of cereals in Bundelkhand districts: District wise analysis of growth rate reflects positive growth in overall area and production of cereal crops in all the seven districts of Bundelkhand region of UP state during the overall study period (2000-20), though variations were observed in different periods (Table 4). Highest growth rate in area coverage and production was observed in Lalitpur district during overall study period.

Banda district recorded growth rate of 0.02 per cent in overall area coverage during 2000-20, however it registered growth rate of 3.00 per cent in production of overall cereals. A decline in area coverage under all the crops was witnessed during overall study period; however in contrast, the production of all cereals except maize recorded positive growth during the same study period. In case of barley and paddy, the decline in area was recorded for all the three periods in continuous. A continuous decline in area coverage under paddy in Banda district is special concern as Banda district accounts for about 68.7 per cent of paddy area in the region.

Alike Banda district, Chitrakoot also had recorded a decline (-0.60%) of area coverage in overall cereals during 2000-20. Despite recording decline in area coverage, the production recorded the growth rate of 1.80% during the same period. Among all cereals crops analysed, growth rate of production was recorded to be highest (5.11%) for barley during the overall study period. In contrast, the area and production of under barley recorded a continuous decline during period I (-3.72% and -3.46%) and period II (-1.89% and -0.32%).

As against the trends of Banda and Chitrakoot districts, Hamirpur district recorded positive growth rate in area coverage in all the cereals crops except paddy (-14.4%). In similar lines, the production of all the cereals recorded growth except maize (-4.15%) and paddy (-10.22%). In the district, barley and wheat witnessed a continuous growth rate in area and production in all the three periods. Paddy however recorded continuous decline in area during all three periods.

Maize recorded highest growth rate (2.2%) in area coverage in Jalaun district in the region, while it recorded a decline in production by 1.40 per cent during the overall study period (2000-20). Further, all the cereal crops except paddy recorded positive growth rate in area coverage during overall study period, while a positive growth rate

Table 4: District wise CAGR of area and production of major cereal in Bundelkhand region of UP state

	Area			Production		
	2000-20 (%)	**2000-10 (%)**	**2010-20 (%)**	**2000-20 (%)**	**2000-10 (%)**	**2010-20 (%)**
Banda						
Maize	-1.50	-12.74	-12.34	-1.02	-3.70	-5.26
Barley	-4.90	-9.24	-2.03	1.66	-9.52	-1.21
Paddy	-0.20	-7.60	-0.12	4.54	-8.68	6.15
Wheat	-0.07	-0.21	0.10	2.24	0.00	4.94
Total	0.02	-2.10	0.25	3.00	-1.60	5.30
Chitrakoot						
Maize	-1.70	1.97	-9.50	1.52	8.17	-4.60
Barley	-1.50	-3.72	-1.89	5.11	-3.46	-0.32
Paddy	-0.20	-7.47	2.88	2.74	-15.49	11.29
Wheat	-0.14	-1.27	0.38	1.58	-4.00	4.13
Total	-0.60	-2.40	0.50	1.80	-4.90	4.30
Hamirpur						
Maize	0.90	-10.25	11.20	-4.15	-12.61	11.10
Barley	6.40	3.50	4.79	13.96	3.26	6.01
Paddy	-14.40	-24.65	-1.95	-10.22	-26.62	3.66
Wheat	2.50	0.40	2.04	4.59	1.69	4.23
Total	2.60	0.30	2.10	4.60	1.60	4.20
Jalaun						
Maize	2.20	7.50	-7.20	-1.40	-3.14	7.41
Barley	0.08	2.39	2.63	1.30	-0.67	4.38
Paddy	-4	-15.65	-2.59	2.29	-13.54	1.78
Wheat	1.50	1.27	0.89	1.79	-1.00	3.17
Total	1.40	1.20	0.90	1.70	-0.90	3.10
Jhansi						
Maize	-2.60	5.20	-5.40	0.32	-0.04	-10.07
Barley	5	3.05	3.61	8.29	7.95	8.76
Paddy	12.30	-1.40	8.35	12.34	-1.41	8.35
Wheat	2	-1.06	0.39	2.63	-2.16	3.35
Total	2.40	-0.80	0.60	2.80	-1.90	3.40
Lalitpur						
Maize	-1.40	5.80	-4.80	-2.38	7.31	-9.95
Barley	3.30	4.63	0.50	7.02	9.61	2.63
Paddy	-10.89	-9.27	-5.46	-10.89	-9.28	-5.47
Wheat	4.60	1.10	1.93	8.02	3.53	5.57
Total	3.20	2	0.75	6.70	3.80	4.20
Mahoba						
Maize	-4.30	-2.18	-10	2.99	21.41	-14.21
Barley	5.30	-1	8.20	12.66	-1.30	9.09
Paddy	-16.50	-18.80	8.19	-16.59	-18.80	8.19
Wheat	0.50	-6.14	0.93	3.01	-7.45	7.90
Total	0.76	-5.90	1.30	3.50	-7.20	7.90

was recorded in production of all crops except maize during the same period. Interestingly paddy recorded highest decline in area coverage but it recorded highest growth rate in production during the overall study period (2000-20).

In Jhansi district, among all the cereal crops, paddy crop recorded high growth in area (12.3%) and production (12.34%) during over all study period though the crop witnessed negative growth rate in area (-1.4%) and production (-1.41%) during period I. Barley crop also witnessed growth in area (5.0%) and production (8.29%). In contrast, Maize recorded decline in area (-2.6%), while gain in production by 0.32 per cent during over all study period.

Lalitpur district recorded highest growth rate of area and production of wheat during the overall study period. Further, a continuous positive growth rate was observed with regard to area and production of wheat during period I and period II. In addition, barley crop also witnessed growth rate in area and production in all the three periods, while paddy registered a decline in area and production in all three periods.

Mahoba district recorded highest decline in area coverage (-16.5%) and production (-16.59%) of paddy in overall study period. Maize also registered a decline in area (-4.3%) however it registered growth in production during the same period. In same line, barley crop also witnessed growth in area (5.3%) and production (12.66%) in the district during overall study period.

The district wise trends helped to infer that among all the cereal crops, barley recorded highest growth rate in production in all the districts of Bundelkhand region of UP except in Banda, Jalaun, Jhansi and Lalitpur districts during the overall period in compare to other cereal within each district. Highest growth in barley crop recorded in Hamirpur followed by Mahoba and Jhansi, in the region. Area under maize crop recorded a declining trend in the entire region except Jalaun and Hamirpur district. Paddy registered decline area coverage in Bundelkhand region except in Jhansi district that recorded growth rate at 12.30 per cent in whole study period. In contrast, area coverage under wheat crop registered increase in all the districts of the region except Banda and Chitrakoot districts, while in terms of production, it observed a positive growth rate in the entire region.

CONCLUSION

Bundelkhand region despite being the traditional pulses growing region, accounts for about 6.4 per cent of total area and total production of cereals in the state. Barley, wheat, paddy and maize contributed most in terms of area coverage and production. The average productivity of cereal was low as compared to state and national level productivity averages. The trend analysis of cereals witnessed positive growth in overall area (1.6%), production (3.59%) and productivity (2.77%) during the overall study period (2000-20), however radical changes were noticed within the various cereal crops. Among all the cereal crops cultivated in the region, barley recorded highest annual increase in area (2.18%), production (6.15%) during the study period. In contrast, maize recorded highest decline in area (-4.86%), production (-10.01%) during 2010-20. District wise analysis shows that among all the cereal crops, barley recorded highest growth rate in area and production in all the districts of Bundelkhand region except Banda, Jalaun, Jhansi and Lalitpur districts. In contrast area coverage under maize registered decline in all the district of Bundelkhand except Jalaun and Hamirpur districts. Hamirpur contributed the highest growth rate in production of barley during overall study period. In similar lines Lalitpur district contributed highest growth in area and production of wheat. The highest growth in area as well as production of paddy was observed in Jhansi. The above analysis gave sufficient insight of temporal dynamics of different cereal crops in Bundelkhand region of UP.

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Swot and Constraint Analysis of Farmer Producer Organisations in West Bengal

Sudip Kumar Gorai[1]*, Monika Wason[2], R.N. Padaria[2], D.U.M. Rao[2], Sudipta Paul[3] and Ranjit Kumar Paul[4]
[1]Ph.D Student, [2]Principal Scientist, Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[3]Scientist, ICAR-National Rice Research Institute, Cuttack-753006, Odisha
[4]Scientist, Statistical Genetics Division, ICAR-Indian Agricultural Statistics Research Institute, New Delhi-110012

ABSTRACT

The present study was carried out with an objective to analyze the functioning of Farmer Producer Organisations (FPOs) in the state of West Bengal. Using random sampling procedure, data were collected from 120 farmer members and 40 FPO facilitators through personal interview and focus group discussions. Major strength of FPOs were the primary producers availed the benefits of economies of scale, groups had more power to bargain with input suppliers, banks and buyers than individual farmers. Major weaknesses of FPO were reluctance of farmers to join FPO, lack of business orientation and proper business plan and low involvement of members in group activity. With respect to opportunities available, FPOs had the opportunity for linking with multiple service providers ranging from public to private companies for support and better marketing. Threats include middlemen and political intervention and high tax rate. Lack of government support and credit facility was the major constraints that the farmers perceived in the functioning the FPOs. Middlemen and political intervention and lack of working capital were the major constraints perceived by Promoting Institute members and officials of Sponsoring Agency respectively.

Keywords: Farmer producer organisations, SWOT analysis, Constraints, West Bengal

INTRODUCTION

During the difficult times, when the world struggles under the COVID-19 pandemic, Farmer Producer Organisations (FPOs) helped farmers with provision of inputs, advisory and marketing services and income support to its' members. In this context, the Government of India puts greater emphasis on FPOs, as is evident from its various policy guidelines and recommendations for the states. For example, in order to maintain the supply line, the central government instructed state governments to make efforts to link FPOs with the bulk buyers, big retailers and processors (Economic Times April 08 2020). The central government requested state market boards to allow FPOs to purchase directly from farmers or buy from mandis for trade purposes (Press Information Bureau April 21, 2020). Several state governments facilitated FPOs to sell agricultural produce by relaxing limitations on transportation and marketing. The report of 'Doubling of Farmer's Income (DFI)' has recommended formation of 7,000 FPOs by 2022 towards convergence of efforts for doubling the farmers' income (Report of the Committee on Doubling Farmers' Income September 2018). But there was a significant gap in the potential of the Farmer Producer Organizations and its' progress (Raju *et al.,* 2017). It could be due to a lack of efficient business plans, more administrative controls, limited knowledge of the promoting institutions, lack of adequate infrastructure etc. (NABCONS, 2011; Mukherjee *et al.,* 2019; Nikam *et al.,* 2019). Farmers did not perceive the FPOs as a profit-oriented organization and lack of awareness of farmers about FPOs would make it more difficult for the FPOs to grow rapidly using their full potential (Deepa *et al.,* 2018). In this background, SWOT Analysis on Farmer Producer Organizations was done to understand the perception of farmers and other stakeholders about the functioning of FPOs, what is working well and what is not so good in FPO model. The study also assessed the constraints faced by the stakeholders for targeted development of FPOs and its sustainability.

*Corresponding author email id: sudipad97@gmail.com

MATERIALS AND METHODS

The present study was conducted in the state of West Bengal as it represents among highest number of farmer producer organisations (SFAC December 2021 and NABARD Portal on Farmer Producer Organisation 2021) but very few researches have been reported on the sustainability, success or failures of the FPOs. Random sampling procedure was used for sample selection in this study. There are 236 registered FPOs in West Bengal but only 30 FPOs are working for more than five years. Ten farmer producer organizations, which were Farmer Producer Company (FPCs) under the section 581(C) of Indian Companies Act, 1956 as amended in 2013, were selected for the study. These FPCs were functioning for more than five years from the four districts namely Birbhum, Murshidabad, Purba Bardhaman and Nadia. Among these ten FPOs, five were high performing FPOs and five were low performing FPOs as graded by officials. Those FPOs which were engaged in agriculture related activity were considered for this study. From each farmer producer organizations 2 office bearers and 10 general members were selected randomly. Forty facilitators, which includes officials of NABARD and SFAC, staffs of FPO promoting institutions, senior extension scientists, bank officials and officials of Department of Agriculture of Government of West Bengal were also selected for the study. Thus, the total sample size of the study was 160. The name of the selected FPOs are given in Table 1 and Table 2.

SWOT (strengths, weaknesses, opportunities and threats) Analysis is a strategic planning technique that helps one organization discover it's strengths, overcome challenges and determine what new leads to pursue. SWOT Analysis of farmer producer organizations was done by finding out what's working well, and what's not so good and asking the members and facilitators of FPOs where they want to go, how they might get there – and what might get in their way. Constraints analysis was done through enlisting the constraints first and then asking the respondents to rank them in order of severity by Garrett ranking method.

RESULTS AND DISCUSSION

The internal strengths, weaknesses and external opportunities and threats of the farmer producer organizations as perceived by the facilitators and member farmers are discussed below:

Strengths: Strengths are the internal characteristics of the organizations that give it an advantage over others. Strengths of FPOs include:

The primary producers availed the benefits of economies of scale in all ten FPOs. A group has collective accountability and more power to bargain with input suppliers, banks and other credit suppliers, and with buyers of their products than individual farmers. Producers in Murshidabad Agro Producer Company Limited processed (graded, cleaned, dried) their vegetables in their own food

Table 1: List of high Performing FPOs selected for the study

Name of the FPO	Promoting Agency	District
Nadia Vegetable Producer Company Limited	SFAC	Nadia
Spandan Producer Company Limited	NABARD	Nadia
Murshidabad Agro Producer Company Limited	SFAC	Murshidabad
Brindaban Krishibandhab Producer Company Limited	NABARD	Birbhum
Srijoni Green Producer Company Limited	NABARD	Birbhum

Table 2: List of low Performing FPOs selected for the study

Name of the FPO	Promoting Agency	District
Bardhaman-Katwa Farmers Producer Company Limited	SFAC	Purba Bardhaman
Progressive Majida Farmers Producer Company Limited	SFAC	Purba Bardhaman
Seherakuri Vivekananda Farmers Producer Company Limited	NABARD	Birbhum
Jagaran Producers Organization	NABARD	Murshidabad
Bhagwangola Agro Producer Company Limited	NABARD	Murshidabad

processing units, packaged and parceled them in their own pack-houses and sent them off directly to bigger market. This was done by the FPO members without any hindrance from the middlemen. Instead of selling their vegetables to the wholesaler at reduced rates, now they got to sell them directly to the consumers at much higher prices. Further it paved the way towards crop diversification, value addition and enhancement of employment and income of the farmer members. In case of Srijoni Green Producer Company Limited, from spice unit the members have diversified their activity into cashew processing, honey processing, vermicompost, decorative candle making, wool knitting, pulse processing, organic vegetable production and marketing, mango processing and exploring international markets for mangoes, etc.

In addition to the public extension system, FPOs have become another key source of information for the small and marginal farmers. FPOs were a good answer for the problems faced by the extension system. FPOs are a solution for extension system to reach large number of farmers with limited time and effort. The knowledge management is easier, when farmers join as group. Due to continuous field experience farmers gain native knowledge. FPOs like Murshidabad Agro Producer Company Limited, Nadia Agro Producer Company Limited and Spandan Producer Company Limited became a good platform of knowledge management for the members by picking the relevant inputs either from external source or from members' own experience.

Moreover, major strength of the FPO was that it had come out as an institution of equal opportunity for all and that it provided equitable distribution of benefits to all members. Only producer can be the member and shareholder of FPOs and equal share was provided for all members. FPOs like Srijoni Green Producer Company Limited and Brindaban Krishibandhab Producer Company Limited started giving dividend to its members from third year onwards and everyone got equal dividend. Share cannot be sold and traded in the market. No one can exclude the members from FPO. Shareholder's share will be transferred to the next generation by ancestry.

FPO has the provision of direct marketing of products by e-NAM (*e-National Agricultural Market*) or FPO Web Portal "KRISHIMANCH" (http://krishimanch.nabkisan.org/). KRISHIMANCH is an online bilingual web portal launched on 28th September 2017 and developed by NABKISAN, which serves as a digital knowledge-sharing platform for Farmer Producer Organizations (FPOs). By using this dynamic web portal, members of Srijoni Green and Nadia Vegetable Producer Company Limited had accessed the information on various lending /leading products offered by NABKISAN Finance Limited, information on Mentor services, general data on FPO sector, etc. A feature was added on Credit rating of FPOs wherein FPOs can obtain information on their credit rating which helps them in accessing loan from financial institutions. Promoting Institute staffs had helped the members in these activities.

NABARD sponsored Promoting Institutions had rich experience in facilitating the farmers in Wadi Programme, Watershed Development Programmes, Self-help groups and Cooperative Societies etc. in the district. The national level NGOs like Access Development Services, Indian Grameen Services and BASIX Krishi Samruddhi Limited which had mobilised the farmers to join the producer organisations had a huge experience to work with people. So, these institutions were good at understanding the ground realities and have developed good network with farmers. This increased motivation of the farmers in functioning of the FPOs.

In producer organisations, due to so many compliances in the registration and establishment process, there were fewer chances of politics and corruption in its working. As the FPOs follow business model, it is successful in inculcating business skills in farmers. The board of directors were all selected from the members. It brought transparency and trust among the members. This had direct and indirect impacts by creating the employment opportunities. Frequent meetings were organized and all members had equal right to give their views about the functioning of organization. Also, there were annual general meetings generally in six months in which whole activity, transactions etc. were revealed and discussed. This strengthened the working structure of the organization. As the farmers worked collectively in the organizations, the organizations received the support from various governmental and non-governmental institutions for both financial and technical purposes.

Trebbin (2012) in his study observed that the producer companies in Maharashtra increased employment opportunities for 42.5 per cent of participants from 8 and 12 months after establishment. Deepa *et al.* (2018) in their study found that the key strength of the FPOs was to prevent the intermediaries from taking away the largest share in marketing channel.

Weaknesses: Weaknesses are the characteristics of the organization that place the organization at a disadvantage relative to others. The perceived weaknesses of the FPOs were:

Farmers were reluctant to give share money for joining the groups of producer organizations because of their poor financial condition. In many cases farmers perceived the organizations as chit fund and they had the fear that their money will be stolen. Groups become destabilized if regular group meeting does not occur. Members in Progressive Majida Farmers Producer Company Limited and Bardhaman-Katwa Farmers Producer Company Limited had the feeling that others are getting more benefits than him or her, which caused poor performance of these two FPOs.

Farmers failed to perceive FPO as a profit-oriented business organization. In case of Jagaran Producers Organization, neither farmers were having business-oriented mind, nor the organization have proper business plan. Clash of interests of the member farmers and low involvement of members in meeting and group activity also posed as a weakness for FPO as it was not easy to collectivize thousands of farmers in divergent socio-economic and political setting of rural areas. If one member-farmer was cultivating more profit-making crops, they asked for more dividend. This attitude destabilized two FPOs: Bardhaman-Katwa Farmers Producer Company Limited and Seherakuri Vivekananda Farmers Producer Company Limited.

Lack of working capital was the main factor hindering the expansion of business of FPOs. After formation, the FPOs are supported by NABARD, SFAC or POPIs (Producer Organization Promoting Institutes) employed by it for three years. After three years, complete withdrawal of support makes those companies unsteady and lose the momentum which have not become sustainable. Instead of bank guarantee given by SFAC and NABKISAN, bankers are skeptical in providing lending support to FPOs as full-fledged security is not there. There were no firm rules and regulation in banks for giving loan to FPOs. NABARD, as the apex bank was engaged in refinancing and did not do direct lending. In contrast, while there are specialized banks for housing, small and medium enterprises and so on, there may be a need for such dedicated banks as nearly all existing banks for agri-business fall short of the required priority sector lending targets to direct agriculture.

Management and CEOs of FPOs were not so efficient. If CEO was efficient, there was a tendency for CEOs to leave when they get better opportunity. Groups become destabilized when CEO leaves. Moreover, the directors were selected from farmer-members only, so they were not so business-minded. External support from NABARD or other promoting agency was needed for imparting training to the Board of Directors and CEOs.

In some cases, CEO, Directors or few farmers dominate while all the members are docile in the organization building, as in case of Jagaran Producers Organization. People had a natural resistance to adopt the change and cultural barriers, organisational culture hinders the farmers from joining the group. Low loss bearing capacity of FPOs due to lesser fund resources. No fund for advertisement of the products of FPOs. So FPOs *lag* behind in competition with other companies.

Manaswi *et al.* (2019) in their study observed that lack of professional expertise and low involvement of the members as major weakness.

Opportunities: Opportunities are the elements in the environment that the organization could exploit to its advantage. There were various such factors for FPOs:

Multiple service providers ranging from public institutions (NABARD, SFAC, KVK or State Government Agriculture or Agricultural Marketing department) to private organizations (NGOs) were available for FPOs.

FPOs can link with other private companies for support and better marketing as in case of Murshidabad Agro Producer Company Limited, Nadia Agro Producer Company Limited and Srijoni Green Producer Company Limited. Direct marketing opportunity to local, regional, national and international markets were being explored now.

As the FPOs have limited government control they were found to take up any one or more activities in the value chain of the produce, right from procurement of raw material to delivery of the final product to the ultimate consumers' doorstep which will benefit the members of FPO in better price realization. Provision of equity fund support from SFAC up to fifteen lakhs for FPOs with capacity of 1500 members. Members became aware about producing quality products as quality products always fetch higher prices and get easily absorbed in the market. FPOs were found to take up such group activities that involve

women members' skills and pursuits as *woolen sweater knitting, tailoring school uniforms, embroidery works* leading to more employment to women, gender equity and women empowerment.

Trebbin (2014) reported that Producer Companies have the immense potential to strengthen the linkages with modern retail chains like Mother Dairy or SAFAL as they procure 60 percent of their supplies through farmer associations themselves.

Threats: Threats are elements in the environment that could cause trouble for the organizations. The threats for a producer organization are:

Main threats for FPOs were middlemen and political interventions. Existing traders and middlemen continued to resist direct retailing of the products in the market and they were always backed by strong political support. They have always tried to break the group. High tax rate by the government like dividend tax on dividend posed as a serious threat for FPO as it hindered FPO from expanding its business and capital formation.

Inter-FPO competition was also found to lower market prices. This was one of the serious threats to FPOs. FPOs had to face competition from large private companies and supermarkets which have comparative competitive advantage of advertising and having large market share. FPOs were dependent on external source of finance like NABARD or SFAC for their business expansion but when the resource institutes withdraw their support, they were not able to sustain. FPOs have tried to find out different sources through which they have wisely used for their income generation.

Deepa *et al.* (2018) observed that FPOs faced many threats, such as increased competition from existing private companies, lack of self-sustainability, and more administrative controls by the CEOs offer less opportunity to expand their business activities.

Constraints coming in the way of functioning and achieving stability of farmer producer organizations

A. Constraints as perceived by members of FPOs: The opinion of the members of FPOs were analyzed using the Garrett ranking Method and given in Table 4. Lack of government support and credit facility was the major constraints that the farmers perceived in the functioning the FPOs. Clash of interest between the members, organization is not taking whole of member's produce, politics and competition, few member control the organization, lack of infrastructure, high procedural formalities and lack of good quality leadership were the other factors constraining in the efficient performance of FPOs. Inefficient price realization, inadequate efforts by POPIs and high membership fees were the relatively less problem perceived by the members of FPOs.

B. Constraints as perceived by Producer Organization Promoting Institutes (POPI) members in promoting FPOs: Producer Organization Promoting Institutes (POPIs) catalyze the functioning of FPOs by helping in documentation process, providing technical guidance to members, developing awareness among

Table 3: SWOT Analysis of the sample FPOs in the study area

Strengths	**Weaknesses**
√ Producers can avail the benefits of economies of scale	√ Reluctance of farmers to join FPO
√ Group has more power to bargain with input suppliers, banks and other credit suppliers, and with buyers of their products	√ Lack of business orientation and proper business plan
	√ Clash of interests and low involvement of members group activity
√ Can successfully inculcate business skills in farmers	√ Lack of working capital
√ Producers have direct market access	√ Management and CEOs of FPOs are not so efficient
√ Can pave the way towards crop diversification, value addition	
√ Enhancement of income of the farmer members	
Opportunities	**Threats**
√ Can link with multiple service providers ranging from public to private for support and better marketing	√ Middlemen and political intervention
	√ High tax rate
√ limited government control	√ Inter-FPO competition
√ Provision of equity fund support	√ Competition from large private company
√ Awareness about quality products	√ Dependent on external source of finance
√ Women empowerment	

Table 4: Major constraints perceived by the members of FPOs and their ranks

S.No.	Constraints	Average score	Rank
1.	Organization is not taking whole of member's produce	63.37	III
2.	FPO not located in the village	39.33	IX
3.	High membership fees	23.43	XII
4.	Inefficient price realization	35.15	X
5.	High procedural formalities	47.68	VII
6.	Lack of government support and credit facility	76.04	I
7.	Inadequate efforts by POPIs	30.83	XI
8.	Clash of interest between members	70.90	II
9.	Few members control the organization	55.71	V
10.	Lack of good quality leadership	46.60	VIII
11.	Politics and competition	59.74	IV
12.	Lack of infrastructure for aggregation, storage and transport facilities	52.00	VI

farmers and offering the requisite information to FPO members. POPI members perceived middlemen and political intervention, convincing the producers of the village, divergent interests of the members and lack of working capital were the major constraints in promoting FPOs. The CEO and BODs of the FPOs lack the professional expertise and therefore resulted in imperfect business planning. Moreover low involvement of members and lack of awareness about FPOs amongst farmers, corporate sector, input suppliers, commercial banks and agricultural department officials were also constraints faced by POPI members in promoting FPOs. The major constraints and their ranks are given in Table 5.

C. Constraints as perceived by officials of SFAC and NABARD in sponsoring FPOs: Sponsoring agencies (SFAC and NABARD) helps in FPO registration, providing financial support for three years, training for BODs, CEOs and members and arranging meeting for members. Some of the major constraints experienced by officials were lack of working capital, middlemen and political intervention, weak skeptical response from banks in providing lending support to FPOs and high rate of taxation. Officials also observed that divergent interest of the members and lack of professional managers to manage the organization were also constraints in the working of FPOs. The major constraints and their ranks are given in Table 6.

Raju *et al.* (2017) in their study in Andhra Pradesh reported that major problems that hampered the growth and development of FPCs were the lack of a coordinated approach in promoting farmers' organizations by the promoting agencies and the government. Nikam *et al.* (2019) stated that lack of working capital and managerial

Table 5: Major constraints perceived by POPI members and their ranks

S.No.	Constraints	Average score	Rank
1	Lack of working capital	47.25	IV
2.	Lack of awareness about FPOs amongst producers, corporate sector, input suppliers, commercial banks and agricultural department officials	30.60	VIII
3.	Problem in convincing in producers of the village	67.15	II
4.	Low involvement of members	39.00	VII
5.	Divergent interests of the members	50.55	III
6.	Few members control the organization	27.95	IX
7.	Lack of professional managers to manage the organization	43.55	V
8.	Middlemen and political intervention	72.30	I
9.	No viable business plan	42.45	VI

Table 6: Major constraints as perceived by officials in sponsoring FPOs and their ranks

S.No.	Constraints	Average score	Rank
1.	High rate of taxation	58.00	IV
2.	No viable business plan	44.45	VIII
3.	Middlemen and political intervention	70.40	II
4.	Lack of awareness about FPOs amongst producers, corporate sector, input suppliers, commercial banks and agricultural department officials	44.65	VII
5.	Lack of effective coordination and consultative mechanism at the regional level to network FPOs and leverage their collective voice	25.35	X
6.	Weak skeptical response from banks in providing lending support to FPOs	61.35	III
7.	Low involvement of members	33.35	IX
8.	Divergent interest of the members	50.75	V
9.	Lack of professional managers to manage the organization	50.35	VI
10.	Lack of working capital	71.90	I

capabilities among farmer members were the major constraints in functioning the FPOs.

CONCLUSION

SWOT Analysis is used to assess current position of an organization before deciding on any new strategy. Essentially the collected information on the strengths and opportunities had helped the FPOs to have a good understanding of the internal positive forces that need to be strengthened further. Similarly collected information on weaknesses and threats have provided useful insights to get warned in time to wake up and prepare for external negative forces. Analysis of constraints can provide direction for policy framework regarding efficient functioning of these Farmer Producer Organizations.

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Impacts of Self-help Groups on Empowerment of Rural Women: A Study in Thoubal District of Manipur

Nikita Khoisnam[1]* and S.D. Mukhopadhyay[2]
[1]Department of Economics and Extension, School of Agriculture, Lovely Professional University, Jalandhar-144411, Punjab
[2]Department of Agricultural Extension, Institute of Agriculture, Visva-Bharati, Sriniketan-731236, West Bengal

ABSTRACT

The study was conducted in the Thoubal district of Manipur. A total of twelve SHGs were selected from Thoubal and Kakching block. A sample of 120 respondents (10 respondents from each SHG) was selected for the study. The study revealed that majority of the respondents were having medium to low level of socio-economic conditions. Different impact analyses (using ranking technique) revealed that 'increased knowledge about SHG activities' resulted in knowledge/awareness/attitude impact, 'increased skill in record keeping , accounting and Bank operations' resulted into capacity building/skill enhancement, 'increased mobility' resulted into self-developmental impact, 'enjoying better standard of life' resulted in personally benefitted/ empowered by SHG, 'increased influence in social, community and other activities' resulted into socially benefited impact, 'feel empowered to decide upon daily activities' resulted into daily time management impact. The results of the overall perception of the respondents about all six aspects of impacts perceived high level of impacts.

Keywords: Aspects, Impacts, Ranking, Self-help group, Socio-economics

INTRODUCTION

Women are the best change agent to touch the core of poverty and are very important segment in development at local to global level. Women constitute about 48 per cent of the country's population and play an equally important role with men in creating a better family life (Singh and Mathur, 2005). The Government of India has launched and implemented a number of schemes towards poverty alleviation and women empowerment, but it was observed that women in rural areas especially from the poor families could not be benefitted. This led to the country to launch a mother programme called Swarnajayanti Gram Swarozgar Yojana (SGSY) which was based on a group approach. Here, the rural poor especially women were organized into Self Help Groups (SHGs) to enable them to take up viable economic activities on their own on a sustained basis with the support from bank loans and government subsidy.

SHGs are small informal associations of people in a localised context, created for the purpose of enabling members to reap economic benefit out of mutual help, solidarity, and joint responsibility (Anand, 2002). Studies of Suguna (2006), Usha Pitta (2010), Vasanthakumari (2011); Sah *et al.* (2018); Kiran and Aslam (2019); Shobha *et al.* (2021) etc. have depicted that SHGs play major important role in socio-economic empowerment of women. In order to understand the impact of SHG on socio- economic condition and its extent of empowerment through SHGs' activities of rural women in the North Eastern state, the present study has been conducted in Thoubal district of Manipur with the following broad objectives:

1. To study the socio-economic orientation of the respondent SHG members.
2. To study the impact and extent of empowerment of group members through SHG activities.

MATERIALS AND METHODS

The present study was conducted in Thoubal and Kakching Block of Thoubal district of Manipur. The area of the study is comprised of six Gram Panchayats, three each from both the blocks viz. from Thoubal Block- Khangabok

*Corresponding author email id: adzora.khois91@gmail.com

Part-1, Khangabok Part-2, and Charangpat whereas from Kakching Block- Wabagai, Hiyanglam and Sekmaijin. Two SHGs from each Gram Panchayat having at least twenty members each have been studied. Proper scientific procedures for selecting the district, blocks, SHGs and respondents have been followed. Thus, in total 120 respondents (taking 10 respondents from each SHG) were selected. Data related with impact of SHG on respondents' socio-economic orientation and their extent of empowerment of group members through SHG activities has been collected. Six major types of impact have been considered like, knowledge/awareness/attitude, capacity building/skill enhancement, self-developmental, personally benefitted/empowered by SHG, socially benefitted by SHG and daily time management. A number of statements were framed against each major type of impacts. Respondents were asked to mention their perception against each statement in a three-point scale containing 'Strongly Agree' with corresponding score of 3, 'Agree' with corresponding score of 2 and 'Disagree' with corresponding score of 1(Hardikar, 1998). The statistical tools used were; frequency, percentage, index value, rank score according to the frequency of the respondents against each of impacts. The Index Value for each determinant was calculated by following the formula (Moktan and Mukhopadhyay, 2012).

$$\text{Index Value} = \{\text{Score}_{\text{Obtained}} / \text{Score}_{\text{Max}} \text{ X } 100\}$$

Index value (ranging from 0-100) was classified into four different class intervals, like low (with value 0-25), Semi-Medium (26-50), Medium (51-75) and High (with index value 76-100).

RESULTS AND DISCUSSION

Socio economic profile of women SHGs members: Socio-economic profiles help in deriving a comprehensive picture of the respondents and the society in which they live. The socio economic profile of women respondents studied with the help of different variables as presented in Table 1.

Table 1: Distribution of respondents according to their socio-economic and psychological characteristics (n=120)

S.No.	Category	Major 1 (%)	Major 2 (%)
1.	Age	36-50 years (60.83)	Above 50 years (20.83)
2.	Marital status	Married (83.83)	Unmarried (10)
3.	Caste	OBC (91.67)	General (2.5)
4.	Family Type	Nuclear (66.67)	Joint (33.33)
5.	Family Size (No. Of family member.)	3-5 (72.5)	6-9 (27.5)
6.	Respondent level of education	M.E school (32.5)	High school (30.83)
7.	Respondent's family level of education	M.E school (60)	High school (35)
8.	House structure	Mixed (61.67)	Pucca (33.33)
9.	Family occupation: Primary occupation	Cultivation- (60)	Business- (25.83)
10.	Secondary occupation	SHG-(84.17)	Business-(6.67)
11.	Tertiary occupation	SHG-(15)	-
12.	Family land holding	Up to 1 acre (58.33)	1.1- 2 acres (39.17)
13.	Livestock possession	Up to Rs. 1,000 (49.17)	Rs.1,001-2,000 (15.83)
14.	Household possession	Rs. (>1,00,000) (44.17)	Rs.50,001-60,000 (15.83)
15.	Agricultural possession	Up to Rs. 5,000 (98.33)	Rs. (>1,00,000) (1.67)
16.	Communication materials	Mobile (40.83)	Radio (25.83)
17.	Level of social participation	Low (100)	-
18.	Extent of social participation	Semi-medium (61.67)	Low (38.33)
19.	Visiting outside village for work	Semi-medium (40)	Low (35.83)
20.	Level of contact with extension agent	Low (100)	-
21.	Annual income from SHG	Rs.1,00,001-1,50,000 (67.5)	Rs.1,50,001-2,00,000 (21.67)
22.	Total family annual income	Above Rs. 2,00,000 (100)	-

Table 1 revealed that majority of respondents (60.83%) belonged to age group of (36-50 years), followed by (20.83%) age group of above 50 years. 80.83 per cent of the respondents were married followed by 10 per cent are unmarried. Further it was revealed that 91.67 per cent of the members are of OBC category and 2.5 per cent are General. 66.67 per cent of the respondents were found live in nuclear family and only 33.33 per cent live in joint family. 72.5 per cent of the respondents had up to 3-5 members and only 27.5 per cent had 6-9 members in their family. The respondents' educational status revealed that 32.5 per cent respondents possessed middle elementary school followed by 30.83 per cent had high school level of education whereas for respondent's family education had (60%) middle elementary school followed by (35%) high school level of education. 61.67 per cent of the respondents resides in mixed houses whereas 33.33 per cent in pucca houses. Cultivation was found to be the primary family occupation of majority of the respondents (60%) followed by business (25.83%). And SHG (84.17%) was found to be the major secondary occupation of the family followed by business (6.67%). 58.33 per cent of the respondents' family possess up to 1-acre land holding followed by (39.17%) having 1.1-2.00 acres.49.17% of the respondents were found to have livestock possession worth of up to Rs.1,000 followed by (15.83%) Rs. 1,001-2,000. 44.17 per cent of the respondents were found to have household possession worth of more than Rs. 1,00,000, followed by 15.83 per cent of the respondents possessed household articles worth of Rs. 50,001- 60,000. 98.33 per cent of the respondents possessed agricultural implements worth of up to Rs. 5,000 followed by only (1.67%) worth more than Rs. 1,00,000 of agricultural possession. The above findings are similar with the findings of Rahul Sarania (2015). 40.83 per cent of the respondents use mobile phones whereas 25.83 per cent were found to use radio as communication materials. Further it was revealed that 100 per cent of the respondents have low level of social participation. Majority of the respondents (61.67%) had semi-medium level followed by low (38.33%) level of extent of social participation. Table 1 also reveals that majority of the respondents (40%) were having semi-medium level followed by (35.83%) low level of visiting outside village for work. About 100 per cent of the respondents belonged to low level of contact with extension agent. 67.5 per cent of the respondents had annual income from SHG activities ranging from Rs. 1,00,001 to Rs. 1,50,000 followed by 21.67 per cent with annual income from SHG activities ranging from Rs. 1,50,001- Rs. 2,00,000. In case of total family income (inclusive of all sources of all family members) it was found that 100 per cent of the respondents having total annual family income to the tune of more than Rs. 2, 00,000.

Impacts on women SHGs members: The results of the impacts studied are presented below separately against each area.

Impact on knowledge/ awareness/ attitude: To ascertain the knowledge/awareness/attitude impact eight aspects have been identified. Using the scale as mentioned above, the results obtained from the analysis of data are discussed in Table 2 (A). The data revealed that participation in SHG "Increases knowledge about SHG activities" and were assigned rank first with 90.56 per cent by the respondents, while "Changes attitude positively to work with group" (88.89%) and "Increases knowledge about

Table 2: Knowledge/ awareness/ attitude of SHG members

A. Knowledge/ Awareness/ Attitude	Thoubal District (n=120)		B. Knowledge/Awareness/Attitude index		
	P	Rank	Range	F	P
Increases a member's awareness & knowledge about SHG	84.72	IV	0-25 (Low)	0	0
Increases knowledge about SHG activities	90.56	I	26-50 (Semi-medium)	0	0
Changes attitude positively to work with group	88.89	II	51-75 (Medium)	27	22.5
Increases knowledge about income generating activities	80.83	VIII	76-100 (High)	93	77.5
Increases knowledge about bank dealing	81.67	VII			
Increases knowledge about savings	83.89	V			
Increases knowledge about production process	82.22	VI			
Increases knowledge about marketing	87.78	III			

*F= Frequency, P= Percentage.

marketing" (87.78%) were ranked second and third, respectively by the respondents.

The overall perception of impact on their 'knowledge/ awareness/attitude' of the respondents 'Index Value' was calculated taking the responses of respondents against all eight aspects identified for the purpose together. The distribution of respondents against the 'Index Value' is presented in Table 2 (B) in four class intervals, as mentioned above. From Table 2 (B) it can be observed that majority of respondents perceived (77.5%) high level of impact on their knowledge/awareness/attitude of the SHG members followed by medium level (22.5%).

Impact on capacity building/ skill enhancement: To study the perception of the impact on capacity building/ skill enhancement of the SHG members, eight aspects of SHG activities have been identified for the purpose. From Table 3 (A), the data depicted that "Increases skill in record keeping & accounting" and "Increases skill in Bank operations" were assigned rank first with 87.78 per cent each followed by "Increases skill in production process" (87.5%) and "Increases skill in group management" (86.67%) were ranked second and third, respectively which is supported by the findings of Shambharkar *et al.* (2012).

The overall perception of the respondents on 'capacity building/ skill enhancement' impact is presented in Table 3 (B). It is observed that majority of the respondents (85%) perceived a high level of impact on their 'capacity building/ skill enhancement' followed by medium level (15%).

Impact on self-developmental: For ascertaining the impact on empowerment by self-developmental by the rural women SHG members, eight aspects of SHG activities have been taken into consideration for the purpose.

It was observed from the Table 4 (A) that "Increases mobility" (85.56%) ranked first followed by "Increases cosmopoliteness" (80.83%) and "Increases social contacts" (79.44) in rank second and third respectively. Shambharkar *et al.* (2012) have also reported in their study that there was positive change towards self education, possessing desired social status, freedom to mix with women friends, participation in decision about girl's marriage and freedom to adopt practices for maintaining health by the respondents after joining SHG.

Table 4 (B) represents the overall perception of the respondents about the impact on their 'self-developmental' of the SHG members and it was found that majority of respondents' perceived high (55.83%) level followed by medium (44.17%) level of impact on 'Self-developmental'.

Personally benefitted/ empowered by SHG: To study the perception of personally benefitted/ empowered by SHG by the respondents, nine aspects have been identified and are shown in the table below. It was noticed from Table 5 (A) that "Enjoying better standard of life" (99.44%) ranked first followed by "Self dependent to meet own requirement" (94.72%) and "Dependability minimized" (91.67%) in rank second and third respectively which is similar with the findings of Loganathan (2008) and Sakergayen, (2018).

Table 5 (B) represents the overall perception of the respondents about all nine major impacts considered for the study. From Table 5 (B), it can be observed that all the

Table 3: Capacity building/ skill enhancement of the SHG members

A. Capacity building/ Skill Enhancement	Thoubal District (n=120)		B. Capacity building/Skill Enhancement index		
	P	Rank	Range	F	P
Increases skill in managing SHG functions	85.00	V	0-25 (Low)	0	0
Increases skill in record keeping & accounting	87.78	I	26-50 (Semi-medium)	0	0
Increases skill in Bank operations	87.78	I	51-75 (Medium)	18	15
Increases skill in vocation selection	80.56	VII	76-100 (High)	102	85
Increases skill in income generating activities	85.28	IV			
Increases skill in production process	87.5	II			
Increases skill in marketing	84.17	VI			
Increases skill in group management	86.67	III			

*F= Frequency, P= Percentage.

Table 4: Self-developmental of the SHG members

4 (A). Self-developmental	Thoubal District (n=120)		4 (B). Self-developmental index		
	P	Rank	Range	F	P
Increases social contacts	79.44	III	0-25 (Low)	0	0
Increases cosmopoliteness	80.83	II	26-50 (Semi- medium)	0	0
Increases mobility	85.56	I	51-75 (Medium)	53	44.17
Increases institutional contacts	78.33	IV	76-100 (High)	67	55.83
Enhances linkage with experts	75.83	VI			
Improves personality traits	77.5	V			
Improves coordination among group members	72.78	VIII			
Improves managerial efficiency	75.56	VII			

*F= Frequency, P= Percentage.

Table 5: Personally benefitted/ empowered by SHG

A. Personally benefitted/ empowered by SHG	Thoubal District (n=120)		B. Personally benefitted/ empowered by SHG index		
	P	Rank	Range	F	P
Dependability minimized	91.67	III	0-25 (Low)	0	0
Self dependant to meet own requirement	94.72	II	26-50 (Semi-medium)	0	0
Better living standard	87.22	VI	51-75 (Medium)	0	0
Recreational activities increased	88.06	V	76-100 (High)	120	100
Own transport & mobility	83.89	VIII			
Independency in purchasing ornaments	85	VII			
Independency in purchasing of domestic goods	85	VII			
Lower dependence on money lender	90.83	IV			
Enjoying better standard of life	99.44	I			

*F= Frequency, P= Percentage.

respondents perceived high (100%) level of 'Personally benefitted/ empowered by SHG'.

Socially benefited by SHG: For socially benefited of the group members, seven aspects of SHG activities have been identified for the purpose and are shown in the Table 6 (A). The result obtained from the analysis of data depicted that "Increases influence in social, community and other activities" (92.5%) as ranked first followed by "Increase in social awareness" (90%) and "Becoming more progressive" (85.56%) in rank second and third respectively. This finding is supported by Palinichamy (2011) and Sakergayen (2018) in which it was reported that SHG enhanced the equality status of women as participants, social and cultural sphere of life, decision making on important issues and beneficiaries in the democratic, economic, and knowledge of banking procedures.Table 6 (B) represents the overall perception of the respondents regarding their impact on 'Socially benefitted by SHG' and it was found that majority of the respondent's perceived high (95%) followed by medium (5%) level of impact on 'Socially benefitted by SHG'.

Impact on daily time management: Data were collected from the respondents with five aspects of SHG activities and were taken into consideration for the purpose of ascertaining daily time management of the SHG members as given in Table 7 (A). As observed from the table below it was found that "Feel empowered to decide upon daily activities" (93.06%) was assigned as ranked first followed by "Able to prioritize activity" (0.83%) and "Managing daily work routine in better way" (90%) as ranked second and third respectively.

The overall perception of the respondent's impact on 'Daily time management' is presented in Table 7 (B). It is

Table 6: Socially benefited by SHG

A. Socially benefitted by SHG	Thoubal District (n=120)		B. Socially Benefitted by SHG index		
	P	Rank	Range	F	P
Increase member's image in society	84.72	V	0-25 (Low)	0	0
Increases influence in social, community and other activities	92.5	I	26-50 (Semi-medium)	0	0
			51-75 (Medium)	6	5
Increases social status	78.89	VII	76-100 (High)	114	95
Becoming more progressive	85.56	III			
Improves social identity	85	IV			
Better access to financial services	81.11	VI			
Increase in social awareness	90	II			

***** F= Frequency, P= Percentage.

Table 7: Daily time management of the SHG members

A. Daily time management	Thoubal District(n=120)		B. Daily time management index		
	P	Rank	Range	F	P
Able to provide time for earning income	86.67	IV	0-25 (Low)	0	0
Managing daily work routine in better way	90	III	26-50 (Semi-medium)	0	0
Understand the value of time	84.44	V	51-75 (Medium)	53	44.17
Able to prioritize activity	90.83	II	76-100 (High)	67	55.83
Feel empowered to decide upon daily activities	93.06	I			

* F= Frequency, P= Percentage.

observed that majority of the respondents (55.83%) perceived a high level of impact on their 'Daily time management' followed by medium level (44.17%).

CONCLUSION

From this study, it may be concluded that majority of the SHGs were of medium to low level of socio-economic conditions. However, the women SHG members perceived high level of impacts regarding various major aspects of impacts through the SHG activities. The study found that there was increased in their knowledge about SHG activities and positive attitude to work with group, as knowledge/awareness/attitude impact. There was increased skill in record keeping, accounting and Bank operations as their impact on capacity building/skill enhancement. As impact on self development of the SHG members, there was increased in mobility, cosmopoliteness and social contacts. They were personally benefitted as they enjoyed better standard of life and had become self dependent to meet their own requirements resulting in minimizing their dependability. The women SHG members were socially benefitted as they have increased their influence in social, community and other activities and are socially aware and become more progressive. Lastly there was huge impact on their daily time management as they now felt empowered to decide and prioritise upon their daily activities & managed daily work routine in a better way.

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Spiritual Intelligence Analysis of Youth: A Cultural Perspective

Manisha Dhami[1]*, Seema Sharma[2] and Tejpreet Kaur Kang[3]
[1]Research Scholar, [2]Principal Extension Scientist, [3]Professor, Human Development & Family Studies, Punjab Agricultural University, Ludhiana-141001, Punjab

ABSTRACT

Spiritual intelligence is a capacity in humans to ask questions about the purpose of life and integrated relationship between mind, spirit and the outer world. To assess and compare the spiritual intelligence of youth from two different states of India, a study was conducted on 360 youth aged between 20-22 years. Dhar and Dhar (2010) Spiritual intelligence scale was used to assess the spiritual intelligence among youth. Result showed a significant difference where Punjab youth were found more benevolent, modest, compassionate and had higher overall spiritual intelligence than the youth of Uttarakhand, whereas, youth of Uttarakhand were found more optimistic than youth of Punjab with a significant difference. A significant positive correlation was found in spiritual intelligence and academic achievement.

Keywords: Academic achievement, Benevolence, Compassion, Conviction, Magnanimity optimism, Modesty, Spiritual intelligence

INTRODUCTION

Spiritual intelligence is awareness of facts, values, validity and ethics of the individual (King, 2008). It is also believed that spiritual intelligence is a degree of adaptability and capability of the person to solve problems and achieve goals. Spiritual intelligence gives the base for efficient performance of IQ and EQ and also regarded as an ultimate intelligence (Danah and Ian, 2012). With the proficient inclusion of intelligent quotient and Emotional Quotient, Spiritual Quotient proffers the well enlightened means of finding the real meaning of life with the result of wisdom, compassion, integrity, joy, love, creativity, and peace. Moreover, it is related to the inner life of mind and soul of human beings and their connection in being in this humankind (Vaughan, 2002).

Before the advent of spirituality, religiosity was most common word to describe spiritual dimensions of the human psyche (James, 2007). In present world religiosity may be associated with spirituality at a time but psychologists make strong difference between both the words (King, 2008). Religion is a organized set of belief and practices that are shared by a society or a group of people whereas spirituality is more linked with individual conscience which have a sense of peace and purpose.

All around the globe, there is an advent of globalization, world is changing at rapid speed so that lifestyle of people are also getting changed. No doubt modernization has provided comfort to humankind but at the same time human beings faced multiple challenges as well along with opportunities which create an impact on their life. India has a good population of youth. Youth are the most pertinent and dynamic segment of the population in any country. The innovative mind, energy and vigor of youth is current demographic strength of the nation (Som *et al.,* 2018). Youth studying in colleges generally are evaluated on their academic achievement. Academic achievement for any student also become an important criteria for their growth and development. Guidance and counselling are an imperative needs of students (Dhami and Sharma, 2021). Increasing spiritual intelligence can help people to have optimistic personality and eliminate negative behaviour. Growth of spiritual intelligence allows to escalate quality of life and create a positive effect on well being of people (Emmons, 2000). It enhance abilities to choose actions, experiences, belief and help to make larger meaning and purpose of humanity.

It is a crucial time to draw attention towards youngsters' spiritual intelligence so that they could grow as healthy

*Corresponding author email id: manisha-hd@pau.edu

adults not only physically, mentally but also spiritually. Keeping the above concept in view, the comparative study was undertaken within 2 different setting and state of India to assess and compare spiritual intelligence of youth.

MATERIALS AND METHODS

Sample

The sample was comprised of 360 youth aged between 20-22 years studying in Punjab Agricultural University, Ludhiana (Punjab) and Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Uttarakhand).

Research Instruments

Assessment of spiritual intelligence: Spiritual intelligence was assessed by using Spiritual Intelligence Scale (Dhar and Dhar, 2010). The scale contains 53 items with six dimensions which are Benevolence, Modesty, Conviction, Compassion, Magnanimity and Optimism.

Academic achievement: The academic achievement level of the selected students was assessed through the GPA obtained by them in previous class as per the college records.

RESULTS AND DISCUSSION

The overall sample of 360 respondents brings to light that near about one-fourth population (26.38%) fell at high level of benevolence, whereas, at low and average level 37.77 and 35.83 per cent youth were found. For the dimension of modesty near about half population (48.88%) were at average level followed by low (27.22%) and high level (23.88%). Major population (65.55%) were found at average level of conviction and only 14.72 per cent were at low level. A similar trend as the conviction was seen with compassion, magnanimity and optimism where average level is followed by high and low level, whereas, for overall spiritual intelligence near about half respondents (48.33%) were seen at average level followed by the quarterly population at high (25.27%) and low level (26.38%).

Locale wise gender differences in distribution of respondents across various dimensions and levels of spiritual intelligence revealed that greater proportion of Punjab youth (36.67%) fall at high level of benevolence than the youth of Uttarakhand (16.11%) with a significant difference ($Z=2.01$; $p\leq0.5$), whereas, at average level Uttarakhand youth (45.00%) superseded Punjab youth (26.67%) with a significant difference ($Z=2.07$; $p\leq0.5$). More than half of Punjab youth (52.78%) and 45.00% of Uttarakhand youth were found at average level of modesty and a greater proportion of Uttarakhand youth (34.44%) were accumulated at low level of modesty than Punjab youth (20.00%). The major proportion of Punjab youth (67.78%) and Uttarakhand youth (63.33%) was found at average level of conviction followed by high (Punjab: 18.33; Uttarakhand: 21.11%) and low level of conviction (Punjab: 13.89; Uttarakhand: 15.56%). Similarly, for compassion, major proportion of youth from both the state were at average level. (Punjab 62.78% and Uttarakhand 63.89%). A significant difference ($Z=2.20$; $p\leq0.5$) was seen at average level of magnanimity dimension where Uttarakhand youth (63.33%) were found more than Punjab youth (47.78%) whereas 31.67 per cent of Punjab youth and 24.44 per cent of Uttarakhand youth were at high level of magnanimity. In the optimism dimension, 62.78 per cent and 56.11 per cent of Punjab and Uttarakhand youth were at average level, whereas, 21.11 per cent of Punjab youth and 31.11 of Uttarakhand youth were found at high level of optimism. A significant difference ($Z=1.84$; $p\leq0.10$) was found at low level of overall spiritual intelligence where Uttarakhand youth (35.56%) were found more at low level than Punjab youth (17.22%), whereas, 51.11 per cent of Punjab youth and 45.56 per cent were accumulated at average level. Only 18.89 per cent youth from Uttarakhand and 31.67 per cent of youth from Punjab were at high level of spiritual intelligence with no significant difference.

A study by Eriksen, 1999 concluded that among the three ethnic groups a significant difference was found where Hindu-Mauritians ethnic group scored highest in spiritual intelligence. Thus, it can be concluded that with difference in culture and ethnicity spiritual intelligence also varies.

Data put forth in Table 2 showed that mean scores of Punjab youth showed higher mean scores in benevolence (66.30), modesty (57.55), compassion (36.47) and Overall Spiritual intelligence (213.08) than the youth of Uttarakhand with a significant difference as Uttarakhand youth scored 61.87, 53.01, 35.55 and 203.83 for benevolence (t value: 3.57; $p\leq0.1$), modesty (t value: 4.42; $p\leq0.1$), compassion (t value: 1.76; $p\leq0.10$) and overall spiritual intelligence (t value: 3.60; $p\leq0.1$) respectively. A contracting result was found in the dimension of optimism where youth of Uttarakhand were found to have a greater mean score (8.506) than the youth of Punjab (8.03) with a significant difference (t value: 2.89; $p\leq0.1$). Conviction and

Table 1: Locale differences in distribution of respondents across various dimensions and levels of spiritual intelligence

Dimensions of Spiritual intelligence		Locale				Z test	Total (n=360)	
		Punjab (n_1=180)		Uttarakhand (n_2=180)				
		f	%	f	%		f	%
Benevolence	Low	66	36.67	70	38.89	0.27	136	37.77
	Average	48	26.67	81	45.00	2.07**	129	35.83
	High	66	36.67	29	16.11	2.01**	95	26.38
Modesty	Low	36	20.00	62	34.44	1.52	98	27.22
	Average	95	52.78	81	45.00	1.03	176	48.88
	High	49	27.22	37	20.56	0.71	86	23.88
Conviction	Low	25	13.89	28	15.56	0.17	53	14.72
	Average	122	67.78	114	63.33	0.72	236	65.55
	High	33	18.33	38	21.11	0.29	71	19.72
Compassion	Low	30	16.67	44	24.44	0.80	74	20.55
	Average	113	62.78	115	63.89	0.17	228	63.33
	High	37	20.56	21	11.67	0.86	58	16.11
Magnanimity	Low	37	20.56	22	12.22	0.82	59	16.38
	Average	86	47.78	114	63.33	2.20**	200	55.55
	High	57	31.67	44	24.44	0.80	101	28.05
Optimism	Low	29	16.11	23	12.78	0.34	52	14.44
	Average	113	62.78	101	56.11	0.99	214	59.44
	High	38	21.11	56	31.11	1.07	94	26.11
Total Spiritual intelligence	Low	31	17.22	64	35.56	1.84*	95	26.38
	Average	92	51.11	82	45.56	0.73	174	48.33
	High	57	31.67	34	18.89	1.33	91	25.27

*p≤0.10; **p≤0.05; ***p≤0.01

Table 2: Locale differences in the mean scores of respondents across various dimensions and levels of spiritual intelligence

Dimensions of Spiritual intelligence	Punjab (n_1=180)		Uttarakhand (n_2=180)		t- value
	Mean	SD±	Mean	SD±	
Benevolence	66.30	12.21	61.87	11.26	3.57***
Modesty	57.55	8.17	53.01	11.08	4.42***
Conviction	32.87	4.24	32.93	4.56	0.144
Compassion	36.47	4.84	35.55	5.06	1.76*
Magnanimity	11.83	2.40	11.95	2.07	0.493
Optimism	8.03	1.59	8.50	1.45	2.89***
Overall Spiritual intelligence	213.07	25.08	203.83	23.46	3.60***

*p≤0.10; **p≤0.05; ***p≤0.01

Table 3: Correlation analysis of various dimensions spiritual intelligence and academic achievement among respondents of Punjab and Uttarakhand

	Punjab	Uttarakhand
Benevolence	0.432**	0.434**
Modesty	0.382**	0.389**
Conviction	0.270**	0.219**
Compassion	0.369**	0.128
Magnanimity	0.306**	0.162*
Optimism	0.232**	0.194**
Total Spiritual intelligence	0.496**	0.489**

magnanimity showed no significant difference in locale-wise difference.

In line with these findings, Chae *et al.* (2004) also admitted the strong connection between ethnic identity and spiritual development. The difference was found among the ethnic group in the way they identify their cultural and spiritual orientation. Similarly, Wilber (1993) also discovered the difference in the higher level of awareness with respect to different geographical locations and cultures.

The analysis of Table 3 showed correlation analysis of various dimensions spiritual intelligence and academic achievement among respondents of Punjab and Uttarakhand. Irrespective of locale, positive correlation was found between academic achievement and dimensions of spiritual intelligence where in Punjab, benevolence ($r=0.432$; $p\leq0.01$), modesty ($r=0.389$; $p\leq0.01$), conviction ($r=0.270$; $p\leq0.01$), compassion ($r=0.369$; $p\leq0.01$), magnanimity ($r=0.306$; $p\leq0.01$) and optimism ($r=0.232$; $p\leq0.01$) had significant correlation. A study by Tetzner and Becker (2017) also showed that the results widen the proof on benefits of optimism by linking optimism to academic success. On the other side in Uttarakhand, all the dimensions were significantly and positively correlated except compassion ($r=0.128$), it was found positively correlated without significance. Similarly both the state (Punjab: $r=0.496$; $p\leq0.01$ and Uttarakhand: $r=0.489$; $p\leq0.01$) portrayed a significant positive and approximately similar correlation with spiritual intelligence and academic achievement. With line to this results, Turi *et al.* (2020) found positive relationship between spiritual intelligence and academic performance. Thus this construct (spiritual intelligence) needs better amalgamation in academic practices, routine and culture which can be used by institutions to promote academic performance of the students.

CONCLUSION

In today's time when world is changing so fast, youth are confronted with multiplicity of problems in daily life where they found lot of dilemmas which sometimes results in depression and commitment of Suicide. Spiritual intelligence provides a gateway that leads from fear and defensiveness to love and compassion; from ignorance and confusion to wisdom and understanding. It construct capacity in humans for developing meaning, vision, purpose and value of life which results in being creative, aware and insightful. Above result showed that spiritual intelligence varies in respect to culture and spiritual intelligence had positive relation with academic achievement. Thus, spiritual intelligence can be incorporated in students' curriculum so that they can have better vision and purpose of their life.

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Uplifting Farming in Rohtak District of Haryana State: Training Needs Assessment

Nirmal Chandra, Nishi Sharma*, Pratibha Joshi and J.P.S. Dabas
Centre for Agricultural Technology Assessment and Transfer, ICAR-Indian Agricultural Research Institute, New Delhi-110012

ABSTRACT

Identifying and assessing training needs is the most important step for prioritizing extension capacity development programmes. The present study on training needs analysis of the farmers was conducted under the project "out scaling agricultural innovations for enhancing farm income and employment" at adopted Village Nidana, Rohtak district in Haryana in the year 2020-21. A list of 11 major components/ thematic areas was prepared under crop husbandry (crop production, plant protection, soil health and fertility management and agroforestry); horticulture sector (fruits vegetables and ornamental plants); animal husbandry, fisheries and on-farm production of inputs and women empowerment. Under each major component, specific and relevant training need items were collected and systematically incorporated into the interview schedule and administered. Respondents were asked to rate the priority levels of training topics and knowledge areas related to thematic areas and a weighted score was calculated to identify prioritization. It was found from the study that in crop production component training on weed management was the most sought after by farmers (47%) in Nidana, followed by integrated farming and water management (38% and 40%) of the field crops and training on seed production (39%). For plant protection, integrated pest management of the crops was the most needed area for training (64%), followed by biological control of pests and disease (31%). In the horticultural sector, cultivation of off-season vegetables and production of low-volume and high-value crops were the most important training needs as about 45.71 percent and 42.86 percent of farmers. Regarding animal husbandry, fisheries and off-farm production of inputs, all components were perceived as most important for skill development and crop management. The women empowerment component is also found very important for food and nutritional security through Nutri-gardening (48.57%), income generation activities for rural women for empowerment (52%) and value addition (41.43%).

Keywords: Training need assessment, Crop production, Animal husbandry, Women empowerment, Skill development

INTRODUCTION

Among various other ways of developing economically, the promotion of entrepreneurship is presently being sought as one of the reliable and viable options. The need assessment is an important tool for determining whether training is necessary or not. Defining the problem and its identification is the beginning of needs analysis. Need analysis can recognize more than one training needs that should be prioritized and consider a formal training plan or record for future training. Training for farmers is an educational activity that customarily takes place outside the formal learning institutions utilizing adult learning principles and improving performances. Training has a crucial role in advancing human performance, just like the farmers, since it provides a systematic advance of knowledge and skill. These developments are useful in the working proficiency of learners (Sajeev, 2010).

Meenambigai and Seetharaman (2003) asserted that training is the most singular factor affecting individuals' attitude, productivity, improvement, risk minimization and quality of job performance in any endeavor. It entails skillful management of both human and physical resources to facilitate desired change. Qamar (2005) reported that most of the training of farmers becomes part of agricultural extension, which can be defined as the provision of need and demand-based agricultural knowledge and skills to rural men, women and young people in a non-formal participatory approach in helping to improve the quality

*Corresponding author email id: nishisharm@gmail.com

of their life. Saurabh *et al.* (2019) cited in their research that when the training need of farm women was assessed, almost all respondents were curious to know about the new technologies and time management techniques.

Today farming needs to be made profitable. To do so, we need to provide on-farm knowledge to small and marginal farmers on how to grow high-value crops, or they will continue with low-value subsistence farming. Training is an important tool for human resource development and effective transfer of technology (Narinder *et al.,* 2015). Bhalla (2010), based on empirical evidence, tried to analyze the actual costs of the farmers adopting high-yielding varieties of seeds (HYVs) and the resulting benefits. The research study has attempted to identify the important areas. If skill and knowledge are imparted to the farmers, their income levels from agriculture and allied fields can be raised considerably and thus make agriculture a profitable venture.

This study assessed training need in the adopted village Nidana under an in-house research project to assess and transfer technologies for enhancing farm income and profitability. The training need assessment was done in crop production, plant protection, soil health and fertility management and agroforestry, horticulture, animal husbandry, fisheries, on-farm production of inputs and women empowerment. It was expected that the study's findings would help develop capacity-building training programs where farmers need training, as training will form a fundamental part of any growth activity (Pandey *et al.,* 2015) of the farmers. Agricultural extension in general consists of three basic tasks: disseminating useful and practical information relating to agriculture and home economics, supporting farmers to practically apply that knowledge to analyze their problems, and assisting farmers in using the technical knowledge to solve their farming constraints (Zakaria, 2010).

MATERIALS AND METHODS

The study was conducted during the *kharif* season in 2020. The study was conducted on training needs assessment of the farmers in Nidana village of Rohtak district. Nidana village was selected for the study under the Transfer of Technology program based on the following criteria:

- The village represents the agro-climatic situation of Rohtak district.
- The selected village represents the major farming systems of the region.
- The village was selected considering the production potentials in diversified farming and enterprises.

A questionair was designed to conduct a need assessment study to determine the farmer's needs and demographic information. The categorization of training needs of the farmers was computed as done by Rahman *et al.* (2018). The survey target audience was comprised of 70 farmers selected randomly. The data were collected through personal visits, mobile phone-based survey considering the country's prevailing COVID situation and secondary sources. Selected farmers were asked to rate the priority levels of educational topics, knowledge areas and preferred educational delivery methods. We also made three field visits to talk with farmers using participatory methods to see what farmers perceive as problems.

Appropriate statistical tools were utilized to analyze and prioritize the problems. Based on the results, an exercise was conducted to develop solutions for the identified problems by discussing them with the experts in the field. Crop production, plants protection, soil health/ fertility management, horticulture (vegetables and fruits), animal husbandry, fisheries, on-farm production of inputs, women empowerment were the major training need components identified for the study.

RESULTS AND DISCUSSION

Nidana village is located in Maham Tehsil of Rohtak district in Haryana, India. It is situated 20 km away from block headquarter Maham and 15 km away from district headquarter Rohtak. Nidana village, a gram panchayat, has a total geographical area of 959 hectares and 4093 people. There are about 707 houses in Nidana village. The female population is 46.5%. Wheat, Paddy and Sugarcane are the main agricultural commodities that grow in this village. The total irrigated area in this village is 741 hectares, out of which irrigation through canals is done in 701 hectares and Boreholes/Tube wells are used to irrigate 40 hectares area. Untreated Tap Water Supply is available all around the year. Hand Pump is another drinking water source.

In Nidana village, out of the total population, 1148 are engaged in work activities. 79.79 percent of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 20.21 percent were involved in Marginal activity providing a livelihood for less than six months. Of 1148 workers engaged in Main Work, 373 were cultivators (owner or co-owner), while 151 were Agricultural laborers. Training needs of the farmers are presented in the form of weighted scores in

Table 1: Demographic information of Nidana village

Particulars	Total	Male	Female
Total no. of houses	707	-	-
Population (2020)	4093	2191(53.5 %)	1902(46.5%)
Population density	205 people per km^2		
Schedule caste	1,002	544 (54.2%)	458 (45.8%)
Schedule tribe	0	0	0
Literacy	75.77 %	84.38 %	65.68 %
Total workers	1,148	884 (77%)	264 (33%)
Main worker	916	-	-
Marginal worker	232	67 (28.8%)	165 (31.2%)

Source: Census 2011

Table 2: Weighted score and rank of the training needs of farmers of Nidana village in the area of crop production, plant protection, soil health and fertility management and agroforestry (*Figures in parentheses are percent*)

Thematic area	Nidana Village (N=70)				
	Very much needed	Needed	Not needed	Weighted score	Rank
Crop production					
Weed management	33 (47.14)	18 (25.71)	19 (27.14)	2.20	I
Resource conservation technologies	25 (35.71)	17 (24.29)	28 (40.00)	1.96	IV
Cropping systems	19 (27.14)	27 (38.57)	24 (34.29)	1.93	V
Crop diversification	17 (24.29)	21 (30.00)	32 (45.71)	1.79	VII
Integrated farming	27 (38.57)	27 (38.57)	16 (22.86)	2.16	II
Water management	28 (40.00)	25 (35.71)	17 (24.29)	2.16	II
Seed production	27 (38.57)	18 (25.71)	25 (35.71)	2.03	III
Nursery management	18 (25.71)	26 (37.14)	26 (37.14)	1.89	VI
Fodder production	7 (10.00)	19 (27.14)	44 (62.86)	1.47	IX
Production of organic inputs	11 (15.71)	18 (25.71)	41 (58.57)	1.57	VIII
Plant protection				0.00	
Integrated pest management	45 (64.29)	13 (18.57)	12 (17.14)	2.47	I
Bio-control of pests and diseases	22 (31.43)	29 (41.43)	19 (27.14)	2.04	II
Production of bio-control agents and bio-pesticides	12 (17.14)	24 (34.29)	34 (48.57)	1.69	III
Soil health and fertility management					
Soil fertility management	41 (58.57)	15 (21.43)	14 (20.00)	2.39	I
Soil and water conservation	38 (54.29)	18 (25.71)	14 (20.00)	2.34	II
Integrated nutrient management	34 (48.57)	15 (21.43)	21 (30.00)	2.19	III
Production and use of organic inputs	22 (31.43)	25 (35.71)	23 (32.86)	1.99	V
Management of problematic soils	26 (37.14)	20 (28.57)	24 (34.29)	2.03	IV

Tables 2 to 3. WS in the range of 2 – 3 were considered for ranking within the disciplines and the first three rankings were identified as training needs of the village farmers. Weighted scores were ranked within each domain and the first five rankings were determined as training needs of the farmers of the Nidana village. The following are the thematic areas where farmers have high training needs in Nidana village.

A) Crop production, plant protection, soil health and fertility management and agroforestry

Crop production: Training on weed management was the most sought after by farmers (47%) in Nidana, followed by integrated farming and water management (38% and 40%) of the field crops and training on seed production (39%) (Table 2). Training on resource conservation technologies in field crops was also very close for ranking. Weeds are often considered the major biotic problem in crop production. Therefore, suitable integrated weed management practices are a prerequisite for profitable farming in the region and are well understood by farmers in Nidana village.

Plant protection: Results show that integrated pest management of the crops was the most needed area for training need (64%), followed by biological control of pests and disease (31%) (Table 2). Over-adoption of fertilizers and pesticides/ fungicides has resulted in more severity of pests and diseases in the area. ICAR-IARI, through its outreach programs, has been successful in making the farmers realize the importance of integrated pest management in agriculture for sustainable crop production.

Soil health and fertility management: It is observed from Table 2 that under soil health and fertility management, over half of the respondents had expressed their needs for skill-oriented training on technologies for the management of soil fertility (59%) and soil and water conservation (54%), respectively. Integrated nutrient management was another important preferred area in which they wanted to receive training (49%). Management of problematic soils was another area of concern for the villagers because soil salinity in half of the agricultural area in the village, and farmers cannot take good crop yields.

Table 3: Weighted Score and rank of the training needs of farmers of Nidana village in the area of horticulture (*Figures in parentheses are percent*)

Thematic area	Nidana village (n=70)				
	Very much needed	Needed	Not needed	Weighted score	Rank
Vegetable crops					
Off-season vegetables	32 (45.71)	20 (28.57)	18 (25.71)	2.20	I
Production of low-volume and high-value crops	30 (42.86)	17 (24.29)	23 (32.86)	2.10	II
Nursery raising	23 (32.86)	22 (31.43)	25 (35.71)	1.97	III
Exotic vegetables like broccoli	11 (15.71)	18 (25.71)	41 (58.57)	1.57	V
Export potential vegetables	5 (7.14)	15 (21.43)	50 (71.43)	1.36	VII
Grading and standardization	5 (7.14)	18 (25.71)	47 (67.14)	1.40	VI
Protective cultivation (green houses, shade net)	11 (15.71)	19 (27.14)	40 (57.14)	1.59	IV
Fruits					
Training and pruning	14 (20.00)	17 (24.29)	39 (55.71)	1.64	III
Layout and management of orchards	5 (7.14)	15 (21.43)	50 (71.43)	1.36	VI
Cultivation of fruit	16 (22.86)	20 (28.57)	34 (48.57	1.74	II
Management of young plants/orchards	5 (7.14)	22 (31.43)	43 (61.43)	1.46	IV
Rejuvenation of old orchards	8 (11.43)	13 (18.57)	49 (70.00)	1.41	V
Export potential fruits	6 (8.57)	10 (14.29)	54 (77.14)	1.31	VII
Micro irrigation systems of orchards	4 (5.71)	17 (24.29)	49 (70.00)	1.36	VI
Plant propagation techniques	19 (27.14)	19 (27.14)	32 (45.71)	1.81	I
Ornamental plants					
Nursery management	13 (18.57)	17 (24.29)	40 (57.14)	1.61	I
Export potential of ornamental plants	2 (2.86)	5 (7.14)	63 (90.00)	1.13	III
Propagation techniques of ornamental plants	11 (15.71)	11 (15.71)	48 (68.57)	1.47	II

Table 4: Weighted score and rank of the training needs of farmers of Nidana village in the area of animal husbandry, fisheries and on-farm production of inputs (*Figures in parentheses are percent*)

Thematic area	Nidana village (n=70)				
	Very much needed	Needed	Not needed	Weighted score	Rank
Animal husbandry					
Dairy management	27 (38.57)	20 (28.57)	23 (32.86)	2.06	I
Poultry management	21 (30.00)	22 (31.43)	27 (38.57)	1.91	II
Fisheries					
Integrated fish farming	31 (44.29)	14 (20.00)	25 (35.71)	2.09	I

Table 5: Weighted Score and rank of the training needs of farmers of Nidana village in the area of on-farm production of inputs (*Figures in parentheses are percent*)

Thematic area	Nidana Village (n=70)				
	Very Much Needed	Needed	Not Needed	Weighted Score	Rank
On- farm production of inputs					
Vermi-compost production	38 (54.29)	20 (28.57)	12 (17.14)	2.37	I
Seed production and planting material production	39 (55.71)	12 (17.14)	19 (27.14)	2.29	II
Bee-keeping	3 (4.29)	19 (27.14)	48 (68.57)	1.36	VI
Bio-pesticides production	12 (17.14)	31 (44.29)	27 (38.57)	1.79	III
Farm implements	8 (11.43)	24 (34.29)	38 (54.29)	1.57	V
Livestock feed and fodder production	15 (21.43)	20 (28.57)	35 (50.00)	1.71	IV

So this was recognized as the fourth important area for receiving training.

B) Horticultural sector

Concerning the horticultural sector (Table 3), the study revealed that "cultivation of off season vegetables" and "production of low volume and high value crops" were the most important training needs as about 45.71 percent and 42.86 percent of farmers, respectively rated their most important needs horticulture (fruits, vegetables, flowers, plantations, tuber, spices, medicinal/ aromatic plants), animal husbandry, fisheries, on-farm production of inputs, women empowerment were the major training needs components identified for the study.

(C) Animal Husbandry, Fisheries and On-farm Production of Inputs

Animal Husbandry, Fisheries: The majority of the respondents (39%), as shown in Table 4, opined to have training in Dairy Management as the most important. This area of interest might be because rural farmers have inadequate knowledge about the technical aspects of dairy farming. This aspect of the training was followed by poultry management. In the fisheries sector, integrated fish farming was reported as the most needed training area by 44 percent of the respondents.

On-Farm Production of Agricultural Inputs: Training on the production of vermicomposting and seed and planting material production were still hot topics among farmers, which called for specific training programs as expressed by 53 percent and 51 percent respondents respectively (Table 5).

(D) Women Empowerment

It was revealed in the study that household food and nutritional security through Nutri-gardening was the most sought after training need by 49 percent of farmers. This need was followed by income-generating activities for rural women for empowerment and value addition by 53 percent and 41 percent farmers, respectively.

CONCLUSION

In the modern age, training has been considered as one of the important inputs in all the aspects of developmental programmes. Therefore, in the present study, training needs

Table 6: Weighted scores and rank of the training needs of farmers of Nidana village in the area of women empowerment
(*Figures in parentheses are percent*)

Thematic area	Nidana village (n=70)				
	Very much needed	Needed	Not needed	Weighted score	Rank
Women empowerment					
Household food and nutritional security through nutri- gardening	34 (48.57)	21 (30.00)	15 (21.43)	2.27	I
Formation of SHGs	17 (24.29)	25 (35.71)	28 (40.00)	1.84	V
Minimizing storage and post-harvest losses	22 (31.43)	20 (28.57)	28 (40.00)	1.91	IV
Income generation activities for rural women for empowerment	37 (52.86)	14 (20.00)	19 (27.14)	2.26	II
Value addition	29 (41.43)	12 (17.14)	29 (41.43)	2.00	III

analysis of the farmers was conducted under Out scaling agricultural innovations for enhancing farm income and employment project at adopted Village Nidana, Rohtak. It was found that in crop production component training on weed management, integrated farming, water management, seed production, resource conservation technologies, cropping systems, nursery management, crop diversification, production of organic inputs and fodder production was the most sought. For plant protection, integrated pest management of the crops was the most needed area for training, followed by biological control of pests and disease. However, in the horticultural sector, themost important training needs were cultivation of off season vegetables and production of low-volume and high-value crops. In addition to that training on the production of vermicomposting and seed and planting material production were also expressed by farmers, which called for specific training programs. Women Empowerment is also an important human resource that requires skill orientation in household food and nutritional security through nutri- gardening, Income generation activities for rural women for empowerment, Value addition, etc.

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Constraints Perceived by Dairy Farmers in Adoption of Animal Welfare Management Practices

Jaspreet Kaur, Y.S. Jadoun*, Jaswinder Singh and S.K. Kansal
Department of Veterinary and Animal Husbandry Extension Education, Guru Angad Dev Veterinary & Animal Sciences University, Ludhiana-141004, Punjab

ABSTRACT

Present study was conducted in the three selected regions viz. Majha, Malwa and Doaba of Punjab to assess constraints perceived by the dairy farmers in adoption of animal welfare management practices. The data were collected from total 240 respondents through personal interview method on various constraints perceived by the respondents namely; infrastructural, technical, economic, communicational and miscellaneous constraints and these constraints were analysed by using Garrett's ranking technique. The results made from collected data revealed that "concerned veterinary staff not taking interest in imparting awareness training camps about the animal welfare practices (mean score: 67.84); "lack of trained, field-oriented and experienced veterinary personnel in the research locale" (mean score: 60.74); were perceived as more severe infrastructural constraints. Under the category of technical constraints; "A.H. officials do not visit the area regularly" (mean score: 68.93); and lack of awareness about general animal welfare practices" (mean score: 63.60); was perceived as most important constraints. Among the economic constraints; "low economic gain from dairy enterprise" (mean score: 75.30); and "sale price of dairy animal is very low" (mean score: 65.16); were major constraints in terms of severity. "Lack of training centres and institutes in the research locale" (mean score: 72.95); and "difficulty in approach to various veterinary services at field level" (mean score: 65.91); were perceived most important communicational constraints. "Difficulty in disposing-off the unproductive cattle and dead animals" (mean score: 69.30); "inadequate veterinary services and facilities for treatment of sick animals at farmer's doorstep" (mean score: 64.77); were major miscellaneous constraints perceived by the dairy farmers. These constraints faced by the dairy farmers will be of great help for, training organizations, policy makers and research institutes, animal husbandry officials to plan future activities more effectively for the welfare of dairy animals as well as their owners.

Keywords: Adoption, Animal welfare, Constraints, Dairy farmers, Garrett's ranking technique

INTRODUCTION

Dairying is the most primitive of all livestock enterprises having been rooted in our country's rural areas for thousands of years, providing jobs to millions of rural residents who have been involved directly or as a side business of the dairy farming enterprise, which provides them the additional source of income and employment opportunities also helps in improving their socioeconomic status. Presently, India is having 193.46 million cattle and 109.85 million buffaloes (20th Livestock census 2019) and is producing 198.4 million tons of milk with per capita availability of milk is 407 grams / day whereas, Punjab is among the major milk producing states of the country and leading State in the dairy sector and has become a role model for other States and is producing 13.34 million tonnes amount of milk/ annum from 40.16 lakhs buffaloes and 25.31 lakhs cattle (Statistical Abstract of Punjab 2020). The state presently has the maximum per capita availability of the milk in the country, with 1225 grams per day, compared to the national average of 407 grams per day (SAOP, 2020).

The demand of milk and milk products is increasing day by day and to meet this increasing demand of milk, farmers are practicing intensive farming on a small chunk of land, which leads to compromise in animal welfare practices. The welfare need of animals must be ensured to have good milk both in terms of quality and quantity but the dairy farmers are facing infrastructural, technical,

*Corresponding author email id: ysvet1203@gmail.com

economic, communicational and miscellaneous constraints which are a key problem impeding the dairy farmers in adoption of the various animal welfare management practices with respect to the animal welfare standards or five freedoms of animal welfare.

MATERIALS AND METHODS

The study was conducted in 03 regions viz; Majha, Malwa, Doaba of Punjab. From each region, 02 districts were selected purposively on basis of milk production, number of dairy animals, and well-developed infrastructure for dairy development. From each district, 02 blocks were selected randomly. From each selected block, 02 villages (01 peri-urban and 01 rural villages) were identified having a good number of dairy animals with the help of records maintained by dairy cooperative officials, officials of the animal husbandry department, and other concerned officials. From each village 10 dairy farmers having at least minimum 05 dairy animals and minimum 05 or more years of experience in dairy farming were selected randomly giving a total sample size of 240 respondents. Then the various constraints perceived by the respondents were recorded in five major sets which include infrastructure, technical, economic, communicational and miscellaneous constraints based on interview schedule. Garrett's ranking technique was used to rank the several sets of constraints on the basis of their mean score.

As per Garrett's ranking technique, respondents were asked to list and assign ranks to various issues, which were then utilised to prioritise problems. The respondents' orders of merit were converted into rankings using the following formula:

$$\text{Percent position} = [100\ (R_{ij} - 0.50)] / N_j$$

Where, R_{ij} = Rank given for i^{th} problem by j^{th} individual.

N_j = Number of problems ranked by the j^{th} individual.

Thus, the percentage position of each rank was then translated into scores by referring to Garrett's Table. Individual respondents' score for a specific problem were summed and divided by the total number of respondents. The mean score for all the constraints were sorted in descending order and rankings were assigned to prioritise the problems.

RESULTS AND DISCUSSION

A constraint is something that restricts or prevents something from being done. The constraint for this study was defined as "all those variables that hamper respondents' participation" to access and manage various animal welfare practices (AWPs). The major constraints experienced by the dairy farmers were classified and addressed as infrastructural, technical, economic, communicational, and miscellaneous constraints. Garrett's ranking technique was used to rank these constraints based on their mean score.

Infrastructural constraints perceived by the dairy farmers: It could be inferred from the Table 1, under infrastructural constraints; "concerned veterinary staff not taking interest in imparting awareness about the animal welfare practices" (mean score: 67.84); "lack of trained, field -oriented and experienced veterinary personnel in the research locale" (mean score: 60.74); and "improper location of veterinary hospitals and A.I centers" (mean score: 60.16); and were perceived as more severe and ranked as 1^{st}, 2^{nd} and 3^{rd} by the dairy farmers.

Table 1: Infrastructural constraints perceived by the dairy farmers

S.No.	Constraints	Garrett's Mean Score	Rank
1	Lack of space for dairy farm and shed for animals	54.55	V
2	Concerned veterinary staff not taking interest in imparting awareness about the animal welfare practices	67.84	I
3	Lack of trained, field-oriented and experienced veterinary personnel in the research locale	60.74	II
4	Lack of audio-visual aids for educating the beneficiaries in training program	50.06	VII
5	Improper location of veterinary hospitals and A.I. centers	60.16	III
6	Non- availability of storage and preservation facility for feed and fodder	40.00	VIII
7	Lack of knowledge about schemes animal welfare practices	57.90	IV
8	Practical demonstration facilities regarding animal welfare practices were inadequate	54.17	VI
9	Lack of involvement of NGO, PETA, SPCA and another animal welfare agencies	29.94	IX

The other constraints such as "lack of knowledge about schemes animal welfare practices" (mean score: 57.90); "lack of space for dairy farm and shed for animal" (mean score: 54.55); "practical demonstration facilities regarding animal welfare practices were inadequate" (mean score: 54.17); "lack of audio-visual aids for educating the dairy farmers in training programmes" (mean score: 50.06); "non- availability of storage and preservation facility for feed and fodder" (mean score: 40.00); and "lack of involvement of NGO, PETA, SPCA and another animal welfare agencies" (mean score: 29.94); were ranked 4th, 5th, 6th, 7th, 8th and 9th respectively. These observations are in agreement with the findings of (Patil *et al.,* 2009), (Yadav and Sagar, 2016) and (Chadda, 2019).

These constraints can sort out by establishing training institutes, providing basic storage and preservation facilities for feed and fodder, appointing experienced veterinary staff, organization of training programmes and animal welfare camps etc., in the research locale.

Technical constraints perceived by the dairy farmers: The data presented in the Table 2 revealed that, "veterinary doctors /A.H officials do not visit the area regularly" (mean score: 68.93); was perceived as most important constraint and ranked first. "Lack of awareness about general animal welfare practices" (mean score: 63.60); and "lack of knowledge about scientific feeding, housing, breeding, health care and management practices" (mean score: 55.87); were ranked second and third most important constraints faced by dairy farmers. These findings were in line with the findings of (Patil *et al.,* 2009), (Singh *et al.,* 2004).

The other constraints includes, "less qualified staff working at A.I centers" (mean score: 54.25); "lack of facilities for conducting various A.H services" (mean score: 55.02); "lack of knowledge about balance feeding of dairy animals" (mean score: 49.49); "inadequate knowledge about preparation of mineral mixture" (mean score: 47.61); and "unavailability of A.I services at their doorsteps" (mean score: 45.84); and "lack of awareness about deworming and vaccination schedule" (mean score:38.43); were ranked as 4th, 5th, 6th, 7th ,8th and 9th respectively, on the basis of their mean score among the various technical constraints which are in accordance with the findings of (Vyas and Patel, 2001) and (Tiwari *et al.,* 2003).

From the above findings it can be concluded that irregular visits of veterinary doctors/ A.H officials and lack of knowledge about general animal welfare practices were the most important constraints faced by the dairy farmers. It may be due to low level of extension contacts, minimum exposure to mass media channels and improper technical advice on time and these problems can be resolved out by organizing capacity building programmes and proper and timely guidance to the dairy farmers about calf rearing, feeding, breeding, housing, health care and milking management practices with the objective to create mass awareness about the animal welfare practices.

Economic constraints perceived by the dairy farmers: The findings in Table 3 depicted that, "low economic gain from dairy enterprise" (mean score: 75.30); "sale price of dairy animals is very low" (mean score: 65.16); and "high cost of feed and fodder" (mean score: 63.91); and were perceived as more severe economic constraints and ranked 1st, 2nd and 3rd.

The other constraints such as "lack of transportation facilities" (mean score: 58.64); "high cost of emergency

Table 2: Technical constraints perceived by the dairy farmers

S.No.	Constraints	Garrett's Mean Score	Rank
1	Lack of awareness about general animal welfare practices	63.60	II
2	Unavailability of A.I services at their doorsteps	45.84	VIII
3	Lack of knowledge about scientific feeding, breeding, housing, health care and management practices	55.87	III
4	Less qualified staff working at A.I centers	54.25	IV
5	Lack of knowledge about balance feeding of dairy animals	49.49	VI
6	Inadequate knowledge about preparation of mineral mixture	47.61	VII
7	Veterinary doctor / A.H officials do not visit the area regularly	68.93	I
8	Lack of awareness about deworming and vaccination schedule	38.43	IX
9	Lack of facilities for conducting various A.H services	55.02	V

veterinary services" (mean score: 55.72); "lack of credit facilities / loans" (mean score: 49.79); "non-availability of A.I. facilities on time" (mean score: 42.88); "high cost is involved in providing a balance diet to the dairy animals" (mean score: 40.08); and "improper utilization of funds related with A.H. activities" (mean score: 29.46); were ranked 4th, 5th, 6th, 7th 8th and 9th respectively. Similar results were depicted by (Singh *et al.,* 2004), (Singh *et al.,* 2015) and (Chadda, 2019).

These constraints can be resolved out by providing dairy based inputs at remunerative prices, reasonable emergency veterinary services, credit facilities and proper utilization of funds exclusively allotted to animal husbandry (A.H.) activities for the welfare animals as well as for the dairy farmers.

Communicational constraints perceived by the dairy farmers: The results presented in the Table 4 revealed that; "lack of training centers and institutes in the research locale" (mean score: 72.95); was perceived as most important constraint and ranked first. "Difficulty in approach to various veterinary services" (mean score: 65.91); and "poor market information system for sale and purchase of dairy animals and other input services" (mean score: 59.73); were ranked second and third most important constraints faced by dairy farmers.

The other constraints includes, "non-availability information providers/channels regarding animal welfare management practices at field level" (mean score: 54.66); "lack of internet and other ICT facilities in the study area" (mean score: 52.81); "inadequate extension contacts of dairy farmers with various extension agencies" (mean score: 46.36); "inadequate knowledge about the use of various dairy farming based mobile applications" (mean score: 45.13); and "lack of mass media approach by the dairy farmers" (mean score: 45.12); and "ambulatory service

Table 3: Economic constraints perceived by the dairy farmers

S. No.	Constraints	Garrett's Mean Score	Rank
1	High cost of emergency veterinary services	55.72	V
2	Lack of credit facilities / loans	49.79	VI
3	Non-availability of A.I facilities on time	42.88	VII
4	Low economic gain from dairy enterprise	75.30	I
5	High cost of feed and fodder	63.91	III
6	Sale price of dairy animals is very low	65.16	II
7	Lack of transportation facilities	58.64	IV
8	High cost is involved in providing a balance diet to the dairy animals	40.08	VIII
9	Improper utilization of funds related with A.H. activities	29.46	IX

Table 4: Communicational constraints perceived by the dairy farmers

S.No.	Constraints	Garrett's Mean Score	Rank
1	Poor market information system for sale and purchase of dairy animals and other dairy based input services	59.73	III
2	Non availability information providers/channels regarding animal welfare management practices at field level	54.66	IV
3	Difficulty in approach to various veterinary services at field level	65.91	II
4	Ambulatory service facility was not available timely in the study area	43.23	IX
5	Inadequate extension contacts of dairy farmers with various extension agencies	46.36	VI
6	Lack of training centers and institutes in the research locale	72.95	I
7	Lack of mass media approach by the dairy farmers	45.12	VIII
8	Inadequate knowledge about the use of various dairy farming based mobile applications	45.13	VII
9	Lack of internet and other ICT facilities in the study area	52.81	V

Table 5: Miscellaneous constraints perceived by the dairy farmers

S.No.	Constraints	Garrett's Mean Score	Rank
1	Poor knowledge of beneficiaries regarding facilities provided by the A.H department / various universities / KVKs / ATIC / NGOs / ATMA etc.	38.55	IX
2	Concerned personnel do not provide proper information about animal welfare practices	57.63	IV
3	Difficulty in maintaining records due to illiteracy and lack of awareness about importance of record keeping	56.30	V
4	Inadequate veterinary services and facilities for treatment of sick animals at farmer's doorstep	64.77	II
5	Lack of technical expertise of field functionaries in the field of veterinary extension	64.41	III
6	Inadequate contact of beneficiaries with the resource persons in the study area	49.50	VI
7	Difficulty in disposing off the unproductive cattle and dead animals	69.30	I
8	lack of rapport building collaboration between field functionaries and dairy farmers	38.73	VIII
9	Very less emphasis was given on educating the dairy farmers about animal welfare management practices	42.92	VII

facility was not available timely in the study area" (mean score: 43.23); were ranked as 4th, 5th, 6th, 7th,8th and 9th respectively, on the basis of their mean score among the various communicational constraints. These findings are in line with the findings of (Brar, 2020) who also studied that almost same type of communicational constraints perceived by the dairy farmers.

The above findings can be resolute out by providing minimum support price (MSP) to the sale and purchase of animals, milk and milk products, internet facilities, proper extension contacts and mass media exposure and good interpersonal communication between field functionaries and end users in the study area.

Miscellaneous constraints perceived by the dairy farmers: The results depicted in Table 5 indicated that "difficulty in disposing off the unproductive cattle and dead animals" (mean score: 69.30); "inadequate veterinary services and facilities for treatment of sick animals at farmer's doorstep" (mean score: 64.77); and "lack of technical expertise of field functionaries in the field of veterinary extension" (mean score: 64.41) and were perceived as more severe constraints and ranked 1st, 2nd and 3rd by the dairy farmers.

The other constraints such as "concerned personnel do not provide proper information about animal welfare practices" (mean score: 57.63), "difficulty in maintaining records due to illiteracy and lack of awareness about importance of record keeping" (mean score: 56.30); "inadequate contact of beneficiaries with the resource persons in the study area" (mean score: 49.50); "very less emphasis was given on educating the dairy farmers about animal welfare management practices" (mean score: 42.92); "lack of rapport building and collaboration between field functionaries and dairy farmers" (mean score:38.73); and "poor knowledge of beneficiaries regarding facilities provided by the A.H department / various universities / KVKs/ ATIC / NGOs / ATMA etc" (mean score: 38.55); were ranked 4th, 5th, 6th, 7th, 8th and 9th constraints as perceived by dairy farmers, respectively.

From the above the results, it could be concluded that difficulty in disposing-off unproductive cattle and dead animals and inadequate veterinary services for treatment of sick animals in the research area were found to be the most severe constraints as perceived by the dairy farmers. These issues can be solved by providing facility of disposal of dead and unproductive animals, doorstep veterinary services for the treatment of the sick animals, timely technical advice and proper collaboration at each level for transfer of technologies and services to the dairy farmers in their research locale.

CONCLUSION

From above study it could be concluded that to run the dairy farming smoothly and successfully and in order to attain rapid and anticipated improvements there is a need to construct proper training organizations or institutes located in the rural and peri-urban areas and promote the various animal husbandry extension activities like awareness campaigns, animal welfare camps, scientist-farmer-

interactions, kisan goshthis, livestock shows and distribution of literature material etc., regarding animal welfare management practices. The problems faced by the dairy farmers will be of great help for, training organizations, policy makers and research institutes, animal husbandry officials to plan future activities more effectively for the welfare of dairy animals as well as their owners.

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Impact Assessment of Frontline Demonstration on Productivity and Profitability of organic Garden Pea Cultivation under Zero- Tillage

Manoj Kumar[1]*, R.K. Avasthe[2], Raghavendra Singh[2,3], P.K. Pathak[1], J.K. Singh[1], B. Lepcha[1] and Bina Tamang[1]
[1]Krishi Vigyan Kendra, East Sikkim, Ranipool, Sikkim
[2]ICAR-National Organic Farming Research Institute, Tadong, Sikkim
[3]ICAR-Indian Institute of Pulse Research, Kanpur, Uttar Pradesh

ABSTRACT

Zero-tillage is an important resource conservation technologies for their cost effectiveness, labour saving, high energy saving and moisture conservations for higher productivity and environmental benefits. Looking the importance of technology, the present study was carried out in six different villages under East District of Sikkkim where frontline demonstrations of garden pea were conducted by ICAR-KVK, East Sikkim. A total of 154 nos. of FLDs were evaluated to find out the yield gaps between garden pea variety Kashi Uday Avira 11 and local cultivar grown by farmers. Yield data of both demonstration and farmer's practice were recorded and their yield gap, technology gap, extension gap and technology index were analyzed. Results revealed that the yield attributes were higher in demonstration plot than the farmer's practices. Mean yield of garden pea was 33.49 per cent higher than the farmer's practice. Technology gap, extension gap and technology index were recorded as 28.68 q/ha, 15.38 q/ha and 31.87 per cent, respectively. Average net return was Rs. 143382.00/ha and Rs. 97646.00/ha with demonstrations and farmer's practice, respectively. Higher benefit to cost ratio, production efficiency and economic efficiency were recorded in demonstration plots than the farmers' practice.

Keywords: Economic, Extension gap, Garden pea, Technology gap, Technology index, Yield

INTRODUCTION

Vegetables are vital to the general good health of human beings, providing essential vitamins and minerals, dietary fiber, and phytochemicals, and reducing the risk from dangerous diseases and other medical conditions. Most of the vegetables are marketed fresh with only a small portion being processed. Almost three-fourths of the world's production of vegetables occurs in Asia, mostly in China which produces over half of the world's vegetables. India is the second largest producer of vegetables next only to China in the world with a production of 40 million tonnes from four million hectares of land area. In spite of that, this seemingly high level of production can provide only 272 grams of vegetables per capita per day (Horticulture Statistics at a Galance, 2018) as against the suggested dietary intake of 300 g per capita per day (Sachdeva *et al.,* 2013).

In India, the area of pea was (540480 ha) in 2017-2018 with production of 5422620 MT (Horticulture Statistics at a Galance, 2018). The main constituent of cost of cultivation of peas is organic manures followed by cost on bullock/ human labour for cultivation. As growing of vegetable crops provided almost four times higher income compared to food grain crops. Area under garden pea cultivation in Sikkim is 4100 ha with a production of 17700MT. Productivity of garden pea in Sikkim is 4317 kg/ha, which is far below against national productivity (Horticulture Statistics at a Galance, 2018). Huge gap is being observed in demand and supply of vegetables due to low production in the state. Thus there is potential for growing of vegetable pea in rice-fallow areas for increasing the cropping intensity, productivity and income of the farmers. Therefore, the ICAR-Krishi Vigyan Kendra (KVK), East Sikkim, Ranipool took the initiative and conducted frontline demonstration (FLD) under NICRA on garden pea in the Rabi season in lowland rice-fallow under zero-tillage with the objective of showing the production potential of the new production technologies under actual farming situation. Keeping the above points

*Corresponding author email id: mkumar_cprs@yahoo.co.in

in view, the present study was undertaken to determine the effects of FLDs on bridging the yield gap in terms of technology gap, extension gap and technology index.

MATERIALS AND METHODS

ICAR-Krishi Vigyan Kendra, East Sikkim, Ranipool conducted Frontline Demonstrations on zero-tillage garden pea cultivation for increasing the productivity and profitability at farmer's field during six consecutive years from 2014-2015 to 2019-20 during winter (*rabi*) season in NICRA adopted village (Nandok, Timpyem, Thanka, and Lingtam) and other neighbouring villages (Sajong and Saureni) of East Sikkim District (Table 1). The total rainfall received during crop season was as follows: 2014-15 (87.50 mm), 2015-16 (84.20 mm), 2016-17 (31.10 mm), 2017-18 (363.60 mm), 2018-19 (87.80 mm), 2019-20 (78.30 mm), and the maximum temperature during cropping season 2014-15 (19.08 °C), 2015-16 (18.06 °C), 2016-17 (20.6 °C), 2017-18 (20.48 °C), 2018-19 (19.30 °C), 2019-20 (18.36 °C) and the minimum temperature 2014-15 (9.54 °C), 2015-16 (9.62 °C), 2016-17(10.69 °C), 2017-18 (9.38 °C), 2018-19 (8.59 °C), 2019-20(9.17 °C). Total 154 nos. of farmers were involved under the FLD programme in six different villages covering an area of 7.6 ha. Garden pea was sown as second crop in residual soil moisture just after harvesting of lowland rice during the second week of November to last week of November. Recommended organic management practices (FYM @ 2.5 t/ha + vermicompost @ 1.0 t/ha + neem cake @ 0.5 t/ha + dolomite @ 0.5 t/ha) at were applied before sowing of garden pea under zero-tillage system. Rice was harvested at a height of 20 cm from the soil level in the month of November every year. Immediately after rice harvest garden pea was sown under zero-tillage system. Kashi Uday and Avira 11 were demonstrated during 2014-15 to 2017-18 and 2018-19 to 2019-20, respectively. A narrow furrow was opened 30 cm apart with hand hoe or locally made wooden row marker and all the organic nutrients were applied. Seed was placed after manuring at a spacing of 15 cm plant to plant. The surface layer of soil should remain sufficiently moist to allow good germination. Two hand weeding was done at 15 and 35 days after sowing. Neem oil (1500 ppm) was sprayed @ 3-4 ml per litre of water to manage the insect-pest and disease problem at intervals of 7-10 days. Observations were recorded for yield attributes parameters such as branches/ plant, number of pods/plant, 100 pot weight, pot length, number of seed/ pot from the demonstrations and farmers' practice. Garden pea 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).

RESULT AND DISCUSSION

Yield attributing parameters: The results indicated that the frontline demonstrations gave good impact over the farmers' practices. The yield attributing parameters like number of branches/plant, number of pods/ plant, weight of 100 seed, number of seeds, 100 pod weight, pod length of vegetable pea obtained over the years under

Table 1: Particulars showing the details of vegetable pea grown under front line demonstration

S.No.	Particulars	Demonstration package	Farmers practice	Gap
1	Improved variety	Kashi Uday / Avira 11	Local variety	Complete gap
2	Seed rate	80 kg/ha	100 kg/ha	High seed rate
3	Time of Sowing	14 November to 15 December	1st week of November	Complete gap
4	Method of sowing	(Ridges and furrows) 30 cm row - row 15 cm plant - plant	Ridge methodLine sowing	Complete gap
5	Seed treatment	Used Trichoderma viride @ 5g/kg	Nil	Complete gap
6	Use of bio pesticide	No insecticide used	Nil	
7	Basal application	Vermicompost @ 2 t/ha + FYM @ 10 t/ha + Neem cake @ 0.5 t/ha	FYM @ 5 t/ha	Partial gap
8	Weed management	Two hand weeding at 30 and 50 DAS	Two hand weeding at 30 and 50 DAS	No gap
9	Control of white fly	Spray of New oil @ 5 ml/L of water (1500 ppm)	No insecticide used	Complete gap
10	Mechanical support	No need of staking	Staking with bamboo sticks	Complete gap

Table 2: Yield attributes under demonstrations and existing farmers' practice

Yield parameters	Demonstration package	Existing farmers practices
Number of branches/plant	10-13	6-10
Number of pods/plant	14-18	10-16
Weight of 100 seed	16-18 (g)	14-16 (g)
Number of seeds/ pot	5-8	4-7
Pod weight (g)	7.6	5.2
Pod length	7.81	6.28

recommended practices as well as farmers' practice are presented in Table 2. Maximum number of branches/ plants of vegetable pea ranged 10 to 13 in recommended practice than the farmer's practices (6 to 10 nos.). Similarly, higher number of pots/plant were recorded under recommended practice (14 to 18) as compared to farmer's practice (10 to 16). This might be due to the use of quality seeds of improved variety, time of sowing, line sowing, seed treatment, application of recommended dose of manures and timely plant protection management. During the year of demonstration similar results have been reported earlier Yadav *et al.* (2017).

The weight of 100 seeds of vegetable pea ranged from 16 to 18 (g) under recommended practice on farmers field against farmers' practice that ranged from 14 to 16 (g). The number of seeds/pod under recommended practice ranged from 5 to 8 as compared to farmers' practice where it ranged from 4 to 7. The longest pod length of pea was recorded under recommended practice (7.81 cm) than farmers practice (6.28 cm). Similar findings have been reported by Shaukat *et al.* (2012). The number of seeds in a pod is variable depending upon the cultivar. These findings are supported with those obtained by Gupta and Singh (2007) and Sharma *et al.* (2010).

Yield: The yields of garden pea obtain over the years under recommended practices as well as farmer's practice is presented in Table 3. Higher average yield of garden pea ranged 57.8 to 63.9 q/ha in recommended practice (zero tillage) with higher mean value of 61.32 q/ha as compared to farmers' practice (ranged 30.81 to 33.4 q/ ha) with mean value of 32.14 q/ha during the period 2014-15 to 2019-20. Higher mean garden pea yield (6 years) of 57.8 q/ha was obtained under recommended practices than the farmers' practices (47.30 q/ha). The mean yield recorded in recommended practices was 33.49 per cent higher than the farmers practice during the experimentation. The variation in yield might be due to quality seed, seed treatment, line sowing, application of recommended dose of manures and timely plant protection management. The cumulative effect of technological intervention over six years indicated that the productivity enhancement of vegetable pea variety Kashi Uday from the recommended practice was higher than the farmers' practice. Mukherjee (2003) reported that the innovations may have superior implication in enhancing productivity. Similar results also were reported by Mishra *et al.* (2009).

Extension and technology gap: Extension gap is the difference in the yield of the demonstration and farmers' practices. The extension gap recorded was 19.1, 16.5, 16.2, 17.3, 12.4, 10.5 q/ ha during the years 2014-15, 2015-16,

Table 3: Grain yield and gap analysis of front line demonstration of vegetable pea

Year	Area (ha)	No. of farmers	Yield q/ ha			% increase over farmers practice	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)	Production efficacy (kg/ha/day)	
			Potential	Recommended practices	Farmer's practice					Recommended practices	Farmer's practice
2014-15	1.5	12	90.0	63.7	44.6	19.10	26.30	19.1	29.22	52.64	31.63
2015-16	2.1	20	90.0	61.8	45.3	16.50	28.20	16.5	31.33	50.24	31.68
2016-17	1.4	18	90.0	58.8	42.6	16.20	31.20	16.2	34.67	47.42	29.58
2017-18	2.8	25	90.0	63.9	46.3	17.60	26.10	17.6	29.00	51.12	31.93
2018-19	3.2	37	90.0	61.9	49.5	12.40	28.10	12.4	31.22	49.92	34.38
2019-20	3.4	42	90.0	57.8	47.3	14.02	32.20	10.5	35.78	46.99	31.74
Total	14.4	154	540	367.9	275.6	95.82	172.1	92.3	191.22	298.33	190.94
Mean	-	-	90.0	61.32	45.93	15.38	28.68	15.38	31.87	49.72	31.82

2016-17, 2017-18, 2018-19 and 2019-20, respectively (Table 2). The mean extension gap of six years recorded was 15.38 q/ha which emphasizes the need to educate the farmers through various means for adoption of improved agriculture production technologies to reverse the trend. In this context, front line demonstrations played an important role in popularizing the improved garden pea variety among the farming community of East Sikkim.

The technology gap is the difference between the potential yield and demonstration yield. The technology gap ranged between 26.10 to 32.20 q/ha with mean value of 28.68 q/ha. Technology gap existed due to the variation in soil and climatic conditions. Similar finding was also reported by Singh *et al.* (2014) and Lalit *et al.* (2015).

Technology index: The technology index showed the feasibility of evolved technology at the farmer's fields. Lower the value of technology index higher is the feasibility of the technology. As such the reduction of technology index varying from location to location exhibited the feasibility of technology demonstrated. The technology index recorded was 29.22, 31.33, 34.67, 29.00, 31.22, 35.78 per cent during the year 2014-15, 2015-16, 2016-17, 2017-18, 2018-19 and 2019-20, respectively. Mean technology index of six years was recorded 31.87 per cent. As the fluctuation in technology index during the study period in certain villages might be attributed to the dissimilarity in soil fertility status, weather conditions, non-availability of irrigation water and insect-pest attack in the crop. Mitra and Samajdar (2010) opined that lower the value of technology index more is the feasibility of the technology demonstrated. Similar finding was reported by Kumar *et al.* (2020).

Economics: The input and output prices of commodities prevailing during the six years of demonstration were taken for calculating the cost of cultivation, gross return, net return, benefit to cost ratio (Table 4). The economic indicator clearly showed that net return from the recommended practice was substantially higher than the farmers' practice during the demonstration period. Results revealed that the net return recorded was Rs. 134350.00, 128650.00, 130410.00, 165800.00, 157700.00 and 143350.00 per ha in demonstration plot and 84120.00, 86150.00, 85570.00, 111070.00, 121320.00 and 113620.00 per ha in farmers' practice during the year 2014-15, 2015-16, 2016-17, 2017-18, 2018-19 and 2019-20, respectively. Higher mean net return of six years recorded was Rs. 143382.00 per ha in the demonstrated plot as compared to farmers' practice. Benefit to cost ratio was also recorded higher in demonstrated plot (3.49:1) than the farmers' practice (2.93:1). This is due to higher yield obtained under recommended practice as compared to farmers' practice. Similar findings were reported by Kumar *et al.* (2020). Higher mean production efficiency and economic efficiency of six years were recorded 49.72 kg/ha/day and 1161.23 Rs/ha/day, respectively in demonstration plot than the farmers practice (31.82 kg/ha/day, 680.32 Rs/ha/day, respectively). Therefore, to exploit the potential of improved production and protection technologies efforts through FLDs ought to be increased for higher awareness among the farmers.

CONCLUSION

It may be concluded that the cultivation of garden pea under zero tillage in rice-fallow system under Sikkim condition not only increased the production, productivity and profitability, but also enhanced the cropping intensity, which ultimately increased the yield of the succeeding crop. Zero tillage cultivation practices are most suitable for their

Table 4: Economic analysis of demonstrated plots and farmers' practice

Year	Net return (Rs./ha)		B:C ratio		Economic efficiency (Rs/ha/day)	
	Demonstrated plot	Farmers practice	Demonstrated plot	Farmers practice	Demonstrated plot	Farmers practice
2014-15	134350	84120	3.37	2.69	1110.33	596.60
2015-16	128650	86150	3.27	2.73	1045.93	602.45
2016-17	130410	85570	3.26	2.69	1051.69	594.24
2017-18	165800	111070	3.87	3.18	1326.40	766.00
2018-19	157700	121320	3.68	3.34	1271.77	842.50
2019-20	143350	113620	3.43	3.19	1165.45	762.55
Mean	143382.00	97646.00	3.49	2.93	1161.23	680.36

cost effectiveness, labour saving, high energy saving, increase cropping intensity and higher net income with efficient utilization of locally available resources in the villages of East Sikkim.

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Pineapple Cultivation in Tripura: Differential Knowledge and Adoption of Scientific Practices and their Determinants

Priyanka Roy and Souvik Ghosh*
Department of Agricultural Extension, Institute of Agriculture, Visva-Bharati University, Sriniketan, West Bengal

ABSTRACT

Pineapple (*Ananas comosus*) is one of the most important commercial crops in Tripura providing a source of farm livelihood and economic security. The government has taken several steps to boost pineapple production in the state by promoting scientific cultivation practices and effective marketing infrastructure. Present study was undertaken to assess knowledge and adoption of scientific practices by pineapple growers and their determinants. Probability proportionate random sampling technique was followed to select 80 farmers as respondents. Farmers had knowledge on different aspects of pineapple cultivation at varied level with average knowledge index value 64.92. They adopted recommendation of growing pineapple on suitable soil, improved variety, proper time of planting, using proper planting material, proper weed management, giving proper irrigation, harvesting, etc.; however, the level of overall adoption was low with mean adoption index value 35.13. Bridging the gap of about 30 per cent between farmers' knowledge and adoption level of scientific pineapple cultivation techniques is the need of the hour. Education, land holding, annual income, expenditure and communication sources use pattern (localite sources and mass media) have significantly determined more than 50 per cent variations in both knowledge and adoption level; thus, drawing attention of advisories for improving pineapple production through upscaling scientific cultivation practices.

Keywords: Adoption, Determinants, Knowledge, Pineapple growers, Scientific cultivation practices

INTRODUCTION

Pineapple (*Ananas comosus*) is one of the important commercial fruit crops in India. India ranked sixth with share of produces more than eight percent of total world production of pineapple. Pineapple is one of the most important cash crops of Tripura; it is grown in almost all districts of Tripura, but mainly in West Tripura & North Tripura districts. Tripura has got a diverse agro-climatic condition which is highly suitable to grow pineapple fruit. Many farmers directly depend on pineapple for their livelihood (Das *et al.*, 2019). The main variety grown here is "Queen" & "Kew". The famous 'Queen' variety which has a GI tag is the best quality of pineapple in the world. Tripura's 'queen', or queen pineapple, was declared 'state fruit' by President Ramnath Kovind in 2018. However, the traditional cultivation practice has to deal with a lot of weeds and wild vegetation, leading to moisture wastage, low growth and a host of other problems. Tripura grows an estimated 1.28 lakh MT pineapple every year, in orchards spanning 8,800 hectares (Deb, 2020). Farmers have pioneered pineapple cultivation in Tripura; and they have carefully preserved a belief that "Pineapple would never betray them". That any crop may fail in an unfavourable circumstance, but pineapple is just a viable crop of survival, providing substantial income year after year (www.pineappleindia.com, 2008).

The Tripura government has taken several steps to boost pineapple production in the state by promotion of scientific cultivation practices and creation of market infrastructure and laying emphasis on export. Pineapple does not flower uniformly even after physiological maturity so 80% of pineapple fruit are harvested within only 2-3 months (May-July), resulting in a huge market glut in almost all markets of the state. During May to July, the state usually receives high rainfall accompanied with high relative humidity and temperature, which results in rapid deterioration in the keeping quality and because of that the farmers get very low prices. In order to overcome this

*Corresponding author email id: souvik.ghosh@visva-bharati.ac.in

problem, year-round production by using different grades of suckers and slips (300, 600 and 900 g), staggered planting from April to October at monthly intervals followed by chemical induction by application of ethephon at 25 ppm at 38-40 leaf stage result in off season flowering and fruiting. Moreover, spreading production into the off season plays a vital role in nutrition and livelihood opportunity for rural and tribal areas of the state for employment and income generation. (Das *et al.*, 2014).

Pineapple cultivation is not delivering the desired output as it is still highly unorganized, inefficient, and unprofitable in spite of having various policies and schemes by various government agencies (Pathak *et al.*, 2015). Changing climate has been causing the rising temperature, declining rainfall, decreasing water availability and increasing pest and disease infestation in Tripura (Feroze *et al.*, 2019). Due to climate change, pineapple farmers have been facing a lot of problems for sustaining pineapple production. The average production is very low because of traditional cultivation practices. It is also constrained by several factors like, lack of warehouse/ proper storage for pineapple, lack of market information, problems of credit facilities, lack of transportation facilities, lack of training about scientific pineapple cultivation and high price fluctuation in market (Sharma *et al.*, 2018). The problems faced by the majority of the pineapple farmers is lack of knowledge about updated technologies of pineapple cultivation; so effective extension programme should be implemented through which pineapple growers will come to know about the latest package of practices of pineapple cultivations followed by their adoption. New and low-cost pineapple cultivation technologies must be introduced through intensive extension system with proper training programmes for farmers from time to time, so that the farmers can easily adopt the new technologies (Roy *et al.*, 2013). ICAR Research Complex for NEH Region Tripura Centre (2005) has recommended scientific pineapple cultivation including soil & climate, plantation techniques, varieties, treatment of planting materials, propagation, land preparation, manuring, water management, weeding, and harvesting.

On this backdrop present study was conducted to measure the knowledge and adoption level of pineapple growers towards scientific cultivation techniques and to determine the influencing factors in pineapple growing regions of Tripura.

MATERIALS AND METHODS

Present study was undertaken in the state of Tripura that was purposively selected being one of the major pineapple-growing states in India. Sepahijala district was purposively selected out of eight districts of Tripura as pineapple is one of the major crops grown in this district. Out of three subdivisions, one subdivision i.e., Sonamura was randomly selected. Under this subdivision two blocks were selected randomly i.e., Boxonagar and Mohanbhog. The villages under these two blocks selected were: Kuluibari, Aralia and Kalapania, Diptali following random sampling technique. A probability proportionate simple random sampling was done for selection of respondents; accordingly, 25 farmers (31%) from Kuluibari, 13 farmers (16%) from Aralia, 26 farmers (33%) from Kalapania and 16 farmers (20%) from Diptali were selected. Thus, a total of 80 pineapple growers were chosen as respondents in present study.

Socio-personal, socio-economic and communicational characteristics of the pineapple farmers were considered as independent variables. While farmers' knowledge level and adoption level of different scientific pineapple farming practices were considered as dependent variables. The knowledge of scientific pineapple cultivation practices recommended by ICAR Research Complex for NEH Region Tripura Centre and their level of adoption was measured on 3-point continuum viz., 'Full'- '2', 'Partial'- '1' and 'No'- '0'. Data were collected from the sampled respondents with the help of interview schedule developed for the purpose and pretested before administration to sampled respondents. Collected data were compiled and analysed to derive descriptive statistics like frequency percentage, mean, standard deviation and range as well as relational statistics like correlation and regression coefficients.

RESULTS AND DISCUSSION

Profile of selected pineapple growers: A descriptive study on profile of the sampled pineapple growers has revealed their socio-personal, socio-economic and communicational attributes. Majority of the respondents (81.25%) were middle aged (36-60 years), had primary level education (43.75%) and farming as a main occupation. Family size of more than half of them was small (upto 4 members) and having nuclear type of family (91.25%). Majority of them were from BPL category (96.25%).

According to present study, about 85 and 11.25 percent of the respondents had land holding of 0.61- 2.14 acre and >2.14 acre, respectively. The average income of most respondent-farmers (88.75%) was in the range between rupees 43 thousand to 1 lakh. Their average annual expenditure was ranged between rupees 38 to 66 thousand. About 94% of the respondents used personal localite source at a medium level for their required information; while about 54% of them also used personal cosmopolite source at a medium level. All most all the respondents (98%) also used mass media source at medium level.

Farmers' knowledge on scientific pineapple cultivation practices: Knowledge is an important tool which facilitates in decision making to make farming more profitable and sustainable. In the present study, a knowledge test was developed for the purpose of measuring knowledge level of farmers on pineapple cultivation practices. Extent of knowledge of the pineapple cultivation practices is presented in Table 1 and Figure 1.

All of the pineapple growers, sample in present study as the respondents, had a full knowledge about the required suitable soil as well as climate condition for pineapple cultivation. They all know that laterite soils on hill tops or medium to heavy loams, rich in humus, slightly acidic, humid tropical climate is required for Pineapple cultivation. And it also requires 16 to 32°C temperature and high humidity. More than 80 per cent of the respondents had full knowledge about improved pineapple varieties; rest had partial knowledge about the improved varieties. Among the improved varieties (Smooth Cayenne, Hilo, Kew, Giant Kew, Common Queen, Mauritius and Ripley Queen, Red Spanish, Singapore, etc.), farmers mostly prefer to grow Queen and Kew.

On the aspects related to land preparation, all the respondents (100%) had full knowledge. They all know that the land should be thoroughly ploughed and pulverized to a good tilth. About 96.25 per cent respondents had full knowledge of proper time of planting, while 3.75% respondents had the partial knowledge about proper time of planting, at the onset of monsoon, avoiding heavy precipitation in the pre-establishment period. About 47.50 per cent of the sampled pineapple growers had full knowledge of proper planting materials (suckers, fruit

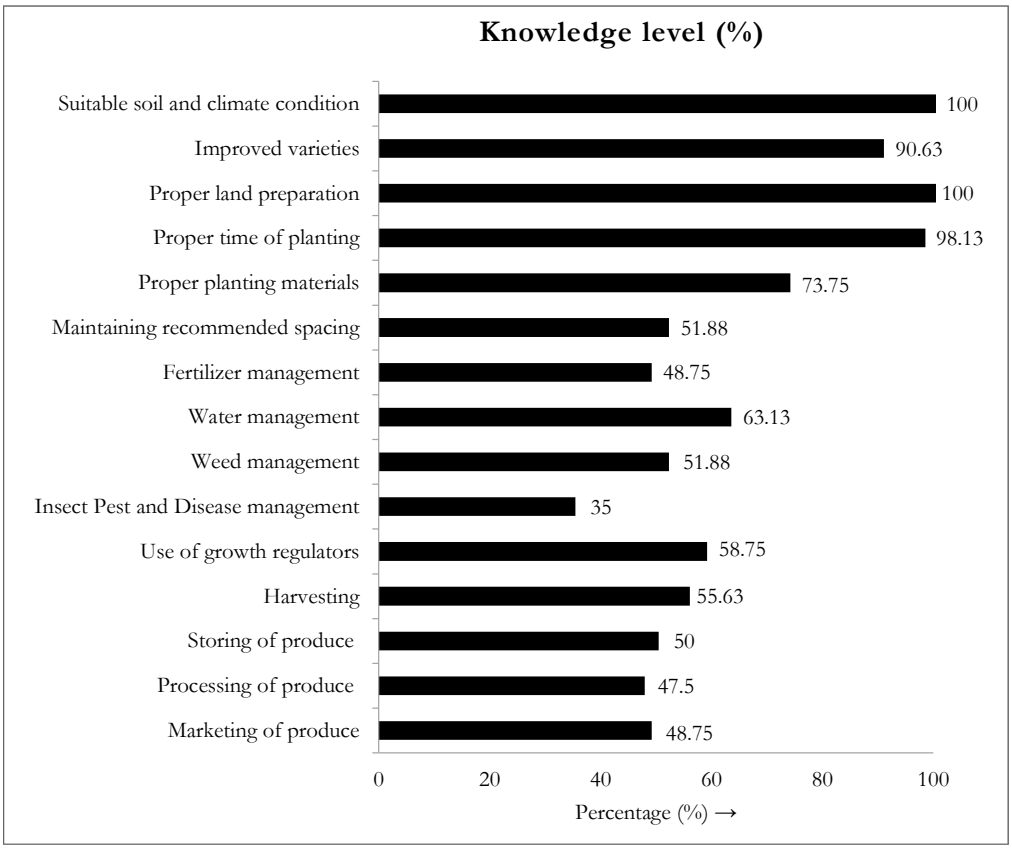
Table 1: Knowledge level of the pineapple growers on scientific cultivation practices

S.No.	Pineapple cultivation practices	Frequency (%) n=80	Mean (SD) n=80	Range (Min. to Max.)
1	***Suitable soil and climate condition***		2.00 (0.00)	2 to 2
	Full Knowledge	80 (100)		
	Partial Knowledge	-		
	No Knowledge	-		
2	***Improved varieties***		1.81 (0.39)	1 to 2
	Full Knowledge	65 (81.25)		
	Partial Knowledge	15 (18.75)		
	No Knowledge	-		
3	***Proper land preparation***		2.00 (0.00)	2 to 2
	Full Knowledge	80 (100)		
	Partial Knowledge	-		
	No Knowledge	-		
4	***Proper time of planting***		1.96 (0.19)	1 to 2
	Full Knowledge	77 (96.25)		
	Partial Knowledge	3 (3.75)		
	No Knowledge	-		
5	***Proper planting materials***		1.48 (0.50)	1 to 2
	Full Knowledge	38 (47.50)		
	Partial Knowledge	42 (52.50)		
	No Knowledge	-		

Table 1 contd...

S.No.	Pineapple cultivation practices	Frequency (%) n=80	Mean (SD) n=80	Range (Min. to Max.)
6	***Maintaining recommended spacing***		1.40 (0.19)	1 to 2
	Full Knowledge	3 (3.75)		
	Partial Knowledge	77 (96.25)		
	No Knowledge	-		
7	***Maintaining proper fertilizer /manure dose/ fertilizer management***		0.98 (0.16)	0 to 1
	Full Knowledge	-		
	Partial Knowledge	78 (97.50)		
	No Knowledge	2 (2.50)		
8	***Proper irrigation scheduling / water management***		1.26 (0.44)	1 to 2
	Full Knowledge	21 (26.25)		
	Partial Knowledge	59 (73.75)		
	No Knowledge	-		
9	***Proper weed management***		1.04 (0.25)	0 to 2
	Full Knowledge	4 (5)		
	Partial Knowledge	75 (93.75)		
	No Knowledge	1 (1.25)		
10	***Proper insect pest and disease management***		0.70 (0.49)	0 to 2
	Full Knowledge	1 (1.25)		
	Partial Knowledge	54 (67.50)		
	No Knowledge	25 (31.25)		
11	***Use of growth regulators for proper timing of flowering and fruiting***		1.18 (0.38)	1 to 2
	Full Knowledge	14 (17.50)		
	Partial Knowledge	66 (82.50)		
	No Knowledge	-		
12	***Harvesting***		1.11 (0.32)	1 to 2
	Full Knowledge	9 (11.25)		
	Partial Knowledge	71 (88.75)		
	No Knowledge	-		
13	***Storing of produce***		1.00 (0)	1 to 1
	Full Knowledge	-		
	Partial Knowledge	80 (100)		
	No Knowledge	-		
14	***Processing of produce***		0.95 (0.22)	0 to 1
	Full Knowledge	-		
	Partial Knowledge	76 (95)		
	No Knowledge	4 (5)		
15	***Marketing of produce***		0.98 (0.16)	0 to 1
	Full Knowledge	-		
	Partial Knowledge	78 (97.50)		
	No Knowledge	2 (2.50)		
	Overall knowledge	**-**	**19.48 (0.93)**	**17 to 22**
	FKI (%)	**-**	**64.92 (3.09)**	**57 to 73**

Figure 1: Knowledge level of different Pineapple Cultivation practices



stalks cut into bits known as discs) and 52.59 per cent of them had partial knowledge about the planting materials.

About 96.25 per cent respondents had partial knowledge to maintaining recommended spacing, that is plant to plant 22.5-30 cm; row to row 45-60 cm; trench to trench 75-90 cm with plant population varying from 40000/ha to 50000/ha. Only 3.75 per cent of the respondents had full knowledge about maintaining recommended spacing. Most of the respondents (97.50%) had partial knowledge about proper fertilizer /manure dose/ fertilizer management, viz., 600 kg N, 400 kg P_2O_5, 600 kg K_2O with 25-30 tons FYM/ha in three split doses: onset of monsoon (June-July), end of rainy season (September-October), third dose (February-March). However, 2.50 per cent of had no knowledge about maintaining proper fertilizer /manure dose/ fertilizer management.

In case of proper irrigation scheduling / water management, 73.75 per cent had partial knowledge and 26.25 per cent had full knowledge. This refers to irrigate during dry spells (November to March) at 20-25 days interval, and good drainage as the crop is sensitive to waterlogging. About 93.75 per cent of the respondents had partial knowledge about proper weed management and 5 per cent of the respondents had full knowledge, and only 1.25 per cent of the respondents had no knowledge. For proper insect pest and disease management, 67.50 per cent had partial knowledge, 31.25 per cent of the pineapple growers had no knowledge about the insect, pest and disease management. Only 1.25 per cent of the respondents had full knowledge about the management. 82.50 per cent of the respondents had partial knowledge about the use of growth regulators for proper timing of flowering and fruiting. Only 17.50 per cent of them had full knowledge.

With respect to time of harvesting the common index is yellowing of half basal portion of fruit, 88.75 per cent of the respondents had partial knowledge and 11.25 per cent of the respondents had full knowledge. All the sampled pineapple growers had partial knowledge about storing. Whereas 95 per cent of the respondents had partial knowledge about the processing of the produce and only 5 per cent of the respondents had no knowledge about it. Even in case of marketing the produce, 97.50 per cent of the respondents had partial knowledge and only 2.50 per cent of the respondents had no knowledge about the marketing of produce.

Present study observed that most of the farmers had knowledge on different aspects of pineapple cultivation at varied level, *viz.,* most the pineapple growers had partial knowledge on proper planting materials (52.50%), maintaining recommended spacing (96.25%), Maintaining proper fertilizer /manure dose/ fertilizer management (97.50%), proper irrigation scheduling / water management (73.75%), proper weed management (93.75%), insect pest and disease management (67.50%), timing of flowering and fruiting (82.50%), harvesting (88.75%), storing (100%), processing (95%) and marketing (97.50%). Majority had full knowledge on suitable soil and climate condition (100%), improved varieties (81.25%), proper land preparation (100%) and proper time of planting (96.25%). Overall Knowledge Index is found as 64.92 per cent.

As depicted in Figure 1, knowledge level is found to better in case of the practices like suitable soil and climate condition, improved varieties, proper land preparation, proper planting materials and proper time of planting. The overall knowledge level is found to be relatively lower in case of practices like maintaining recommended spacing, fertilizer management, water management, weed management and insect, pest, disease management, flowering and fruiting and harvesting.

Adoption behaviour of pineapple farmers: Level of adoption of the sampled farmers was measured with the help of interview schedule including 15 aspects of scientific pineapple cultivation. Extent of adoption of the pineapple cultivation practices is presented in Table 2 and Figure 2.

Majority of the pineapple growers (98.75%) had fully adopted and rest of the respondents had partially adopted the requirement of suitable soil as well as climate condition. They all adopted the practice of growing pineapple on hill tops having laterite soils or medium to heavy loams, rich in humus, slightly acidic. It also fulfils the requirement of desirable temperature i.e., 16 to 32°C temperature and high humidity. About 70 per cent of the respondents had partially adopted the new improved varieties, whereas 30 per cent respondent had fully adopted the improved varieties for Pineapple cultivation. With respect to recommended practices for land preparation, 75 per cent of the respondents had partially adopted and remaining of the respondents had fully adopted.

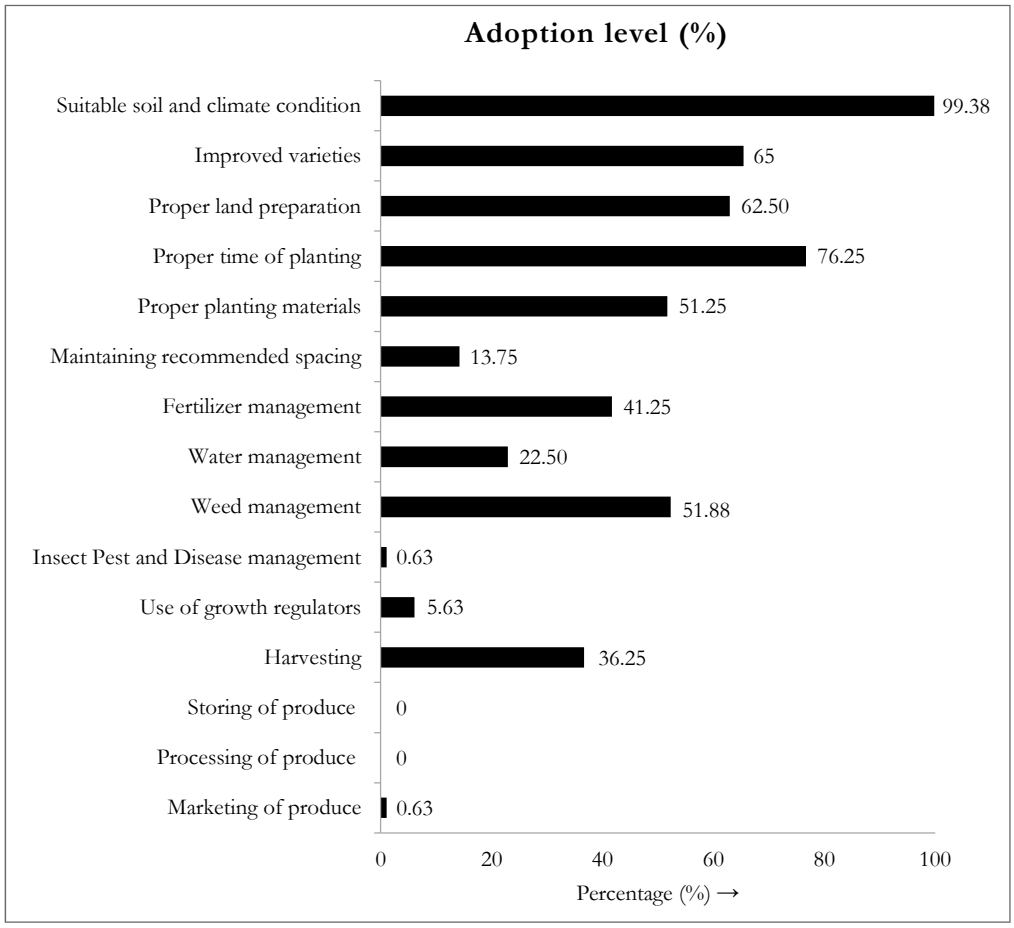
Table 2: Adoption level of the pineapple growers on scientific cultivation practices

S.No.	Pineapple Cultivation practices	Frequency (%) n=80	Mean (SD) n=80	Range (Min. to Max.)
1	***Suitable soil and climate condition***		1.99 (0.11)	1 to 2
	Full Adoption	79 (98.75)		
	Partial Adoption	1 (1.25)		
	No Adoption	-		
2	***Improved varieties***		1.30 (0.46)	1 to 2
	Full Adoption	24 (30)		
	Partial Adoption	56 (70)		
	No Adoption	-		
3	***Proper land preparation***		1.25 (0.44)	1 to 2
	Full Adoption	20 (25)		
	Partial Adoption	60 (75)		
	No Adoption	-		
4	***Proper time of planting***		1.53 (0.53)	0 to 2
	Full Adoption	43 (53.75)		
	Partial Adoption	36 (45)		
	No Adoption	1 (1.25)		
5	***Proper planting materials***		1.03 (0.22)	0 to 2
	Full Adoption	3 (3.75)		
	Partial Adoption	76 (95)		
	No Adoption	1 (1.25)		

Table 2 contd....

S.No.	Pineapple Cultivation practices	Frequency (%) n=80	Mean (SD) n=80	Range (Min. to Max.)
6	***Maintaining recommended spacing***		0.28 (0.45)	0 to 1
	Full Adoption	-		
	Partial Adoption	22 (27.50)		
	No Adoption	58 (72.50)		
7	***Maintaining proper fertilizer /manure dose/ fertilizer management***		0.83 (0.38)	0 to 1
	Full Adoption	-		
	Partial Adoption	66 (82.50)		
	No Adoption	14 (17.50)		
8	***Proper irrigation scheduling / water management***		0.55 (0.59)	0 to 2
	Full Adoption	4 (5)		
	Partial Adoption	36 (45)		
	No Adoption	40 (50)		
9	***Proper weed management***		0.94 (0.24)	0 to 1
	Full Adoption	-		
	Partial Adoption	75 (93.75)		
	No Adoption	5 (6.25)		
10	***Proper insect pest and disease management***		0.01 (0.11)	0 to 1
	Full Adoption	-		
	Partial Adoption	1 (1.25)		
	No Adoption	79 (98.75)		
11	***Use of growth regulators for proper timing of flowering and fruiting***		0.11 (0.32)	0 to 1
	Full Adoption	-		
	Partial Adoption	9 (11.25)		
	No Adoption	71 (88.75)		
12	***Harvesting***		0.73 (0.45)	0 to 1
	Full Adoption	-		
	Partial Adoption	58 (72.50)		
	No Adoption	22 (27.50)		
13	***Storing of produce***		-	-
	Full Adoption	-		
	Partial Adoption	-		
	No Adoption	80 (100)		
14	***Processing of produce***		-	-
	Full Adoption	-		
	Partial Adoption	-		
	No Adoption	80 (100)		
15	***Marketing of produce***		0.01 (0.11)	0 to 1
	Full Adoption	-		
	Partial Adoption	1 (1.25)		
	No Adoption	79 (98.75)		
	Overall Adoption	**-**	**10.54 (1.18)**	**17 to 22**
	FAI (%)	**-**	**35.13(3.93)**	**27 to 50**

Figure 2: Adoption level of different Pineapple Cultivation practices



About 53.75 per cent respondents had fully adopted the proper time of planting, while 45 per cent respondents had partially adopted the proper time of planting, i.e., at the onset of monsoon, avoiding heavy precipitation in the pre-establishment period. However, 1.25 per cent of the respondents did not adopt the proper planting time.

Only 3.75 per cent of the pineapple growers had fully adopted the proper planting materials, where as 95 per cent of the respondents had partially adopted the proper planting materials; 1.25% of the respondents had not adopted the proper planting materials. About 27.50 per cent respondents had partially adopted the maintaining recommended spacing while none had fully adopted the practice of maintaining recommended spacing. It is important to note that 72.50 per cent did not follow the recommended spacing. 82.50 per cent of the respondents had partially adopted the proper fertilizer /manure dose/ fertilizer management. About 17.50 per cent of the respondents did not adopt it. No respondents fully adopted fertilizer management. In case of proper irrigation scheduling / water management, 5 per cent had fully adopted and 45 per cent had partially adopted. However, 50 per cent of the respondents did not adopt the proper irrigation scheduling.

About 93.75 per cent of the respondents had partially adopted the proper weed management and remaining respondents had not adopted this practice, and no one adopted the practice fully. With respect to proper insect pest and disease management, only 1.25 per cent had partially adopted, and 98.75 per cent have not adopted it. 11.25 per cent of the respondents had partially adopted the use of growth regulators for maintaining proper time of flowering and fruiting. Regarding use of harvesting index to decide on harvesting time, 72.50 per cent of the respondents had partially adopted it during harvesting. None adopted proper storing and processing practices. Only 1.25 per cent respondents had partially adopted proper marketing procedure. Overall Adoption Index found as 35.13 per cent.

It is evident from the Figure 2 that level of adoption of suitable soil and climate condition was 99.38 per cent. Most of the farmers had adopted proper time of planting of pineapples (76.25%), 65 per cent was the level of adoption of the respondents with respect to the cultivation

of improved pineapple varieties. For proper land preparation technique, the adoption level was 62.50 per cent. Adoption level of weed management was about 51.88 per cent with hand weeding being followed mostly by the growers. Level of adoption of proper planting materials was 51.25 per cent. recommended fertilizer management was practiced by 41.25 per cent respondents. Adoption level of proper harvesting technique was 36.25 per cent. Adoption level of water management was low (22.50%). Maintaining recommended spacing between plants to plants and row to row had very low level of adoption (13.75%). Use of growth regulator for flowering, attaining maturity of the fruits was adopted at a very low level (5.63%). In case of insect pest and disease management and marketing, the adoption level was 0.63 per cent.

Therefore, present study revealed overall adopting of recommended pineapple cultivation technology at a low level (35.13%). According to Chanu *et al.* (2014), majority of the pineapple growers in Manipur state had medium extent of adoption of the pineapple cultivation practices. Cent percent adoption was observed in pineapple cultivation practices such as selection of variety that is similar to finding of present study, use of mechanical hand weeding for intercultural operation, use single row system as the best method of planting, dependent on rain fed irrigation, followed ordinary type of storage and ripening. Alam *et al.* (2019) in their study in Bangladesh reported that almost every pineapple farmer had used either medium or high extent of agrochemicals in pineapple cultivation, where majority (62%) of them had high extent of use of agrochemicals and remaining (38%) had used medium extent of use of agrochemicals (urea, TSP, Mop, super fix, gibberellic acid, calcium carbide and formalin). Das *et al.* (2019) in their study in Tripura mentioned that majority (39.58%) of the pineapple growers fully adopted certain recommended practices, like grading the pineapple fruits. Further 81.25 per cent of them partially adopted the recommended practices of climate and soil, while 97.92 per cent growers did not adopt the practices like curing of plant materials, chemical induction of flowering, proper methods of chemical application and insect pest and diseases management practices. These findings are similar in many aspects with findings of present study.

Determinants of knowledge and adoption: It is important to find out the factors influencing the knowledge level on cultivation of pineapple. It is also important to know how the adoption level being influenced by different factors. Therefore, the factors affecting the knowledge and adoption of the farmers were identified through the correlation and multiple regression analyses considering socio personal, socio-economic, and communicational attributes of the farmers as independent variables and each knowledge and adoption level of the pineapple farmers as dependent variables.

The correlation analysis indicates that, farmer's attributes like family size, education, earning members of the family, available farm implement, annual income, annual expenditure, cultivable land, use of mass media are significantly and positively correlated with knowledge level (Table 3). However, use of personal localities sources used shows a negative correlation. So, the farmers who are cosmopolite they were having a better knowledge level.

The adoption level of the farmer was having significant associations with the farmer's attributes like age, family size, education, earning members of the family, available farm implement, annual income, annual expenditure, cultivable land, use of personal cosmopolite sources, use of mass media sources and knowledge level had the significant correlation coefficient values in each case (Table 3).

Table 3: Correlation between the attributes of farmers, knowledge level and adoption level of recommended pineapple farming practices

Attributes	Correlation coefficient (r)	
	Knowledge level	Adoption level
Age	0.096	.308**
Family size	.436**	.443**
Education	.257*	.252*
Earning members	.310**	.257*
Annual Income (Rs.)	.390**	.647**
Farm implement	.435**	.468**
Cultivable land (acre)	.436**	.627**
Annual Expenditure (Rs.)	.294**	.618**
Personal localite information sources use	-.465**	-0.089
Personal cosmopolite information sources use	0.094	.330**
Mass media use	.365**	.446**
Knowledge level	-	.270*

** significant at 1% level of significance * significant at 5% level of significance

Correlation analyses do not indicate the functional relationship among those variables. To reveal functional relationship, multiple regression analyses were done considering the selected attributes of the pineapple growers as independent variables and each knowledge level and adoption level as dependent variables, respectively.

From Table 4, it is revealed that all of the selected attributes together have determined 51.5 per cent of knowledge level of Pineapple growers. Out of 11 attributes, regression coefficients of five attributes are found to be significant upto 10 per cent level of significance. Regression coefficients of education, cultivable land and use of mass media are found as positively significant while that of personal localite sources use and annual expenditure are found as negatively significant.

The result of multiple regression between attributes of farmers as independent variables and their adoption level on scientific Pineapple cultivation technologies as dependent variable is given in Table 5. It is revealed that all of the selected attributes together have determined 53.2 per cent of adoption level of Pineapple growers. Out of 12 attributes, regression coefficients of two attributes are found to be positively significant upto 5 per cent level of significance, which are annual income and cultivable land.

Table 4: Multiple regression between the attributes of farmers and their knowledge level of scientific practices of pineapple farming

Attributes	Std. error	Beta coefficient	t	Sig.
Constant	20.501	58.588 (B value)	2.858	.006
Age	.035	-.027	-.253	.801
Family size	.967	.056	.416	.678
Education	.344	.207	2.132	**.037**
Earning members	.623	.106	1.026	.309
Annual Income (Rs.)	.000	.264	1.194	.237
Farm implement	.636	.130	1.123	.265
Cultivable land (acre)	.628	.259	1.757	**.083**
Annual Expenditure (Rs.)	.000	-.470	-2.402	**.019**
Personal localite information sources use	.998	-.379	-3.936	**.000**
Personal cosmopolite information sources use	.569	-.066	-.671	.504
Mass media use	2.083	.282	1.778	**.080**
R value				0.718
R Square				0.515
F value				6.568**

** significant at 1% level of significance

Table 5: Multiple regression between the attributes of farmers and their adoption level of scientific practices of pineapple farming

Attributes	Std. error	Beta coefficient	t	Sig.
(Constant)	27.411	61.117 (B value)	2.230	.029
Age	.045	.075	.698	.487
Family size	1.224	-.086	-.655	.515
Education	.449	.098	.991	.325
Earning members	.793	.034	.335	.739
Annual Income (Rs.)	.000	.530	2.397	**.019**
Farm implement	.811	.173	1.494	.140
Cultivable land (acre)	.812	.296	1.986	**.051**
Annual Expenditure (Rs.)	.000	-.056	-.278	.782
Personal localite information sources use	1.397	-.095	-.905	.369
Personal cosmopolite information sources use	.721	.055	.565	.574
Mass media use	2.691	-.113	-.705	.483
Knowledge level	.153	-.138	-1.148	.255
R value				0.730
R Square				0.532
F value				6.357**

** significant at 1% level of significance

Present study reveals that education, farm size, annual expenditure, personal localite information sources use and use of mass media have significantly determined more than 50 per cent variations in knowledge; while annual income and farm size have significantly caused more than 50 per cent variation in adoption level of scientific cultivation techniques by the pineapple growers. Similar to these findings, Jha (2010) reported that majority of the pineapple farmers in Nagaland had favourable degree of attitude towards adoption of improved practices of pineapple cultivation. The variables age, farm experience, farm size, sources of information utilized and risk orientation had positive and significant association with the attitude of farmers towards improved practices of pineapple cultivation. In another study, Hassan *et al.* (2011) found that education, farm size, annual income, knowledge and attitude towards pineapple cultivation were positively

correlated with increased income from unit area of pineapple cultivation. Thus, the pineapple growers' attributes specially, education, farm size, income, expenditure, communication and information sources use pattern need to be given due attention in providing advisories for improving pineapple production through upscaling scientific cultivation practices.

CONCLUSION

Pineapple as cash crop has brought change in the agrarian economy of the state of Tripura and farm livelihoods. Present study has revealed an overall gap of about 30 per cent between farmers' knowledge and adoption level of scientific pineapple cultivation techniques which need to be bridged. The adoption behaviour of the farmers varied across different scientific practices of pineapple cultivation. Adoption behaviour was favourable with more than 50 per cent level of adoption towards few practices like adhering to suitable soil and climate condition, proper time of planting, cultivation of improved varieties, proper land preparation technique, weed management, and use of proper planting materials. However, due attention is required to improve the adoption level of other practices like fertilizer management, harvesting technique, water management, maintaining recommended spacing between plants to plants and row to row, use of growth regulator for flowering & attaining maturity of the fruits, insect pest & disease management and marketing. The farmers need appropriate technological guidance and support from the extension functionaries to improve the adoption of these recommended scientific pineapple production technologies. Pineapple growers' socio-personal, socio-economic and communication attributes often determine the knowledge and adoption; therefore, need to be considered for bringing overall improvement in pineapple cultivation and pineapple growers' livelihoods.

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Assessment of Improved Production Technologies of Indian Mustard (*Brassica Juncea*) Through Frontline Demonstrations in Real Farming Situation in NCT Delhi

Samar Pal Singh[1]*, Kailash[2], D.K. Rana[3] and P.K. Gupta[4]
[1]Subject Matter Specialist (Agronomy), [2]Extension, [3]Plant Protection, [4]Head, Krishi Vigyan Kendra, New Delhi

ABSTRACT

India is ranked 3rd after Canada and China sharing about 11.0 per cent of the global rapeseed-mustard production (72.41 mt) and 24.7 per cent and 29.4 per cent in terms of area and production, respectively, of oilseeds in India during 2018-19. Mustard is one of the most important oilseeds crop in India, which plays a major role in supplementing the income of small and marginal farmers. One of the major constraints of traditional mustard cultivation is low productivity due to non adoption of recommended package of practices and improved varieties. To replace this anomaly, Krishi Vigyan Kendra, Delhi had conducted cluster frontline demonstrations at selected farmer's fields in 2018-19 and 2019-20 in rabi season. Cultivation practices comprised under CFLD viz., use of improved varieties i.e. RH 749 and Giriraj, line sowing, seed treatment, INM and IWM. During first year (2018-2019) of experimentation *rabi* season was deficit to rainfall. The average yield of mustard varieties RH-749 and Giriraj were 23.8 q/ha and 21.8 q/ha respectively, under demonstrated technology at farmer's fields as compared to local practice (19 q/ha). In 2019-20 second year of experimentation rabi season received good rainfall during crop duration but higher rainfall occurred at crop maturity stage result average yield of demonstrated technology reduced as compared to first year 2018-19. The higher yield (21 q/ha) was reported of mustard variety Giriraj followed by RH 749 (20.20 q/ha) over local practice (18 q/ha). In both the years of experimentation, average mean yield of RH 749 and Giriraj was found higher as compared the local practice. Maximum gross return Rs. 83300/ha and Rs. 79781/ha, net return Rs. 59730/ha and Rs. 56271 and B- C ratio 2.5 and 2.4 was reported under demonstrated technology at farmer fields as compared to local practice in both year of experimentation.

Keywords: Economics, Frontline demonstration, Gap assessment, Mustard yield

INTRODUCTION

India is the 4th largest vegetable oil economy in the world next to USA, China and Brazil. Oilseeds in India accounted for 16.7, 12.9 and 18.3 per cent of the total arable land, gross and net cropped area, respectively. Anonymous, (2019a). There is a continuous surge in demand of edible oils even at the current level of consumption (17.7 kg/capita/annum) because of increasing population, changing food habits, improved purchasing power, etc. The demand of vegetable oils is likely to grow by about 3.5-6.0 per cent annually over the next 10 years which translates in to total requirement of 29.0-34.0 million tonnes (mt) of oils that works out to be equivalent to 82-102 mt of oilseeds by 2030 from the level of production of 33.50 mt during 2019-20 Anonymous, (2020a). The estimated area, production and yield of rapeseed-mustard in the world was 36.59 million hectares (mha), 72.37 million tones (mt) and 1980 kg/ha, respectively, during 2018-19. Globally, India account for 19.8 and 9.8 per cent of the total acreage and production. During the last eight years, there has been a considerable increase in productivity from 1840 kg/ha in 2010-11 to 1980 kg/ha in 2018-19 and production has also increased from 61.64 mt in 2010-11 to 72.42 m t in 2018-19. Rapeseed–mustard crops in India are grown in diverse agro-climatic conditions ranging from north-eastern/ north western hills to down south under irrigated/ rainfed, timely/late sown, saline soils and mixed cropping.

*Corresponding author email id: samarpalagro@gmail.com

Indian mustard accounts for about 75-80 per cent of the 6.23 m ha under these crops in the country during 2018-19 crop season. Soybean, groundnut and rapeseed-mustard are the major oilseed crops in India contributing nearly 84 and 88 per cent to its total acreage and production, respectively. Frontline demonstration is the new concept of field demonstration evolved by the Indian Council of Agriculture Research (ICAR) with main objective to demonstrate newly released varieties, crop production and protection technologies and its management practices in the farmer's field under different agro-climatic regions of the country under different farming situations. Mustard is the major source of income especially even to the marginal and small farmers in NCT Delhi. NCT Delhi has the sizeable area under mustard cultivation but the productivity level is very low. Keeping the above point in view, the cluster frontline demonstrations on mustard using new crop production technology was started with the objectives of showing the productive potentials of the new production technologies under real farm situation over the locally cultivated mustard crop.

METHOD AND MATERIALS

Krishi Vigyan Kendra, New Delhi conducted 165 Cluster Frontline demonstrations on mustard at farmer's field in different villages of NCT Delhi during 2018-19 and 2019-20. Further, the demonstrations were laid out in road side fields to popularize the improved technology. Each frontline demonstration was laid out on 0.4 ha area and the adjacent 0.4 ha was considered as check (farmers' practice). Mustard varieties RH 749 released from CCSHAU Hissar, Haryana and Giriraj released from ICAR-DRMR Bharatpur, Rajasthan were demonstrated under Cluster frontline demonstrations. For conduct CFLDs, farmers were selected and required inputs were supplied and regular visits to the demonstration fields by the KVK scientists ensured proper technical guidance to the farmers and record observations of fields. Field days and group meetings were also organized to provide the opportunities for other farmers to witness the benefits of demonstrated technologies. The sowing was done during mid-October under assured moisture conditions and harvested during first fortnight of March. Seeds were sown in rows 30 cm apart by drill placed at 2-3 cm depth. However, the practices followed by farmers in general use local cultivars, no seed treatment, sowing in broadcasting manner, imbalance use of fertilizer, no proper weed management and plant protection measures followed. Field days and group meetings were also organized time to time to provide the opportunities for other farmers to witness the benefits of demonstrated technologies. The data output were collected from FLD plots as well as control plots and cost of cultivation, net income, and benefit cost ratio were also worked out. The yield data were collected from both the demonstration and farmers practice by random crop cutting methods and analyzed by using simple statistical tools. The Technology yield gap, extension yield gap and technology index (Samui *et al.,* 2000) were calculated using following formulae given hereunder:

Percent increase in yield= [(Demonstration yield (kg/ ha)-Farmers' practice yield (kg/ ha) ÷ (Farmers' practice yield (kg/ ha)] × 100.

Technology yield gap (kg/ ha) = Potential yield (kg/ ha)-Demonstration yield (kg/ha)

Extension yield gap (kg/ ha) = Demonstration yield (kg / ha)- Farmers practice yield (kg /ha)

Technology index (%) = Potential yield (kg/ ha)-Demonstration yield (kg/ ha) ÷ Potential yield (kg /ha) ×100.

In *rabi* season rainfall also play an important role from sowing to harvesting of crop. During the crop growing season rainfall data were collected regularly from rain gauge. The total rainfall received during the crop season in 2018-19 was quite low (54.10 mm) with February month receiving the highest rainfall (30 mm) followed by January (16.6 mm). While lowest rainfall (7.5 mm) was noticed in December (Figure 1). During 2019-20, crop received normal rainfall (287.7 mm) with march month receiving the highest rainfall (164.6 mm) followed by December (66 mm) and January (47.7 mm), November (7.4) and February (2 mm) (Figure 2). Second year of experimentation received effective rainfall because critical stages of irrigation requirements come generally in November, December and January. However, rainfall received at maturity stages of mustard declined the yield potential of demonstrated varieties.

RESULTS AND DISCUSSION

Technology interventions v/s farmers practice: A participatory rural appraisal (PRA Survey) was carried out before initiation of the front line demonstrations at the farmers' fields. Based on this, the gap between farmer practices and improved technology of mustard cultivation in Delhi region are presented in (Table 1). Among different

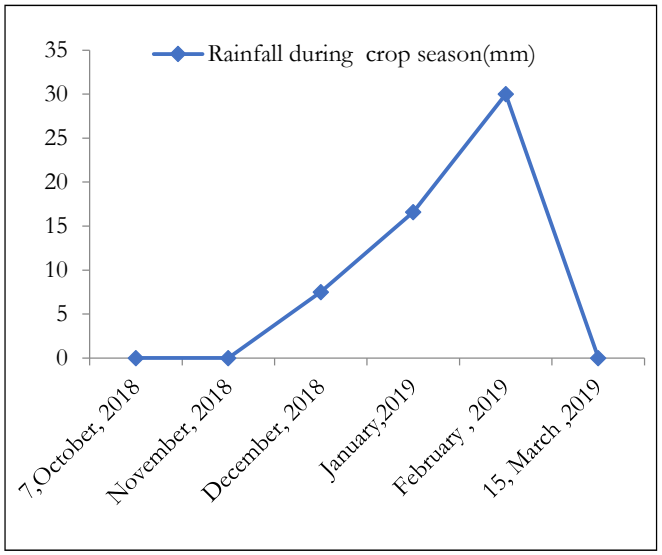

Figure 1: Monthly rainfall data during the crop season, 2018-19

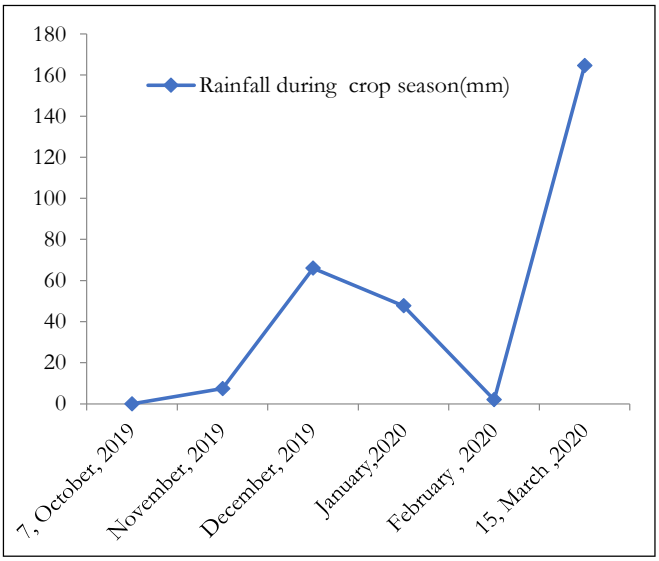

Figure 2: Monthly rainfall data during the crop season, 2019-20

components, Higher gap was observed in bio- fertilizers (93-95%), thinning (95%) soil treatment (95%), varieties (85%) followed by seed treatment (65%), fertilizers (K 60% and S 55%) and disease management (65%). Partial gap was observed in N (20%), P (15%) and planting method (15%). Similar findings also reported by Dayanand *et al.* (2012) and Shivran *et al.* (2020). These gaps noticed at the farmers fields are ascribed to the slow pace of extension machineries, coupled with unreached public extension system, poor accessibility of advanced or improved agro-technologies especially among smallholder farmers and other vulnerable groups. Babu *et al.* (2013) and Reddy and Swanson, (2006) also find the similar findings. Further, farmers used local or old varieties of low yield potential instead of newly released varieties with improper crop management practices. Unavailability of good quality seed in time and lack of awareness were also the other important reasons for low productivity at farmer's fields.

Table 1: Gap analysis of mustard cultivation in NCT Delhi region

S.No.	Technology	Recommended Practice	Farmers' Practice	% Gap
1.	Variety	RH-749, Giriraj and Pusa Vijay etc.	RH749, Pusa Vijay – 15%; Unnotified varieties – 85%	85
2.	Seed treatment	Carbendazim (2 g/kg seed) Trichoderma (10 g/kg seed)	Seed treatment – 35% No seed treatment – 65%	65
3.	Soil treatment	Trichoderma 5 kg/ha	Soil Treatment – 5 %	95
4	Fertilizers			
	N	80 kg/ ha	70-80 kg/ha – 80%; No application – 20%	20
	P	60 kg/ ha	50-60 kg/ ha – 85%; No Application – 15%	15
	K	40 kg/ha	40 kg/ha – 40%; No application – 60%	60
	S	25 kg/ha	25 kg/ha – 45 %; No application – 55%	55
5	Bio-Fertilizer	Azotobactor + PSB (each 500 g/ha)	5-7% application	93-95
6	Planting methods	Line sowing with 30 cm row spacing	Line Sowing – 85%; Broadcasting – 15%	15
7	Thinning	20-25 DAS	Thinning – 5%; No thinning – 95%	95
8	WeedManagement	Application of Pendimethalin (3.3 L/ha) (pre emergence)	Pendimethalin – 10% No weed management – 90%	90
9	Diseases management (Stem rot & white rust)	Carbendazim @ 2 g/L water Redomil @ 2.5 g/L water Mancozeb @ 2g/L water	Use Carbendazim – 20%; Mancozeb – 15% Use of local market fungicides – 65%	65

Seed yield: First year (2018-2019) of experimentation rabi season was deficit to rainfall. The average yield of mustard varieties RH-749 and Giriraj were 23.8 q/ha and 21.8 q/ ha respectively, under demonstrated technology at farmer's fields (Table 2). Lowest yield was reported under local practice i.e. 19 q/ha. Second year (2019-20) of experimentation rabi season received good rainfall during crop duration but higher rainfall occurred at crop maturity stage result average yield of demonstrated technology reduced as compared to previous first year. The higher yield (21 q/ha) of mustard variety Giriraj was reported followed by RH 749 (20.20q/ha) over local practice (18q/ ha). In both the years of experimentation, average mean yield of RH 749 and Giriraj was found higher as compared the local practice. Singh (2016) and Dubey *et. al* (2018) also reported higher yield by demonstrated technology at farmer's fields. The results clearly indicated the positive effect of FLDs over the existing practices toward enhancing the yield of mustard in the study area due to use of high yielding varieties, timely sowing, balance use of fertilizers, proper irrigation, need based plant protection etc.

Yield gap analysis: The front line demonstrations conducted under the study reveals that the technology yield gap was 4.2 to 5.2 and 7.8 to 6 kg/ha during 2018-19 and 2019-20, respectively (Table 2). Technology yield gap variations over the years led to the variation in local climatic conditions, soil fertility status of fields and agricultural practices. Unlike technology yield gap, extension yield gap were also recorded to the tune of 4.8 to 2.8 and 2.2 to 3 kg/ha over the years. The extension yield gap observed under the study emphasized the need to educate the farmers for dissemination of technologies and bridge gap through advanced extension strategies viz; frontline demonstrations, field days, farmers- scientist interactions, trainings, on farm trainings, Kisaan gosthi etc. The technology index, another effective tool for analysis of yield gap under the investigation varied from 15 to 19.2 and 27.8 to 22.2 per cent during 2018-19 and 2019-20, respectively. Lower the value of technology index, greater is the feasibility of technology. This shows the efficacy of overt performance of scientific interventions or technologies demonstrated at farmer's field. As a result, this will increase the yield of mustard under the existing conditions of NCT Delhi region. These findings corroborate the findings as reported by Kiresur *et al.* (2001) and Dhaliwal *et al.* (2018).

Economics: The economics of the improved technology over farmers practice were calculated depending on the prevailing market prices of the inputs and outputs for the particular year (Table 3). In both years of experimentation maximum gross return Rs. 83300/ha and Rs. 79781/ha, net return Rs. 59730/ha and Rs. 56271 and B:C ratio 2.5 and 2.4 was reported under demonstrated technology at farmer fields as compared to local practice. The higher benefit- cost ratio in improved technology was due to the higher yield obtained under improved technology as compared to farmer's practice. Hence higher benefit- cost ratio proved the economic viability of the technology interventions and convinced the farmers on the utility of improved technologies. Similar economic benefits owing

Table 2: Yield demonstrations and famer's practices during 2018-19 and 2019-20

Mustard Varieties	Average yield (q/ha)		Increase yield (%)		Potential yield	Technology gap (kg/ha)		Extension gap (q/ha)		Technology index (%)	
	2018-19	2019-20	2018-19	2019-20	(q/ha)	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
RH-749	23.80	20.20	25	12	28	4.2	7.8	4.8	2.2	15	27.8
Giriraj	21.80	21.00	14	16.6	27	5.2	6	2.8	3	19.2	22.2
Check (T59)	19.00	18.00									

Table 3: Economics of demonstrations and famer's practices during 2018-19 and 2019-20

Mustard varieties	Cost of cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		B:C ratio	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
RH-749	23570	23510	83300	76760	59730	53250	2.5	2.3
Giriraj	23570	23510	76300	79781	52730	56271	2.2	2.4
Check (T59)	21375	22540	66500	69400	45125	45860	2.1	2.0

to adoption of improved technology interventions were also reported by Mitra and Samajdar (2010) and Dubey *et. al* (2018).

CONCLUSION

By conducting frontline demonstrations of proven technologies, yield potential of mustard can be increased to a great extent. This will substantially increase the income as well as the livelihood of the farming community. There is a need to adopt multi-pronged strategy that involves enhancing mustard production through improved technologies in NCT Delhi region. This should be brought to the access of farmers through transfer of technology centers like KVKs.

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Effect of Core Managerial Competencies on Performance of Farmer Producer Companies in NCR of Delhi

Neha Kumari* and Kamini Bisht
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh

ABSTRACT

In an empirical study conducted to assess the relationship between core managerial competencies possessed by office bearers and the performance of farmer producer companies in few districts of National Capital Region of Delhi, it was revealed that four core managerial competencies (*planning and business development, marketing management, managing and controlling business operations*) were positively and significantly associated with level of performance of farmer producer companies. Data were corrected from 80 respondents who were office bearers of 12 FPOs, through specially developed measuring instruments to measure degree of competencies and the level of performance of the FPOs. Strategies were also discussed to enhance the degree of competencies among the office bearers of FPOs.

Keywords: Core managerial competencies, FPOs, Level of performance of FPOs

INTRODUCTION

Farmer producer organizations or farmer producer companies are being considered now as the panacea for all the ills that ail the plight of farming community. Indeed, it is true, producer companies, with farmers as members and shareholders, have the capacity to definitely transform the rural economy if these FPCs are well managed and if necessary supportive ecosystem services are provided. Importance of professional management was emphasized in many research studies, such as, 'professional and honest management is essential to run farmers' cooperatives' (Gupta, 1989); 'competent and convincing management' (Chamala and Shingi, 1997); 'management and entrepreneurial skills (soft assets) for successful and stable farmers' organisations' (Pingali *et al.,* 2005). SFAC (2012) explicitly pointed out the importance to build governance structure and develop managerial capabilities.

But such advice was not paid adequate attention and few researchers have reported lack of managerial skills as the major cause of failure of producer companies. These were: 'lack of management skills' (Vikas-Boas *et al.,* 2000); 'lack of entrepreneurial spirit and lack of cooperative spirit' and 'lack of long-term business plans' (Senanayake, 2004); 'lack of entrepreneurial and management skills' (Esham and Usmi, 2007); weak management (leading to poor accountability to members)' (Singh and Burman, 2009); 'lack of management qualifications of CEO', 'lack of business leadership' and 'lack of business strategy and business diversification' (NABCONS, 2011); 'lack of professional managers among board of directors' (Singh and Singh, 2012); 'lack of knowledge about running business' (Venkataraman, 2017; and lack of management capabilities' (Nikam *et al.,* 2019). All these research studies emphasized the ack of necessary abilities to rum the FPO effectively.

Several capacity building initiatives and training programmes were focused to impart these managerial skills but to less effect and impact. Hence this study attempted to assess the degree of core competencies for managing FPOs and relate them with level of performance of FPOS.

MATERIAL AND METHODS

This study was conducted among the 12 FPOs in four districts of NCR OF Delhi. Eighty respondents were purposively selected from the office bearers – board of directors and few farmer-members of the FPOs. Appropriate measuring instruments were developed to measure the level of performance of FPOs and degree of competencies of office bearers through two rounds of scrutiny by judges and expert on agricultural economics

*Corresponding author email id: nehakumaricoll97@gmail.com

and agricultural extension. Pearson correlation and multiple linear regression were used through SPSS for data analysis.

RESULTS AND DISCUSSION

Since the objective of this research study was to assess the effect of core competencies on performance of the FPOs, the results are presented on level of performance of FPOs and the relation between level of performance and core managerial competencies of office bearers.

Performance of Farmer Producer Organisations: The dependent variable of the study was taken as performance of the FPO, which was observed to be not so amenable for measurement as the respondents were not able to provide adequate data on various performance indicators such as volume of business or value of business in one financial year or in one crop season. So it was discussed with experts in the subject and their opinion was sought.

It was decided to develop few indicators - both economic and social-and get the self-rating done by the respondents on a rating scale of five points. Such data was seen as only perceptive in nature, yet it suffices the measurement of this variable. Hence the following performance parameters were considered for the purpose. Economic parameters: (i) Growth in membership, (ii) Volume of business, (iii) Availability of subsidized inputs, (iv) Direct marketing and better price realization and (v) Infrastructure developed. Social parameters: (i) Member's satisfaction and social prestige, (ii) Sense of ownership and attachment, (ii) Democratic Participation, (iv) Inclusive Growth, and (v) Market Oriented and consumer service. The respondents gave their perception on a five-point rating scale from 1 to 5. So, the total obtainable scores on level of performance as perceived by the respondents ranged from 10 to 50.

Performance of farmer producer organisation: The scores of performance of FPO (as measured using a ten item scale with five-point self-rating procedure) were computed & the frequency distribution is given in Table 1.

Mean score of performance of farmer producer organisations of respondents of this study sample was 29.18, but the standard deviation is very high at 5.38 indicating low consistency among the respondents on their *scores of performances*. This was also justified by the scores of respondents ranging from 14 to 37.

Table 1: Frequency distribution of respondents on their perceptive scores of Performances of FPOs

Level of Performance Scores	Respondents (N=80)	
Mean	29.18	
Standard Deviation	5.38	
Range (Min - Max)	14 – 37	
Frequency distribution		
Categories	**Frequency**	**Per cent**
Very Low (< Mean-2SD)	7	8.75
Low (Between Mean-2SD and Mean- SD)	6	7.50
Moderate (between Mean + 1SD)	57	71.25
High (Between Mean+1SD and Mean+2SD)	10	12.75
Vey High (> Mean +2SD)	0	0.00
Total	**80**	**100.00**

The frequencies fell into a fairly normal distribution, but skewed towards the lower end of performance scores. Frequencies were categorized into five classes using Mean+2SD procedure as very low, low. moderate, high and very high. About 6.75 per cent of respondents were in low category of level of performance.

Another 7.5 per cent had low performance scores. About 71.25 per cent frequencies fell in moderate category of performance of the FPOs. About 12.5 percent of respondents showed high levels of performance scores and none were in very high category of performance of FPOs. This means that the sample of farmers had widely ranged in their perception of levels of performance of their FPOs.

A cursory look at the histogram and normal curve given in Figure 1 also depicts the same picture that the frequencies of respondents on their performance scores fell into a normal distribution, but skewed highly towards lower side level of performance. Lower levels of performance depict the ground realities of the status of farmer producer organisations in the study area. The current health of the producer companies of farmers was observed to be not good due to problems of restricted movement in times of CoViD crisis in NCR of Delhi in two consecutive years 2019-20 and 202-21. All the respondent farmers were not at all enthusiastic about growing more and marketing the vegetables has become quite uncertain and risk-prone. MCD officials and Delhi Police (Traffic) were found to be non-cooperative due to

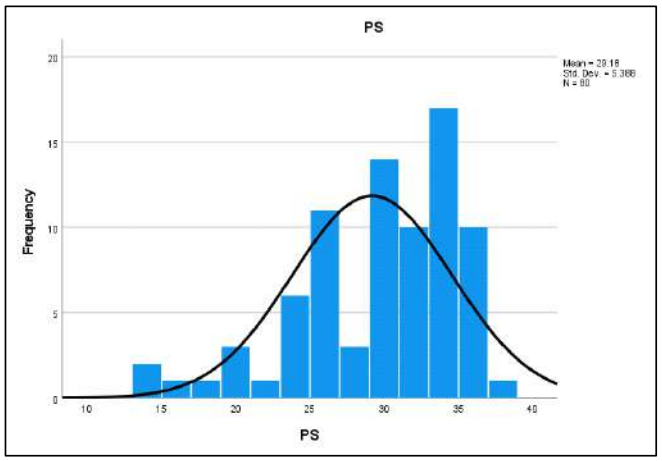

Figure 1: Histogram showing frequency curve of scores of performance of the farmer producer organisation

continuous monitoring and restricting traffic in Delhi and the NCR of Delhi.

Thus, it can be concluded that the perceived performance scores of the farmer respondents were on a lower side, with mean score being lower, compared to the maximum possible score of 50. Low performance scores may represent slower growth and lower levels of business operations. There appeared great scope for improvement in performance.

Relation between level of performance of the FPOs and the office bearers' core competencies: The last objective of the study was to analyse the relation between the dependent variable – performance of the FPO and the core competencies possessed by the office bearers of the FPO. To attain this, Pearson correlation analysis was done. The Pearson correlation coefficients were computed between scores of levels of performance of FPOs and the six socio-personal variables and the results are given in Table 2. Two-tailed levels of significance were used for testing the level of probability of the statistics. The relation between the dependent variable – performance of the FPO and the core competencies possessed by the office bearers of the FPO was tested. Through Pearson correlation analysis and multiple regression analysis. The results of the statistical analysis are presented here.

The results in Table 2 present the relationship between level of performance of the FPO and the degree of competency on the six core competencies of members in FPOs. The results revealed that out of the six core competencies, four were found to be strongly associated with level of performance of the FPOs and were statistically significant at 0.01 per cent level of probability. The null hypotheses were accepted and/or rejected as given below:

1.	There is no relationship between level of performance of FPO and the degree of competency for planning & business development possessed by office bearers of the FPO	Rejected
2.	There is no relationship between level of performance of FPO and the degree of competency for marketing management possessed by office bearers of the FPO	Rejected
3.	There is no relationship between level of performance of FPO and the degree of competency for controlling operations possessed by office bearers of the FPO	Rejected
4.	There is no relationship between level of performance of FPO and the degree of competency for democratic leadership possessed by office bearers of the FPO	Accepted
5.	There is no relationship between level of performance of FPO and the degree of competency for financial management possessed by office bearers of the FPO	Accepted
6.	There is no relationship between level of performance of FPO and the degree of competency for managing operations possessed by office bearers of the FPO	Rejected

Table 2: Correlation coefficients of performance of FPO with six core competency variables

Correlation of Performance scores with	Pearson's Correlation coefficients	Significance (1 tailed)
Competency for Planning and Business Development	0.399**	.000
Competency for Managing operations	0.597**	.000
Competency for Controlling operations	-0.323**	.002
Competency for Democratic Leadership	0.065^{NS}	.284
Competency for Financial Management	-0.084^{NS}	.229
Competency for Marketing Management	0.512**	.000

** Significant at 0.01 level of probability; ^{NS} = Not Significant

Table 3: Multiple Regression Analysis of Level of Performance of FPO with six core managerial competencies

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	patrial 'b'	Std. Error	Beta		
(Constant)	3.177	6.971		.456	.650
Planning & Business Development	.514	.142	.292	3.610**	<.001
Controlling Operations	-.416	.155	-.216	-2.681**	.009
Democratic Leadership	-.004	.203	-.001	-.019	.985
Finanicial Management	-.168	.187	-.072	-.900	.371
Managing Operations (RMT)	1.461	.469	.261	3.113**	.003
Marketing Management (RKMT)	.755	.146	.439	5.180**	<.001

Dependent Variable: Performance Scores of FPO; R = 0.7341; R square = 0.549

F Ratio at 6, 73 degrees of freedom = 14.614**; *** Significant at 0.01 level pf probability*

The competencies for planning and business development, competency for managing business operations and the competency for marketing management were found be positively associated with level of performance of the FPOs. This result means that as the degree of competency of office bearers of FPO increase on these four managerial competencies, it is likely that the level of performance of their FPO would also increase. But the competency for controlling operations was found to be negatively associated with the level of performance of FPOs. This means that as the degree of competency for controlling operations decrease, the level of performance would increase. This result implies that the farmers need not unnecessarily worry about controlling the operations of the FPO because their controlling appeared to be not helping in improving the performance of their FPOs. Hence it is advised that more controlling may be reduced from the office bearers. Two competencies: democratic leadership and financial management were not at all associated with the level of performance of the FPOs.

There was yet another hypothesis – *"None of the core competency variables contributed to the prediction of level of performance of FPOs."*. To test this hypothesis, multiple linear regression was used. This was done for predicting the relative contribution of six competency variables to the, level of performance of FPO. The results of multiple regression analysis fare presented in Table 3.

The results showed that about 54.9 per cent of variance in dependent variable performance of FPO of respondents of the study could be explained by the six competency variables included in the regression equation as can be seen from R^2 being 0.549, which is significant at 0.01 level of probability. F test value of 14.614 at 6, 73 degrees of freedom was statistically significant at 0.01 level of probability. Among all the competency variables, only four variables were found to be significant, i.e., *competency for planning & business development, marketing management, managing operations and controlling operations were* significant at 0.01 level of probability. Indeed, these four competency variables were most significant in contributing to the managerial abilities for running the FPO efficiently. Controlling operations was found to be adversely affecting management in the FPO, as it was negatively contributing to the level of performance of the FPOs.

CONCLUSION

Thus, it can be concluded that the scores of level of performance were found to be lower and the frequency distribution of respondents on their level of performance of FPO scores was slightly skewed towards the lower end. The correlation and multiple regression analysis found that the four competency variables, competency for planning & business development, competency for marketing management, competency for managing operations and competency for controlling operations were significantly contributing to the variability in the level of performance of the FPOs. These four core competencies need to be enhanced among the office bearers of the FPO for effective performance of their FPOs.

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Awareness of Beneficiary Farmers About National Horticulture Mission

Seema Yadav[1]*, K.C. Sharma[2] and Shubham Mishra[3]
[1]Ph.D. Scholar, Department of Extension Education, SKN Agriculture University, Jobner, Jaipur, Rajasthan
[2]Dean, College of Agriculture Navgaon, Alwar, Rajasthan
[3]Ph.D. Scholar, Department of Extension Education, RCA, Udaipur, Rajasthan

ABSTRACT

India is mainly an agriculture based country where majority of the people are engaged in agriculture. Recognizing the vast potential of horticulture in stimulating the growth of Indian agriculture, Government of India had launched a scheme of National Horticulture Mission for the holistic development in the year of 2005-06. The present study was undertaken to measure the awareness of beneficiary farmers about National Horticulture Mission in Jaipur and Tonk districts of Rajasthan. A total of 240 beneficiary farmers were included in the sample of study. Study shows that majority (87.09%) of beneficiary farmers had above average to high awareness about NHM in the selected districts. Statement wise awareness indicated that beneficiary farmers had high awareness about 'Construction of green house/ poly house, shade net house and plastic mulching to cope up with climate variability' with overall MPS 93.54 and was ranked first, followed by 'Legal documents of land is necessary criteria for selecting a beneficiary under NHM' with overall MPS 90.62 and was ranked second. Beneficiary farmers had least awareness about 'Year of initiation of NHM' with overall MPS 52.50 and were ranked twenty three. It was observed that there was no significant difference between the beneficiary farmers of Jaipur and Tonk districts with regard to their awareness about NHM and there was significant correlation between ranks of awareness statements assigned by beneficiary farmers of NHM of Jaipur and Tonk districts.

Keywords: Awareness, Beneficiary farmers, Correlation, Green house, NHM

INTRODUCTION

Agriculture is livelihood for about 70.00 per cent of the Indian population. Indian agriculture is an important factor for sustainable development and poverty alleviation. Horticulture has emerged as an important sector of diversification agriculture. Diversified and boosted growth in agriculture is dependent upon the development of horticulture sector. It plays a pivotal role in improving the productivity of land, generating employment, enhancing exports and improving the economic conditions of the farmers. The horticultural sector has emerged as a prominent sector in the Indian agricultural scenario contributing to an overall economic growth besides providing nutritional and health benefits.

Recognizing the vast potential of horticulture in stimulating the growth of Indian agriculture, Government of India had launched a scheme of National Horticulture Mission during 2005-06 for the holistic development. NHM plays a crucial role in promoting growth in horticulture and helps in augmenting growth in Indian agriculture. NHM playing a important role in increase in area as well as productivity of horticultural crops through motivation of farmers, providing subsidy, guidance and other facilities. NHM puts its focus in the area of horticultural research development, post harvest management, processing and marketing. The programmes under horticulture research will concentrate on technology generation appropriate to each region/state keeping in view their specific agro-climatic and socio-economic conditions. Comprehensive awareness of benefits availed is an important determinant of its wide use by the farmers. For generating information on this dimension, this study is a modest attempt in developing sound and systematic knowledge.

*Corresponding author email id: seemayadavsy91@gmail.com

MATERIALS AND METHODS

Among different Agro Climatic Zones of Rajasthan, Semi-arid Eastern Plain (IIIA) Agro Climatic Zone was selected for the study purpose. This Agro Climatic Zone comprises of four districts namely:- Jaipur, Ajmer, Tonk and Dausa. Out of these Jaipur and Tonk districts were selected for the research study on the basis of maximum number of beneficiary farmers under selected activities of NHM. From Jaipur district 6 tehsils were selected namely:- Amber, Chomu, Shahpura, Jhotwara, Sambhar and Bassi. From Tonk district also 6 tehsils were selected namely:- Newai, Malpura, Tonk, Uniara, Todaraisingh and Deoli, those having maximum number of beneficiaries under selected activities of NHM. A list of beneficiary farmers under selected activities of NHM (farmers benefited from the year 2014 to 2016) from selected districts were prepared. From that list 30 per cent of beneficiary farmers were selected by using simple random sampling in proportionate from each tehsil and selected activities under NHM. These activities were selected on the basis of highest number of farmers taking benefits under NHM. Thus, a total of 240 beneficiary farmers were included in the sample of study. The maximum score amounted to 46 and minimum score was 0. The total awareness score of each respondent was obtained by adding all the scores of their responses of all the statements. Thereafter, the scores of each individual was calculated and categorized into five categories using arbitrary method of classification *viz.,* low (up to 9.2 score), below average (from 9.3 to 18.4 score), average (from 18.5 to 27.6 score), above average (from 27.7 to 36.8 score) and high (above 36.8 score) level of awareness towards NHM. Further, for knowing the statement wise awareness of respondents mean percent score for each statement was calculated and ranked accordingly.

In order to find out the significant difference between the respondents of selected districts about awareness towards NHM, 'Z' test was applied and interpretations were done accordingly and find out the significant relationship between ranks of awareness statements assigned by respondents of Jaipur and Tonk districts, Spearman's rank correlation test was applied and interpretations were done accordingly.

RESULTS AND DISCUSSION

To measure the awareness of beneficiary farmers about NHM, a schedule was developed for data collection from the beneficiary farmers. Responses of respondents were taken on a three-point continuums *viz.* fully aware, partially aware and not aware for all the statements. The data collected regarding these were analyzed and presented in Table 1.

Level of awareness of beneficiary farmers about NHM: To measure the level of awareness of beneficiary farmers about NHM, a schedule containing 23 statements was used. On the basis of arbitrary method the beneficiary farmers were grouped into five categories.

It is revealed from the Table 1 that majority (52.91%) of beneficiary farmers had above average awareness, followed by 29.17 per cent with high awareness, 09.17 per cent with below average awareness, 07.50 per cent with average awareness and only 01.25 per cent with low awareness.

In case of district wise in Jaipur district majority (49.29%) of beneficiary farmers had above average awareness, followed by 36.43 per cent with high awareness, 07.14 per cent with average awareness, 06.43 per cent with below average awareness and only 00.71 per cent with low awareness. In Tonk district majority (58.00%) of beneficiary farmers had above average awareness, followed by 19.00 per cent with high awareness, 13.00 per cent with below average awareness,

Table 1: Distribution of beneficiary farmers according to their level of awareness about NHM

S.No.	Level of awareness	Jaipur district (n_1=140)	Tonk district (n_2=100)	Overall (n=240)
1.	Low (up to 9.2 score)	01 (00.71)	02 (02.00)	03 (01.25)
2.	Below average (from 9.3 to 18.4 score)	09 (06.43)	13 (13.00)	22 (09.17)
3.	Average (from 18.5 to 27.6 score)	10(07.14)	08(08.00)	18(07.50)
4.	Above average (from 27.7 to 36.8 score)	69(49.29)	58(58.00)	127(52.91)
5.	High (above 36.8 score)	51(36.43)	19(19.00)	70(29.17)
	Total	**140(100.00)**	**100(100.00)**	**240(100.00)**

(Figures in the parentheses indicates percentage)

08.00 per cent with average awareness and 02.00 per cent with low awareness. These findings are supported by Vidya *et al.* (2010); Neelam *et al.* (2011) and Kumari and Sharma (2019).

Statement wise awareness of beneficiary farmers about NHM: To find out the awareness of beneficiary farmers about NHM a total of twenty-three statements were considered in the awareness schedule. For this, the Mean Percent Score (MPS) for each statement was calculated and ranked accordingly. The results are presented in Table 2. An effort was also made to determine the relationship between the ranks of awareness statements assigned by beneficiary farmers of Jaipur and Tonk districts by applying Spearman's rank correlation test.

It is evident from data presented in Table 2 that most of the beneficiary farmers had high awareness about 'Construction of green house/poly house, shade net house and plastic mulching to cope up with climate variability' with overall MPS 93.54 and was ranked first, followed by 'Legal documents of land is necessary criteria for selecting a beneficiary under NHM' with overall MPS 90.62 and was ranked second, 'Creation of water sources like community water tank and farm ponds/ reservoirs under NHM' with overall MPS 89.17 and was ranked third, 'The minimum area required for the establishment of new orchard and maximum area per beneficiary' under NHM with overall MPS 87.29 and was ranked fourth and 'NHM is promoting organic farming to maintain the ecological balance by providing input subsidy' with overall MPS 86.04 and was ranked fifth.

Table 2 shows that the beneficiary farmers had less extent of awareness about 'Objectives of NHM' was assigned nineteenth rank with overall MPS 60.83, followed by 'The benefits of Integrated Nutrient Management/ Integrated Pest Management under NHM' with overall MPS 59.17 and was ranked twentieth, 'Horticulture farm mechanization is facilitated under NHM' with overall MPS 58.12 and was ranked twenty one, 'NHM is assisting the scheme of beekeeping for increasing production' with overall MPS 55.42 and ranked twenty two and 'Year of initiation of NHM' with overall MPS 52.50 and was ranked twenty three.

An effort was also made to determine the relationship between the ranks of awareness statements assigned by beneficiary farmers of Jaipur and Tonk districts by applying rank order correlation test. The rank correlation value (0.94) was greater than tabulated value, so the null hypothesis ($NH_{01.1}$) 'There is no significant correlation between ranks of awareness statements about NHM assigned by the beneficiary farmers of Jaipur and Tonk districts' was rejected and alternate hypothesis (RH_1) 'There is significant correlation between ranks of awareness statements about NHM assigned by the beneficiary farmers of Jaipur and Tonk districts' was accepted. It means there is significant relationship between ranks of awareness statements about NHM assigned by beneficiary farmers of Jaipur and Tonk districts. It might be because of the fact that both districts are belong to same agro climatic zone, and beneficiary farmers were getting almost the same benefits under NHM scheme and they have good extension contacts and social participation, so there is significant relationship found in ranks of awareness statements. These findings are supported by Mahadik *et al.* (2017) and Anirudh *et al.* (2018).

Frequency of awareness statements by the beneficiary farmers about NHM: Table 3 indicates that 57.08 per cent of beneficiary farmers were either fully or partially aware with the statement that year of initiation of NHM. It can be seen that 73.75 per cent beneficiary farmers were either fully or partially aware that 'Agency implementing NHM scheme in your area'. The result indicates that 82.50 per cent beneficiary farmers were either fully or partially aware about 'objectives of NHM'. It was observed that 73.75 per cent beneficiary farmers either fully or partially aware that 'Horticulture farm mechanization is facilitated under NHM'. The result shows that 100 per cent farmers were either fully or partially aware about 'Establishment of pre-cooling units, pack houses, onion house, cold storage units etc. under NHM' and also 100 per cent of beneficiary farmers were either fully or partially aware about 'Creation of water sources like community water tank and farm ponds / reservoirs under NHM'.

It was observed that 99.17 per cent farmers were either fully or partially aware about 'NHM is creating more employment opportunities for skilled and unskilled persons, especially for unemployed rural youths', whereas 76.67 per cent were either fully or partially aware about 'The benefits of Integrated Nutrient Management/Integrated Pest Management under NHM', 97.50 per cent were either fully or partially aware about 'The mandate of NHM is to take up post harvest management especially by processing of perishable horticulture products', 99.16 per cent were either fully or partially aware about 'The strategy of NHM to

Table 2: Statement wise distribution of beneficiary farmers according to their awareness about NHM

S. No.	Awareness statements	Jaipur(n_1=140)		Tonk(n_2=100)		Overall(n=240)	
		MPS	Rank	MPS	Rank	MPS	Rank
1.	Year of initiation of NHM	52.86	XXIII	52.00	XXII	52.50	XXIII
2.	Agency implementing NHM scheme in your area	61.43	XVIII	61.50	XVIII	61.46	XVIII
3.	Objectives of NHM	61.07	XIX	59.50	XIX	60.83	XIX
4.	Horticulture farm mechanization is facilitated under NHM	59.28	XXI	55.50	XXI	58.12	XXI
5.	Knowledge about establishment of pre-cooling units, pack houses, onion house, cold storage units etc. under NHM	78.93	XIII	77.00	X	77.92	XI
6.	Awareness about creation of water sources like community water tank and farm ponds / reservoirs under NHM	90.36	III	87.50	IV	89.17	III
7.	Are you aware that NHM is creating more employment opportunities for skilled and unskilled persons, especially for unemployed rural youths	81.78	X	77.50	IX	79.79	IX
8.	Do you know the benefits of Integrated Nutrient Management/ Integrated Pest Management under NHM	60.00	XX	58.50	XX	59.17	XX
9.	Are you aware about the mandate of NHM is to take up post harvest management especially by processing of perishable horticulture products	72.86	XVI	76.00	XII	74.17	XIV
10.	Are you aware about the strategy of NHM to minimize the risk of small and marginal farmers through crop diversification towards orchards and plantation crops	82.50	VIII	79.00	VIII	81.04	VIII
11.	Are you aware about the minimum area required for the establishment of new orchard and maximum area per beneficiary under NHM	87.14	V	87.00	V	87.29	IV
12.	Are you aware that legal documents of land is necessary criteria for selecting a beneficiary under NHM	91.78	II	89.00	II	90.62	II
13.	Knowledge about construction of green house / poly house, shade net house and plastic mulching to cope up with climate variability	93.21	I	94.00	I	93.54	I
14.	Are you aware that NHM is assisting the scheme of beekeeping for increasing production	57.50	XXII	52.00	XXII	55.42	XXII
15.	Do you know that NHM is promoting organic farming to maintain the ecological balance by providing input subsidy	88.21	IV	83.00	VII	86.04	V
16.	Are you aware about the training programmes for skill development and updating the latest technical knowledge	63.21	XVII	66.00	XVI	64.37	XVII
17.	Awareness about the subsidy provided for rejuvenating the old orchards and establishment of new orchards	82.14	IX	86.50	VI	83.75	VII
18.	Do you know about the conditions of having knowledge of horticulture crops cultivation for getting the benefits under NHM scheme	79.64	XII	72.00	XIII	76.67	XIII
19.	Do you know about the plant protection equipments and chemicals provided under NHM	74.28	XV	65.00	XVII	70.42	XVI
20.	Do you know about the technical support provided to the beneficiaries under NHM	82.86	VII	69.50	XIV	77.08	XII
21.	Field inspection of the applicant farmer by the horticultural extension officer is a prerequisite for identifying as beneficiaries of the programme	83.57	VI	88.50	III	85.83	VI
22.	Do you know about the nursery raising for production of planting material under NHM	74.64	XIV	66.50	XV	71.04	XV
23.	NHM scheme supports the beneficiaries since the establishment of orchards to production and marketing	80.36	XI	76.50	XI	78.96	X
	Total	**76.10**		**73.24**		**74.78**	

MPS = Mean Percent Score rs = 0.94** ; rs = Rank order correlation; ** = Significant at the 1 per cent level of significance

Table 3: Frequency of awareness statements by the beneficiary farmers about NHM

S. No.	Awareness statements	Jaipur district (n_1=140)			Tonk district (n_2=100)			Overall (n=240)		
		Fully aware	Partially aware	Not aware	Fully aware	Partially aware	Not aware	Fully aware	Partially aware	Not aware
1.	Year of initiation of NHM	67 (47.86)	14 (10.00)	59 (42.14)	40 (40.00)	16 (16.00)	44 (44.00)	107 (44.58)	30 (12.50)	103 (42.92)
2.	Agency implementing NHM scheme in your area	73 (52.14)	26 (18.57)	41 (29.29)	45 (45.00)	33 (33.00)	22 (22.00)	118 (49.17)	59 (24.58)	63 (26.25)
3.	Objectives of NHM	63 (45.00)	46 (32.86)	31 (22.14)	30 (30.00)	59 (59.00)	11 (11.00)	93 (38.75)	105 (43.75)	42 (17.50)
4.	Horticulture farm mechanization is facilitated under NHM	57 (40.71)	52 (37.14)	31 (22.14)	43 (43.00)	25 (25.00)	32 (32.00)	100 (41.67)	77 (32.08)	63 (26.25)
5.	Knowledge about establishment of pre-cooling units, pack houses, onion house, cold storage units etc. under NHM	81 (57.86)	59 (42.14)	00 (00.00)	53 (53.00)	47 (47.00)	00 (00.00)	134 (55.83)	106 (44.17)	00 (00.00)
6.	Awareness about creation of water sources like community water tank and farm ponds / reservoirs under NHM	114 (81.43)	26 (18.57)	00 (00.00)	75 (75.00)	25 (25.00)	00 (00.00)	189 (78.75)	51 (21.25)	00 (00.00)
7.	Are you aware that NHM is creating more employment opportunities for skilled and unskilled persons, especially for unemployed rural youths	92 (65.71)	46 (32.86)	02 (01.43)	55 (55.00)	45 (45.00)	00 (00.00)	147 (61.25)	91 (37.92)	02 (00.83)
8.	Do you know the benefits of Integrated Nutrient Management/ Integrated Pest Management under NHM	57 (40.71)	54 (38.57)	29 (20.72)	44 (44.00)	29 (29.00)	27 (27.00)	101 (42.08)	83 (34.59)	56 (23.33)
9.	Are you aware about the mandate of NHM is to take up post harvest management especially by processing of perishable horticulture products	70 (50.00)	64 (45.71)	06 (04.29)	52 (52.00)	48 (48.00)	00 (00.00)	122 (50.83)	112 (46.67)	06 (02.50)
10.	Are you aware about the strategy of NHM to minimize the risk of small and marginal farmers through crop diversification towards orchards and plantation crops	92 (65.71)	48 (34.29)	00 (00.00)	60 (60.00)	38 (38.00)	02 (02.00)	152 (63.33)	86 (35.83)	02 (00.84)
11.	Are you aware about the minimum area required for the establishment of new orchard and maximum area per beneficiary under NHM	104 (74.29)	36 (25.71)	00 (00.00)	74 (74.00)	26 (26.00)	00 (00.00)	178 (74.17)	62 (25.83)	00 (00.00)
12.	Are you aware that legal documents of land is necessary criteria for selecting a beneficiary under NHM	121 (86.43)	19 (13.57)	00 (00.00)	78 (78.00)	22 (22.00)	00 (00.00)	199 (82.92)	41 (17.08)	00 (00.00)
13.	Knowledge about construction of green house / poly house, shade net house and plastic mulching to cope up with climate variability	131 (93.57)	09 (06.43)	00 (00.00)	88 (88.00)	12 (12.00)	00 (00.00)	219 (91.25)	21 (08.75)	00 (00.00)
14.	Are you aware that NHM is assisting the scheme of beekeeping for increasing production	58 (41.43)	46 (32.86)	36 (25.71)	33 (33.00)	38 (38.00)	29 (29.00)	91 (37.92)	84 (35.00)	65 (27.08)
15.	Do you know that NHM is promoting organic farming to maintain the ecological balance by providing input subsidy	107 (76.43)	33 (23.57)	00 (00.00)	66 (66.00)	34 (34.00)	00 (00.00)	173 (72.08)	67 (27.92)	00 (00.00)
16.	Are you aware about the training programmes for skill development and updating the latest technical knowledge	60 (42.86)	57 (40.71)	23 (16.43)	51 (51.00)	30 (30.00)	19 (19.00)	111 (46.25)	87 (36.25)	42 (17.50)
17.	Awareness about the subsidy provided for rejuvenating the old orchards and establishment of new orchards	90 (64.29)	50 (35.71)	00 (00.00)	73 (73.00)	27 (27.00)	00 (00.00)	163 (67.92)	77 (32.08)	00 (00.00)

Table 3 contd....

S. No.	Awareness statements	Jaipur district (n_1=140)			Tonk district (n_2=100)			Overall (n=240)		
		Fully aware	Partially aware	Not aware	Fully aware	Partially aware	Not aware	Fully aware	Partially aware	Not aware
18.	Do you know about the conditions of having knowledge of horticulture crops cultivation for getting the benefits under NHM scheme	83 (59.29)	57 (40.71)	00 (00.00)	52 (52.00)	40 (40.00)	08 (08.00)	135 (56.25)	97 (40.42)	08 (03.33)
19.	Do you know about the plant protection equipments and chemicals provided under NHM	74 (52.86)	61 (43.57)	05 (03.57)	42 (42.00)	46 (46.00)	12 (12.00)	116 (48.33)	107 (44.59)	17 (07.08)
20.	Do you know about the technical support provided to the beneficiaries under NHM	93 (66.43)	47 (33.57)	00 (00.00)	53 (53.00)	33 (33.00)	14 (14.00)	146 (60.84)	80 (33.33)	14 (05.83)
21.	Field inspection of the applicant farmer by the horticultural extension officer is a prerequisite for identifying as beneficiaries of the programme	94 (67.14)	46 (32.86)	00 (00.00)	77 (77.00)	23 (23.00)	00 (00.00)	171 (71.25)	69 (28.75)	00 (00.00)
22.	Do you know about the nursery raising for production of planting material under NHM	80 (57.14)	48 (34.29)	12 (08.57)	50 (50.00)	33 (33.00)	17 (17.00)	130 (54.17)	81 (33.75)	29 (12.08)
23.	NHM scheme supports the beneficiaries since the establishment of orchards to production and marketing	87 (62.14)	51 (36.43)	02 (01.43)	57 (57.00)	39 (39.00)	04 (04.00)	144 (60.00)	90 (37.50)	06 (02.50)

minimize the risk of small and marginal farmers through crop diversification towards orchards and plantation crops', 100 per cent were either fully or partially aware about 'The minimum area required for the establishment of new orchards and maximum area per beneficiary under NHM', 100 per cent were either fully or partially aware that 'Legal documents of land is necessary criteria for selecting a beneficiary under NHM', 100 per cent were either fully or partially aware that 'Construction of green house / poly house, shade net house and plastic mulching to cope up with climate variability'.

It was also experienced that 72.92 per cent farmers were either fully or partially aware that 'NHM is assisting the scheme of beekeeping for increasing production', whereas 100 per cent were either fully or partially aware about 'NHM is promoting organic farming to maintain the ecological balance by providing input subsidy', 82.50 per cent were either fully or partially aware about 'The training programmes for skill development and updating the latest technical knowledge', 100 per cent were either fully or partially aware about 'The subsidy provided for rejuvenating the old orchards and establishment of new orchards', 96.67 per cent were either fully or partially aware that 'The conditions of having knowledge of horticulture crops cultivation for getting the benefits under NHM scheme', 92.92 per cent were either fully or partially aware that 'Plant protection equipments and chemicals provided under NHM', 94.14 per cent were either fully or partially aware about 'The technical support provided to the beneficiaries under NHM', 100 per cent were either fully or partially aware that 'Field inspection of the applicant farmer by the horticultural extension officer is a prerequisite for identifying as beneficiaries of the programme', 87.92 per cent were either fully or partially aware about 'The nursery raising for production of planting material under NHM' and 97.50 per cent were either fully or partially aware that 'NHM scheme supports the beneficiaries since the establishment of orchards to production and marketing'.

Comparison between beneficiary farmers of Jaipur and Tonk districts according to their awareness about NHM: To find out the difference in awareness level of beneficiary farmers of two districts about NHM scheme, following hypotheses were formed and tested by employing 'Z' test for significance of difference between the two samples and results are presented in the Table 4.

$NH_{01.2}$: There is no significant difference between the beneficiary farmers of Jaipur and Tonk districts about awareness of NHM.

RH_2: There is significant difference between the beneficiary farmers of Jaipur and Tonk districts about awareness of NHM.

Table 4: Comparison of beneficiary farmers of Jaipur and Tonk districts according to their awareness about NHM (n=240)

Districts	Sample size	Mean score	S.D	'Z' Value
Jaipur	140	35.00	4.64	0.0054^{NS}
Tonk	100	33.69	3.46	

NS = Non-significant

Table 4 shows that the calculated 'Z' value was found less than the tabulated value which is statistically non-significant. So the null hypothesis ($NH_{01.2}$) 'There is no significant difference between the farmers of Jaipur and Tonk districts about awareness of NHM" was accepted and alternate hypothesis (RH_2) was rejected. It means that beneficiary farmers of both the districts had more or less or similar awareness about NHM in the study area. It might be because of the fact that in both districts beneficiary farmers were getting more benefits under NHM scheme, so they have awareness about this and they have good extension contacts and social participation. This helped the beneficiary farmers to increase their awareness. These findings are supported by Kumar and Sisodia (2016); Mahadik *et al.* (2017) and Pal *et al.* (2018).

CONCLUSION

- It was concluded that majority of beneficiary farmers had above average to high awareness. The beneficiary farmers had high awareness about construction of green house/poly house, shade net house and plastic mulching to cope up with climate variability and legal documents of land is necessary criteria for selecting a beneficiary under NHM.
- Similarly, the beneficiary farmers had least awareness about year of initiation of NHM and NHM is assisting the scheme of beekeeping for increasing production.
- It was also found that beneficiary farmers of both the districts i.e. Jaipur and Tonk had more or less or similar awareness about different activities of NHM.

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Determinants of Repayment Performance of Women Dairy Self-help Groups in Rajasthan

Ritu Rathore[1]*, Ravinder Malhotra[2], Udita Chaudhary[3] and Anil Kumar Dixit[2]
[1]Ph.D. Scholar, [2]Principal Scientist, [3]Scientist (SS), DES&M, ICAR-National Dairy Research Institute, Karnal, Haryana

ABSTRACT

The present study was conducted to assess the determinants of repayment performance of women dairy self-help groups in Rajasthan. Secondary data from 80 women dairy SHGs were collected and then TOBIT regression was done to know the factors affecting repayment performance of women dairy SHGs. The results show that 'group size', 'total dependents in a household' and 'loan amount' had negative, while 'years of experience of SHG' had positive and significant effect on the repayment rate of SHGs. The study has concluded that if SHGs are properly monitored then marginal people can also repay the loan in time.

Keywords: Dairy, Determinants, Repayment, Self-help groups, Women

INTRODUCTION

Easy accessibility of credit has always been a major challenge for the poor, as they lack collateral securities. Because of high risk, banks do not found poor people creditworthy. Hence, bank does not provide loan to them. To reduce this issue of credit, government launched several poverty alleviation schemes, under which marginal people got opportunity to take loan without any collateral security. But beneficiaries have taken it as 'grant' instead of loan and they do not showed responsibility to pay it back to the bank. This poor recovery from marginal people increases the non-performing asset of banks. Due to lack of security and failure of poverty eradication schemes, concept of SHG-based microfinance has emerged, which proved that even the marginal people can bankable. Many researcher have reported the recovery rate of about 80-90 per cent from SHGs in different parts of India (Madheswaran and Dharmadhikary, 2001; Puhazhendi and Batadya, 2002, Feroze *et al.,* 2011). SHG-based microfinance is community based program, where the repayment responsibility of external loan is not only on individual but on a group as a whole. In SHGs, group members belong to same locality, where they can exert pressure on each other for timely repayment of loan. Though the SHG-based microfinance has been promoted in all over India but lending without security is still risky because repayment of loans seldom fully guaranteed. Therefore, it is necessary to study that how some external factors affect group repayment and what factors should be consider by micro-finance institutions while giving loan to SHGs, because even few defaulters can weaken these institutes very easily (Zeller, 1998). Hence this paper attempts to assess the factors affecting repayment performance of SHGs.

MATERIALS AND METHODS

Selection of study area: The study has been carried out in Rajasthan. Rajasthan is India's second largest producer of milk (20th Livestock Census, GoI, 2019). It possesses 10.59 per cent of the total animal population of the country and contributes to almost 12.60 per cent of the milk production (20th Livestock Census, GoI, 2019). Income from livestock averages at 22.5 per cent of the total household income, whereas in arid region the contribution of livestock sector is even more than 50 per cent of the total household income (Jagannath and Singh, 2014). The status of SHGs in Rajasthan indicates that out of 83,054 SHGs, 13,136 (15.8%) are defunct (RAJEEVIKA) and out of 33 districts, 23 districts have low coverage of SHGs (Jagannath and Singh, 2014). In the light of all these issues Rajasthan state has been selected purposively for the study.

*Corresponding author email id: riturathore1012@gmail.com

Two districts out of 33 districts of Rajasthan, namely Baran and Jhalawar, which have the highest number of dairy SHGs in the state, were selected purposively (RAJEEVIKA). From each district, 40 SHGs were selected randomly. Thus, 80 SHGs from both the districts were selected.

Data: Secondary data from 80 SHGs were collected from the registers of SHGs. Data with respect to SHG meetings, years of experience of SHGs, amount of loan taken, interest subsidy and age, caste, marital status and other occupation of SHG members were collected.

Analytical framework: TOBIT model was used to assess the factors affecting the repayment performance of SHGs because there is censoring in the dependent variable. Repayment rate was used as dependent variable and it was computed as the proportion of total loan amount repaid at the promised date out of the total loan amount taken (Sharma and Zeller, 1997).

$$\text{Group Repayment Rate (RR)} = \frac{\text{Intra group loan amount repaid}}{\text{Total intra group loan amount}}$$

Where, RR = 1 implies complete repayment in time whereas RR = 0 implies complete internal delinquency i.e. non-repayment.

TOBIT maximum likelihood technique: The function for repayment rate is $RR = f(X)$

X is a vector of group and community variables.

The function is defined for $LAMNT>0$, the assumption is that

$$\lim_{LAMNT \to 0} DEFAULT = 0$$

Where, $LAMNT$ is the amount of loan

This is a reasonable assumption, since defaults on small loans are likely to be zero. Here, the dependent variable is truncated at zero in case of complete delinquency or non-repayment, the equation is specified as

$RR_i^* = \beta X_i + \varepsilon_i$ …….. *(1)*

Where, $RR_i = RR_i^*$ if $RR_i^* > 0$

$RR_i = 0$, otherwise

RR_i^* is a latent variable, observable when it takes a positive value.

Where, RR_i^* is latent variable describing repayment rate

RR_i is observed level of repayment rate

β is vector of parameter

X_i is vector of variables influencing repayment rate

ε_i is error term

Equation 1 was estimated using the maximum likelihood technique.

Explanatory variables used in TOBIT regression are mentioned in Table 1.

RESULTS AND DISCUSSION

Table 2 presents the average values of dependent and independent variables used in TOBIT regression. The data in Table 2 shows that the overall repayment rate measured as ratio of loan repaid to total loan amount was worked out to be 0.81, which shows that 81% of the total loan amount was repaid on the due date.

The data also reveals that, in an SHG about 79 per cent homogeneity was there with respect to age, caste, education, marital status, occupation and land holdings of the group members. To capture peer monitoring, frequency of group meetings per month was used as a proxy

Table 1: List of explanatory variables used in TOBIT regression

Explanatory Variables	Measurement	Expected sign
Homogeneity/Social ties	Scale measuring the homogeneity of the groups with respect to age, caste, marital status, education, occupation and land holding	+/-
Peer monitoring	Frequency of meetings per month	+
Interest subsidy	DI = 1 if group getting subsidy for interest rate for proper repayment; DI = 0 otherwise	+
Group size	Number of group members	-
Total dependents in a household	Total number of dependents per household taken as number of children and elderly	-
Loan amount	Value of loan in Rs	-
Years of experience of SHGs	Years of operation of SHGs since their inception	+

Table 2: Average values of dependent and independent variables used in TOBIT regression

Variables	Unit	Average
Dependent		
Repayment rate	Ratio	0.81
Independent		
Homogeneity/Social ties	%	79.17
Peer monitoring	Number	3.51
Interest subsidy	%	55.00
Group size	Number	10.38
Total dependents in a household	Ratio	3.06
Loan amount	Lakh Rs.	1.12
Years of experience of SHGs	Years	5.53

variable. On an average, 3.51 group meetings were conducted in a month by the SHGs in the study area. Only 55 per cent SHGs (44 SHGs) were getting subsidy for interest rate, while rest 45 per cent SHGs (35 SHGs) were not getting any subsidy on interest rate. In the study area, number of group members varied from 8 to 14 in a group and average number of members in a group was found to be about 10. Average number of dependents in a member household was 3.06. On an average, the loan amount received by the SHGs was Rs. 1.12 lakh in a year. Average years of experience of an SHG were 5.53 years and it ranged from min. of 2 years to max. of 7 years.

Correlation matrix: In order to check the relation between the dependent and independent variables, zero order correlation matrix was constructed and results are presented in Table 3. Results of zero order correlation matrix show that almost all the variables satisfied the a-priori theoretical assumptions because signs of correlation coefficients were same as expected earlier. It means the data supports the postulated hypothesis about the relationship between the dependent and the independent variables. The correlation coefficients of almost all independent variables with dependent variables are significant.

TOBIT regression: The results of TOBIT analysis are being presented in Table 4. The results indicated that 'group size', 'total dependents in a household', 'loan amount', and 'years of experience of SHG' had significant effect on the repayment rate of SHGs.

'Group size' had negative and significant influence on repayment performance of SHGs. This implies that with an increase in group size, repayment rate decreases. A possible explanation is that bigger the size of group, flow of proper information is difficult between the members. This makes the monitoring of group more costly and less effective and hence repayment rate decreases. This finding is contradictory to the findings of Zeller (1998) and Feroze *et al.* (2011).

Table 3: Zero-order correlation matrix: repayment rate and the independent variables

Variables	Repayment rate	Homo-geneity	Peer monitoring	Interest subsidy	Group size	Total dependents in a household	Loan amount	Years of experience of SHGs
Repayment rate	1.00							
Homogeneity	0.09	1.00						
	(0.34)							
Peer monitoring	0.02	0.00	1.00					
	(0.83)	(0.97)						
Interest subsidy	0.15	0.06*	-0.10	1.00				
	(0.17)	(0.05)	(0.37)					
Group size	-0.27*	-0.14	0.08	-0.15	1.00			
	(0.02)	(0.22)	(0.46)	(0.19)				
Total dependents in a household	-0.22*	-0.161*	-0.02	-0.01	-0.26*	1.00		
	(0.04)	(0.02)	(0.08)	(0.09)	(0.02)			
Loan amount	-0.21*	-0.03	-0.01	0.04	0.23*	-0.22*	1.00	
	(0.05)	(0.77)	(0.09)	(0.69)	(0.04)	(0.05)		
Years of experience of SHGs	0.16	-0.08	-0.21*	-0.02	0.27*	-0.19	0.46**	1.00
	(0.15)	(0.49)	(0.01)	(0.84)	(0.01)	(0.09)	(0.00)	

*=P≤0.05, **=P≤0.01, Figures in parenthesis are p-value.

Table 4: Estimated TOBIT coefficients of determinants of repayment rate

Variable	Estimated coefficient
Constant	0.57 (0.316)
Homogeneity/ Social ties	0.01 (0.094)
Peer monitoring	0.03 (0.015)
Interest subsidy	0.05 (0.026)
Group size	-0.03* (0.012)
Total dependents in a household	-0.07** (0.024)
Loan amount	-0.02** (0.005)
Years of experience of SHG	0.16** (0.038)
Number of observations	80
Log likelihood	44.54
Pseudo R-square	0.27
LR chi-square (9)	38.01**

*=P≤0.05, **=P≤0.01, Figures in parenthesis are standard error

As per hypothesis, 'total dependents in a household' was negatively associated with the 'repayment rate'. It shows that with the increase in number of dependents in a household, repayment rate decreases. The reason being that higher number of dependents in a family makes subsistence costly for the SHG members belonging to lower socio-economic 'Years of experience of SHGs' had positive and significant effect on repayment rate of SHGs. It indicates that SHGs with more experience were found to be less prone to defaults. The possible explanation is that with time, SHGs gain sufficient experience to run extra income-generation activities which helps the members to repay the loan amount in time. Moreover, saving per member also increases as years of operation of SHG increases and hence repayment rate increases.

As per hypothesis, loan amount was negatively associated with the repayment rate. This implies that as amount of loan increases, chances of default also increases. This is because, SHG members belong to lower socio-economic class, hence, with high loan amount they find it more difficult to complete the repayment obligation out of their personal funds. This finding is in line with the findings obtained by Feroze (2009).

Though the variables 'homogeneity', 'peer monitoring' and 'interest subsidy' were found to be non-significant but sign of their coefficient are important for the study. The sign of coefficient of homogeneity was positive which indicates that higher the scale measuring the homogeneity of the group with respect to age, caste, marital status, education, occupation and land holding, higher the chance of repayment in the study area. The sign of homogeneity was found to be contrary to what was observed by Wydick (1999); Verhelle and Berlage (2003); Von (2004) and Feroze *et al.* (2011).

As expected, the sign of coefficient of 'peer monitoring' was positive. This indicates that higher the frequency of meetings in a month, higher will be the repayment rate. The reason being that regular meetings promote better monitoring and functioning of SHGs. Sometimes, it also creates pressure on borrower for timely repayment of loan amount, hence repayment rate increases.

The subsidy for interest rate acts as incentive for better repayment performance of the group. As expected, sign of variable 'interest subsidy' was positive, but statistically non-significant. This finding is similar to the findings as reported by Verhelle and Berlage (2003), but contradictory to the findings of Von (2004) and Feroze *et al.* (2011). LR Chi-square with value 38.01 ($p<0.01$) shows that together all the predictors have a significant effect on the repayment rate of SHGs.

CONCLUSION

For the poor people, easy access of credit has always been a challenge as they lack collateral security. Banks do not provide loan to them because of their poor repayment capacity. Hence, concept of SHG-based microfinance has emerged, which provides easy and continuous credit to the poor people. Though the SHG-based microfinance has been promoted in all over India but lending without security is still risky because repayment of loans seldom fully guaranteed. Therefore, study on determinants of repayment performance of SHGs was undertaken. The findings reveal that 'group size', 'total dependents in a household' and 'loan amount' had significantly negative, while 'years of experience of SHG' had positive and significant effect on the repayment performance of SHGs. The study shows that coefficient of variable interest subsidy was not significant, which indicates that subsidy disbursed to SHGs failed to improve the repayment performance of the SHGs. Subsidy hinders the true spirit of self-help among the members. Hence, consideration may be given to discontinue interest subsidy. It can be concluded that if SHGs are properly monitored then poor people can also repay the loan in time.

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Opinion of Girl Students Towards Agricultural Education in West Bengal

Tanushree Saha[1]*, Monirul Haque[2] and Debabrata Basu[3]
[1,2]Ph.D. Research Scholar, [3]Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia–741252, West Bengal

ABSTRACT

Educational research is a steadily growing field of study where new techniques, frameworks and new ideas are continually being found. Farming is assuming a basic part of the overall development of most developing nations. Indian agriculture is as of now experiencing huge changes and it is evident that this has significant ramifications for agricultural education and learning. In a worldwide agricultural economy, production, processing, storage and marketing the major operations that rely heavily on agricultural education taught in schools, colleges and universities as formal education leaving informal and nonformal education too. In the present context of the Indian agricultural education system, the participation of girl students has been increasing over the years. The present study examines the opinion and attitude of the girl students who are pursuing their undergraduate agricultural education and their suggestion for the present situation of agricultural education in Bidhan Chandra Krishi Viswavidyalaya (B.C.K.V.), West Bengal. The study has been conducted by interviewing one hundred fifty girl students selected randomly. It has been found that urban students are coming to agricultural education in higher percentage and most of them have a job-oriented background. Most of the students are interested in agricultural education for a secure and prosperous job and they want to join Government Service after completion of their education. The source of information and inspiration about agriculture education for these girl students are mainly their teachers and parents. Most of the girl students are satisfied with the present situation of the education due to cooperation from teachers, well-equipped laboratories, appropriate class timing etc. The rest of the students are not satisfied with the present situation of agriculture education and suggested more practical with field-orientation and revised course curriculum. Some students are also dissatisfied with the Under Graduate Scholarship system. Provision of more library hours and doubt clearing classes with subsequent improvement of the placement process are some of the suggestions opined by them for improvement of agricultural education.

Keywords: Agricultural education, Girl students, Opinion, Improvement

INTRODUCTION

As Charles Fourier stated, "The extension of women's rights is the basic principle of all social progress" (*Théorie des Quatre Mouvements* (1808). The development of a community, society or nation in any field, be it social, economic, political or spiritual depends as much on women as on men. Any Nation can never attain the state of progression at which it ought to be by ignoring the development and welfare of women (United Nations, 2006). Indian agriculture is the largest livelihood source of India, where almost 70 per cent of its rural households depend directly or indirectly on agriculture and allied activities with 82 per cent of farmers being small and marginal (FAO, 2019).

Academic activities, as well as research in the field of agriculture, is relatively modern in Asian countries. Earlier there are only two to three centres where it was carried out. The State College of Agriculture was established in 1952 by the Govt. of West Bengal during the Chief-ministership of Dr. B.C. Roy. That college was shifted to Haringhata, Nadia in 1958 then in 1974, Bidhan Chandra Krishi Viswavidyalaya was established at Mohanpur, Nadia (Chattopadhyay, 1998). In the present scenario, it is indeed going through significant changes and it is clear that this

*Corresponding author email id: tanushreesaha94@rediffmail.com

has major implications for agricultural education and research also. This sector has been evidenced increasing women's role and participation and also the rising opportunities in agriculture over the years. The role of women farmers cannot be ignorable otherwise it will hamper the overall growth of the developing states (Priyanka *et al.*, 2020). This may be attributed to gender dynamics in agriculture that is poised for a good amendment, notably within the context of adjusting socio-economic, institutional, policy and natural surroundings.

The proportion of women agricultural workers who recognized about seventy per cent of total women workers in 2001 lessened to sixty-five per cent in 2011 (ICAR, 2019). On the opposite hand, the share of women in total agricultural workers that exhibited an upward trend till 2001 declined to regard thirty-seven per cent in 2011. The direction and extent of amendment across Indian states additionally vary widely. Moreover, women in India are subject to varied kinds of inequality that reduce the pace of their progress (ICAR-CIWA Annual Report, 2019).

In twenty first century, we are observing that for sixty to eighty decades, there were no opportunities for girls to pursue agriculture. But from the last part of eighty decades, a small percentage of girl students took admission in the stream of agriculture. However, in the last ten years, we have observed from 10 per cent to 40 per cent increase in the population of girls in the stream. More women's participation in the grassroots level sectors like education and research is the only way of reducing gender discrimination and improving the societal condition of the nation.

As there is a positive trend in enrollment of girl students in Agriculture in India over the past two decades their opinion, perception and preferences matter a lot for improving the agricultural education of the country. Another study also revealed that the increasing practical oriented classes, intellectual faculties as well as students supporting academic learning programmes are quite effective in retaining graduate students in higher agriculture education (Kumar and Kumar, 2020). In this context, the current study aims to capture the opinions, perceptions and suggestions of the girl students regarding agriculture education.

MATERIALS AND METHODS

Bidhan Chandra Krishi Viswavidyalaya was chosen for the study purposively from five agricultural institutions (three public and two private) of West Bengal. The study was conducted in Matangini Abas (Undergraduate Ladies Hostel) of the university. A questionnaire was prepared to collect the information regarding their opinion on agriculture education. One hundred and fifty girl students had responded out of 180 total undergraduate girl students after three reminders in the year 2020 (January-February). Descriptive statistical analysis like frequency and percentage were used for this study.

RESULT AND DISCUSSION

Analysis of the study revealed that majority of the girl students *i.e.* 105 students (70%) have come from urban settlements and the rest are from rural areas (Table 1).

Table 1: Residential area of the students (N = 150)

Residential area	Frequency	Percentage
Urban	105	70
Rural	45	30

Regarding the source of income of their family, it is clear that 76 per cent or 114 girl students are from families having service background. 16 per cent i.e. 24 students are from families whose occupation was business and only 12 (8 per cent) students are from families having an agricultural background, which is depicted in Table 2.

Table 2: Source of income of their family (N=150)

Source of income	Frequency	Percentage
Service	114	76
Business	24	16
Agriculture	12	8

Table 3 reveals that the educational background of the head of the families of the girl students is very good.80 per cent of the head of the families have education up to graduate level and above,14 per cent of head of the families are up to higher secondary level, 4 per cent are up to Madhyamik level and 2% belong up to primary level.

Table 3: Educational background of the head of the family of the students (N = 150)

Family education	Frequency	Percentage
Graduate and above	120	80
Upto Higher Secondary	21	14
Upto Madhyamik	6	4
Upto Primary	3	2

From Table 4, it is clear that most of the girl students (70%) expressed their views as they consider agriculture education as a technical course due to secure and prosperous job. According to them, in agriculture job opportunity is more than general education. Further, it revealed that 20 per cent of respondents wanted to have higher education as this sector has better scope for higher education. Unfortunately, only 10 per cent of students are interested in the agricultural stream to serve for the development of agriculture because they believe that agriculture can change the condition of the country positively.

Table 4: Reasons behind the interest in agriculture education (N = 150)

Particulars	Frequency	Percentage
Job security	105	70
Higher education	30	20
Serve for development of agriculture	15	10

Regarding the availability of information (Table 5), 72 per cent of sources of information and inspiration about agriculture education to the girl students are teachers and parents. Relatives and neighbours serve as a good source of information and inspiration (20%) and very few (8%) of students have got information from mass media.

Table 5: Availability of information about agriculture education (N=150)

Availability of information	Frequency	Percentage
Teachers and parents	108	72
Relatives and neighbors	30	20
Mass media	12	8

From Table 6, it is clear that the majority (96%) of girl students would like to join the government sector for agricultural services because they are more secure. 2 per cent of students are interested in the private sector and the rest 2 per cent students are interested in farming.

Table 6: Type of profession desired by students (N = 150)

Type of profession	Frequency	Percentage
Govt service	144	96
Private sector	3	2
Farming	3	2

It is well known that better learning ensures students satisfaction. 96 per cent of girl students having a positive attitude about the present agricultural education system and only 4 per cent of students' attitude is negative in this regard which is depicted in Table 7.

Table 7: Distribution of students according to their degree of attitude towards agriculture education (N = 150)

Attitude	Frequency	Percentage
Positive	144	96
Negative	6	4

Table 8 portrays that 69.44 per cent of girl students have positivity in their attitude because of having better job opportunities whereas 20.14 per cent of students show positiveness in their attitude as it has flexible and fascinating subjects and 10.42 per cent of students having a positive attitude as it improves their farming performance.

Table 8: Reasons behind positive attitude about the agricultural education (N = 144)

Particulars	Frequency	Percentage
Job security	100	69.44
Interesting and versatile subject	29	20.14
Improves farming performance	15	10.42

Very few girl students showing negativeness in their attitude, out of 6 respondents 3 of them cited poor infrastructure of the University and another 3 students opined that unnecessary subjects are taught in some of the semesters which is shown in Table 9.

Table 9: Reasons for negative attitude about agricultural education (N = 6)

Particulars	Frequency	Percentage
Poor infrastructure	3	50.0
Some subjects felt as unnecessary	3	50.0

In Table 10, it is clear that 68 per cent of girl students are satisfied and the rest are unsatisfied. Students are satisfied because the teachers are helpful in every situation, well-equipped laboratory, appropriate class timing etc. Rest of the students (48%) is not satisfied because of lack of administrative control, delay in result declaration, inappropriate library facility, coverage of huge syllabus within a short time etc.

Table 10: Opinion about present agricultural education (N = 150)

Opinion	Frequency	Percentage
Satisfied	102	68
Unsatisfied	48	32

The Suggestions of the girl students for the advancement of their present academic situation is presented in Table 11. According to the responses given by girl students, 68 per cent suggest for more field-oriented and practical oriented course curriculum (rank I), which may be beneficial for the capacity building of the students. Followed by more time for library and doubt clearing classes (60%, rank II), safe working environment in laboratory (56 per cent, rank III), Easily understandable content as class note (50%, rank IV), Appropriate use of vocabulary and terminology in the class (40%, rank V), More clarification of abstract concepts with examples (36%, rank VI), Enjoyable and interesting contents (30%, rank VII) respectively. On the other hand, it also clearly depicted that the students give the least priority to the suggestions like Contents related to syllabus (rank VIII), Compact and revised course-curriculum (rank IX) and Frequent and varied learning activities apart from classes (rank X).

The suggestions of the girl students related to infrastructural improvement and policy interventions is presented in Table 12. Provision of UG scholarship got the highest priority (rank I) followed by Adequate space for hostel accommodation, Improvement hostel amenities relevant to girl students (rank III), Special focus on placement process for girls (rank IV), Betterment in security facility in hostel and campus (rank V), Cheap canteen facility in the campus (rank VI), Equal opportunity for boys and girls (rank VII) and Good relationship with teachers and students (rank VIII).

CONCLUSION

Agriculture education is now in the process of development along with the fast-changing nation. The present study helps to get different opinion and attitudes of girl students

Table 11: Suggestions of the girl students related to academic improvement (N = 150)

S.No.	Suggestions	Frequency	Percentage	Rank
1	More field oriented and practical oriented course curriculum	102	68	I
2	Suitable time for library and doubt clearing classes	90	60	II
3	Safe working environment in laboratory	84	56	III
4	Easily understandable content as class note	75	50	IV
5	Appropriate use of gender sensitive vocabulary and terminology in the class	60	40	V
6	More clarification of abstract concepts with suitable examples	54	36	VI
7	Enjoyable and interesting contents	45	30	VII
8	Contents related to syllabus	36	24	VIII
9	Compact and revised course-curriculum	30	20	IX
10	Frequent and varied learning activities apart from classes	27	18	X

Table 12: Suggestions of the girl students related to infrastructural improvement and policy interventions (N = 150)

S.No.	Suggestions	Frequency	Percentage	Rank
1	Provision of UG scholarship	108	72	I
2	Adequate space for hostel accommodation	102	68	II
3	Improvement hostel amenities relevant to girl students	96	64	III
4	Special focus on placement process for girls	60	40	IV
5	Betterment in security facility in the hostel and campus	48	32	V
6	Cheap canteen facility in the campus	24	16	VI
7	Equal opportunity for boys and girls	18	12	VII
8	Good relationship with teachers and students	15	10	VIII

regarding agricultural education. It has been found that a greater number of girl students are coming from service holding family, with higher educational background. In most cases, their source of information about agriculture education and inspiration is the teacher and parents. Maximum girl students choose the curriculum for better job security. They desire for Govt. agricultural job and finally, most of the girl students are satisfied with the present education system. Although agriculture education should be developed in such a way that more emphasize should be given on human resource development. The university authorities should also take care their suggestions as in most of the decision making bodies their priorities and preferences are often ignored and less heard.

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Farm Profitability of Osmanabadi Goat Keeping Households in Latur Region of Maharashtra

Abhishek Randhave[1], Narendra Khode[1]*, Sharad Avhad[1], Sudhakar Awandkar[1] and Santosh Pathade[2]
[1]College of Veterinary and Animal Sciences, Udgir Dist. Latur, Maharashtra
[2]College of Veterinary and Animal Sciences, Parbhani Dist. Parbhani, Maharashtra

ABSTRACT

The present ex-post-facto study was conducted to examine the profitability of Osmanabadi goat-keeping households in purposively selected Latur and Osmanabad districts. A total of 120 goat keepers were equally selected across both districts using the multistage random sampling technique. The data was collected by personal interview method using a pre-tested semi-structured interview schedule. The study revealed that the annual net return from goat rearing was Rs. 18469 in small, Rs. 27039 in medium, and Rs. 44350 in large goat keepers. Goat keeping was low input-intensive in the study area. Osmanabadi goat keepers obtained maximum returns through the sale of goat kids, whereas milk and manure were unexplored and underutilized sources of income. An increase in net returns over total cost was increased with an increase in flock size and the adoption of scientific management practices. However, the net returns per goat per annum decreased linearly with an increase in flock size. Efforts are needed to improve the adoption of scientific management practices and; explore goat milk and manure as sources of income to fetch better profit by Osmanabadi goat-keeping households.

Keywords: Cost, Investment, Osmanabadi goat keeper, Profitability, Returns

INTRODUCTION

India ranks second in goat population (148.88 million), contributing 27.79 per cent share among other livestock. This sector shares 14 and 3 per cent of total meat and milk production (GOI, 2019). Goats contribute significantly to the Indian economy by sustaining livelihood and supplementing small, marginal, and landless rural mass income. Generally, few local goats are kept by rural people as a source of additional income, insurance against income crises, crop failure, etc. Most people in rural areas rear goats for their subsistence purposes to support the livelihood of families (Singh *et al*., 2014). Goat has one of the most inclusive growth rates among livestock, and rural resource-poor farmers preferred goat rearing as an option for self-employment. Goat is a vital food animal due to its short inter kidding period and higher prolificacy. The most widely adopted goat rearing activity in the country has the potential of an excellent source of income for the rural poor. Osmanabad and Latur districts are the home track of Osmanabadi goat and had around 94 per cent of Osmanabadi goat population of the Latur region (GOM, 2007). Osmanabadi goat is a hardy, dual-purpose breed having well adaptability under adverse climatic conditions and is generally reared for meat purposes and, to some extent, for milk (Raskar *et al.,* 2018). Many studies had conducted to assess the cost, returns, and profitability of goat rearing (Kumar, 2007; Kumar *et al*., 2011; Chavan *et al*., 2015; Dixit and Singh, 2018). The current study was undertaken to examine the profitability of Osmanabadi goat keeping in the Latur region of Maharashtra and the factors determining profitability.

MATERIALS AND METHODS

The present ex-post-facto study was conducted purposively in selected Osmanabad and Latur District of Latur region in Maharashtra. Osmanabad and Latur districts are home tracts of Osmanabadi goat. Multistage random sampling technique was used, and in the first stage, two talukas from each district were randomly selected viz. Bhum and Umerga (Osmanabad district), Ahmedpur and Udgir (Latur district). Then five villages from each taluka and six Osmanabadi goat-keeping households were

*Corresponding author email id: khodenarendra@gmail.com

randomly selected from each village. The person belonging to the Osmanabadi goat-keeping household, who had control over the decision and operations of the goat farm, was the respondent. Thus, a total of 120 goat keepers were the sample size for the study. Profitability was ascertained following the procedure of Dixit and Singh (2018) and collected responses on a recall basis towards investment, fixed expenses, variable expenses, and receipt through output per year in rupees. Besides this, the investigator collected information about the socio-economic profile of Osmanabadi goat keepers. Using a pre-tested semi-structured interview schedule field survey was conducted during December-January, 2020-2021. The value of the stock, cost of goat sheds, equipment was grouped under fixed investment. The interest rate on fixed cost was assumed to be 10.5 per cent, depreciation on shed at five percent, and depreciation on equipment 10 percent to ascertain the fixed cost. Variable costs included expenses over dry fodder and concentrate, grazing charges, veterinary and miscellaneous expenses. After data collection, these respondents were further grouped into small (2-5.35 Standard Goat Unit), medium (5.35-8.70 SGU), and large (8.70-18.75 SGU) goat keepers using the cumulative square root frequency method. The standard goat unit was worked out by assigning one SGU to each adult doe and buck, ½ SGU to each kid that had an age between 3 to 6 months, and ¼ SGU to each young kid below 3 months of age.

RESULTS AND DISCUSSION

Average investment, expenditure and returns of Osmanabadi goat farming: The results (Table 1) revealed that major investment (73.4%) was made on the purchase of goat stock, followed by shed construction (19.7%) and equipment purchase (6.9%). Investment per goat was highest in small and lowest among large goat keepers. Dixit and Singh (2018) reported major investment by goat keepers on the purchase of goats and the highest investment per goat in small flock size. The reason might be the distribution of investment over large flock units. Under variable cost, expenses over feed/fodder and grazing increased with the increase in flock size. Veterinary expenses were as equal as expenses over dry fodder and concentrate. It might be due to the less input-intensive goat rearing system followed by the respondents and lower expenditure made over the feed and fodder, the share of veterinary expenses in variable cost was high (34.9%). Kumar *et al.* (2011) demonstrated that the actual cost of goat rearing was very low. Interest on fixed capital accounted for most of the expenses (86.2%) among non-recurring costs, followed by non-cash costs, including depreciation on shed (8.1%) and depreciation on equipment (5.7%).

Total cost increased with the increase in the flock size. Overall, the average total cost per goat was Rs. 1366. The maximum return was found from the sale of goat kids (95.7%) across the flock size. The return obtained through the sale of milk and manure was merely 4.4 per cent. Milk and manure were unexplored and underutilized areas of goat production activity in the investigation area. Goat sale was the major mean of obtaining returns, as reported by Kumar (2007). Total, per annum return from goat rearing among different categories of goat keepers was Rs. 23987 in small, Rs. 36580 in medium, and Rs. 60344 in large goat keepers. Similar findings were recorded by Nandi *et al.* (2011); Braj *et al.* (2012); Prasad *et al.* (2013); Chavan *et al.* (2015) and Sabapara (2016). Overall, the annual net return over gross cost was Rs. 28941 per household and Rs. 4145 per goat. Similar findings were reported by Dixit and Singh (2018). However, the net returns per goat per annum decreased linearly with an increase in flock size due to inadequate management by large flock keepers. Prasad *et al.* (2013) also observed a similar trend in Uttar Pradesh.

Application of One-way ANOVA revealed a highly significant difference in average net return over total cost across all groups of goat keepers [$F(2) = 68.37^{***}$, $P=0.000$]. Bonferroni post-hoc test revealed highly significant pairwise mean differences between small and medium goat keepers, with an average difference of Rs. 8570, between medium and large goat keepers with an average difference of Rs. 17311 and between small and large goat keepers, with an average difference of Rs. 25881 in annual net return over the total cost. It indicated that large flock owners generated higher income than small and medium goat keepers.

Determinants of profit in Osmanabadi goat farms: Multiple regression analysis was carried out in order to assess the contribution of independent variables in generating a net return through goat rearing. In the first stage of multiple regression analysis (Table 2), an entire set of 13 independent variables were considered. Out of these variables, only flock size and adoption of scientific goat management practices had positive and highly significant influence over the net return of goat keepers. Contrary to these findings, Kumar (2007) didn't find a relationship

Table 1: Average investment, expenditure and returns of Osmanabadi goat farming (household/year in Rs.)

Particulars	Goat keepers			Pooled
	Small (n=38)	Medium (n=50)	Large (n=32)	(N=120)
Investment on goat farming (Rs.)				
Goat	13645(75.0)	21880(72.1)	31313(73.9)	21788 (73.4)
Shed	3342 (18.4)	6460 (21.3)	7923 (18.7)	5863 (19.7)
Equipment	1195 (6.6)	2000 (6.6)	3134 (7.4)	2048 (6.9)
Total investment	18182	30340	42370	29698
Investment/goat	4533	4406	3754	4272
Variable cost (Rs.)				
Dry fodder and concentrate	1000 (30.1)	1939 (33.2)	3912 (36.1)	2168 (34.0)
Grazing charges	674 (20.3)	1100 (18.9)	2769 (25.6)	1410 (22.1)
Vet. expenses	1223 (36.8)	2306 (39.5)	3283 (30.3)	2223 (34.9)
Misc. expenses	426 (12.8)	488 (8.4)	872 (8.0)	571 (9.0)
Total variable cost	3323	5832	10835	6372
Fixed cost (Rs.)				
Interest on fixed capital[1]	1909 (86.9)	3186 (85.9)	4449 (86.3)	3118 (86.2)
Depreciation on shed[2]	167 (7.6)	323 (8.7)	396 (7.7)	293 (8.1)
Depreciation on equipment[3]	119 (5.4)	200 (5.4)	313 (6.1)	205 (5.7)
Total fixed cost	2196	3709	5158	3616
Total cost	5518	9541	15993	9988
Cost per goat	1338	1382	1373	1366
Total returns and net return from goat farming (Rs.)				
Sale of kid	23447(97.7)	35090 (95.9)	56984 (94.4)	37242 (95.7)
Sale of milk	447 (1.9)	910 (2.5)	1797 (3.0)	1000 (2.6)
Sale of manure	92 (0.4)	580 (1.6)	1563 (2.6)	688 (1.8)
Total return	23987	36580	60344	38929
Net return over total cost	18469	27039	44350	28941
Net return per goat	4748	3965	3711	4145

[1]Interest on fixed cost at 10.5% interest rate, [2]Depreciation on shed at 5%, and [3]Depreciation on equipment at 10%.
Figures in parenthesis indicate percentage to total
One-way ANOVA (Net return over total cost) F (2) =68.37***, P=0.000

between goat flock size and system of management with net returns. It further revealed that age, gender, experience in goat farming, and mass media use were non-significant but had positive regression co-efficient, reflecting their contribution to goat keeper's net return. Soodan *et al.* (2020) revealed a positive and significant influence of goat farming experience over income generation. Training participation did not directly affect income from goat farming. However, Dhara *et al.* (2016) showed the effectiveness of training in earnings from goat rearing. The coefficient of multiple determinations (R^2) was found to be 0.789, which was highly significant. It indicated that 78.90 per cent of the variation in the net return of goat keepers across all flock sizes was due to the combined influence of 13 independent variables taken for the study.

Optimum model of multiple regression analysis: Furthermore, to identify a set of independent variables contributing maximum net return among goat keepers, stepwise multiple regressions (Table 3) with backward elimination procedure was carried out. The analysis indicated that out of thirteen variables, two variables were identified as the most contributing factors towards the net return of goat keepers. It showed that flock size and adoption of scientific management practices together were able to predict 77.40 per cent variability in generating a net return through goat rearing activity. It was quite interesting

Table 2: Linear estimates of determinants in net returns of Osmanabadi goat farm

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	S.E.	Beta		
(Constant)	-11.507	7.606		-1.513	.133
Age	.010	.093	.006	.105	.917
Gender	-.504	1.429	-.018	-.353	.725
Education	-.067	.766	-.005	-.087	.931
Land holding	-.176	.390	-.024	-.450	.654
Experience in goat farming	.075	.189	.022	.399	.691
Use of mass media	.539	.489	.057	1.102	.273
Extension agency contact	-.271	.544	-.025	-.498	.620
Training participation	-1.264	2.128	-.031	-.594	.554
Flock size	3.308	.283	.840	11.673	.000
Production system	.338	.290	.059	1.166	.246
Rearing system	-.790	.820	-.046	-.963	.338
Adoption of scientific management practice	.300	.092	.179	3.251	.002
Investment	-4.146	.000	-.045	-.713	.477

R=.888; R^2 = .789; *F*=30.54***; (*P*=.000, df=13)

Table 3: Optimum model of multiple regression analysis with independent variables influencing net return of Osmanabadi goat farm

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	S.E.	Beta		
(Constant)	-7.947	3.742		-2.124	.036
Flock size	3.189	.184	.810	17.295	.000
Adoption of scientific management practice	.273	.079	.163	3.473	.001

R=.880; R^2 = .774; R^2 change = -0.004; *F* =199.95*** (*P*=.000, df=2)

to note that eliminating eleven variables from the regression model resulted in a minor reduction in R^2 value, and the decrease was -0.004. This particular result highlighted the major contribution of flock size and adoption of scientific management practices in goat farm return with positive regression co-efficient. These two contributory variables may serve as a baseline in manipulating the net return of goat keepers.

CONCLUSION

The major investment of Osmanabadi goat keepers was in the purchase of goat stock. Recurring expenses over dry fodder and concentrate were found proportionately low compared to veterinary expenses. They obtained maximum returns through the sale of goat kids, whereas milk and manure were unexplored and underutilized sources of income. An annual net return of goat rearing was Rs. 18469 in small, Rs. 27039 in medium, and Rs. 44350 in large goat keepers. An increase in returns was observed with an increase in flock size and the adoption of scientific management practices. Efforts are needed to improve the adoption of scientific management practices among Osmanabadi goat keepers. They need to be educated about health management practices and in minimizing veterinary costs. Milk and manure should be explored and mobilized as sources of income to fetch a better profit.

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Vulnerability of Farmers to Livelihood Insecurity due to Climate Change: Experiences from South India

T.P. Anseera[1]*, Jiju P. Alex[2] and T.K. Ajitha[3]
[1]Ph.D. Scholar, [2]Professor, [3]Associate Professor, College of Agriculture, Thrissur, Kerala Agricultural University, Kerala

ABSTRACT

Assessing vulnerability to climate change is very important in mainstreaming climate resilient agricultural development in any country. Though climate change is a global phenomenon, its impacts would be highly location specific. Therefore, assessing regional vulnerability is essential for designing specific interventions to build resilience of communities. This paper focuses on the status of livelihood vulnerability of farming communities in two most vulnerable districts in the state of Kerala, South India and the various factors that affect it. Livelihood Vulnerability Index (LVI) method based on balanced weighted average was employed to assess the extent of vulnerability of households. This index would help identify vulnerable communities, understand factors contributing to vulnerability at community level and prioritize potential interventions applicable to policy makers, local authorities and development organizations. This shall also be used to decide adaptation investments specific to more vulnerable regions based on decentralized and participatory approaches. LVI was assessed based on socio-demographic profile, livelihood strategies, social network, crop health, food and nutrition, natural disaster and climate variability with various sub-components. The study revealed that access to water was the most significant factor that rendered an area vulnerable. Linear discriminant analysis showed that livelihood strategies, social network and crop health were the major factors that would differentiate the sample of farmers as vulnerable and non-vulnerable. The major issues that contributed to vulnerability were 'crop loss due to climate change' followed by 'pest and disease incidence due to climate change' and 'weak social participation'. The results emphasized the need to assess vulnerability of communities to climate change and livelihood security at the micro level, as mitigation strategies are to be specific to local characteristics and requirements.

Keywords: Climate change, Discriminant analysis, Livelihood vulnerability index, Resilience, Vulnerability

INTRODUCTION

Assessing vulnerability to climate change is very important in mainstreaming climate resilient development in any country. Though climate change is a global phenomenon, its impacts differ from region to region, country to country, sector to sector and community to community (Adger *et al.,* 2003; IPCC, 2012; O'Brien *et al.,* 2012). Therefore, assessing regional vulnerability is a prerequisite for devising specific interventions to build resilience (Rao *et al.,* 2016). Mainstreaming climate resilience into agricultural development can only be possible through site specific practices, which require mapping of vulnerability (Sharma, 2014).

Since vulnerability varies according to socio-economic and institutional development (Heltberg *et al.,* 2009), its assessment should be based on the characteristics of the vulnerable system spanning over physical, economic and social factors (Fussel, 2007). Reviews reveal that vulnerability of agricultural production systems to climate change is analyzed by means of socio-economic approach, integrated approach or biophysical approach (Ravindranath *et al.,* 2010; Palanisami *et al.,* 2010; Pandey and Jha, 2012; Aryal *et al.,* 2013; Etwire *et al.,* 2013; Shah *et al.,* 2013; Sridevi *et al.,* 2014).

As stated earlier, assessment of vulnerability at micro level would be highly helpful in designing location specific strategies for mitigation at the community level as well as individual level. Further, identification and analysis of the adaptation mechanisms evolved in response to climate change in different specific environments would help fine-tune the strategies for up-scaling them with research and

*Corresponding author email id: anseera-2019-21-042@student.kau.in

policy focus (Ranganathan *et al.,* 2010). It has been observed that in India that analysis of vulnerability to climate change at the district level is of utmost importance, since most of the development planning and programme implementation are done at the district level (Rao *et al.,* 2016). This necessitates that many strategies would be required to address the impact of climate change at different levels (Reddy *et al.,* 2010; Schubert, 2015; Mutamba, 2016). For instance, redesigning of rainwater harvesting structures and strategies to handle higher runoff in a shorter period would be an effective strategy in places where there is water scarcity (Rao *et al.,* 2016). Similarly, community seed banks could enhance the resilience of farmers, communities and households that were most vulnerable to climate change (Vernooy *et al.,* 2017).

It was in this backdrop this study attempted to assess the extent of vulnerability of the farming community to climate change in selected villages in two districts in Kerala which have recorded history of extreme climatic conditions. Magnitude of vulnerability was estimated in terms of an index developed exclusively for this purpose, adopting the technique developed by Hahn *et al.* (2009) and modified by Panthi *et al.* (2015), with replacement of some indicators to suit the local context. Later, LVI was used by many researchers in different contexts (Pandey and Jha, 2012; Aryal *et al.,* 2013; Etwire *et al.,* 2013; Shah *et al.,* 2013).

Livelihood Vulnerability Index (LVI), as it is termed, was computed using primary data from households combined with data obtained from secondary sources. To be more precise, this index comprised various parameters of livelihood security at the household level as well as vulnerability indicators at the macro level. LVI is regarded as a practical method to understand the demographic, social and other related factors contributing to the impact of climate change on means of livelihood, particularly with respect to farm and farm household. This estimate of vulnerability of a community to livelihood insecurity as a fall out of climate change would help us assess the relative vulnerability status of specific locations and the interventions required thereof.

MATERIALS AND METHODS

The study followed ex-post facto design to assess the factors and impact as mentioned earlier. Data on the components that contribute to livelihood insecurity as a result of climate change were collected through personal interviews. The locales for the study were Palakkad and Wayanad districts of Kerala, South India. These areas were selected purposively, based on the incidence of severe climate change in terms of excessive rain and drought, and its reported impact on agriculture. Data from the farming community were collected through structured interview schedule and focused discussions with farmers. Secondary data on climate parameters and other indicators were collected from the grama panchayath (village local body) level offices of the department of agriculture and research stations of the Kerala Agricultural University.

Out of the 95 grama panchayat level offices in Palakkad and 27 offices in Wayanad, ten were selected in the proportion of 7:3 from these districts respectively. From each of the ten grama panchayaths thus selected, 10 prominent farmers were randomly selected to form sample of 100 farmers. The sample also included 40 extension officials to obtain information on the extent of climate vulnerability and its impact on livelihoods in the study area as experienced by them.

As stated earlier, Livelihood Vulnerability Index (LVI) which integrates primary data from households and data from secondary sources was calculated to find out the vulnerability of the livelihood options of farming community to climate change. Being an index that measures vulnerability of livelihoods of the farming community to climate change, it reflects on individual socio-economic variables as well as risks emanating from flooding, temperature and rainfall experienced across the area over a period of time. Specifically, LVI comprises eight major components: socio-demographic profile, livelihood strategies, social networks, crop health, food, access to water, natural calamity risks and climate variability. Indicators of these components were selected based on extensive review of literature and consultation with experts.

RESULTS AND DISCUSSION

As stated earlier, eight major components and 27 sub components were considered for calculating LVI of the districts and the villages selected for the study. The results showed that Palakkad district (0.14) had a higher LVI than Wayanad district (0.12), indicating that the farming community in Palakkad had greater vulnerability to the deleterious impact of climate change than the farmers in Wayanad. The value of sub-components of LVI calculated for the two districts are given Table 1.

Table 1: Value of the sub components of LVI of Palakkad and Wayanad districts

Sub-components	Sd Palakkad	Sd Wayanad
Socio-demographic profile		
Percentage of dependent people (<15 years and >60 years)	0.37	0.30
Percentage of female headed households	0.00	0.10
Percentage of household where head of the household is illiterate male with >50 years of age	0.67	0.66
Livelihood strategies		
Percent of households which reported change in sowing/planting time	0.92	1.00
Percent of households who had changed to new crop variety/ new crop	0.57	0.50
Percent of households depending solely on agriculture as a source of income	0.91	0.77
Average agricultural livelihood diversification index	0.50	0.37
Social network		
Percent of household not having access to communication media	0.00	0.00
Percentage of household not having access to local govt. services	0.00	0.00
Percent of household not having access to institutions to purchase of seeds/seedlings	0.00	0.00
Percentage of household not associated with any organizations (cooperatives/ groups)	0.00	0.23
Crop health		
Percent of household reported pest and disease incidence due to climate change	0.90	0.93
Percent of household reported stress due to climate factors	0.95	1.00
Percent of household reported crop loss (>50 %) due to pest/disease incidence	0.91	0.93
Percentage of household not practicing INM	0.17	0.00
Percentage of household not adopted IPDM	0.25	0.40
Food		
Percentage of household not saving seeds	0.00	0.00
Percentage of household with decreasing production	0.94	1.00
Percentage of household depending solely on family farm for food	0.30	0.20
Water		
Average number of water sources to a household	0.60	0.40
Percentage of households with problem for access to irrigation water	0.81	0.80
Percentage of household having persistent water supply	0.44	0.53
Percentage of household affected due to water stress	0.92	0.73
Natural disaster		
No of flood events since 2009	0.80	0.50
No of drought events since 2009	0.40	0.30
Climatic variability		
Mean standard deviation of monthly average of average maximum daily temperature since 2009	0.43	0.20
Mean standard deviation of monthly average of average minimum daily temperature since 2009	0.57	0.19

The aggregate value of major components of LVI computed from the components listed above for the two districts are given in Table 2. Though different components were found to be predominantly decisive in these two districts, Palakkad was found to be more vulnerable to climate change as indicated by the aggregate LVI. Palakkad district was more exposed to extreme natural calamity such as frequent flooding of agricultural fields in erratic monsoon showers, average maximum daily temperature and average minimum daily temperature. As evident from Table 2, the farming community of Palakkad district was more vulnerable to livelihood insecurity owing to the greater

Table 2. Major components of LVI calculated for the two districts

Major components	Md Palakkad	Md Wayanad
Socio-demographic profile	0.347	0.353
Livelihood strategies	0.725	0.660
Social network	0.000	0.058
Crop health	0.636	0.652
Food	0.413	0.400
Water	0.693	0.615
Natural disaster	0.600	0.400
Climatic variability	0.500	0.290
LVI	**0.14**	**0.12**

possibilities of non-availability of food and water, occurrence of natural disasters and extreme climatic variability. Meanwhile, the farming community in Wayanad was found to be vulnerable due to the socio-demographic status of the farmers, which was determined by percentage of independent people in households, number of female headed households, literacy of the male household head and percentage of dependent people.

Wayanad was also found to be vulnerable in terms of inadequate social network and lesser crop health. However, social network was not found to be a decisive factor in determining livelihood vulnerability in Palakkad, which could be a reflection of the better interaction of the farming community with extension agencies and various other information and communication sources as understood from the survey.

Even earlier, Palakkad was found to be more drought prone compared to Wayanad. Both the districts had been identified as medium vulnerable districts by Rao *et al.* (2016), while assessing district level vulnerability of agriculture to climate change throughout India. However, a close analysis of the component indices showed the factors that were decisive in determining vulnerability to livelihood insecurity due to climate change in these districts.

Socio-demographic profile: That poor socio-economic status and prominence of vulnerable groups in the population may lead to higher vulnerability to livelihood insecurity (Kandlinkar and Risbey, 2000; Adger *et al.,* 2003; O'brien *et al.,* 2012; Ahmed, 2013) is a proven fact. The components of the measure of socio-demographic profile in this study included percentage of dependent people, percentage of female headed households and percentage of households with illiterate male of more than 50 years of age. Areas with more of these characteristics are probably more vulnerable to livelihood insecurity. It was found that Palakkad district had slightly higher indices of households with dependent people and percentage of households with illiterate male of more than 50 years age as head of the family. However, Wayanad showed slightly higher index scores on percentage of female households. Aggregate scores showed that Wayanad district had higher vulnerability in terms of socio-demographic profile of the sample selected.

Livelihood strategies: Out of the different components that constituted the LVI, livelihood strategies had an index value of 0.492 in both the districts. This observation reiterates the statement (Wassmann *et al.,* 2009 and Can *et al.,* 2013) that higher vulnerability index in livelihood strategies could be due to high numbers of households depending on agriculture as major source of income, lack of non-farm activities and joblessness during heavy rains. In this case, index of livelihood strategies was computed from discrete indices of variables that contributed to the livelihood options of farmers. The observations primarily included percentage of households which reported change in sowing or planting time, implying that there had been strategic changes in cultivation; percentage of households who had changed to new crops; percentage of households depending solely on agriculture as a source of income and agricultural livelihood diversification by means of other enterprises. While the index of changes in cultural practices like sowing/planting time was more in Wayanad (1) compared to Palakkad (0.92), index of changes in crop varieties was slightly higher in Palakkad (0.57). While the index of dependence of farmers on agriculture as the only source of livelihood was more in Palakkad, index of diversification of agricultural livelihood was found to be higher in Wayanad (0.5), as majority of the farmers were found to possess livestock- either poultry alone or cattle and poultry.

This is evident from the practices followed by farmers in response to climate change. Farmers in Palakkad (92 per cent) reported that they had changed time of paddy sowing in *viruppu* (southwest monsoon) and *mundakan* (northeast monsoon) seasons in response to the delay in rains. Farmers in Palakkad district used to postpone paddy sowing to avoid flooding in the first crop season *(viruppu;* April-May to September-October) and to mitigate drought during the second crop season (*mundakan*; September-October to December-January). In Wayanad, the first crop

nancha (May-June to Oct-Nov) and second crop *puncha* (Dec-Jan to April-May) paddy were sown earlier by minimum ten days d due to variability in climatic parameters, especially rainfall and temperature.

As a possible way of combating climate change, new crop and crop varieties were found to be adopted by farmers in Palakkad district. Instead of using the most proven varieties viz. Uma and Jyothi that are traditionally cultivated in this tract, farmers switched over to long duration rice varieties which could withstand drought, especially for the second crop. They had also started growing hybrid vegetables with drought tolerance and stress resistance traits. In Wayanad, the coffee plantations were rejuvenated with a varietal selection that had efficient tap root system to mitigate water stress. Diversity index and cropping intensity were found to be the critical factors that decided vulnerability of a farmer to climate change. Maximum integration of allied components like livestock, poultry and apiculture with main crop would decrease the risk factors. The input and income from these auxiliary enterprises would enhance resilience to climate change, thereby decreasing vulnerability.

However, the composite index thus calculated showed that Palakkad districts had higher index value on livelihood strategies. This index value also expressed the fact that 91 per cent of the farmers selected for the study in Palakkad was solely dependent on agriculture as their income source. With regard to livelihood diversification index, Wayanad scored lower (0.37) as 95 per cent farmers were having livestock, either poultry alone or cattle and poultry, and thus the diversification index was lower for Wayanad when compared to farmers in Palakkad, indicating low vulnerability.

Social network: Vulnerability to livelihood insecurity on account of lack of social network was not found to exist among the farmers in Palakkad district. However, it was found to be slightly higher among farmers in Wayanad district as there were farmers who were not members of any farmer group, producer collective or co-operatives. Being actively linked to a social network which supports individual farmers in different ways would reduce vulnerability to livelihood insecurity (Handmer *et al.,* 1999; Meinke *et al.,* 2004; Aggarwal, 2008; Adebayo *et al.,* 2012; Athira, 2017; Raghuvanshi *et al.,* 2017). Almost all the farmers were well connected to local government services, communication networks and institutions providing inputs. In a state like Kerala which has high infrastructure facility and literacy, social isolation would be highly unlikely, except in remote tribal villages. As much as about 93 per cent of the total respondents were either a member or office bearer in local groups/ organization, especially in paddy farmers' collectives or collectives of pepper farmers' and coconut farmers. More than half of the sample respondents were office bearers of any of the above mentioned groups. Thus, the farmers in both the district were found to have more contact with extension officials.

Crop health: Incidence of pests and diseases due to climate change and subsequent crop loss is reported to be on the rise throughout the state. As much as 90 per cent of farmers in Palakkad and 90 per cent in Wayanad had reported increased incidence of pest and diseases. Pest resurgence due to shift in optimum threshold temperature of the pest population had also been reported. For instance, minor pest like coconut whitefly and mites in vegetables had emerged as serious pests as a result of prolonged summer days. Farmers in these two districts were found to explore innovative coping strategies to mitigate the outbreak of new pests and diseases.

Similarly, 95 per cent of the farmers in Palakkad and cent per farmers Wayanad reported ever increasing stress due to climatic aberrations and its ill effects on crop. Though integrated nutrient management (INM) is widely regarded as a means of mitigating climate change, only 17 per cent of the farmers in Palakkad were found to have adopted this practice. With regard to integrated pest and disease management (IPDM). It was found that 75 per cent farmers in Palakkad were found to have adopted IPDM while only 60 per cent farmers in Wayanad had at least partially adopted IPDM as a climate resilient method for managing pests and diseases. Rest of the farmers were found to be more interested in quick and easy measures of controlling of pests and diseases. This trend had reflected on the crop health component of the index, with slightly higher value for Wayanad (0.457) than for Palakkad (0.436).

Food: As regards food security, it was quite impressive that almost cent per cent of the farmers were found to have seed security, either by preserving seeds in own house or as in Registered Seed Growers' Programme (RSGP). The index on percentage of households with decreasing production was more in Wayanad (1.0) compared to Palakkad (0.94), which would be a matter of concern that might have been contributed by the predominance of perennial crops and plantations in the district which show

decline in yields. It was also observed that the index on percentage of households depending solely on family farm was low in Wayanad compared to Palakkad.

Water: Water stress in farming as a component of vulnerability index was more severe in Palakkad, with 92 per cent of the farmers reporting the experience of water stress, compared to that in Wayanad (73%). The monsoon fluctuations, in terms of quantity and time had always put Palakkad paddy cultivation at the mercy of monsoon. As seen in the table, about 81 percent of the farm households reportedly faced problems of access to irrigation water towards the fag end of first crop season. Similarly, 80 per cent of households in Wayanad also faced several problem of access to irrigation water, with 53 per cent of farmers suffering from persistent shortage of water supply. Varghese (2012) found that 30 per cent of the farmers were vulnerable to water shortage for domestic purpose, and more than fifty per cent farmers were vulnerable to water shortage for agricultural purpose in the district of Wayanad in Kerala.

Natural disasters: The index of occurrence of floods since 2009 was more in Palakkad (0.8) than in Wayanad (0.5). In the case of floods as well, the incidence was found to be slightly more in Palakkad (0.4) compared to Wayanad (0.3).

Climatic variability: Indices of climatic variability measured in terms of mean standard deviation of the monthly average of average maximum and minimum daily temperature since 2009 did not show wide variability within the districts. Though Palakkad is in the dry tract and Wayanad is in the high range zone, standard deviation of minimum temperature showed more variation in Palakkad (0.57) compared to standard deviation of maximum temperature (0.43). But the values did not vary much in Wayand district which showed more consistency in climate.

Classifying farmers as vulnerable or non-vulnerable to climate change based on linear discriminant analysis

Linear discriminant analysis was done to find the extent to which a linear combination of identified factors succeeded in differentiating farmers as vulnerable or non-vulnerable to climate change. Table 3 provides information on the discriminant function produced. The maximum number of discriminant functions produced is the number of groups minus 1. Using two groups here, namely 'vulnerable' and 'non-vulnerable', only one function is necessary.

The Eigen values describe how best the functions possess discriminating ability. The percentage of variance is the discriminating ability of the function. The discriminant function evolved in the study could account for 100 per cent of the variance present in the data. The canonical correlation is the multiple correlation between the levels of the dependent variable and the discriminant function. The higher the correlation value, better the function that discriminates the groups. One is considered as perfect. Here in this case, correlation value of 0.823 is comparatively very high (Table 3).

Table 3: Classification of farmers as vulnerable and non-vulnerable based on discriminant analysis

Function	Eigen value	% of variance	Cumulative %	Canonical correlation
1	2.104[a]	100.0	100.0	.823

a. First 1 canonical discriminant functions were used in the analysis

On the other hand, Wilks' lambda indicates the signiûcance of the discriminant function. Table 4. indicates a statistically signiûcant function ($p < .000$) and it would help distinguish between groups which implies that there is statistically significant discriminating power in the variables included in the model. It can be concluded that the group means differ significantly.

Table 4. Distinguishing between vulnerable and non-vulnerable farmers based on Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.322	107.026	7	.000

Standardized canonical discriminant function coefficients were calculated to identify the relative importance of each of the components of LVI (Table 5).

Table 5. Standardized canonical discriminant function coefficients

Components	Function coefficient
	1
Socio-demographic profile (S)	.157
Livelihood strategies (L)	.731
Social network (S)	.665
Crop health (C)	.505
Food (F)	.402
Water (W)	.271
Natural disaster (N)	.384

Out of the seven components, livelihood strategies, with function coefficient 0.731 was the strongest predictor that would classify farmers as vulnerable or not vulnerable to livelihood insecurity due to climate change. Social network (0.665) and crop health (0.505) were the next important predictors in the order of their significance. These three factors with large coefûcients were found to strongly predict classification of farmers as vulnerable or non-vulnerable. Socio demographic profile score that includes subcomponents age, sex and education of the farmers were less successful as predictors. Components like food security, water availability and occurrence of natural disasters were also found to be unsuccessful predictors in classifying farmers based on their vulnerability to livelihood insecurity.

It was also found that the power of the discriminant function used in the study was very high, as 95.7 per cent of the original grouped cases could be correctly classified by the discriminant function adopted (Table 6).

Table 6: Extent of classification of grouped cases by discriminant function

		VAR00008	Predicted Group Membership		Total
			1.00	2.00	
Original	Count	1.00	51	2	53
		2.00	2	45	47
	%	1.00	96.2	3.8	100.0
		2.00	4.3	95.7	100.0

a.96.0% of original grouped cases correctly classified.

As evident from the discriminant function, the livelihood strategies adopted by the farmers is the most important factor that determines vulnerability to climate change. To explain further, livelihood strategies to cope up with climate change aberrations included 'livelihood diversification' by switching over to intercropping or mixed cropping from conventional mono cropping. The strategies can also include alternative income generation activities, changing crop/ varieties to suit the changing climate, particularly by adopting more stress tolerant crops or varieties.

It could be observed that strong social network was an effective mechanism for building up resilience, which would enable farmers to adapt with the changing climate and its consequences on farming. The social network would greatly reduce stress of farmers as community action and group initiatives become apparently easier. Moreover shared information on new technologies and relevant weather forecast would reduce their vulnerability to livelihood insecurity to a considerable extent. When the farmers engage frequently with the extension agency or institutions related to their occupation, social networking will facilitate informed decision making in farming and related enterprises. Among all, social participation or the contact with fellow farmers/ groups was found to be most relevant factor in creating a climate resilient farming community.

It is undoubtedly clear that climate change affects crop health adversely in almost every stage of growth. The uneven and unexpected rainfall and extreme variation in temperature will increase crop stress which eventually results in lower productivity, making the farmer more vulnerable to livelihood insecurity. This will be further worsened by huge crop loss due to the pest and disease outbreak. The equilibrium of pest and natural enemy population will be disturbed by the fluctuation of climate variables resulting in resurgence and frequent outbreaks. This will be accelerated by farmers' ignorance on integrated pest and disease management (IPDM) and their hesitation to adopt such measures.

Determinants of vulnerability to livelihood insecurity

In order to find out the exact level of vulnerability and the sub-components contributing to it, weightage was given to the sub-components that would contribute to vulnerability based on importance perceived by farmers. The selected variables are included in Table 7. Taking 18 variables (sub-components) which had high scores based on their weighted averages of 100 respondent farmers, they were ranked as shown in the Table 8. The least weighted sum scored component was ranked the highest, indicating that sub-component as the major contributing variable towards farmers' vulnerability. The linear discriminant analysis (Table 6) had revealed that livelihood strategies (L) (0.731), social network (N) (0.665) and crop health (C) (.0505) were the major components that discriminated the farmers into vulnerable or non-vulnerable categories. Thus, the sub-components under these three highly discriminating components (sub-components with highest ranks obtained) could be considered from the table 8 as the major variables that contributed to farmer's vulnerability to climate change in the selected districts. Hence, under the identified discriminating major components,

Table 7: Weighted index of the components contributing to farmers climate vulnerability

Sub-components	Weighted sum score	Weigh-tage
Saving seeds (F1)	18	18
Sex (S2)	16.745	17
Persistent water supply (W3)	15.36	16
Access to communication services (N1)	14.22	15
Sources of family income (F3)	13.20667	14
Adoption of IPDM (C5)	11.96	13
Adoption of INM (C4)	10.76	12
Age (S1)	8.983333	11
Institutional support(N3)	8	10
Access to govt. services (N2)	7.0425	9
Climate related stress (C2)	6.006667	8
Livelihood diversification (L4)	**5.226667**	**7**
Climate related water stress (W4)	4.33	6
Access to irrigation water (W2)	3.366667	5
Pest and disease incidence (C1)	**2.653333**	**4**
Reliable number of water sources (W1)	1.99	3
Social participation/ extension contact (N4)	**1.306667**	**2**
Crop loss due to climate change (C3)	**0.6425**	**1**
	149.8	

(livelihood strategies (L), social network (N) and crop health (C)) the sub-components that mostly contributed to farmers' vulnerability were 'crop loss due to climate change' (C3) followed by 'pest and disease incidence due to climate change' (C1),'weak extension contact/social participation'(N4) and livelihood diversification (L4) as evident from the Table 7 (here taking only those sub-components that had obtained weighted sum score below 6).

For farmers who are solely dependent on farming, it is evident that without diversified sources of income frequent climate aberrations would render them highly vulnerable to the deleterious consequences of climate change. This also reiterates the fact that vulnerability of the farming community get aggravated if they have weak social connection from where reliable information are delivered. This could be resolved only by providing means of alternative livelihoods to the farm households. Climate change would impact production systems in several ways, by increasing crop loss either due to issues of pest and disease resurgence, shift in optimum threshold temperature of the pest population or climate related crop stress.

CONCLUSION

Estimation of Livelihood Vulnerability Index (LVI) to assess the vulnerability of regions and communities to consequences of climate change as detailed above has revealed the key factors that contribute to vulnerability of farm households to livelihood insecurity. Since small and marginal farmers are the most vulnerable to climate change, their livelihood options would always be under risk. Though it is a universal issue, we need to address the problems of the less endowed farmers more specifically, considering the features of their production systems and socio economic conditions. Though we ought to design the generic approaches for mitigating climate change, it is more important to find out the specific factors that contribute to vulnerability, as it would be helpful to devise effective interventions to resolve the issues. This illustrative study has reiterated that vulnerability to livelihood insecurity of the farming community in the districts selected for the study could be mainly attributed to climatic variability, natural disaster, water stress and the nature of livelihood strategies adopted by farming community. The study has compared the LVI of these two districts and it has been found that LVI for Palakkad was higher than that of Wayanad. The indexed values for each component and the sub-component varied noticeably among the districts, which would provide insights into the design and implementation of site-specific coping strategies in these districts

Discriminant analysis employed to predict whether a farmer was vulnerable to climate change or not was also found to be very useful in designing interventions both at the household and community levels. As revealed by the study, the variables that predicted the probability of a farmer to be vulnerable were socio demographic profile, livelihood strategies, social network, crop health, food, water and natural calamity. These predictor variables were the major components of livelihood vulnerability index (LVI). Signiûcant mean differences were observed for all the predictors. Further, discriminant function revealed signiûcant association between groups and all predictors, accounting for 67.7 per cent of between group variability. The three major predictors namely livelihood strategies, social network and crop health which contributed substantially to this variability demand new approaches and

strategies based on these factors. The extension systems have to adapt and innovate in view of the key factors that influence vulnerability to climate change.

Since every intervention for sustainable agricultural development will have to address the issue of climate change and its impact on livelihood security, extension system, will have to forge strategies to mainstream climate change into the overall development framework. This would essentially require better understanding of climate change impact, factors contributing to vulnerability and the coping strategies of communities. Assessment of the extent of vulnerability would help design the most appropriate options for building up climate resilience for vulnerable communities.

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Increased Knowledge on Physical Activity Level (PAL) Improves Blood Glucose Level (BGL) of Adult Males with Type-2 Diabetes Mellitus: A Comparative Study from Border-belt of Indian Punjab

Piverjeet Kaur Dhillon* and Balwinder Kumar
Agriculture Science Centre, Guru Angad Dev Veterinary and Animal Sciences University, Booh, Harike Pattan-143412, Tarn Taran, Punjab

ABSTRACT

A tremendous transformation in lifestyle is considerably a reason for progression of metabolic disorders such as type-2 diabetes mellitus for middle-aged population the world over. Moreover, rural masses possess very little knowledge about the association between PAL and Type-2 diabetes mellitus. To manage these type of ailments, physical activity level should be altered on individual basis through employing scientific calculations. Therefore, the present study was planned to assess BMI, PAL, BGL and to study the impact of dissemination of PAL knowledge on BGL of adult males with Type-2 diabetes mellitus. Cluster randomized design was employed to conduct a comparative study (2017-2019) on 300 adult males (aged between 40-80 years) with Type-2 diabetes mellitus from six different villages of district Tarn Taran, Punjab, India and these males were divided equally into two groups i.e. Group I (N=150) (Control) and Group II (N=150) (Experimental, imparted with PAL knowledge). Modified WHO-STEPS questionnaire version 3.01, was worked out to collect data on socio-demographic, BMI and BGL parameters. PAL was calculated through recording activities performed by males by Physical Activity Diary Method (PADM) for three consecutive days. PAL knowledge was tested through knowledge and practice (KP) questionnaire. Collected data was analyzed through applying t-test, paired t-test and One-way ANOVA (analysis of variance) with Tukey's post-hoc test. Results have shown a significant (p<0.05) association between PAL knowledge and BGL. An increase of 5.0 points in mean PAL knowledge scores and a decline of 78 mg/ dL in mean BGL of adult males with Type-2 diabetes mellitus in group II was noted, after implementation of PAL knowledge intervention. In view of above-findings, the current study calls a need for physical activity related knowledge interventions for effective management of Type-2 diabetes mellitus at rural areas.

Keywords: Modified WHO-STEPS questionnaire, BMI, BGL, PAL, PADM, KP Questionnaire

INTRODUCTION

Globally, 8.3 per cent of the total adult population has been living with diabetes (International Diabetes Federation, 2014). As the scenario of diabetes mellitus in India is concerned, as per India State-Level Disease Burden Initiative Diabetes Collaborators (2018), during 1990-2016, the number of persons living with diabetes has increased from 26 million to 65 million, with specific increase of 2.5 per cent in crude prevalence rate for adult males. Furthermore, crude and age-adjusted prevalence rates of diabetes mellitus with reference to overweight have also been observed and a rise of 11.4 per cent from the year 1990 to 2016; depicting the mounting diabetes burden in every state of the country was reported. Continuing these figures, it has also been stated that 38 / 100 Indian overweight adults were living with diabetes and this percentage is of high concern as the world average for the same cluster was reported as 19 per 100 overweight adults (India State-Level Disease Burden Initiative Diabetes Collaborators, 2018).

Contemporarily, Type-2 diabetes mellitus, a major public health concern, accounts for more than 90 percent of all diabetes types. It is known to be caused by insulin resistance and deficient insulin secretion; and is currently considered as a major lifestyle disorder for both affluent and less privileged (Yang *et al.,* 2019). A steep rise has been

*Corresponding author email id: dhillonpiver@yahoo.com

noticed in Indian diabetes epidemic attributed by a rapid socio-economic transition. Therefore, specifically, in rural Indian settings, preponderance of diabetes has been increased from 1.9 to 12 per cent from the year 1994 to 2009, respectively (Misra *et al.,* 2011). It is impertinent to mention that majority (72.2%) of the Indian population resides in rural areas, has minimal access to healthcare services and the rural masses generally overlook key factors (such as dietary lifestyle and physical activity level) for efficacious management of Type-2 diabetes mellitus (Government of India, 2011; Mendenhall *et al.,* 2010).

Apart from healthcare amenities, lifestyle modifying therapies have been recognized as the game changers, with minimal risks and side effects. Physical activity level (PAL) has been considered of chief significance. Uninterrupted physical work outs were proven as a panacea in management of Type-2 diabetes mellitus through endorsement of insulin supply, along with adjusting the Body Mass Index of an individual. Elaborately, on enhanced physical activity level, expression of glucose transporter 4 protein i.e. GLUT4 increases in muscles, resultantly, raises the synthesis of insulin (Dos Santos *et al.,* 2015; Stanford and Goodyear, 2014). Besides, skeletal muscles act as hormonal mediators for physical exercise, release cytokines which regulate energy metabolism and help increasing insulin secretion (Yang *et al.,* 2019). Therefore, PAL can be a predominant modifying factor in management of Type-2 diabetes mellitus. Aiming at curtailment of further rise in Type-2 diabetes mellitus prevalence, a multifaceted approach with an individual level observation and requisite management, is needed to be focused (Little *et al.,* 2017).

MATERIALS AND METHODS

Study Design and Sample Population: A comparative study was undertaken on 300 Punjabi adult males (aged between 40-80 years) with Type-2 diabetes mellitus dwelling in six different villages of Patti block of District Tarn Taran, a North-Western district of Indian Punjab, located near the border of Pakistan, with its predominance for low and middle income groups. The adult males were divided into two groups i.e. Group I (Control) and Group II (Experimental) by employing cluster design (as individual randomization is not possible to a specific geographical area due to biasness, thus, study groups were taken as units from different villages) to study the impact of PAL knowledge on BGL. The study was conducted from November 2017 to March 2019. A written consent was obtained from each respondent before initiation of the study. The inclusion criteria for study population was adult rural males aged between 40-80 years with type-2 diabetes mellitus and having understanding of Punjabi language. These adult males were invited to complete above-designed questionnaire both at the beginning and end of the study.

Development of Questionnaire: A questionnaire with adaption of WHO-STEPS version 3.1 questionnaire (WHO, 2017) was developed in Punjabi language containing questions regarding socio-demographic information *viz.* age, education, socio-economic status; their physical measurements i.e. height and weight and biochemical measurements i.e. blood glucose level (post prandial). Present level of knowledge regarding Physical Activity Level (PAL) was also assessed through knowledge and practice (KP) questionnaire by incorporating a set of 10 multiple choice questions related to physical activity pattern and its implication as a health regimen. One (1) mark was awarded for every correct answer whereas zero (0) point was allotted for each wrong answer. The responses recorded as don't know were expelled from the evaluation process.

Execution of the study: Data on socio-demographic information, physical measurements and biochemical measurements of adult males with Type-2 diabetes mellitus was collected through modified WHO-STEPS questionnaire. Under this process, a team of experts including Medical officer, Health officer, Assistant professor (Home Science), Laboratory technician was formed and underwent through two days training in order to learn and follow the protocol for surveillance to collect data for the study.

Dissemination of knowledge regarding diverse PAL patterns: Detailed knowledge regarding three different PAL patterns was imparted to adult males with Type-2 diabetes mellitus in Group II for 90 days at one week interval to increase their physical activity level.

Reference Methods to collect data: Data vis-à-vis anthropometric measurements, PAL and BGL (post prandial) was collected both at pre and post intervention phases through standard methods as discussed below:

Anthropometric measurements: Height and weight were recorded using standard methods. The height of adult males with Type-2 diabetes mellitus was measured with a stature meter (26SM) in centimeters up to 0.5 cm. accuracy. Besides, adult males with Type-2 diabetes mellitus were

Table 1: Classification of Body Mass Index (BMI)

Classification	BMI (kg/m²) Principal cut-off points
Underweight	<18.50
Normal	18.50-24.99
Overweight	≥25.00
Pre-obese	25.00-29.99
Obese	≥30.00

(WHO, 2004)

weighed on a electronic weighing balance (with capacity of weighing 200 kg) in kilograms (kg) up to 0.1 kg accuracy. Body Mass Index (BMI) of adult males with Type-2 diabetes mellitus was calculated by formulae (WHO 2004) mentioned below and they were further categorized (Table 1) according to their computed BMI.

Physical Activity Level (PAL): Data on physical activity levels was collected by PADM (Physical Activity Diary Method) (FAO/ WHO/ UNU 2004) for three consecutive days. The detailed information related to time allocated to individual task performed under physical activity by each adult male with Type-2 diabetes mellitus was recorded. Then, the obtained data was multiplied with energy cost defined for each activity and the total sum obtained was divided by 24 to get Mean PAL value which was used to categorize adult males with Type-2 diabetes mellitus into three different categories i.e. sedentary, moderate and active (Table 2).

Table 2: Classification of lifestyle in relation to the intensity of habitual Physical Activity Level (PAL)

Category	Physical Activity Level
Sedentary	1.40-1.69
Active	1.70-1.99
Vigorous	2.00-2.40

(FAO/WHO/UNO, 2004)

Blood Glucose Level (BGL): Serum samples of adult males with Type-2 diabetes mellitus were drawn by finger-pricking and analyzed using blood glucose monitoring system (Dr. Morepen GlucoOne BG 03) by a trained laboratory technician to assess post prandial blood glucose level.

Statistical Analysis: t-test and paired t-test using GraphPad Prism software version 5.01 were applied to analyze the mean difference between heights and body weights of adult males with Type-2 diabetes mellitus, respectively. Data regarding BMI and PAL have been presented as percentages according to diverse categories. Further, the collected data under PAL knowledge and BGL was analyzed using One way Analysis of Variance (ANOVA) with Tukey's post-hoc test.

Ethical Considerations: The present investigation was conducted after getting approval from Scientific Advisory Committee of Krishi Vigyan Kendra (Agriculture Science Centre), Tarn Taran, working under the aegis of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab, India and Indian Council of Agricultural Research, New Delhi, India. Besides, consent from Community Health Centre, Harike Pattan was obtained. Moreover, written consent of the study participants was also taken after explaining the significance and entire procedure of the study.

RESULTS

Socio-demographic information of adult males with Type-2 diabetes mellitus: Socio-demographic data of adult males with Type-2 diabetes mellitus is summarized in Table 3.

Table 3: Demographic information of the adult males with diabetes (N = 150)

Variables	Group I	Group II
Age		
31-40 years	18 (12.0)	08 (5.3)
41-50 years	29 (19.3)	27 (18.0)
51-60 years	43 (28.7)	55 (36.7)
61-70 years	49 (32.7)	42 (28.0)
> 70 years	11 (7.3)	18 (12)
Education Level		
Illiterate	54 (36.0)	61(40.7)
Primary	33(22.0)	32(21.3)
Middle	31(20.7)	46(30.7)
Matric	17(11.3)	03(2.0)
Intermediate	15(10.0)	08(5.3)
Socio economic status		
Low	41(27.3)	36(24.0)
Middle	94(62.7)	82(54.7)
High	15(10.0)	32(21.3)

Figures in parentheses represent the percentages

The research findings revealed that majority of adult males with type-2 diabetes mellitus aged above 50 years. Elaborately, 28.7 & 36.7 and 32.7 & 28.0 per cent adult males with Type-2 diabetes mellitus in group I & group II, were in the age-groups of 51-60 years and 61-70 years, respectively. Further, 7.3 and 12.0 per cent of adult males in both the groups aged above 70 years. Figures on education level of these adult males represent that more than a quarter of males in group I (36.0%) and Group II (40.7%) were illiterate. In contrast, only 10.0 and 5.3 per cent of the total adult males received education after matriculation (Table 3). Simultaneously, these males were categorized according to their socio-economic status as per Kuppuswamy socio-economic classification (2016) on the basis of information obtained with regard to their per capita family income. Results showed that more than half of the total adult males with Type-2 diabetes mellitus belonged to middle income group and the percentage was 62.7 and 54.7 in group I and group II, respectively. In addition to this, the percentages of adult males from low income group were, 27.3 and 24.0 in two groups, correspondingly. Furthermore, a double portion (21.3%) of adult males with Type-2 diabetes mellitus in group II, belonged to high income families as compared to those (10.0%) in group II.

Knowledge of Physical activity level (PAL) among adult males with Type-2 diabetes mellitus: Adult males with Type-2 diabetes mellitus in two groups were analyzed according to their obtained PAL knowledge scores. Data showed that a significant ($p<0.05$) increase has been observed in PAL knowledge of adult males with Type-2 diabetes mellitus in group II while the level of pre-existed knowledge for PAL remained constant for adult males with Type-2 diabetes mellitus in group I (Figure 1).

Anthropometric measurements of adult males with Type-2 diabetes mellitus: Heights of adult males ranged between 159 to 182 cm and 153 to 185 cm in group I and group II, respectively. A significant ($p<0.05$) difference in mean weights of adult males with Type-2 diabetes mellitus was observed in both the groups. However, the mean weight of adult males with Type-2 diabetes mellitus in the first group was increased by 4.2 kg while the same was decreased by 3.7 kg in second group after PAL intervention took place (Table 4).

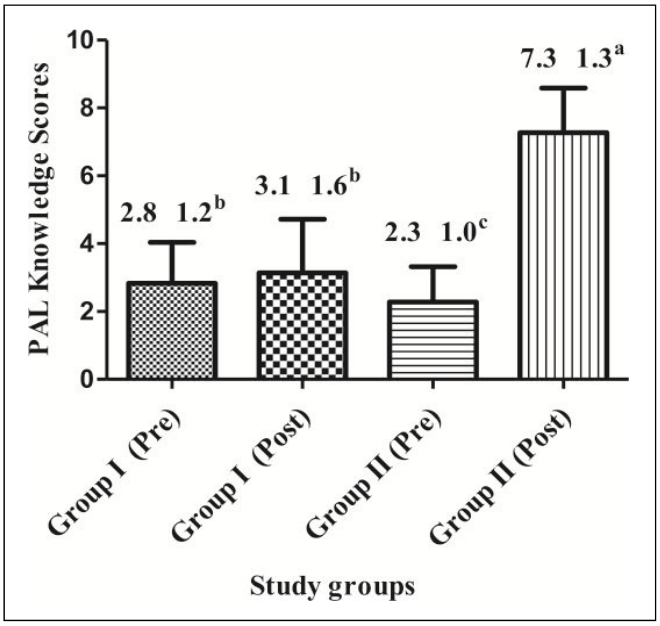

Figure 1: Mean PAL knowledge score of adult males with diabetes mellitus. Different superscripts in different columns denote significantly difference ($p<0.05$) between PAL knowledge scores of adult males whereas same superscripts in different columns depict no significant difference ($p>0.05$).

Further, as per the classification of BMI (WHO 2004), 2.0 & 1.3, 67.4 & 68.7, 18 & 21, 9.3 & 4.0 and 3.3 & 4.7 per cent of total adult males with Type-2 diabetes mellitus in group I and II, were categorized as underweight, normal, overweight, pre-obese and obese, respectively (Figure 2).

Physical activity level (PAL) of adult males with Type-2 diabetes mellitus: Figure 3 represents the physical activity level practiced by adult males with Type-2 diabetes mellitus. It has been remarkably seen that majority (76 and

Table 4: Anthropometric measurements of adult males with diabetes

Parameter	Group I				Group II			
	Range	Pre test (Mean+ SD)	Post test (Mean+ SD)	t value	Range	Pre test (Mean+ SD)	Post test (Mean+ SD)	t value
Height (cm)	159-182	173.5±6.3	153-185	172.1±5.8	**2.07***			
Weight (kg)	64.7-111	78.6±9.6	82.8±8.9	**3.89*****	50-113	78.3±12.0	74.6±9.0	**2.96****

Values are Mean ± SD from 150 determinations; different superscripts in the same row are significantly different ($p<0.05$)

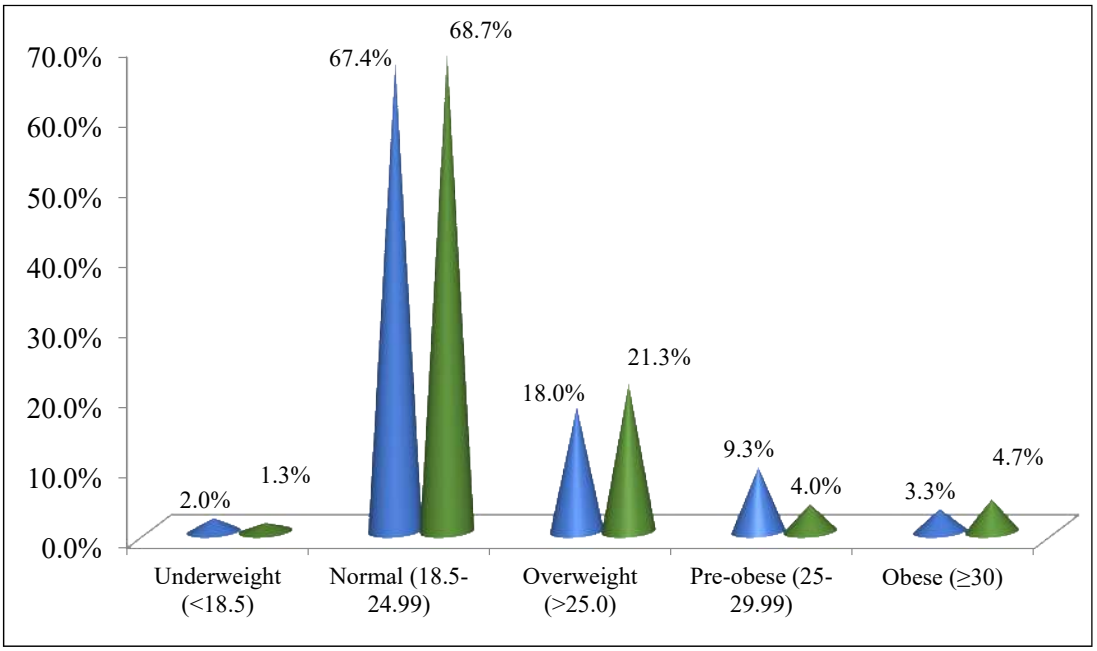

Figure 2: Distribution of adult males with diabetes mellitus according to their BMI. Blue cone in the graph denotes as Group I treated as control whereas orange cone illustrates Group II represents experimental subjects who were promulgated with PAL knowledge

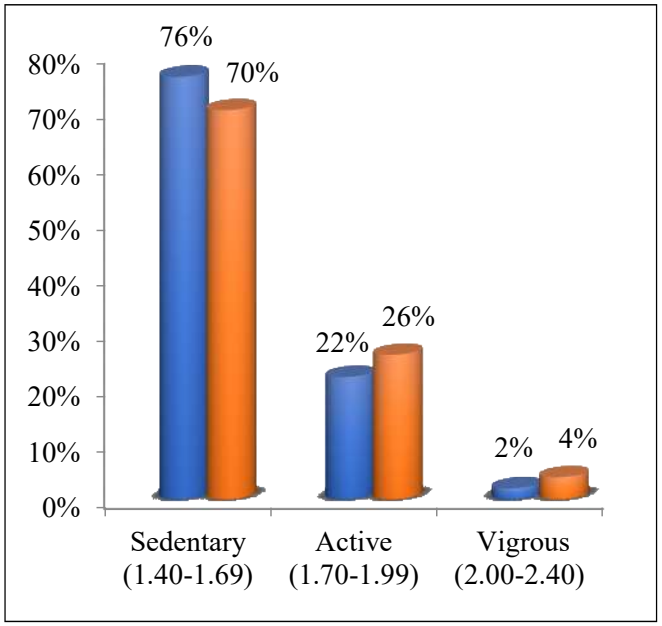

Figure 3: Distribution of adult males with diabetes mellitus according to their PAL. Blue cone in the graph denotes as Group I treated as control whereas red cone illustrates Group II represents experimental subjects

70%) of adult males with Type-2 diabetes mellitus in both the groups had sedentary lifestyle. In contrast, only 2 and 4 per cent adult males with Type-2 diabetes mellitus in group I and II, were habitual of following vigorous activity pattern. Besides, percentages of active adult males with Type-2 diabetes mellitus have been noted as 22 and 26 in group I and group II, respectively.

Blood Glucose Level (BGL) of adult males with Type-2 diabetes mellitus: Figure 4 portrays the

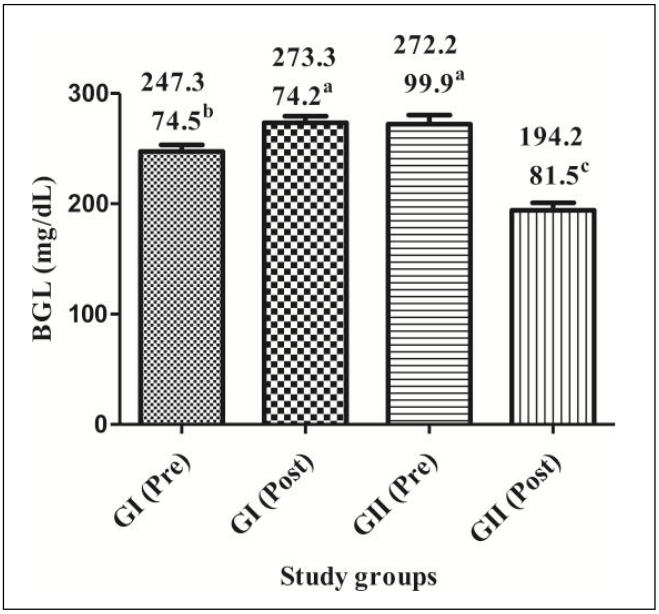

Figure 4: Mean BGL of adult males with diabetes mellitus. Different superscripts in different columns denote significantly difference ($p<0.05$) between blood glucose levels of adult males whereas same superscripts in different columns depict no significant difference ($p>0.05$)

affirmative impact of PAL knowledge on BGL of adult males with Type-2 diabetes mellitus in group II. As it can be evidently seen from the figure, a significant ($p<0.05$) decline in the mean BGL of adult males with Type-2 diabetes mellitus in group II was noted after PAL knowledge disseminated to them. Whereas, mean BGL was significantly ($p<0.05$) increased for adult males with Type-2 diabetes mellitus in group I.

DISCUSSION

During present study, socio-demographic profile of adult males with Type-2 diabetes mellitus reflected the higher portion (68.7 and 76.7%) of adult males aged above 50 years in both the groups. Type-2 diabetes mellitus is identified as the disease of mediocre age group with 40 per cent of its pervasiveness among the persons between 41 to 50 years of age (Chaudhary *et al.,* 2019; Borah and Goswami 2017; Salam and Siddiqui 2013; Rana *et al.,* 2015). Education level of the adult males with Type-2 diabetes mellitus revealed that this lifestyle related ailment was more prevalent (36 and 40.7%) among illiterate masses of the border-belt. These findings are in accordance with the results reported by Bhalerao *et al.* (2014). With regard to socio-economic status of adult males with Type-2 diabetes mellitus, most (62.7 and 54.7%) of the males were from middle income group in contrast to only few (10 and 21.3%) from high income group, during current study. Recent studies supported the fact that middle income group had higher preponderance of diabetes as compared to low and high income groups (Suwannaphant *et al.,* 2017; Kalangadan *et al.,* 2020).

Sedentary lifestyle was popular among most of the middle-aged adult males (>70%) with Type-2 diabetes mellitus in a study conducted on Polish population (Klupa *et al.,* 2016). Similar observation were recorded during our study as the percentages of adult males with Type-2 diabetes were 76 and 70 in group I and group II, respectively. Body mass index has no significant impact on development of Type-2 diabetes mellitus. A study conducted by Kalangadan *et al.* (2020) reported that majority (51.67%) of males with diabetes in their study had normal BMI. Similar findings were observed during present study. Nonetheless, normal BMI ought to be managed through improved physical activity level in adults with Type-2 diabetes mellitus, so as to increase insulin sensitivity by triggering higher glycolipid uptake and utilization in the muscles (Yang *et al.,* 2019). Physical activity level is considered as prominent factor for developing lifestyle and metabolic diseases such as diabetes, because of its connection with obesity and low physical activity was significantly ($p<0.05$) associated with Type-2 diabetes mellitus prevalence (Islam, 2017). Shrivastava *et al.* (2013) quoted being physically active as among seven essential self-care practices for management of Type-2 diabetes mellitus.

In present study, mean PAL knowledge score of adult males were quite low i.e. 2.8 and 2.3 in group I and group II, as most of them being illiterates and received education up to middle standard. Advocating this fact, PAL knowledge scores of participants who did not received higher education were found poor during a study conducted in Hong Kong with an objective to find out the association between education level and PAL knowledge of the subjects with Type-2 diabetes (Hui *et al.,* 2014). A recent study reported that adequate health promotion behaviours related intervention have been trending only among 15 per cent of individuals with Type-2 diabetes mellitus in South India (Kalangadan *et al.,* 2020) and the investigators stressed upon individually tailored intervention with perspective of increased physical activity level (Hui *et al.,* 2014; Kalangadan *et al.,* 2020). Furthermore, Shrivastva *et al.* (2020) supported the above recommendation by stating the facts on knowledge and self-care practices among persons with Type-2 diabetes mellitus. The researchers found a quite lower (4.9) mean physical activity score among the subjects when compared to their diet and glucose management scale scores i.e. 6.6 and 6.9, respectively, even attending tertiary healthcare facilities.

Our study demonstrates a significant ($p<0.05$) association of increased PAL knowledge to declined BGL among adult males with Type-2 diabetes mellitus. Additionally, a significant association between good knowledge of PAL and increased physical activity has been observed while carrying out a study on older adults with Type-2 diabetes mellitus (de Lima *et al.,* 2019).

CONCLUSION

As per the research findings from present study, it can be affirmed that dissemination of PAL knowledge had a significant ($p<0.05$) impact on lowering the BGL of adult males with Type-2 diabetes mellitus. Because sedentary lifestyle, by performing monotonous activity schedule each day, is widespread among middle-aged adults,

consequently, leads to overweight, obesity and impaired insulin secretion in the body and ended up with poorly managed Type-2 diabetes mellitus which further call up various complications *viz.* diabetes retinopathy, diabetes nephropathy etc. Thus, knowledge intervention focused on physical exercises according to different physical activity levels must be conducted for middle aged individuals for management of Type-2 diabetes mellitus so as to facilitate carrying out the self-care process in proper manner.

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Conflict of Interest: The authors declare that they have no conflict of interest.

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Orchestration of Hunger Poverty and Voice: An Analytical Study

Anannya Chakraborty[1] and S.K. Acharya[2]*
[1]Ph.D. Scholar (UGC NET-SRF Fellow), Department of Agricultural Extension, BCKV, Mohanpur, Nadia, West Bengal
[2]Professor, Department of Agricultural Extension, BCKV, Mohanpur, Nadia, West Bengal

ABSTRACT

India is a country of agriculture and rivers. Nearly 70 per cent of its population is directly or indirectly depends on agriculture. Having 2/3rd of its population in villages, India's economy and its problems is largely affected by its people residing in villages. The villages of India are quite wholesome in nature and it has a proper comprehensive ecosystem comprising of farm and off farm sector. Here in this study the farm locality is Beraberi gram panchayat, Habra II Block, North 24 pgs. and the non farm locality is Bilkanda gram panchayat, Barrackpur 2 block, North 24 pgs. 13 independent variables were studied against 4 dependent variables Hunger, Poverty, Voice and Cognitive Differentials. The respondents were women under the age group of 15 to 60. Total 150 respondents were selected. The statistical tool used in this study were partial correlation analysis and canonical covariate analysis. The study revealed that communication variables, homestead land, stress perception, risk orientation and education. these were the parameters which were the most significant as far as the dependents variables were concerned.

Keywords: Hunger, Poverty, Voice, Cognitive differentials, Stress, Risk orientation, Education

INTRODUCTION

Hunger is the sauce of life that drives us to the golden harvest; it's the fire either, that destroys socio-ecological balances to invite ever increasing entropy. The UNO in its recent press release express concerns that more millions will die not due to COVID pandemic only, it is because of hunger and poverty. The humongous up surging of joblessness, economic disaster and social disorder due to this pandemic, the poor, hungry and voiceless people are going to die, a repetition of social Titanic episode can be as worst as an analogy! In India only close to 10 million migrant workers have become emigrant for the worse destiny, a close to five million have lost their job or extremely vulnerable to a sudden joblessness due to economic apocalypse as reflected in a appalling -23 per cent growth revealed by the ministry of finance, India. The need of the our is to elicit the factual data on the damaged and vulnerability status with an immediate restart of economical repairing and social healing process (Chakaborty and Acharya, 2019). We have no choice but to make people, those who are reeling under dire marginalization, free from fear psychosis by restoration of both economy and morals. Silence is the moth lethal inputs that make poor the poorer, deprived with a stubborn silence and the hungry with an unacceptable negotiation with social hegemony and extortion inflicted on the pair by the mighty richer community. So, a comprehensive research offers an inevitability of a study that would delineate and decipher the lethality of a venomous combination amongst and between hunger-poverty-silence, the trio that causes deadening consequences of deprived people and the civilization at length. In India 350 million people are living below the poverty line and of them, 200 million people have become victim to moderate to extreme hunger indexes. 42 per cent of the new born babies are under weight. 60 per cent of the children are suffering from moderate to high level of anaemia experiencing stunted growth. Beyond the curtain of hunger, there is another problem that is chronic hunger. Based on hunger index we the nation is occupying 100th position in the world (IFPRI Report, 2017). The scenario of chronic hunger is even worse and astoundingly it is worse than African nations as well. The voice here is measured in terms of ability and permeability to communicate with others or availing communication from others as to their need for survival and growth. The unique

*Corresponding author email id: acharya09sankar@gmail.com

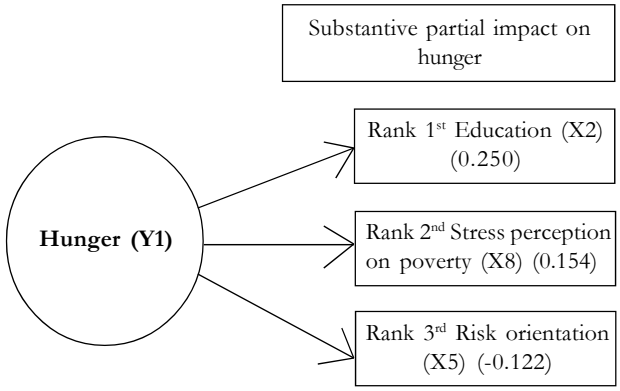
character of studying silence 'Uninformed Diaspora' in India is that for farmers huge pile of information are there, but only a minuscule proportion is being accessed by the farmers. In this post modern era, hunger is not only a failure of agriculture, rather it is a social, economic and political problem. To get rid of hunger, the socio-political models should be reconciled and re- organized if necessary. On a broader spectrum, the policy generations and modifications should be based on the empirical study researches, as well as should be realistic and broad based. Adding to this, the government should be complementary with a proper bureaucratic set up, a transparent and non-bias news media, voluntary non governmental organizations, active public discussion systems etc. Hunger does not involve only food but there are much more interconnections of other social, economic and political aspects (Amartya Sen, 1997). A survey was done by FAO in 2009. A key objective of the Voices of the Hungry project (VoH) is to estimate comparable prevalence rates of food insecurity in national populations for more than 140 countries every year. These estimates are based on conditions and behaviours reported by adults through the Food Insecurity Experience Scale survey module (FIES-SM). The data collected in nationally representative surveys of the adult population in each country are used to compute a measure of severity of the food insecurity status for each respondent, focusing on conditions reflecting limited access to food. Individual measures are then calibrated against a common global reference scale of severity, thus allowing classifications and estimates of prevalence rates that are comparable across countries and population groups. Indian agriculture is the largest but unorganised economic sector of the world. The farm entrepreneurs, are suffering from both the vagaries of nature and market. The decelerating agricultural economy has thrown the growers into a vicious cycle of hunger, poverty and silence. Hunger here has been denoted by the level of food, calorie and nutrition intake by human bodies within the framework of minimum requirement set by World Health Organisation (WHO). Poverty here has been measured in terms of per capita income per month from a unit of holding, which is 121 million in India (NSSO data, 2014-2015). Here in this paper we have used partial correlation and canonical covariate analysis to analyse the social networking of hunger, poverty, voice and cognitive differentials.

Area of Study: The present study has conducted in two separate socio-ecological strata. One study has conducted among the farm families and the other one has conducted on the non farm families. Here we have only selected women at the age group of 15-60 as respondents. The farm locality is Beraberi gram panchayat, Habra II Block, North 24 pgs. and the non farm locality is Bilkanda gram panchayat, Barrackpur 2 block, North 24 pgs. 13 independent variables from both the sectors were selected. Dependent variables were hunger, poverty, voice and cognitive differential.

Tools and Technique: The data were collected with the help of a structured interview schedule and by face to face interaction. The statistical tool used to analyse the data are partial correlation analysis and canonical covariate analysis.

RESULT AND DISCUSSION

Partial Correlation Analysis: Partial correlation is a primary tool to study the non linear path way of the instances and impact of several independent variables under study.

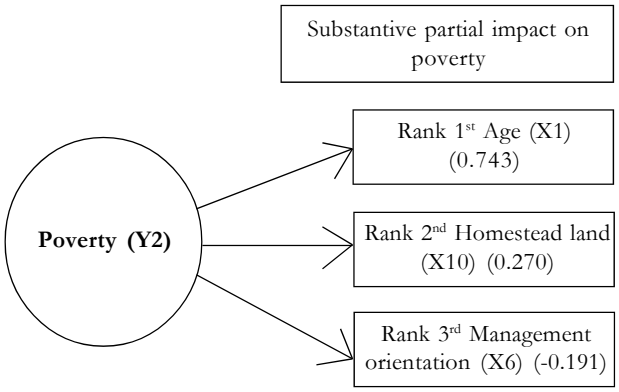


Hunger (Y1) vs. 13 independent variables

It has been seen that the risk orientation, stress perception and education are creating highest partial impact as far as the hunger status is concerned. Things may so happened that due to poorer education the respondents are having less risk bearing ability and more psycho somatic stresses and thus collectively they effect on hunger in a substantive manner.

Poverty (Y2) vs. 13 independent variables

It has been seen that the age, homestead land and management orientation are creating highest partial impact as far as the poverty status is concerned. These three variables have the highest substantive effect than all the

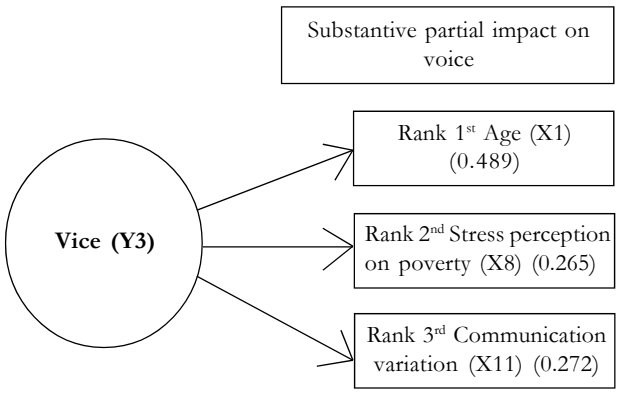


remaining independent variables on the said dependent variable. with the age maturity comes and with the maturity the sense of status comes. People starts understanding their actual condition. On the other hand homestead land is an indicator of the status of a person whether he/she is from farm or off farm back ground. The third substantially impactful variable is management orientation. Be it in a farm situation or in an off farm situation the well managed resources are always the key factor. The entrepreneurs or the agripreneurs now a days are more successful than a simple shop owner or a farmer. Indian farmers are poor because they are poor in agripreneurship. They are innovatively poor. They are not managing their resources like the Vietnam or the Israel farmers are doing. So, why the Indian farmers are poor? is it only because they are monetarily poor or resource- poor? Else, because they a poor in ideas or innovation?

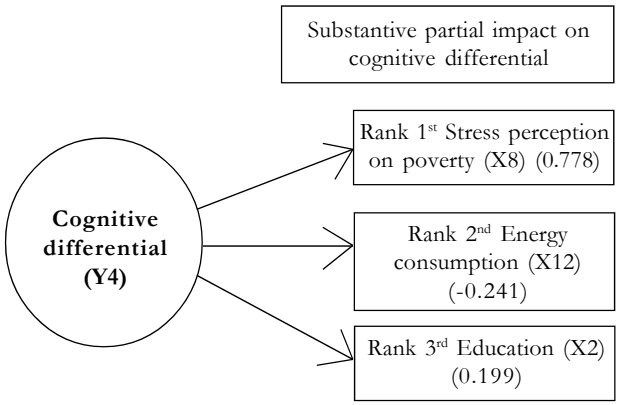
Hence, from this above discussion one thing can be clearly concluded that if we want to change the status of our poorer population, we have to train them, groom them, motivate them and encapacited them to generate ideas and to utilize their resources the fullest.

Voice (Y3) vs. 13 independent variables

Here in the above model it has been seen that the age,



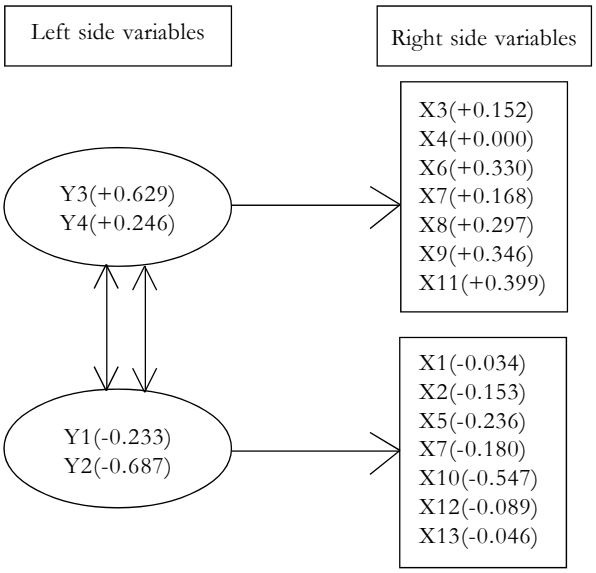
stress perception on poverty and communication variables are creating highest partial impact as far as their capacity to raise voice is concerned. As with the age the sense of status is grown, in the same manner with the age the desire and capacity to break silence is also elevated. Stress perception is also a stimulator in this issue. If the stress is high, people are frustrated, depressed, morose and finally suffer from withdrawal syndrome where they are totally indifferent about their surrounding ambience. Lastly, the communication variables. They are basically the precursors of one's voice. With communication, information come. And, with these information the urge and need for voicein generated.



Cognitive differential (Y4) vs. 13 independent variables

Here in the model it has been seen that the stress perception on voice, energy consumption and education are creating highest partial impact as far as the cognitive differential of the respondents are concerned. Like we have discussed earlier, stress causes depression, inactive nature and lastly withdrawal syndrome. So, it is very different for a person in stress to increase their informative behaviour and awareness. Energy consumption is basically the indicator of a person's overall mobility. Energy consumption is becoming a very important and predominant factor in the entire dynamics of the ecological changes in the sector of agriculture. Now, as far as education is concerned, lesser the education more would be cognitive differential. You are less educated (non formal and informal education is also considered) means you are less aware. Sometimes you can be ignored rather. Why you are not allowed to speak, is can simply because you are a drop out.

***Canonical co variate analysis*:** In statistics, CCA is a way of inferring information from cross-covariance



matrices. If we have two vectors, $X=(X_{1,.....,}X_n)$ and $Y=(Y_{1,.....,}Y_n)$ of random variables and there are correlations among the variables, then canonical correlation analysis will find linear combinations of the X_i and Y_j which have maximum correlation with each other. T.R Knapp notes that" virtually all of the commonly encountered parametric tests of significance can be treated as special cases of canonical correlation analysis, which is the general procedure for investing the relationships between two sets of variables". The method was first introduced by Harold Hotelling in 1936.

CCA for this study has been applied to extract the canonical covariates between two sets of variables. The left side variables and the right side variables. It has been observed that the LS variable again has formed two conglomerations further. Here, voice (Y3) and cognitive differential (Y4) both have picked together seven independent variables those are family size (X3), economic motivation (X4), management orientation (X6), stress perception on hunger (X7), stress perception on poverty (X8), stress perception on voice (X9) and Communication variables (X11). On the other hand hunger (Y1) and poverty (Y2) have picked together the remaining six independent variables those are age (X1), education (X2), risk orientation (X5), stress perception on hunger (X7), Homestead land (X10), Energy consumption (X12), BMI (X13).

So, from CCA we have come to know that the groups of Y variables have got precise selectivity to ultimately form a splendid strategy as to cater component related interaction to characterize the perception hunger, poverty and voice.

CONCLUSION

Nobel laureate Abhijit V. Banerjee and Ester Duflo's research elicited a large percentage of households with at least one member of the family owning their own business; however, entrepreneurship is not a common aspiration of the poor. What they really want is for their children to land government jobs – such as teachers. Duflo recounts a very interesting anecdote about the correlation between Mexican maquiladoras (manufacturing centers) located in a mother's village, and strongly increased nutrition of her children. The additional income the mother earned at the maquiladoras was not enough to explain the substantial increase in the children's nutrition (Chakaborty and Acharya, 2020). Instead she proposes that "Perhaps the sense of control over the future that people get from knowing there will be an income coming in every month – and not just the income itself – is what allows these women to focus on building their careers and those of their children". A predictable, dependable income separates the poor from the middle class and alleviates the stress that was so additionally detrimental. The present paper also indicates that homestead land, risk orientation, education, stress perception and age these five are the vital parameters for the rural people, be it farm or off farm economy. Farming becomes stressful and non-luring for today's youth (Sharma *et al.,* 2019). As the canonical covariate shows voice and cognitive differential is interlinked, it is a clear indication of misinformation and information lacking being the cause of voicelessness and vice versa.

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Survival Under Heaps of Trash- A Schema of Household Waste Management

Priyanka Ginwal[1] and Preeti Sharma[2]*
[1]Junior Research Fellow, [2]Assistant Professor, Department of Extension Education and Communication Management, Punjab Agricultural University, Ferozpur Road, Ludhiana-141004, Punjab

ABSTRACT

This paper embarks on household waste and its management strategies. It gives an insight into the strategies to manage household waste, pillars of waste management structure, factors affecting household waste management, and the measures needed to motivate people to take-up waste management activities. Ample literature was reviewed for the purpose and it was revealed that food waste is the most common type of waste generated from the households. The 3R strategy, composting, pyrolysis, decluttering, and WMC (Waste Management Charge) are effective strategies for managing household waste. Pro-environmental values, circumstantial strands, and balanced psychological factors serve as pillars for a strong waste management structure. High knowledge, positive attitude, and righteous values and beliefs are positively linked with waste management, whereas, lack of facilities and regulations for waste management, low education, and economic status is negatively associated with waste management. Administrative measures, economic measures, physical measures, and effective information dissemination are important measures that should be undertaken to motivate people to take up waste management activities. Based on the literature reviewed, a model/ schema of household waste management is developed and presented in the paper.

Keywords: 3R strategy, Administrative measures, Composting, Decluttering, Household waste management, Pro-environmental issues, Psychological factors, Pyrolysis

INTRODUCTION

Human activities do much harm than good to the environment. One such activity is waste production. Waste is produced when there is an imbalance between production and processing of waste (Wulandari *et al.,* 2021). The world is increasingly generating chunks of trash without a proper waste management system. In many parts of the globe only a few countries are dealing with waste tremendously but majority of nations specially the developing ones, are burdened with loads of waste (Babaei *et al.,* 2015).

Waste is a global hot topic. Anything that is useless can be regarded as waste (El-Maghraby *et al.,* 2014; Mishra *et al.,* 2014). It is a problematic issue and is deteriorating the mother earth with each passing day (Asteria and Haryanto, 2021). It is expected that by 2025 the waste generated around the world would rise to 2.2 billion tonnes and 3.4 billion tonnes by 2050 (Hoornweg and Bhada-Tata, 2012). The high rise in population, urbanization, and industrialization goes hand in hand with the rise in waste production (Knickmeyer, 2020). It poses a threat to human health and environment (Asteria and Haryanto 2021) by constructing unhygienic conditions and generating numerous troubles related to landfills (Lebersorger and Schneider, 2011). A high imbalance is witnessed when developed and developing countries are put into the picture. Therefore the paper was planned to explore household waste and its management strategies adopted in different countries, to identify the pillars of waste management structure, to explore the factors affecting household waste management and the measures required to motivate people to engage in waste management activities.

MATERIALS AND METHODS

A systematic review of English language literature published between 2000–2021 was carried out. The

*Corresponding author email id: preetisharmahsee@pau.edu

databases used in the initial search strategy included Google Scholar and Research Gate. Search strategy used terms like 'waste', 'household waste' and 'household waste management'. After proper screening articles with clear objectives, sound study designs, satisfying data collection method and well described data analysis procedure were downloaded and the final set of articles was reviewed.

RESULTS AND DISCUSSION

Household waste and its management strategies adopted in different countries: The majority of the waste produced around the globe includes household waste. Household waste/domestic waste is a product of household activities (Pakpour *et al.,* 2014). It is the generation of waste from households. It constitutes about 2/3rd part of the Municipal Solid Waste (MSW) (Inglezakis and Moustakas, 2015). Household waste can be categorized as organic and inorganic. Organic waste mainly includes food waste, plant remains, wood scraps, and paper. These can be used as materials for composting as they can be easily decomposed. Inorganic waste includes plastic, glass, metal, electronic items, etc. (Mandevere and Jerie, 2018). Household waste releases greenhouse gases like methane and nitric oxide (Jalil, 2010). If household food waste is biologically treated the emission of greenhouse gases can be reduced (Bernstad and la Cour, 2011).

Food waste: Of the waste produced at the household level, food waste is the most common. Out of the total waste in landfills, 1/5th is food waste. Food waste comprises parts of food that are inedible. It is the discarded part of food products that is no longer useful. Food waste constitutes a major portion of household waste. Tonnes of fruit skin, food leftover, vegetable scraps, eggshells, etc. occupy maximum space in bins (Lebersorger and Schneider, 2011). The common reasons for food wastage include infestation by flies, temperature and storage issues, etc. (Lebersorger and Schneider, 2011).

Food waste is being generated at a very rapid pace; dejectedly minimum consideration is given on combating this serious affair.

Hazardous Household Waste: Hazardous Household Waste puts the environment at risk as this type of waste is arduous to dispose of. These include batteries, pesticides, expired medicines, paint, etc. A majority of household waste makes its way to the landfill, with one percent by weight of it being poisonous. European countries mainly Ireland, Germany, and Luxembourg are doing quite well to manage Hazardous Household Waste with versatile waste management schemes such as door to door collection, mobile collection service, recycling centers, etc. (Inglezakis and Moustakas, 2015). Plastic, batteries, and medical waste (syringes and expired tablets) are major contributors to hazardous waste being produced from households (Slack *et al.,* 2004). Therefore hazardous household waste should be managed very carefully. Its collection should be done separately and people should avoid disposing of hazardous waste at landfills (Inglezakis and Moustakas, 2015).

Household waste management strategies: Waste management deals with directing and running activities for managing waste to save the environment (Pongrácz *et al.,* 2004). Waste management strategies are multifaceted (Barr *et al.,* 2005) and require the engagement of multiple stakeholders such as residents, government and private organizations, etc. (Jian *et al.,* 2021; Wulandari *et al.,* 2021). Some waste management strategies are discussed below:

3R strategy: 3R stands for reduce, reuse, and recycle.

Reducing is the practice of producing less waste. It contributes to waste minimization. Household waste can be reduced in numerous ways (El-Maghraby *et al.,* 2014). Some of these include repairing rather than discarding, composting, saying no to plastic bags and using cloth/ reusable bags, using reusable containers at home, etc.

Reusing is the practice of using something over and over again until it reaches a point where it should be thrown away (El-Maghraby *et al.,* 2014). It is done to minimize waste production and helps to preserve natural resources. It is preferred over other methods as it requires less input of energy and resources to manage waste (Mandevere and Jerie, 2018).

Recycling is a method of transforming waste into a class of usable products (Pathak *et al.,* 2011). In this process the things that are thrown away are turned into new products. Recycling has numerous benefits like helps in lowering greenhouse gases (Mandevere and Jerie, 2018), reduces demand for raw material, lays less drastic effect on the environment, etc. (Martin *et al.,* 2006).

Composting: Composting is a sustainable resource management strategy. It plays a key role in waste management. It is an environment friendly practice to manage waste production. It is a natural process of transforming biodegradable parts of waste into materials

that can be used as compost which is a rich source of plant nutrients (Pathak *et al.,* 2011). It involves decomposing the organic waste products into organic fertilizer that serves as agricultural nutrients (Ferreira *et al.,* 2018). It conditions the soil (Shams and Ibrahimu, 2003) and results in nutrient enrichment (Bernstad and la Cour, 2011).

Composting is an extremely effective method that is used to manage waste. It also helps in sustainable agricultural practices. Combustible fuel can also be produced by composting. Apart from environmental benefits composting also has economical effects (Pathak *et al.,* 2011).

Pyrolysis: It is the process of decomposing organic matter in the presence of high heat (El-Maghraby *et al.,* 2014). It occurs in the absence of oxygen. Pyrolysis is very beneficial as it leads to the production of a clean fuel gas that has a high calorific value. Also, the residual output i.e. char can be used as a fuel. It has environmental advantages too as it is an alternative to landfilling. Landfilling is extremely dangerous for the environment as it releases harmful gases in the environment. Therefore, Pyrolysis helps in the reduction of waste going into the landfills (Al-Salem *et al.,* 2009).

Decluttering: Decluttering is the practice of transforming messy household spaces into organized and tidy ones. It is an approach aimed at achieving neatness and tidiness by removing unnecessary things at workplaces, households, etc. Decluttering involves the redistribution of things. It generates a sense of comfort and cleanliness in the house (Cherrier and Belk, 2015). It has a wide number of benefits like calms the human mind, works like therapy for humans, allows people to focus on goods/items that are not important, etc.

WMC (Waste Management Charge) Strategy: Household waste management strategies like WMC (Waste Management Charge) are productive means to engage and encourage people to reduce waste production. The use of economic instruments can be very helpful for eg. Charges placed for polluting, disposing of, using certain products, environment tax, etc. WMC is a great way to deal with household trash (Welivita *et al.,* 2015).

Pillars of household waste management structure: The framework of waste management in developing countries is very loose and fragile. This is due to the lack of proper waste management strategies and also due to the lack of individual participation in waste management (Babaei *et al.,* 2015). A strong waste management structure is supported by three pillars namely environmental values, circumstantial strands, and psychological factors (Barr *et al.,* 2005).

Environmental values: It is the worth placed on the environment by a particular individual. It is an ethical and moral relationship of a person with the environment. Environmental values are intrinsic and lay stress on determining which activity is environmentally appropriate or not.

Based on possessing environmental values, people are classified in four ways i.e. committed, mainstream, vocational, and non-environmentalist. Committed environmentalists are the individuals who are very keen to recycle and also indulge in donations. Mainstream environmentalists are quite same as committed environmentalists when it comes to recycling but they engage in less composting activities. Occasional environmentalists are the ones who less frequently participate in recycling, composting, and reuse. Non-environmentalists include people who hardly ever recycle and seldom engage in waste management activities. They mainly include males, low-income family groups, and less formal education groups (Barr *et al.,* 2005).

Circumstantial strands: Circumstantial strands are physical stimulus in a particular surrounding. These are social and demographic characteristics. They pertain to the context. These strands are the external factors that determine an individual's take on something. They are external influences e.g. school, college, workplace, office, etc. According to many research studies and experiments females, young ones, employed, and well-educated people are expected to indulge in more waste management activities (Barr *et al.,* 2001; Barr *et al.,* 2005).

Psychological factors: Psychological factors resonate around comprehension, realization, observation, sensation, believes, etc. These are the components that amplify one's thinking and originate from the individual level of processing. One's psychological state is also determined by objective norms and standards. Many people have selfish reasons to recycle. They are driven by extrinsic and intrinsic motivation. Stimulation and inspiration play a vital role in influencing people to indulge in recycling (Barr *et al.,* 2001; Barr *et al.,* 2005).

Factors affecting household waste management: If we excel in understanding and finding out the factors that target waste management, it would feasible to formulate

effective strategies, campaigns, and other programs (Pakpour *et al.,* 2014).

Knowledge: Lack of knowledge and awareness about waste management practices refrain people to create a cleaner surrounding (Pakpour *et al.,* 2014). There exists a positive relationship between knowledge level and recycling (Babaei *et al.,* 2015).

Attitude: Attitude plays a vital role in influencing one's behavior (Lee and Paik, 2011). Once an attitude is established then the actions are determined. According to the Theory of planned behavior (TPB), if an individual has a favorable attitude towards any behavior, he or she is more likely to perform that behavior. The intention of a person to engage in behavior can be predicted by his attitude towards that particular behavior (Cheung and To, 2016).

Values and Beliefs: There exists great diversity in people's values and beliefs, and these play a vital role in shaping their attitude, behavior, and perception which in turn determines one's involvement in waste management activities.

Age: Age is positively related to waste management and recycling behavior (Babaei *et al.,* 2015).

Gender: Gender is a notable predictor of household waste management. Women are more likely to engage in waste management activities (Pakpour *et al.,* 2014).

Education and economic status: Education and economic status are positively associated with one's participation in household waste management (Wang *et al.,* 2018).

Distance between residences and waste disposal area: The more is the distance between residences and waste disposal area, the less is the participation in household waste management (Mintz *et al.,* 2019, Wang *et al.,* 2018).

Other factors include lack of facilities discourages people to participate in activities related to waste management (Stoeva and Alriksson, 2017); inefficient working of municipalities and negligible regulations pave way for people to recklessly dispose of household waste (Inglezakis and Moustakas, 2015). Therefore attitude, age, and income impose a significant impact on waste management activities (Lee and Paik, 2011). Moreover, recycling behaviour and the barriers associated with it vary by socio-demography. Therefore one should be mindful of resident's characteristics while planning waste management activities (Knickmeyer, 2019).

Measures required for motivating people to manage household waste production: Motivating and empowering people to take up waste management activities can help in saving the earth from shriveling under trash stacks. There are certain measures required to motivate people for inculcating pro-environmental values and behavior for proper waste management. These include administrative measures, economic measures, physical measures and information dissemination.

Administrative measures: The administration responsible for dealing with household waste must carry out their work responsibly. Proper supervision of the organizations dealing with household waste management should be done. eg. Legal obligations (Stoeva and Alriksson, 2017). Fine can also be charged for improver dumping and burning waste. On the other hand rewards can be given for active participation in waste management activities.

Economic measures: Economic measures deal with introducing prices. To mitigate the issue of household waste management economic measures can prove to be very helpful. Imposing fees and taxes on waste generation are some essential ways to alleviate the problem (Stoeva and Alriksson, 2017).

Physical measures: Physical measures mainly include positioning of bins at different junctions, door to door waste collection, etc. (Knickmeyer, 2019; Stoeva and Alriksson, 2017).

Information Dissemination: Household waste management is more of a social affair rather than environmental. Therefore information needs to be disseminated to the people living in different societies using different methods and techniques. To receive and understand environment-related information, non-formal education is the best way. It helps people to become pro- environmentalists and have a positive attitude towards the environment (Ballantyne *et al.,* 1998). Well-founded, prospective, and efficient communication methods and tools should be used to persuade people to participate in waste management activities (Knickmeyer, 2019) for achieving sustainable development. The use of campaigns, rallies, and other programs also help in making people aware and maximize information dissemination (Stoeva and Alriksson, 2017).

CONCLUSION

A substantial body of literature talks about household waste management. Based on the literature reviewed, a model for household waste management is developed that discusses the prerequisites for human beings, various strategies to be applied, and the administerial support required at various levels. The structure of waste management needs to be strong enough and to meet this; one's environmental values, situational, and psychological factors play a vital role. Apart from this, a constellation of factors like knowledge, values, attitude, etc. determines an individual's engagement in household waste management. To deal with the trash produced at the household level effective waste management strategies should be employed. A considerable amount of stress should be laid on waste minimization activities. Moreover, it is highly important to address this issue by taking appropriate measures. Therefore, the administration needs be to very active and people should be exposed to information that can mold their behavior positively and drive them towards good deeds and actions.

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Occupational Stress Among the Teachers of a State Agricultural University

Maitreyee Tripathy[1], Sarthak Chowdhary[2]* and Arijit Roy[3]
[1]Ph.D. Scholar, Department of Extension Education, College of Agriculture, Odisha University of Agriculture & Technology, Odisha
[2]Professor, [3]Ph.D. Scholar, Department of Agricultural Extension, Palli Siksha Bhavana (Institute of Agriculture), Visva Bharati University, West Bengal

ABSTRACT

In contemporary societies majority of people seem to be talking about stress and its various consequences. Individual's reactions to severe stress has become the major concern of the stress researchers in different disciplines. Job life, wherein, employees spend more than one third of their daily routine is the major source of satisfaction of their various needs, as well as of frustration and stress. Occupational stress has been noted to put impairing effect on employee's job behaviour and physical and psychological well-being, representing serious cost to organizations in decision and monetary terms. Taking that into account, a study was undertaken in Odisha University of Agriculture and Technology, Bhubaneswar, Odisha to measure occupational stress among the teachers of that university. The findings of the study suggest that teachers experience various levels of occupational stress. It was noted that the respondents get higher level of occupational stress due to miserable current career opportunities, the way changes and innovations were implemented in the institution and health issues due to occupational stress as because they don't feel that they are playing a usual part in things followed by they don't feel capable of making decisions about things. As an output of this study we have also devised corrective managerial action goals.

Keywords: Stress, Occupational stress, Health issues, Teachers

INTRODUCTION

Mental health is a major concern worldwide and India is not far behind in sharing this. If we evaluate developments in the field of mental health, the pace appears to be slow. Dr. Brock Chisholm, the first Director-General of the World Health Organization (WHO), in 1954, had presciently declared that "without mental health there can be no true physical health." More than 60 years later, the scenario has not altered substantially. About 14 per cent of the global burden of disease is attributed to neuropsychiatric disorders (Kolappa *et al.,* 2013). Work related Musculo-skeletal disorders are one of the greatest occupational health concerns today. Similar to communicable diseases, occupational diseases can be regarded as traditional, emerging and re-emerging (Deepali and Rekha, 2010). The burden of mental disorders is likely to have been underestimated because of inadequate appreciation of the inter-play between mental illness and other health disorders. There remain considerable issues of priority-setting based on the burden of health problems and of addressing inequalities in relation to determinants and solutions for health problems.

"Stress" is our body's response to pressure. Many different situations or life events can cause stress. It is often triggered when we experience something new, unexpected or that threatens our sense of self, or when we feel we have little control over a situation. Feelings of stress are normally triggered by things happening in your life which involve: being under lots of pressure, facing big changes, worrying about something, not having much or any control over the outcome of a situation, having responsibilities that you're finding overwhelming, not having enough work, activities or change in your life, times of uncertainty. There might be one big thing causing you stress, but stress can also be caused by a build-up of small pressures. Occupational stress has been considered as leading stressor among adults. Occupational stress is defined by the National Institute for Occupational Safety and Health (NIOSH,

*Corresponding author email id: sarthakpsb@gmail.com; sarthak_chowdhury1@rediffmail.com

2008) as, "the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the workers." Job life, wherein, employees spend more than one third of their daily routine is the major source of satisfaction of their various needs, as well as frustration and stress. Occupational stress has been noted to put impairing effect on employee job behaviour and physical and psychological well- being representing serious cost to organizations in human and monetary terms. According to Keiper and Busell (1996) stress can contribute to poor performance, absenteeism, job dissatisfaction, accidents and various health problems. Majority of respondents suffered from tension/ worry due to low pay scale, family problems and working conditions. Boredom was also faced by respondents due to working condition (Sudha and Renu, 2008)

In many countries, teaching is often considered as one of the most stressful profession (Ravi-Chandran, 2007). Kyriacou (2000) defined teacher stress as, "the experience by a teacher of unpleasant negative emotions such as anger, frustration, anxiety, depression and nervousness resulting from some aspect of their work." Teachers all over the world are facing the problem of occupational stress, though the extent of problem varies according to Kristensen (2005) about 10 to 40 per cent of teachers are suffering under extreme stress or burnout in European countries. Maslach (2001) argues for even higher stress level among teachers of Asian countries.

Today, the teaching and Research organisations, particularly the Agricultural Universities and Research organisations are facing a new challenge in the context of changing agricultural and economic scenario. Further, there is indication that in the coming years, due to resource crunch there would be emphasis on improving the present human resources for agricultural teaching and research organisations to maintain a competitive edge in the emerging environment. Thus, reducing the occupational stress of the teachers to improve their productivity is of paramount interest. The present study was undertaken to identify the extent of occupational stress and factors influencing the occupational stress of Odisha University of Agriculture and Technology, Bhubaneswar.

MATERIALS AND METHODS

For the present investigation all the faculties working in the main campus of the College of Agriculture and College of Agricultural Engineering of OUAT were considered as the respondents of the study. The total number of faculty respondents from College of Agriculture was 60 and College of Agricultural Engineering were 40. Hence, the total number of respondents was 100. All the faculties of College of Agriculture and Engineering were considered as respondents (by complete enumeration for measuring occupational stress following procedures by Cooper *et al.* (1987).

RESULTS

Considering work related activities of the respondents of OUAT, from the Table 1, it is interesting to note that faculties spend 3.35 hours on and average per day on taking class followed by extension activities (1.54 hours), research activities (1.20 hours) and non-teaching duties (1.06 hours) per day. It is further revealed that respondents spend highest time in preparation for classes (2.02 hours) followed by preparation for research (1.29 hours), non-teaching duties (1.20 hours) and others (0.81 hour) per day.

Table 1. Distribution of respondents according to work information

Activities	Average hours spent	Rank
During College Hours		
Teaching Classes	3.35	I
Extension Activities	1.54	II
Research Activities	1.20	III
Non-Teaching Duties	1.06	IV
Total	**7.15**	
After College Hours		
Preparation for Classes	2.02	I
Preparation for Research	1.29	II
Non-Teaching Duties	1.20	III
Others	0.81	IV
Total	**5.32**	

In Table 2, 22 statements are there to measure occupational stress of respondents. Total 100 respondents were taken. The extent of stress of respondents was measured by using a 7-point scale continuum where; VMS = Very Much Satisfied = 7; MS = Much Satisfied = 6; SS = Slightly Satisfied = 5; U = Undecided = 4; SD = Slightly Dissatisfied = 3; MD = Much Dissatisfied = 2; VMD = Very Much Dissatisfied = 1

Table 2: Distribution of respondents according to occupational stress

S.No.	Statements (Independent variables)	Extent of Stress						
		VMS 7	MS 6	SS 5	U 4	SD 3	MD 2	VMD 1
1	Communication and way of information flows around yourOrganisation	76(76%)	14(14%)	10(10%)	0(0%)	0(0%)	0(0%)	0(0%)
2	Relationship you have with other people at work	81(81%)	19(19%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
3	The feeling you have about the way your efforts are valued	77(77%)	9(9%)	14(14%)	0(0%)	0(0%)	0(0%)	0(0%)
4	The actual job itself	75(75%)	14(14%)	11(11%)	0(0%)	0(0%)	0(0%)	0(0%)
5	The degree to which you feel motivated by your job	64(64%)	34(34%)	2(2%)	0(0%)	0(0%)	0(0%)	0(0%)
6	Current career opportunities	7(7%)	56(56%)	37(37%)	0(0%)	0(0%)	0(0%)	0(0%)
7	The level of job security in your present job	65(65%)	33(33%)	1(1%)	0(0%)	0(0%)	0(0%)	0(0%)
8	The extent to which you may identify with the public image or goals of your organisation	44(44%)	40(40%)	16(16%)	0(0%)	0(0%)	0(0%)	0(0%)
9	The style of supervision that your supervisor use	0(0%)	29(29%)	71(71%)	0(0%)	0(0%)	0(0%)	0(0%)
10	The way changes and innovations were implemented	17(17%)	29(29%)	54(54%)	0(0%)	0(0%)	0(0%)	0(0%)
11	The kind of work or task you are required to perform	34(34%)	31(31%)	35(35%)	0(0%)	0(0%)	0(0%)	0(0%)
12	The degree to which you feel that you can personally develop or grow in your job	72(72%)	28(28%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
13	The way in which conflicts are resolved in your organisation	46(46%)	42(42%)	12(12%)	0(0%)	0(0%)	0(0%)	0(0%)
14	The scope your job provides to help you to achieve your aspirations or ambitions	71(71%)	25(25%)	4(4%)	0(0%)	0(0%)	0(0%)	0(0%)
15	The amount of participation which you are given in important decision making	63(63%)	28(28%)	9(9%)	0(0%)	0(0%)	0(0%)	0(0%)
16	The degree to which your jobs taps the range of skills, which you feel, you possess	46(46%)	32(32%)	22(22%)	0(0%)	0(0%)	0(0%)	0(0%)
17	The amount of flexibility and freedom you feel you have in your job	26(26%)	35(35%)	39(39%)	0(0%)	0(0%)	0(0%)	0(0%)
18	The psychological feel or climate that dominate in your organization	23(23%)	43(43%)	34(34%)	0(0%)	0(0%)	0(0%)	0(0%)
19	Your level of salary related to your experience	64(64%)	33(33%)	3(3%)	0(0%)	0(0%)	0(0%)	0(0%)
20	The design or shape of your organization's structure	33(33%)	55(55%)	12(12%)	0(0%)	0(0%)	0(0%)	0(0%)
21	The amount of work you are given to do whether too much or too little	1(1%)	69(69%)	30(30%)	0(0%)	0(0%)	0(0%)	0(0%)
22	The degree to which your feelings extended in your job	29(29%)	43(43%)	28(28%)	0(0%)	0(0%)	0(0%)	0(0%)

The figure in the parenthesis indicates percentage (%). It indicates that for each statement, the percentage of respondents experience respective extent of stress. For example, for statement-1, 76 per cent, 14 per cent and 10 per cent of respondents experience very much satisfaction, much satisfaction and slight satisfaction respectively and so far, it goes for rest of the statements.

It is noted from Table 2 that majority of occupational stress of the teachers comes from the style of supervision their supervisor use followed by the way changes and innovations were implemented, current career opportunities, the amount of work given is whether too much or too little, the amount of freedom and flexibility respondents' have in their job.

In Table 3, 11 statements are there to measure health issues of respondents due to occupational stress. Total 100 respondents were taken for this study. The extent of stress of respondents was measured by using a 4- point scale continuum indicating. a = Not at all; b = No more than usual; c = Rather more than usual; d = Much more than usual

The figure in the parenthesis indicates percentage (%). It indicates that for each statement, the percentage of respondents experience respective extent of stress. For example, for statement-1, 12 per cent, 85 per cent and 3 per cent of respondents experience no more than usual, rather more than usual and much more than usual extent of stress respectively and so far, it goes for rest of the statements.

Health is an important casualty in case of occupational stress. From the Table 3 it is revealed that the respondents got higher health issues due to occupational stress as because they don't feel that they are playing a usual part in things (28%) followed by they don't feel capable of making decisions about things (17%), they have not been feeling reasonably happy, all things considered (8%). The respondents get least health issues due to occupational stress in the area that they feel that they are able to overcome their difficulties.

DISCUSSION

The above results are found in conformity with the results found by following scientists. Various studies confirmed that role conflict leads to job stress. Fisher and Gittleson (1983); Johnston *et al.* (1990); Netemeyer *et al.* (1990). Sekaran (1986) pointed out that the work and non-work domains of one's life are closely interlinked. Seldin (1987) noted that the academic environment of the 1980s had imposed surprisingly high levels of job stress on academics, and that the level of stress would continue to increase in future decades. Dunham (1992) provided new insights by proposing a third emphasis on coping strategies that teachers can adopt to tackle stress problems, the rationale of this approach is that, in order to understand stress, more attention should be given to problem-solving and coping behaviour. People were less stressed and most satisfied at work when their personalities and the workplace match reported by Holland (1992); Tokar *et al.* (1998).

Table 3: Distribution of respondents according to health issues due to occupational stress

S.No.	Statements	Extent of Stress			
		a	b	c	d
1	Been able to concentrate on whatever you're doing?	0(0%)	12(12%)	85(85%)	3(3%)
2	Lost much sleep over worry?	80(80)	20(20)	0(0%)	0(0%)
3	Felt that you are playing a usual part in things?	0(0%)	0(0%)	72(72%)	28(28%)
4	Felt capable of making decisions about things?	0(0%)	0(0%)	83(83%)	17(17%)
5	Felt constantly under strain?	81(81%)	19(19%)	0(0%)	0(0%)
6	Felt you couldn't overcome your difficulties?	92(92%)	8(8%)	0(0%)	0(0%)
7	Been able to enjoy your normal day-to-day activities?	0(0%)	0(0%)	93(93%)	7(7%)
8	Been able to face up to your problems?	0(0%)	16(16%)	84(84%)	0(0%)
9	Been feeling unhappy or depressed?	8(8%)	92(92%)	0(0%)	0(0%)
10	Been losing confidence in yourself?	10(10%)	90(90%)	0(0%)	0(0%)
11	Been feeling reasonably happy, all things considered?	0(0%)	0(0%)	92(92%)	8(8%)

Fischer (1994) found that traditionally university teaching has been perceived as a stress-free profession, particularly by those who are not related to this profession. Blix *et al. (*1994) in their research on "occupational stress among university teachers" found out that two third of the university faculty reported that they perceived job stress at least half of the scheduled time. They also found that found that over workload is one of the most frequently quoted reasons for considering job change. Fenlason and Beehr (1994) suggested that work-related stress has most effectively dealt with by the work-related sources of support; however, work-related social support might be more beneficial in decreasing occupational stress than non-work-related social support due to the specific nature of the stress the individual is experiencing.

Duggan *et al.* (1995) from their studies found that Personalities which were more outgoing and positive generally experience positive psychological health while personalities which were more negative were traditionally associated with greater stress.

CONCLUSION

The findings of the study suggest that teachers experience occupational stress. The researchers believe that there is not a one size fits all approach that will work to help reduce stress among the teachers. The factor that may mitigate feelings of stress such as empowerment and stakeholder support may have a varying effect based on job demands. Administrators must take the time to really understand the concerns of their staff members in order to find ways to reduce the stressors that affect them. The researchers believe that university system must support the needs of the teachers in order to maintain an efficient and effective workforce who are up to the challenge of educating a diverse student population. The important step in organizational level stress management is to conduct a needs diagnosis which is the prevalence of stress among employees. In a workplace setting, a needs diagnosis could also examine the incidence and distribution of health, family and performance consequences. The next phase of a needs diagnosis is to establish corrective managerial action goals.

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Functional Clothing – A Safety Tool for Small Scale Grinding *Chakki* Workers of Himachal Pradesh

Sapna Gautam* and Archana Sharma
Professor & Head, Department of Textiles and Apparel Designing, College of Community Science, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur–176062, Himachal Pradesh

ABSTRACT

Processing of agriculture produce at small scale level plays a pivotal role which otherwise help in providing sustainability and livelihood security to the marginal farmers. Although now a day's safety and protective textile have become an integral part in one or other form but workers involved in grinding work at small scale cottage industries level are mostly least concerned about the disorders and infections faced by them at work place due to ignorance, illiteracy, poverty and poor ventilation which is a basic problem in grinding *chakkis*. During processing dust accumulate in work place hence workers get exposed to excessive amount of flour dust. Long term continuous exposure of workers to fine dust leads to pulmonary and respiratory diseases. Following the same aspect; the status of grinding *chakki* workers was studied using random selection method and implementation of designed and developed functional clothing was studied at field level to confirm the protection efficacy at the working environment. All the functional wear were found suitable in all the parameters like design, easy wear and care, fabric properties, wearing time, suitability and adoption feasibility.

Keywords: Evaluation, Functional clothing, Grinding *chakki,* Health, Suitability

INTRODUCTION

Clothing performs multiple purpose from aesthetic to basic. Functional clothing provide functionality to the user by protecting individuals how are exposed to life threatening or hazardous environment during work. Health hazards in the workplace form a major threat to a large proportion of the world's population. Among the works of agriculture workers is the processing of raw cereals grains into flour, a finely ground particles (Abdulsalam *et al.*, 2015). Flour is fine powder made from cereals or other starchy food sources. India is 2nd largest producer of wheat; producing 85-90 million metric tons (MMT) every year. 40-45 MMT of wheat is ground to produce whole wheat flour, locally known as *atta* in cottage mills known as *chakkis* (Sakhare and Inamdar, 2014). In India, agriculture processing is predominantly in unorganized sector and mainly exists at cottage level. Apart from over 1,100 large flour mills that convert wheat into products, there are nearly three lakhs small units operating in this segment across the country in the unrecognized sector (Abhyuday, 2011). The workplace environment affects the health of workers directly or indirectly. In grinding mills, workers remain in continuous exposure to flour dust, which is ingested or inhaled by the worker which later produces a number of lung disease and respiratory tract infections and inflammation (Babel *et al.,* 2015). El-Bukhary *et al.* (2007) stated that the flour dust is a heterogeneous substance with respiratory sensitizing properties; its long term exposure may cause acute or chronic respiratory diseases. Continuous flour dust inhalation can lead to symptoms of lower respiratory track inhalation such as cough and shortness of breath. In this context workers of small scale grinding mills / *chakkis* at village level were supposed to face many health problems like short breathlessness, asthma or respiratory problems. They sometime use an old cloth, towel, scarf or any other used fabric material, which cannot serve them in facilitating completer protection from minute dust particles. Due to this reason the present study was undertaken to recognize as well as minimize their health problems by using some protective measures like functional clothing, head gear, mask etc.

*Corresponding author email id: gautams88@yahoo.com

MATERIALS AND METHODS

Data regarding personal profile of the respondents was collected from local areas of Kangra, Nurpur and Hamirpur of Himachal Pradesh, based on random selection of workers involved in small scale grinding mills / *chakkis* using interview method. Person / workers involved in small scale grinding *chakkis* were randomly selected from different areas of Himachal Pradesh. Cotton polyester blended thick fabric from the local market was chosen for making of functional clothing. Fabric count, thickness and weight of fabric were measured using standard procedures. The functional clothing were tailored to fit the mannequins present in the departmental laboratory.

On the basis of literature reviewed and information collected regarding type of activities performed in grinding *chakkis*, problems encountered while working, health and safety of person involved in rural /small scaled flour mills etc. protective / functional clothing viz. long *kurta* with Chinese collar (Apron I) with separate head gear, long *kurta* with hood (Apron II), Simple Apron III and face mask were designed & developed using fabric which was easily available in the local market. Developed functional clothing was further got evaluated at field level and made popularized by using awareness and demonstration camps. The prime objective of testing the developed functional clothing was concerned with the safety, health and welfare of people engaged on grinding *chakkis*.

RESULTS AND DISCUSSION

Survey on present status of functional clothing (Plate I) being used by small grinding *chakki* workers, revealed that during pulverizing, pounding, grinding, packing and labeling only 4-5 per cent workers use locally available *parna* or towel to protect their face and front part of body with their basic dress during grinding and reason for not wearing functional clothing they told was a mental block against its use, poor economic conditions, unawareness regarding importance and availability of such type of clothing.

Personal profile of the respondents showed (Table 1) that the persons involved in grinding *chakkis* work were in the age group of between 40 and > 60. About 96.67 per cent males were involved in this profession. 30.00 to 36.67 per cent had education level of primary or middle. 60.00 per cent were living in the nuclear family system. Working hours of workers engaged in *chakkis* were dependent on the availability of produce from nearby areas and grinding work was based on shifting pattern of the crop cultivation. During study it was observed that no special protection being used by the workers while working on *chakkis* and problems encountered with existing functional measures was also noticed.

In grinding *chakkis* at local level, approximately 96.67 per cent of loading, pulverizing, pounding, grind, unloading and sieving activities were carried out by male workers manually whereas female workers were involved in packing & labeling. Only 26.67 percent males' participation in packing & labeling was observed (Table 2).

Table 1: Personal Profile of the respondents engaged in village level grinding *chakkis* (N=30)

S. No.	Personal parameters		Frequency (%)
1	Age	Below 20 years	1(3.33)
		20-30 years	3 (10.00)
		30-40 years	5 (16.67)
		40-50 years	7 (23.33)
		50-60 years	8 (26.67)
		More than 60 years	6 (20.00)
2	Sex		
	Male		29 (96.67)
	Female		1(3.33)
3	Academic standard	Illiterate	3(10.00)
		Primary	9 (30.00)
		Middle	11 (36.67)
		10^{th}	6 (20.00)
		Graduate	1 (3.33)
		Technical education	-
4	Family type	Nuclear	18 (60.00)
		Joint	12 (40.00)
5	Working hours	Depending upon the availability of material	
6	Wages (Rs.) for grinding		
	Wheat (Rs./kg)		2.50 to 3.00/kg
	Maize (Rs./kg)		3.00/kg
	Pulsest (Rs./kg)		5.00/kg
	Turmeric (Rs./kg)		8.00 to 10.00/kg

Table 2. Activities performed in grinding *chakkis* (N=30)

Activity performed	% Involvement	
	M	F
Loading	29 (96.67)	1(3.33)
Pulverize /pound/grind	29(96.67)	1(3.33)
Unloading	29(96.67)	1(3.33)
Sieving	29(96.67)	1(3.33)
Packing & labelling	8(26.67)	-

Plate I

Plate II

Long *Kurta* having Chinese collar (Apron I) to protect the neck from minute dust particles of flour with full sleeves having elastic at wrist level to protect the arms. Front opening with Velcro for easy operation and flapped pockets on both sides of opening for carrying any material during working. The length of the *kurta* was below the knees so that maximum body part can be covered without hindrance in the work. During evaluation at field level, the prepared functional clothing was appreciated by the workers with WMS between 2.06 to 2.86.

Long *Kurta* with hood (Apron II) to protect the neck as well as head from minute dust particles of flour with full sleeves having elastic at wrist level to protect the arms. Front opening is covered using buttons and flapped pockets on both sides of opening for carrying any valuable or necessary material during working. The length of the *kurta* was below the knees so that maximum body part can be covered without hindrance in the work. Weighted

Table 3: Suitability assessment of Developed Long *Kurta* without hood (Apron I)

Characteristics or functional features	Highly suitable 3	Suitable 2	Somewhat suitable 1	WMS	
Protects neck from dust	8x3	16x2	6x1	2.06	
Protects arms from dust	18 x3	8 x2	4 x1	2.46	
Comfortable	26 x3	4 x2		2.86	

Table 4: Suitability assessment of developed Long *kurta* with hood (Apron II)

Characteristics or functional features	Highly suitable 3	Suitable 2	Somewhat suitable1	WMS	
Protects neck from dust	22 x3	8 x2	-	2.73	
Protects arms from dust	16 x3	12 x2	2 x1	2.46	
Comfortable	20 x3	6 x2	4 x1	2.53	
Patch pocket with flap					
Position of pocket	10 x3	14 x2	6 x1	2.13	
Shape and size of pocket	20 x3	8 x2	2 x1	2.60	
Flap prevents accumulation of dust in side pocket	28 x3	2 x2	-	2.93	

Suitability level: Highly suitable: 2.34 – 3.00***; Suitable: 1.67 – 2.33** Somewhat suitable 1.00-1.66*

Table 5: Suitability assessment of Developed Apron III

Functional features	Highly suitable 3	Suitable 2	Somewhat suitable 1	WMS
Protects front body parts	30x3	-	-	3.00
Comfortable	14x3	10 x2	6 x1	2.26

Suitability level: Highly suitable: 2.34 – 3.00***; Suitable: 1.67 – 2.33** Somewhat suitable 1.00-1.66*

Table 6: Pleated face mask

Functional features	Highly suitable 3	Suitable 2	Somewhat suitable 1	WMS
Easy to put on	30x3	-	-	3.0
Easy to remove	30x3	-	-	3.0
Coverage of face	18 x3	8 x2	4 x1	2.46
Easy to breathe	24 x3	6 x2		2.80
Shape of mask	30 x3	-	-	3.0
Elastic at side of mask comfortable during wear	30 x3	-	-	3.0

Suitability level: Highly suitable: 2.34 – 3.00***; Suitable: 1.67 – 2.33** Somewhat suitable 1.00-1.66*

Mean Score (WMS) for the developed functional clothing ranged between 2.46 to 2.73. For patch pocket with flap WMS was observed as 2.13 for position of pocket, 2.60 for shape and size of pocket and 2.93 for flap prevents accumulation of dust in the side pocket respectively.

Simple apron of thick blended fabric was constructed to protect the front side of the body from minute dirt and dust particles of flour, while working on the small grinding *chakkis*. Straps are attached with the shoulders and side seams. The loose ends of these straps can be rounded and tied at the neck and back-waist. A square pocket was attached at the front for protecting the valuables while working. The purpose for preparing simple apron was only the easy wearing during working and taking off after working. During evaluation WMS was calculated between 2.26 to 3.00.

Head gear: Head gear of cotton fabric for protection of head (in case of long *kurta* with Chinese collar) was also prepared and got evaluated at field level.

Face mask: Face mask for protection of face from minute dust particles was also constructed and got evaluated at field level. It was comprised of fabric having elastic at both opposite sides with strings at both sides so that can be wear/fastened easily and remained tightened at face without creating hindrance during breathing. Pleated mask for protection of face from minute particles of flour dust was also developed and it was observed that prepared masks were easy to put on and remove, shape of mask and comfort ability of elastic at side of mask during wearing with WMS 3.0 whereas WMS for coverage of face and ease to breathe ranged between 2.46 to 2.80 respectively. All the respondents appreciated the designed and developed clothing but they suggested that at the neck velcro should be used in such a way so that it can be tightened according to the need while working. Separate cap was appreciated by all the workers. They also suggested that these clothing should be available in different sizes to fulfill the demands of different body sizes. Respondents appreciated the developed functional clothing because of easy to use and maintain (Plate II). All the respondents showed their interest in pleated mask.

After acceptability assessment of prepared functional clothing / accessories, a kit of complete functional clothing like Long *Kurta* having Chinese collar, Long *Kurta* with hood, simple apron, head gear and pleated mask was prepared and multiplied. The suggestions given by the farmers like Velcro at the neck, separate head gear and pleated mask of fine cotton were also incorporated during multiplication of functional clothing. Awareness camps regarding the importance and use of functional clothing were also organized.

CONCLUSION

The developed functional clothing were appreciated and found acceptable during field level evaluation by the

workers as per the requirement that functional clothing must fit the body so that the person can move, sit and perform loading, grinding and reloading activities smoothly.

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Appraisal of Adoption Constraints and Impact of KVK Interventions in Poplar Based Agroforestry System

Ankurdeep Preety[1] and Gurpreet Singh Makkar[2]
[1]Assistant Professor (Agroforestry), Punjab Agricultural University, Krishi Vigyan Kendra , Ropar-140001, Punjab
[2]Deputy Director (Training), Punjab Agricultural University, Krishi Vigyan Kendra, Ropar-140001, Punjab

ABSTRACT

Poplar is a widely adopted agroforestry tree in North India, especially in the state of Punjab. The present study was undertaken to analyse constraints in adoption of improved poplar based- agroforestry practices in the Ropar district of Punjab and the impact of KVK interventions on knowledge and adoption of improved poplar production technologies. The constraint analysis revealed that the major constraints are the fluctuation in market price (RBQ=90.40) which often remains towards the lower side, low sale price of produce (RBQ=83.80), difficulty in cultivation of intercrops (RBQ=75.20) and yield reduction of intercrops (RBQ=73.20) under different categories of constraints. Based on the constraints, extension activities were undertaken to popularize improved technologies of poplar based agroforestry system, which resulted in the increase in knowledge and adoption of the improved cultivation technologies by 54.3 and 40.0 per cent, respectively. The overall impact of interventions by Krishi Vigyan Kendra, Ropar was also studied, which showed higher knowledge and adoption of recommended cultivation practices after the KVK intervention.

Keywords: Adoption, Agroforestry, Constraints analysis, Knowledge index, Poplar

INTRODUCTION

Agroforestry plays a major role in the crop diversification and environment conservation by increasing area under trees, thereby reducing the pressure on natural forests for meeting the wood demand of the country. Poplar (*Populus deltoides*) is a fast growing tree species which produces around 20 m^3 per ha per year wood on an average (Chauhan *et al.,* 2012). Poplar wood has high demand in plywood, pulpwood, matchsticks and other wood based industries. This tree attains marketable size in five to six years and thus is an economically viable option for inclusion in the conventional cropping system. This is one of the most preferred agroforestry tree species in the northern part of the country (Kumar and Singh, 2012). The fast growth, clean and straight bole, winter deciduous nature, narrow crown and soil enriching properties of leaf litter makes this tree highly suitable for intercropping with conventional field crops, especially in Punjab, in which majority of the farmers follows rice- wheat monoculture. Around Rs. 70,000/- to Rs. 80,000/- annual income per acre is obtained from poplar based agroforestry systems which is approximately three times higher than the conventional rice-wheat rotation system (Saresh *et al.,* 2018). Ropar district, located in the eastern region of Punjab has majority of the population involved in agriculture and livestock production. Ropar has the second largest area under forests (19.28%) among the districts of Punjab after Hoshiarpur district (21.39%) (Anonymous, 2019). The congenial climatic conditions and soil characters of Ropar have led to high adoption of the poplar based agroforestry system in this district. The present study was conducted to investigate the various constraints faced in the adoption of poplar cultivation in Ropar district of Punjab, with the objective to devise extension programmes to increase the adoption of recommended/improved poplar production technologies, which will ultimately lead to enhancement of the farmers' income of the district.

MATERIALS AND METHODS

***Study area*:** Ropar district of Punjab lies between 30.97°N and 76.5°E and 260 m above mean sea level on the bank

*Corresponding author email id: ankurdeeppreety@pau.edu

of river Satluj with Shiwalik range spread along the opposite bank of the river. The temperature of the districts ranges from 4ºC in winters to 45ºC in summers with May and June as the hottest and December and January as the coldest months. The average rainfall in the district is 775.6 mm out of which 78 per cent is received during June to September (Anonymous, 2021). Four blocks of the district *viz.* Nurpur Bedi, Ropar, Chamkaur Sahib and Anandpur Sahib were selected for the study as these comprise of the majority of poplar cultivating farmers.

Data collection and quantification: A total of twenty five poplar cultivating farmers were selected from each of these blocks randomly, thus making a sample size of 100 farmers. A proforma with list of various constraints faced by the farmers in poplar cultivation was prepared and distributed among the selected farmers for ranking of these constraints, where rank 1 signified the most important constraint. The data obtained were then quantified by the Rank Based Quotient method as given by Sabaratnam (1988) using the following formula:

$$RBQ = \frac{\Sigma fi\ (n+1-i^{th})}{N \times n} \times 100$$

Where, fi = number of farmers reporting a particular problem under i^{th} rank,
N = number of farmers
n= number of problems identified

Based on this constraint analysis, different extension programmes were executed at the farmers' fields during three consecutive years from 2018 to 2020, with the objective of demonstrating and popularizing the improved poplar production technologies as recommended by the Punjab Agricultural University, Ludhiana (Table 1), so that maximum profit could be gained by the farmers from their poplar based agroforestry practice. The extension programmes included long and short term training programmes, field demonstrations, methods demonstrations, group discussions, literature support, etc.

To study the impact of these extensions programmes, a pre and post test was administered before and after the KVK intervention. The knowledge gain was worked out on the basis of scores obtained in the pre test and post test as followed by Kobba *et al.* (2020) and Shekhar *et al.* (2019). A well constructed questionnaire to assess the adoption of the improved/recommended cultivation practices of poplar was also prepared and personal

Table 1: Farmer's practice vs. improved practice

S.No.	Agroforestry operation	Farmers' practice	Improved practice demonstrated
1.	Clone of poplar used	Use of unknown clone or old clones	Use of improved clone/ good quality planting material
2.	Source of planting material	Plants purchased without verification of source or from temporary nurseries/ sale points	Plants purchased from established nursery/ authentic source
3.	Dipping in water	ETPs planted directly in fields or kept in open as well as dipped in water for storage purpose.	Dipping of plants in water for 24-48 hours before planting for activation of roots
4.	Pre planting treatment with insecticide	No treatment or drenching of soil/ pit after planting of tree with insecticide	Dipping of lower 1 mt portion of trees (Root portion) in insecticide followed by fungicide prior to planting for 10 – 20 minutes.
5.	Pre planting treatment with fungicide	No treatment with fungicide	
6.	Spacing	6 x 1.5 m, 4.5 x 4.5 m for block plantations and 1.5-2 m for boundary plantation	8 x 2.5 m or 5 x 4 m for block plantations and 3 meter for boundary
7.	Fertilizer application	No additional urea application	Additional application of Urea other than that applied to the intercrop
8.	Irrigation	1-2 times during summers, once a month during winters	Irrigation at weekly intervals during summer, Irrigation at 15 day interval during winters
9.	Pruning	No specific time followed	Pruning of trees during winter season
10.	Water stress management	No practice followed	Planting of trees in water channels
11.	Depth of pit for planting	0.8 to 0.9 meter	Planting depth not less than 1 meter

interviews of the farmers were conducted to gather the information as per this questionnaire. The adoption index before and after the KVK's interventions was studied by the calculating the percentage of farmers adopting the particular recommended agroforestry practice. The correct answer was scored as '1' and the wrong answer as '0' and the total score was thus obtained for each question. The maximum obtainable score was 100 and minimum score was zero. The knowledge index for each practice was calculated by using the formula given below as used by other workers (Kaur and Rampal, 2020; Singh and Hensel 2014; Meena and Singh, 2010):

$$\text{Knowledge index} = \frac{\text{Score obtained}}{\text{Total obtainable score}} \times 100$$

The overall impact was calculated by studying the change or increase in knowledge of the respondents as well as increase in adoption of the agroforestry practices by the respondents. The per cent impact was calculated by using the following formula (Mahant *et al.,* 2018; Soumya and Bindu, 2016):

$$\text{Impact (\%)} = \frac{\text{Sum of difference of knowledge and adoption index}}{2}$$

RESULTS AND DISCUSSION

Constraint analysis: The constraints in poplar cultivation was divided into seven different categories *viz.* social, psychological, technological, economical, input related, management and business constraints. This enabled the assessment of constraints by the scientists in every aspect of poplar based agroforestry system, thus the extension programmes carried out were focussed mainly on these identified constraints, which in turn helped in increased adoption of the recommended cultivation techniques of poplar in the district. The data presented in Table 2(A-G) reveals the ranking of constraints in different categories based on the RBQ.

Among the social and personal constraints, lack of cooperation by the farmers having fields next to the farmer's field was the major constraint with RBQ of 70.5 per cent, followed by lack of family cooperation (67.75%) and lack of time due to family duties (56.50%). The psychological constraints like lack of interest and lack of motivation were found to be the major barriers with RBQ of 73.00 and 63.00, respectively. The major technological

Table 2: Constraints faced by farmers in poplar cultivation

S. No.	Social constraints/family/personal	RBQ	Rank
A. Social /personal constraints			
1	Lack of cooperation by farmers having neighboring field	70.50	I
2	Lack of family cooperation	67.75	II
3	Lack of time due to family assignments	56.50	III
4	Lack of interaction with other successful poplar growers	55.25	IV
B. Psychological constraints			
1	Lack of Motivation	63.00	II
2	Lack of Interest	73.00	I
3	Lack of knowledge	60.25	III
4	Lack of Risk bearing ability	53.75	IV
C. Technological constraints			
1	Poor growth of intercrops due to shade of trees	63.80	II
2	Lack of technical guidance	46.40	IV
3	Heavy damage due to insect/disease attack	43.60	V
4	Yield reduction in intercrops	73.20	I
5	Lack of knowledge about production techniques	53.00	III
D. Economic constraints			
1	Heavy fluctuation in sale price	90.40	I
2	Low profit from intercrops	68.20	II
3	Delay in income due to time duration of the tree	59.60	III
4	High cost of good quality planting material	29.20	V
5	High cost of cultivation	32.60	IV
E. Management constraints			
1	Difficulty in management of insect & disease attack	69.80	II
2	Difficulty in cultivation of intercrops	75.20	I
3	Difficulty in weed management	63.20	III
4	Lack of space for storage of poplar nursery plants prior to planting	50.00	IV
5	Land tenure	21.80	V
F. Availability of inputs constraints			
1	Unavailability of good quality planting material	59.20	II
2	Limited availability of skilled labor	54.60	III
3	Lack of capital	62.80	I
4	Lack of irrigation facilities	52.20	IV
5	Lack of required equipments	51.20	V
G. Marketing/Business constraints			
1	Lack of wood based industries	59.20	III
2	Difficulty in transportation of produce	65.20	II
3	Low sale price	83.80	I
4	Non reliability/lack of trust on wood contractors	23.80	V
5	Difficulty in harvesting of trees	48.00	IV

constraints were yield reduction of intercrops (73.20), poor growth of intercrops due to shade of trees (63.80) and lack of knowledge about production technologies (53.00). The major economic constraints faced were heavy fluctuation in sale price with RBQ of 90.40 followed by low profit from intercrops (68.20) and delay in income due to long time taken by the poplar crop to attain marketable size (59.60). Difficulty in cultivation of intercrops (75.20), difficulty in insect pest and disease management (69.80) and weed management (63.20) were the major constraints identified in the management of the poplar based agroforestry system. Lack of capital (62.80), Unavailability of good quality planting material (59.20) and Limited availability of skilled labor (54.60) were found to be the major constraints faced in the availability of inputs. Among the business and marketing constraints, low sale price of the produce (83.80), Difficulty in transportation of produce (65.20) and lack of wood based industries (59.20) were the main constraints in adoption of poplar based agroforestry. Similar results were observed by Pandey *et al* (2020), who observed yield reduction, lack of marketing, land holding, late returns and restriction in tree felling and transport as major constraints in agroforestry adoption.

Knowledge gain and adoption: The knowledge index and adoption percent of the recommended poplar production practices is presented in Table 3 and 4, respectively and are discussed as follows:

a) Use of improved clones: Selection of planting material is a major factor that affects the final timber yield as well intercrop yield in any agroforestry plantation and it is recommended to cultivate the clones having straight bole, narrow crown and fast growth (Anonymous, 2016). Prior to KVK intervention, around 49 per cent of the farmers from the sample were growing improved clones of poplar, which increased to 78 per cent afterwards. The difference in knowledge before and after intervention was 17 per cent. This shows that there is still a need to educate the farmers to adopt improved poplar clones at their fields, which can be achieved by imparting knowledge to the farmers through training programmes and awareness campaigns.

The adoption pattern of poplar clones in the district was also analyzed. The observations before and after KVK interventions are presented in Figure 1 & 2, respectively. It was found that majority of the farmers cultivated the clone G-48 (41%) followed by Wimco-110 (32%) and Udai (10%). Around 10 per cent of the farmers were not aware of about the name of the poplar clone cultivated by them. It was observed that after the intervention of KVK Ropar, majority of the farmers started cultivating the clone L-47 (31%) followed by G-48 (22%), Wimco-110 and L-47 (21%). The overall adoption of PAU recommended clones (L-48, L-47 and PL-5, combined) was 50 percent. The practice of growing clones with unknown name and source was discouraged by the KVK as this practice leads to uncertainty in the quality and quantity of the timber produce. The number of farmers who did not know the clone being grown at their fields was NIL after the KVK intervention.

Table 3: Knowledge gain

S.No.	Agroforestry operation	Knowledge index		Knowledge gain
		Before intervention	After intervention	
1.	Good quality improved poplar clones	80	97	17
2.	Selection of planting material	50	99	49
3.	Pre planting dipping in water	39	89	50
4.	Treatment of plants with insecticide prior to planting	19	92	73
5.	Treatment of plant with fungicide prior to planting	27	98	71
6.	Spacing of trees	25	96	71
7.	Additional application of Urea other than that applied to the intercrop	36	98	62
8.	Irrigation at weekly intervals during summer	28	97	69
9.	Irrigation at 15 day interval during winters	81	99	18
10.	Pruning of trees during winter season	40	87	47
11.	Planting of trees in channels	23	92	69
12.	Depth of pits for tree planting	40	96	56

Table 4: Adoption of recommended cultivation practices (%)

S.No.	Agroforestry operation	No of farmers following improved demonstrated practice		% increase in adoption after intervention
		Before intervention	After intervention	
1.	Use of improved clone/ good quality planting material	49	78	29
2.	Plants purchased from established nursery/ authentic source	52	85	33
3.	Dipping of plants in water for 24-48 hours before planting	79	93	14
4.	Treatment of plants with insecticide prior to planting	32	71	39
5.	Treatment of plant with fungicide prior to planting	2	64	62
6.	Maintenance of recommended row to row and plant to plant spacing	7	47	40
7.	Additional application of Urea other than that applied to the intercrop	11	76	65
8.	Irrigation at weekly intervals during summer	24	79	55
9.	Irrigation at 15 day interval during winters	13	66	53
10.	Pruning of trees during winter season	78	92	14
11.	Planting of trees in water channels	4	35	31
12.	Planting depth not less than 1 meter	33	78	45

b) Source of planting material: The source of plants is highly important as only authentic sources such as government agencies, registered private nurseries and trained farmers provide good quality and healthy plants to the farmers. It was observed that only 52 per cent of the farmers purchased the planting material of poplar from authentic source, while rest of the farmers either purchase from other farmers or non reliable sources or grow their own nursery without any know–how about the standard nursery growing techniques. Similar observations were recorded by Ghuman *et al.* (2017) who observed that 44 per cent farmers did not purchase the planting material from reliable source and were not aware of the importance of good quality planting material. The interventions by the KVK such as vocational trainings on nursery production, trainings and awareness programmes on selection of planting material etc. led to an increase in knowledge and adoption practice of purchase from well established nurseries by 49 per cent and 33 per cent, respectively. The farmers producing their own nurseries from 1 year old poplar nursery plant and as per the techniques recommended by PAU, Ludhiana were

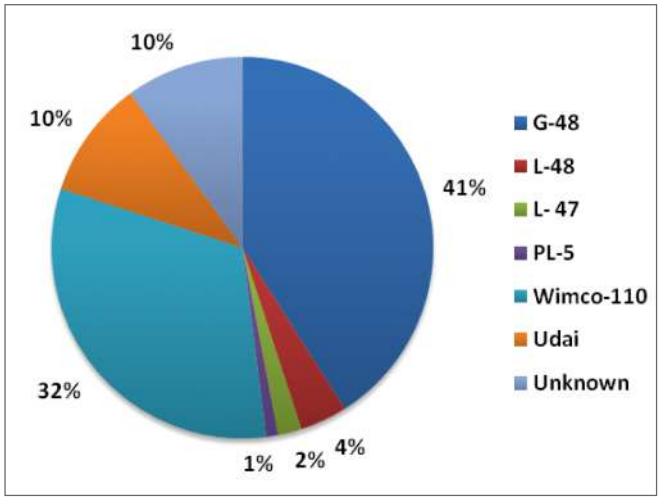

Figure 1: Adoption of poplar clones before KVK intervention

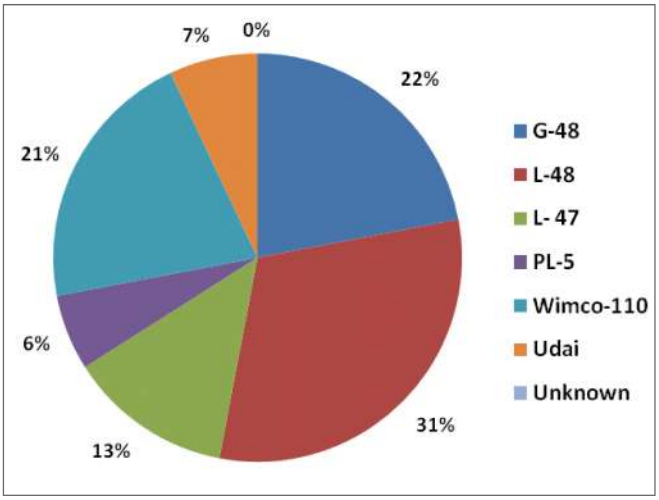

Figure 2: Adoption of poplar clones after KVK intervention

considered in the category of authentic source, while the farmers producing their own nursery from side branches of poplar and without obtaining any training or guidance regarding poplar nursery production were considered as non adopter of the practice.

c) Dipping of the poplar plants in water for 24-48 hours before planting: The poplar plants are planted during dormant season of the tree i.e. from January to February. To activate the roots for better establishment of newly planted trees, it is recommended to dip the whole plant or the lower 1 meter (root part) of the plant in water for at least 24-48 hours. It was observed that the knowledge index increased from 39 to 89 respectively. The study revealed that most of the farmers (79%) of the farmers followed this practice during 2017 which increased to 93 per cent in 2021 after regular KVK intervention. The lack of space for storage and dipping of plants as well as uncertainty in labour availability for planting operation are the major causes due to which the farmer go for direct planting after transportation of the plants to their fields.

d) Treatment of plants with insecticide prior to planting: It is recommended to dip the lower 1 meter part of the poplar plants in insecticide for 10 minutes. The knowledge index for this increased from 19 to 92. However only 32 per cent of the farmers followed this practice before KVK intervention, which increased to 71 per cent afterwards. The low adoption despite of high knowledge gain may be because of the difficulty in execution of the whole process on pre planting treatment due to limited labour resources.

e) Treatment of plants with fungicide prior to planting: To prevent attack of disease in poplar plantations, the treatment of lower 1 meter of the plants with fungicides is recommended after the 10 minute treatment with insecticide. This practice was followed by only 2 per cent farmers in 2017 which increased to 64 per cent during 2021. The knowledge gain was found to be 71 per cent. Lack of awareness of the need of fungicide in addition to insecticide as well was shortage of labour for following additional steps in planting were found to be the main reason for low adoption.

f) Maintenance of recommended row to row and plant to plant spacing: The recommended spacing of 5 x 4 meter and 8 x 2.5 meters in poplar trees was followed by only 7 per cent of the farmers in 2017. With the intervention of KVK, the knowledge index increased from 25 to 96 and adoption of this practice increased to 47 per cent in 2021. Low adoption is mainly due to the ease of tractor operations in the farmers' practice of 4.5 x 4.5 meter and 6 x 1.5 meter, which allows more number of plants. Similar observations were made by Singh and Mavi (2016), who observed that maximum farmers followed 6 x 1.5 meter poplar spacing in their agroforestry plantations. The farmers need to be made aware of the overall profit in terms of total wood production as well as intercrop yield in which the combined profit from the 5-6 year poplar agroforestry unit is comparatively higher than the field with dense poplar plantations as per the farmers' practice.

g) Additional application of urea other than that applied to the intercrop: The poplar plantations require additional nitrogen fertilizer for its better growth, however most of the farmers are not aware of this practice. The study revealed that only 11 per cent farmers added nitrogen in the form of urea to poplar trees initially, while this practice was followed by 76 per cent farmers after KVK's guidance and extension activities, the knowledge index increased from 36 to 98 per cent.

h) Irrigation at weekly intervals during summer: Poplar is a high water requiring tree which survives best in summers if irrigated at seven to ten days interval. The knowledge index for this practice was 28 before KVK interventions with adoption of 24 per cent. However with regular trainings and awareness regarding prevention of drying up of trees due to water stress, the knowledge index was found to be 98% and 79 per cent farmers were reported to adopt this practice in 2021 by the current study. Lack of irrigation facilities is the main reason behind lower adoption even after awareness generation among farmers.

***i) Irrigation at 15 day interval during winters*:** The poplar plantations require irrigation during the winter season at 15 days interval. This practice was adopted by only 13 per cent farmers in 2017 and 66 per cent in 2021. Despite of the knowledge gain of 69 per cent, majority of the non adopters reported less requirement of irrigation in their field due to low evaporation rate as the major cause of less frequent irrigation, thus the adoption is lower.

j) Pruning of trees during winter season: To get a straight and knot free bole, it is recommended that pruning of the poplar trees should be done during the dormant season i.e. during winters. The knowledge gain was found to be 47 and the adoption percentage of pruning in winters was 78 per cent during 2017 and this has increased to 92 per cent during 2020-21.

k) Planting of trees in water channels: Planting of poplar trees in water channels not only saves water to a large extent but also allow irrigation of only tree rows when the intercrop is near harvest, thus preventing any damage to the intercrops. This practice was followed by 4 per cent farmers initially in 2017, which increased to 35 per cent only in 2021 despite of the increase in knowledge index from 23 to 92. Very low adoption despite of regular awareness and training programs was mainly due to labour intensive weed management practices in tree water channels and limitation of movement of tractor and field machinery due to channels for field operations.

l) Pit depth for planting: It is recommended to dig one meter deep pits for planting of poplar plants for proper establishment and firm root grip of the tree. Poplars planted at shallower depth are often susceptible to uprooting due to strong winds especially in irrigated fields or in monsoons. In the current study it was found that 33 per cent of the respondents-followed this practice while 67 per cent of the farmer planted the poplar plants at an average depth of 0.8 to 0.9 meter. The adoption percent of this practice was 78 per cent after KVK intervention. The gap in achieving 100 per cent adoption is due to lack of availability of skilled labour during plantation period and non supervision of the plantation operation by the farmer.

Agroforestry practice

The pattern of adoption of the agroforestry practice such as intercropping of field crops in block plantation of poplar, sole poplar plantation and boundary plantation of poplar was studied. The results are presented in Figure 3. It was observed that majority of the respondents (77%) followed intercropping in block plantations of poplar, in which intercrops such as sugarcane, bajra, fodder maize etc. were cultivated during first two to three years during *kharif* season and wheat, rapeseed mustard, potato, berseem, etc. were cultivated for four to five years during *rabi* season. As per the survey conducted before KVK intervention, the sole cropping was followed by 13 per cent farmers and 10 per cent farmers practised boundary plantation. KVK encouraged the farmers, especially those who were following sole cropping to adopt the practice of intercropping in poplar, as it is beneficial for the trees and also leads to higher overall profit from the field. As a result of this, the percentage of farmers practicing sole cropping decreased to 4 per cent from 13 per cent, while that of intercropping increased from 77 to 87 per cent.

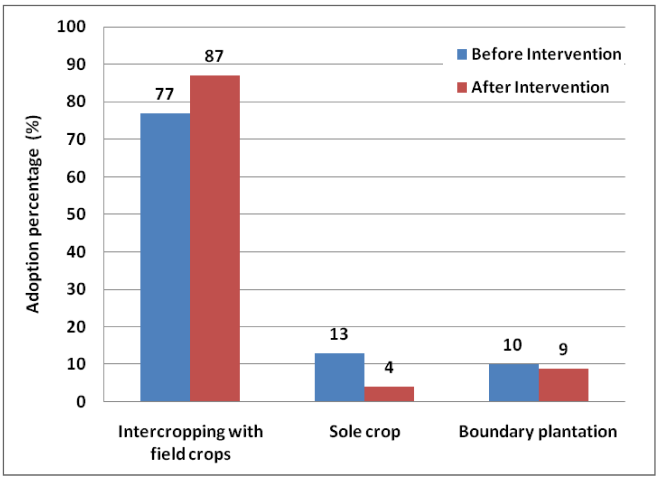

Figure 3: Change in adoption of Agroforestry system after KVK intervention

The 4 per cent farmers practicing sole cropping even after interventions included the absentee farmers who are unable to visit their poplar fields on a regular basis.

Impact: The impact of the study is presented in the Table 5. Overall, it was observed that there was an increase in the knowledge index after regular KVK interventions which shows the effectiveness of the extension programmes. The adoption of the improved recommended production technologies in poplar based agroforestry was also found to be higher after the regular extension programmes conducted by the KVK. The overall impact was found to be 47.16 per cent which showed the success of the interventions conducted in the district. Similar results were reported by Mahant *et al.* (2018) and Soumya *et al.* (2017) who recorded impact percent of 59.2 and 54.46 per cent, respectively in case of different agricultural systems.

Table 5: Impact analysis of extension activities

Particular	Before inter-vention	After inter-vention	Difference
Mean knowledge index	40.67	95	54.33
Mean adoption index	32	72	40.00
Total			94.33
Impact (%) = 47.165%			

CONCLUSIONS

It was concluded form the current study that intensive extension activities on improved cultivation practices of poplar need to be carried out in order to increase the adoption percentage, which will ultimately enhance the overall income of the farmer from his agroforestry field.

The constraints faced by the farmers in poplar cultivation can be overcome by higher adoption of the above mentioned practices, apart from the socio economic policy changes by the government aiming at increased and ensured market price of the poplar produce. The need of the hour is to conduct extensive awareness campaigns, training programmes, and demonstrations of the recommended technologies at the farmers' fields so that the resource poor farmers can get maximum profit from agroforestry based land use system.

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Knowledge about Causes, Effects and Mitigation of Soil Pollution among Farming Families of Punjab

Pratiksha* and Preeti Sharma
Department of Extension Education and Communication Management, College of Community Science, Punjab Agricultural University, Ludhiana-141001, Punjab

ABSTRACT

India is an agrarian nation and produces huge amount of agriculture based waste. Farmers choose burning as an ultimate way to manage the large quantities of produce residue and also to get the field ready for the next crop well in time. Five worst hit districts of Punjab were Sangrur 6,662 stubble burning cases followed by Bathinda 5,798, Ferozpur 5,013, Patiala 3,983 and 3,751 cases registered with Muktsar. (Ludhiana Times, 13 November 2019). The burning of wheat and paddy stubbles & leftover straw in fields contribute to loss of soil fertility. Burning of straw leads to loss of valuable nutrients like 75.0 per cent of potassium, 50.0 per cent sulfur, 25 per cent nitrogen and phosphorus. The present study entitled 'Knowledge about Causes, Effects and Mitigation of Soil Pollution among Farming Families of Punjab' was conducted with the objectives to assess the knowledge level of respondents regarding causes, effects and mitigation practices for soil pollution and to study the application of mitigation strategies by the respondents. 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. A knowledge test was developed and pre tested for its reliability and validity. The data was analyzed using frequencies and percentages. The findings of the study revealed that majority of the respondents across all agro-climatic zones had high level of knowledge for causes and mitigation strategies but had medium level of knowledge about effects of soil pollution. Irrespective of high level of knowledge about mitigation strategies for soil pollution, very few respondents applied these mitigation strategies to combat soil pollution. It is suggested that in extension trainings/ camps more emphasis should be given on information about effects of soil pollution, so that people could be sensitized to take serious action to mitigate the effects of soil pollution. Innovative behaviour change communication strategies need to be applied to improve the practical application of knowledge gained.

Keywords: Agro-climatic zones, Farming Families, Knowledge level, Mitigation, Soil pollution

INTRODUCTION

India is an agrarian nation and produces huge amount of agriculture based waste. Farmers choose burning as an ultimate way to manage the large quantities of produce residue and also to get the field ready for the next crop well in time. The major states involved in the cereal crop residue burning were Uttar Pradesh (72 Mt) followed by Punjab (45.6 Mt), West Bengal (37.3 Mt), Andhra Pradesh (33 Mt) and Haryana (24.7 Mt) (Jain *et al.,* 2014). Pollution from agricultural activities adversely affects the environment. The Supreme Court on 25th November 2019 lashed out at the Punjab, Uttar Pradesh and Haryana governments for their inability to prevent pollution from stubble burning despite orders from the court, saying the smog from the fires had made Delhi a living hell (Anonymous, 2019b). Five worst hit districts of Punjab were Sangrur 6,662 stubble burning cases followed by Bathinda 5,798, Ferozpur 5,013, Patiala 3,983 and 3,751 cases registered with Muktsar (Ludhiana Times, 13 November, 2019). This produces high level of pollutants like (NO_2, SO_2, N_2O, CH_4) etc. and affects health of the human and also decrease quality of soil.

*Corresponding author email id: pratikshasinghcsa@gmail.com

Due to falling fertility of the soil, in the recent years, a drop in crop productivity has also been observed. This is assumed to be due to disproportionate use of chemicals like fertilizers and pesticides over the years. High application of nitrogenous fertilizers in fields with relative under-utilization of other fertilizers and micronutrients has created imbalance in soil micro nutrient in Punjab. In Punjab, during the year 2014-15, the total area covered under Bio-pesticides in the Kharif season was 0.87 Lakh hectares, while, the total area under chemical and Bio pesticides was near around 35.77 lakh hectare. The various studies conducted in Punjab since 1970 revealed the presence of residues of chemical pesticides such as synthetic pyrethroids, organ chlorines, carbamates and organophosphates in human beings, vegetables, water, milk, and other food products in a harmful amount which is dangerous for human, animal and plant health (Gulmeser *et al.,* 2009).

The burning of wheat and paddy stubbles & leftover straw in fields contribute to loss of soil fertility. Burning of straw leads to loss of valuable nutrients like 75.0 per cent of potassium, 50.0 per cent sulfur, 25 per cent nitrogen and phosphorus. It has been assessed that burning of 1 tonne of paddy straw results into loss of 5.5 kg nitrogen, 1.2 kg sulfur and 2.3 kg phosphorus, as well as organic carbon. Further, paddy straw burning generated heat that penetrates into the soil. It leads to loss of useful microbes and moisture, which adversely affects the soil properties. High collection cost and lack of economically viable options are the major factors which force the farmers to burn straw. Loss of soil organic matter due to residue burning is one of the biggest threat for the sustainability of rice-wheat cropping system. The excessive use of fertilizers and pesticides has massively contributed towards deprivation of the quality of soil (Awasthi *et al.,* 2010).

Agriculture is the backbone of Indian economy and production needs to be sustained keeping in view the need of providing food security to each individual but at the same time, there is a need to create an awakening on the problems arising due to faulty agricultural practices, related consequences and to suggest means to reduce the stress on environment in the rural areas which had always been considered pollution free and safe for living. Increase in awareness and knowledge can go a long way in minimizing the causes of environmental pollution to reduce harmful impact on environment in general and health in particular. Thus, the present study was conducted with the objectives to assess the knowledge level of respondents regarding causes, effects and mitigation practices for soil pollution and to study the application of mitigation strategies by the respondents.

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 soil pollution. Overall knowledge level of respondents was also calculated. The data was analyzed using Statistical Package for Social Sciences (SPSS) software.

RESULTS AND DISCUSSION

Table 1 discusses the knowledge of respondents about causes of soil pollution. Almost all the respondents with the percentage of 98.6 per cent from five agro-climatic zones of Punjab knew that stubble burning is one of the causes of soil pollution. Deforestation (94.6%) followed by increase in fast-food culture/disposal packaging material and excessive use of fertilizers/ pesticides/ herbicides with the same percentage (91.3) and improper disposal of computers and laptops (90.0%) also were the reasons of soil pollution as perceived by the reasons. Most of the respondents knew that use of bad quality water for irrigation (87.3%) followed by throwing used phenyl water after mopping floor (85.3%) and increased use of machines and technologies (84.0%) also cause soil pollution. It can be concluded that most of the respondents had knowledge about causes of soil pollution.

Data presented in Figure 1 further discusses the zone and gender wise comparison of knowledge level of respondents about causes of soil pollution. It revealed that majority of the male (72.0%) and female respondents

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

Causes	Frequency	Percentage
Increased use of machines and technologies	126	84.0
Deforestation (cutting of trees)	142	94.6
Stubble burning	148	98.6
Increase in fast-food culture/disposal packaging material	137	91.3
Use of bad quality water for irrigation	131	87.3
Excessive use of fertilizers/ pesticides/ herbicides	137	91.3
Throwing used phenyl water after mopping floor	128	85.3
Improper disposal of computers and laptops	135	90.0

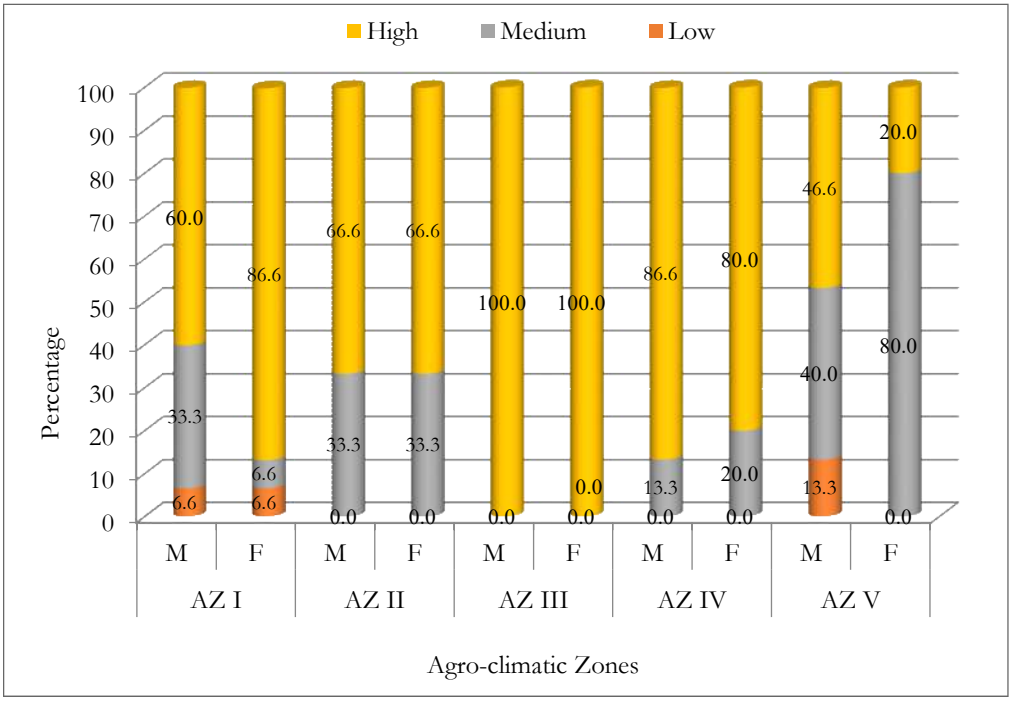

Figure 1: Zone and gender wise distribution of the respondents according to their knowledge level about causes of soil pollution

(70.6%) across five agro-climatic zones had high level of knowledge regarding causes of soil pollution. It was further indicated that comparatively cent per cent of the male respondents of agro-climatic zone III (Central plain zone) followed by agro-climatic zone IV (86.6%), agro-climatic zone II (66.6%), agro-climatic zone I (60.0%) and 46.6 per cent from agro-climatic zone V had high level of knowledge regarding causes of soil pollution. Similarly, cent per cent female respondents of agro-climatic zone III followed by 86.6 per cent from agro-climatic zone I, 80.0 per cent from agro-climatic zone IV, 66.6 per cent from agro-climatic zone II and least 20.0 per cent from agro-climatic zone V had high level of knowledge regarding causes of soil pollution. While comparing agro-climatic zones, it was observed that majority of the respondents of all agro-climatic zone had high level of knowledge except the respondents of agro-climatic zone V (Western zone) where most of the female respondents (80.0%) and 40 percent male respondents had medium level of knowledge about causes of soil pollution (Figure 1).

Thus, it can be concluded from Figure 1 that knowledge level of the respondents across all agro-climatic zones except Zone V was high for causes of soil pollution. The findings are in line with results reported by Obafemi *et al.* (2012).

Data in Table 2 discuss the knowledge of respondents about effects of soil pollution on environment and health of human being. It is revealed that almost all the respondents from all five agro-climatic zones of Punjab had knowledge that soil pollution affects human health. Most of the respondents knew that it causes various diseases

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

Effects	Frequency	Percentage
Human health		
Diarrhea	147	97.3
Constipation	149	99.3
Tonsils	90	60.0
Infertility	125	83.3
Mental retardation	130	86.6
Environment health		
Loss of soil nutrients	144	96.0
Decreases the population of soil micro organisms	137	91.3
Change in soil moisture	139	92.6
Loss of soil organic matter	147	97.3
Quality of agro produce	113	75.3
Quantity of agro produce	111	74.0

related to food like constipation (99.3%) and diarrhea (97.3%). Soil pollution even can causes mental retardation (86.6%) and infertility (83.3%) among human being. Tonsils was also reported by 60.0 per cent respondents as one of the effects of soil pollution.

The respondents also knew the effects of soil pollution on environment. Loss of soil organic matter was the major effect of soil pollution on enviornment known to 97.3 per cent respondents. Most of the respondents also had knowledge of other effects such as loss of soil nutrients (96.0%), change in soil moisture (92.6%), decrease in the population of soil micro-organisms (91.3%), quality of agro produce (75.3%), quantity of agro produce (74.0%).

Data in Figure 2 further discuss the zone and gender wise knowledge disparity about effects of soil pollution. It is indicated that male respondents of agro-climatic zone I (93.3%) followed by 86.6 per cent from agro-climatic zone IV, agro-climatic zone V (66.6%) and 40.0 per cent from agro-climatic zone II had medium level knowledge about effects of soil pollution. Similarly, majority of the female respondents of agro-climatic zone I, IV and V (60.0%) and agro-climatic zone II (53.3%) had medium level knowledge regarding effects of soil pollution. While comparing agro-climatic zones, it was observed that majority of the respondents of all agro-climatic zones had medium level of knowledge except agro-climatic zone III (Central plain zone) where cent per cent of male and female respondents had high level of knowledge about effects of soil pollution. An evident difference was observed in the knowledge level about effects of soil pollution across agro-climatic zones.

A large proportion of male (46.6%) and female (33.3%) respondents from agro-climatic zone II (Undulating plain zone) had low level of knowledge about effects of soil pollution. Similarly 33.3 per cent male and 40.0 per cent female respondents from agro-climatic zone V (Western zone) also had low level of knowledge (Fig. 2).

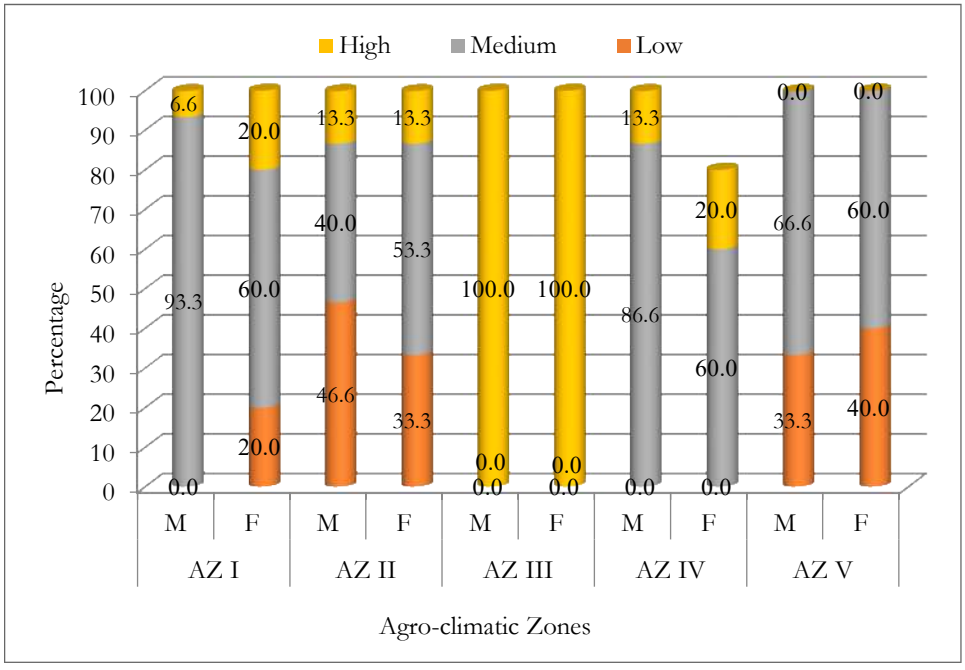

Figure 2: Zone and gender wise distribution of the respondents according to their knowledge level about effects of soil pollution

It can be concluded from Figure 2 that majority of the respondents across all agro-climatic zones had medium level of knowledge for effects of soil pollution. The findings are in line with the results of the study conducted by Gopal *et al.* (2014) and Kumar (2014). Although an apparent difference in knowledge level was reported zone wise, Figure 2 shows a large number of respondents from agro-climatic zone II and V had medium to low level of knowledge as compared to other three zones who had medium to high level of knowledge. It is suggested that more emphasis should be given on agro- climatic zone II (Undulating plain zone) and V (Western zone) while disseminating knowledge about environmental pollution during various extension activities.

Data presented in Table 3 shows the knowledge of respondents about mitigations strategies for soil pollution. It was found that cent per cent of the respondents across all five agro-climatic zones knew that rotation of crops is one way of improving soil quality and can reduce soil pollution. Majority of the respondents with the same percentage of 99.3 across all five agro-climatic zones knew that organic farming system and improved sanitation by using toilets and proper waste management can reduce soil pollution. With the percentage of 98.6 per cent respondents had knowledge that use of leaf colour chart for applying nitrogenous fertilizer to crop can help reducing soil pollution. The majority of the respondents with the percentage of 94.6 per cent knew about biogas plant slurry is useful for manuring without affecting environment is the other mitigation strategies to combat soil pollution. It can be concluded that most of the respondents had excellent knowledge about mitigation of soil pollution.

In case of respondents' knowledge level about mitigation of soil pollution, majority of the male and female (60.0%) respondents had low level of knowledge about mitigations of soil pollution across all agro-climatic zones (Figure 3).

Cent per cent of male and female respondents from agro-climatic zone I, II and III had low level of knowledge

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

Mitigation	Frequency	Percentage
Organic farming system is the approach to control soil pollution	149	99.3
Rotation of crops is one way of improving soil quality	150	100.0
Improved sanitation by using toilets and proper waste management	149	99.3
Use of leaf colour chart for applying nitrogenous fertilizer to crop	148	98.6
Biogas plant slurry is useful for manuring without affecting environment	142	94.6

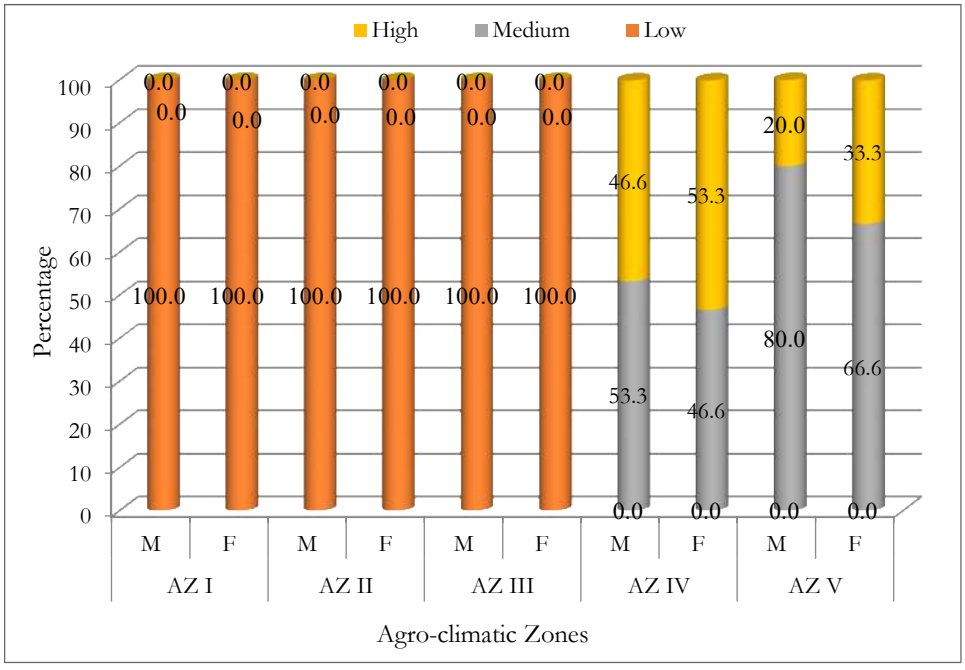

Figure 3: Zone and gender wise knowledge level of respondents according to their knowledge level about mitigations of soil pollution

about mitigation of soil pollution while majority of the male (80.0%) and female (66.6%) respondents from agro-climatic zone V had medium level of knowledge. The respondents of agro-climatic zone IV were equally distributed in medium and high level of knowledge where 53.3 per cent males and 46.6 per cent females had medium level of knowledge and vice versa for high level of knowledge (Figure 3).

Figure 3 concludes that majority of the respondents across all agro-climatic zones had low level of knowledge for mitigation of soil pollution. Zone wise, most of the respondents from agro-climatic zone I, II and III had low level of knowledge for mitigation of soil 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 environmental pollution through social method and extension activities.

Table 5 highlights the various mitigation strategies stated by respondents to combat soil pollution across five agro-climatic zones. In order to reduce soil pollution all the households from agro-climatic zone III (Central plain zone) followed by 73.3 per cent from agro-climatic zone V, 66.6 per cent from agro-climatic zone II, 40.0 per cent

Table 4: Knowledge level of respondents about causes, effects and mitigation of soil pollution (n=150)

Agro-climatic zones	Gender	Knowledge level								
		Causes			Effects			Mitigation strategies		
		L	M	H	L	M	H	L	M	H
AZ I	M(n_1=15)	1 (6.6)	5 (33.3)	9 (60.0)	0 (0.0)	4 (93.3)	1 (6.6)	15 (100.0)	0 (0.0)	0 (0.0)
	F(n_2=15)	1 (6.6)	1 (6.6)	13 (86.6)	3 (20.0)	9 (60.0)	3 (20.0)	15 (100.0)	0 (0.0)	0 (0.0)
AZ II	M(n_1=15)	0 (0.0)	5 (33.3)	10 (66.6)	7 (46.6)	6 (40.0)	2 (13.3)	15 (100.0)	0 (0.0)	0 (0.0)
	F(n_2=15)	0 (0.0)	5 (33.3)	10 (66.6)	5 (33.3)	8 (53.3)	2 (13.3)	15 (100.0)	0 (0.0)	0 (0.0)
AZ III	M(n_1=15)	0 (0.0)	0 (0.0)	15 (100.0)	0 (0.0)	0 (0.0)	15 (100.0)	15 (100.0)	0 (0.0)	0 (0.0)
	F(n_2=15)	0 (0.0)	0 (0.0)	15 (100.0)	0 (0.0)	0 (0.0)	15 (100.0)	15 (100.0)	0 (0.0)	0 (0.0)
AZ IV	M(n_1=15)	0 (0.0)	2 (13.3)	13 (86.6)	0 (0.0)	13 (86.6)	2 (13.3)	0 (0.0)	8 (53.3)	7 (46.6)
	F(n_2=15)	0 (0.0)	3 (20.0)	12 (80.0)	0 (0.0)	9 (60.0)	3 (20.0)	0 (0.0)	7 (46.6)	8 (53.3)
AZ V	M(n_1=15)	2 (13.3)	6 (40.0)	7 (46.6)	5 (33.3)	10 (66.6)	0 (0.0)	0 (0.0)	12 (80.0)	3 (20.0)
	F(n_2=15)	0 (0.0)	12 (80.0)	3 (20.0)	6 (40.0)	9 (60.0)	0 (0.0)	0 (0.0)	10 (66.6)	5 (33.3)
Overall	M(n_1=75)	3 (4.0)	18 (24.0)	54 (72.0)	12 (16.0)	6 (61.3)	20 (26.6)	45 (60.0)	20 (26.6)	10 (13.3)
	F(n_2=75)	1 (1.3)	21 (28.0)	53 (70.6)	14 (18.6)	5 (46.6)	23 (30.6)	45 (60.0)	17 (22.6)	13 (17.3)
	Total (n=150)	4 (2.6)	39 (26.0)	107 (71.3)	26 (17.3)	1 (54.0)	43 (28.6)	90 (60.0)	37 (24.6)	23 (15.3)

Score range	Causes of soil pollution	Effects of soil pollution	Mitigation of soil pollution
Low	2-4	7-8.6	3-5
Medium	4.1-6	8.7-10.3	5.1-7.1
High	6.1-8	10.4– 11.6	7.2-9.2

Table 5: Application of mitigation strategies to combat soil pollution by farm households (n=75)

Soil 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	%
Avoid infected water for irrigation	1	6.6	10	66.6	15	100.0	6	40.0	11	73.3
Organic farming	10	66.7	3	20.0	0	0.0	9	60.0	5	33.3
Use of leaf colour chart for applying nitrogenous fertilizer to crop	0	0.0	0	0.0	0	0.0	8	53.3	2	13.3
Crop rotation	15	100.0	8	53.3	15	100.0	10	66.7	0	0.0
Biogas plant slurry for manuring	2	13.3	4	26.6	7	46.6	6	40.0	4	26.6
Improved sanitation by proper waste management	4	26.6	6	40.0	7	46.6	4	26.6	0	0.0

from agro-climatic zone IV and 6.6 per cent from agro-climatic zone I tried to avoid irrigation using infected water of canal. Instead, they preferred ground water for irrigation.

Use of chemicals in the form of fertilizer is one of the major causes of soil pollution. Thus, majority of the farm households (66.7%) from agro-climatic zone I followed by 60.0 per cent from agro-climatic zone IV, 33.3 per cent from agro-climatic zone V and 20.0 per cent from agro-climatic zone II practised organic farming i.e. use of manure for their farms. It is recommended to refer leaf colour chart while applying nitrogenous fertilizer to crops in order to reduce use of chemical. It was revealed that only half of the households of agro-climatic zone IV (Western plain zone) (53.3%) and 13.3 per cent from agro-climatic zone V used leaf colour charts. Rotation of crops after every year is another way of improving soil condition. Data in Table 5 revealed that all the selected households from the agro-climatic zone I (Sub-mountain undulating zone) and III (Central plain zone) followed by 66.7 per cent from agro-climatic zone IV and 53.3 per cent from agro-climatic zone II practised crop rotation on their farms. Biogas plant slurry work as organic manure that improves the soil condition. A large percentage of households from agro-climatic zone III (46.6%) followed by 40.0 per cent households of agro-climatic zone IV, 26.6 per cent from agro-climatic zone II and V and least 13.3 per cent households from agro-climatic zone I used biogas plant slurry for manuring their farms. These households had installed bio gas plants in their houses and were using that slurry for manuring.

Proper waste management is also one way of reducing soil pollution. Although it was practised by only 46.6 per cent farm households of agro-climatic zone III (Central plain zone) followed by 40.0 per cent farm households from agro-climatic zone II, 26.6 per cent from agro-climatic zone I and IV. It can be concluded from Table 5 that very few percentage of respondents practised mitigation strategies to reduce soil pollution. It was observed that majority of the respondents of agro-climatic zone IV (Western plain zone) practised maximum number of mitigation strategies. The findings are in line with the result of Kumari and Reddy (2013) that farm workers were practising only half of the practises which were known to them.

CONCLUSION

The paper concludes that majority of the respondents had high level of knowledge about causes of soil pollution. They had medium level of knowledge regarding effects of soil pollution. Knowledge level of respondents about mitigation of soil pollution was reported to be high. It is further concluded that zone wise, most of the respondents of agro-climatic zone I, II and III had low level of knowledge for mitigation of soil pollution. These zones need to be given more attention while imparting knowledge about soil pollution. It is suggested that in extension trainings/ camps more emphasis should be given on information about effects of soil pollution, so that people could be sensitized to take serious action to mitigate the effects of soil 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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Entrepreneurial behaviour of Self Help Groups: Enterprise, Income and Efficiency

S.K. Acharya[1]*, Preethi Battu[2], K. Manobharathi[3] and Monirul Haque[3]
[1]Professor, [3]Ph.D. Research Scholar, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Nadia, Mohanpur-741252, West Bengal
[2]Ph.D. Research Scholar, MPKV, Rahuri, Maharashtra

ABSTRACT

The role of Self Help Groups (SHGs) in the development of entrepreneurship especially for women in the rural areas is vital. SHG is a village-based financial intermediary committee normally consist of 10–20 local women or men. Self-help group is basically group of individual members who by free alliance come together for a common communal purpose. The present study was conducted in Pandurangapuram village, under Nandyalmandal and Gopavaram village, under Mahanandimandal of Kurnool district of Andhra Pradesh. The number of respondents were 80 and they were selected randomly. The data were collected through pilot survey and structured interview. The statistical tools used for data analysis are Correlation coefficient, Stepwise regression analysis, Canonical covariate analysis, Factor analysis and Cluster analysis. The correlation coefficients suggest that younger respondents have recorded higher and better entrepreneurial behaviour and this have also been reflected in Experience in SHG. Regression results found that 11 casual variables together have contributed 65.8 per cent of variance in consequent variable Entrepreneurial behaviour (y_1). Extension contacts (x_7) Distance from market (x_{10}), No of trainings attended (x_8) has been retained in the last step of step down regression that means these are the most important causal variables which affect the consequent variable. The results of path analysis envies that the variable No of trainings attended (x_8) have got highest indirect effect on y_1.

Keywords: Entrepreneurial behaviour, Extension contacts, Self Help Group, Trainings

INTRODUCTION

The origin of Self Help Groups (SHGs) is the brainchild of Grameen Bank of Bangladesh, founded by Prof. Mohammed Yunus in 1975, who tried out a new approach to rural credit in Bangladesh. Grameen bank gave loans without asking borrowers either to provide collateral or engage in paper work. In India, NABARD initiated SHGs in the year 1986-87. A self-help group, abbreviated as SHG is a village-based financial intermediary committee normally consist of 10–20 local women or men. Self-help group is basically group of individual members who by free alliance come together for a common communal purpose. Practically, self-help group include individual members recognized to each other and belong to the same village, community and even marketing area. They are homogeneous and have certain pre group social binding factors. In the context of micro-finance, self-help group are made around the theme of investments and credit (Shelke, 2009). Entrepreneur has been defined in the traditional literature as a person who undertakes business and bears associated risk, innovative ability, high need achievement, and religious belief, socially good and economic background (Gupta, 2002). Self Help Group (SHG) undertakes entrepreneurial activities at smaller level with minimum capital requirements. The women led SHGs have successfully demonstrated how to mobilize and manage thrift, appraise credit needs and enforce financial self discipline. SHGs have the potential to ignite socio-economic revolution in rural India (Gurumoorthy, 2000). Women of India have taken commendable part in the field of entrepreneurship. The Government of India has also stressed on special entrepreneurship programmes for women with a view to uplift their status in the economic and social fields. At present, with growing awareness and spread of education, women have ventured into business

*Corresponding author email id: acharya09sankar@gmail.com

to engage themselves in productive activities; women are increasingly seeking to become entrepreneurs in various fields. It is now recognized that women have vast entrepreneurial talents and that have transformed them from jobseekers to job givers. Initially women's activities in business were confined to making papad, pickles, jam, masala, squash, weaving embroidery, spinning and handicraft. Now their business has shifted towards non-traditional activities like engineering, and other technical fields. This is due to spread to technical education among women (Nirmala, 2004). Factors Influencing Their Motivation", analysed the impact of entrepreneurs characterized by competitions, financial gain and independence and the socio-economic setting provided a base for individuals to venture into entrepreneurship. Individuals perform the entrepreneurial role because of a desire to achieve, and individuals with a high need for achievement venture into enterprise building, whether small or large (Sujata, 2006). Women's entrepreneurship is both about women's position in society and about the role of entrepreneurship in the same society. Women entrepreneurs faced many obstacles specifically in market their product (including family responsibilities) that have to be overcome in order to give them access to the same opportunities as men. In addition, in some countries, women may experience obstacles with respect to holding property and entering contracts. Increased participation of women in the labour force is a prerequisite for improving the position of women in society and self-employed women. Particularly the entry of rural women in micro enterprises will be encouraged and aggravated (Maggu, 2016). Self employment is better suited to women. If she is her own master of any of her work schedule, she can adjust her work. At present women have broken the monopoly of men and proved that they are not inferior to men. Over the past few decades the women has been breaking traditional role of a mother or a house wife. It is clear from the study that women entrepreneur of SHGs has good work force, under the dynamic setting of business, if women entrepreneur is given a proper guidance and training to enhance the profitability of the enterprises the future will be bright and prosperous (Rajasekaran *et al.*, 2016). In our present study we identified and decomposed the relationship among and between some exogenous variables & entrepreneurial behaviour of the SHGs women.

MATERIALS AND METHODS

The present study entitled "Entrepreneurial behaviour of Self Help Groups: Enterprise, Income and Efficiency" was conducted in Pandurangapuram village, under Nandyalmandal and Gopavaram village, under Mahanandimandal of Kurnool district of Andhra Pradesh. Eighty (80) respondents in total were selected from two villages, forty (40) from each village to conduct the study following random sampling method. Appropriate statistical tools have been used to carry out the study viz, Correlation coefficient, Step wise regression analysis, canonical covariate analysis, Factor analysis, Cluster analysis. Appropriate operationalization and measurement of the variables have helped the researcher to land upon the accurate conclusions. Therefore, the selected variables for this study had been operationalized and measured in the following manner: 1) Independent variables 2) Dependent variables. Independent variables selected for the study were Age (x_1), Marital status (x_2), Education (x_3), Family Size (x_4), Annual income (x_5), Experience in SHG (x_6), Extension contacts (x_7), Number of trainings attended (x_8), Mass media exposure (x_9), Distance from market (x_{10}) and Land holding (x_{11}). Dependent variable selected for the study was Entrepreneurial behaviour (10 point scale) (y_1).

RESULTS AND DISCUSSION

The subjective information is measured utilizing explicit numerical methodology. Then data analysis i.e. Co-efficient of correlation, multiple regression analysis, and path analysis has been done to evaluate the information (Table 1).

Table 1 presents the coefficient of correlation between y_1 (Entrepreneurial behaviour) and 11 dependent variables. It has been found that the following variables viz. Age

Table 1: Coefficient of correlation between Entrepreneurial behaviour (y_1) and eleven independent variables (x_1-x_{11})

S.No.	Independent variables	r value
1	Age (x_1)	-0.399**
2	Marital status (x_2)	-0.365**
3	Education (x_3)	0.418**
4	Family size (x_4)	0.126
5	Annual income (x_5)	-0.111
6	Experience in SHG (x_6)	-0.377**
7	Extension contacts (x_7)	0.568**
8	No of training attended (x_8)	0.548**
9	Mass media exposure (x_9)	0.476**
10	Distance from market (x_{10})	0.569**
11	Land holding (x_{11})	0.119

**Correlation is significant at the 0.01 level

(x_1), Marital status (x_2) and Experience (x_3) in SHG are having negative but significant correlation with the dependent variable. The variables Education (x_3), Extension contacts (x_7), No. of trainings attended (x_8), Mass media exposure (x_9) and Market facilities(x_{10}) have recorded positive significant correlation with the dependent variable.

The correlation coefficients suggest that younger respondents have recorded higher and better entrepreneurial behaviour, and this have also been reflected in Experience in SHG i.e. those who are new in SHG they are having better entrepreneurial behaviour, at the same time respondents having higher education, better extension contacts and more no of trainings attended, wider mass media exposure have recorded better entrepreneurial behaviour.

Table 2 presents the full model of regression analysis between exogenous variable entrepreneurial behaviour (y_1) vs. 11 causal variables. It is found that 11 casual variables together have contributed 65.8 percent of variance in consequent variable Entrepreneurial behaviour (y_1). The results suggest that the selected variables are more or less functionally relevant to estimate, entrepreneurial behaviour of the respondents.

Table 3 represents stepdown regression analysis. In stepwise regression analysis, it is found that the variable Extension contacts (x_7) Distance from market (x_{10}), No of trainings attended (x_8) has been retained in the last step. In order to scale up Entrepreneurial behaviour of the SHG members, the prime concerns could be to improve extension contacts, give need based training and provide adequate Distance from market of the SHG members. It is interesting to note that these three variables together have contributed 65.8 percent of total variance explained so far to vindicate their distinctive contribution in characterising Entrepreneurial behaviour.

The Table 4 envies that the variable No of trainings attended (x_8) have got highest indirect effect on Y1. This is well disenabling that training has got a direct and sustainable effect on Y1 and marital status (x_2) has got the highest accompanying effect on Entrepreneurial behaviour. It is

Table 2: Regression analysis, Entrepreneurial behaviour (y_1) Vs casual variables (x_1-x_{11})

S.No.	Variables	Reg. coef. B	S.E. B	Beta	t value
1	Age (x_1)	-.044	.038	-.294	-1.169
2	Marital status (x_2)	.047	.033	.361	1.435
3	Education (x_3)	-.014	.049	-.039	-.294
4	Family size (x_4)	-.051	.073	-.050	-.696
5	Annual income (x_5)	-4.118E-005	.000	-.093	-1.258
6	Experience in SHG (x_6)	-.057	.027	-.194	-2.128
7	Extension contacts (x_7)	.286	.094	.305	3.037
8	No of training attended (x_8)	.262	.042	.452	6.279
9	Mass media exposure (x_9)	.039	.104	.048	.371
10	Distance from market (x_{10})	.220	.047	.362	4.739
11	Land holding (x_{11})	.001	.047	.002	.022

R square – 69.6%; Standard error of the estimate: 0.82

Table 3: Step down regression analysis, Entrepreneurial behaviour (y_1) vs casual variables (x_1-x_{11})

S.No.	Variables	Reg. coef. B	S.E. B	Beta	t value
1	Distance from market (x_{10})	.233	.044	.383	5.304
2	No of trainings attended (x_8)	.254	.040	.438	6.415
3	Extension contacts (x_7)	.332	.068	.353	4.858

R square - 65.8%; Standard error of the estimate: 0.83

Table 4: Path analysis: Decomposition of total effects into direct, indirect and residual effect (Entrepreneurial behaviour vs. consequent variables (x_1-x_{11})

S.No.	Variables	Total effect	Direct effects	Indirect effects	Highest indirect effects
1	Age (x_1)	-0.399	-.294	-0.105	0.452 (x_8)
2	Marital status (x_2)	-0.365	.361	**-0.726**	-0.286 (x_1)
3	Education (x_3)	0.418	-.039	0.457	-0.224 (x_2)
4	Family size (x_4)	0.126	-.050	0.176	-0.073 (x_2)
5	Annual income (x_5)	-0.111	-.093	-0.018	0.0614 (x_8)
6	Experience in SHG (x_6)	-0.377	-.194	-0.183	0.236 (x_2)
7	Extension contacts (x_7)	0.568	.305	0.263	-0.174 (x_2)
8	No of trainings attended (x_8)	0.548	**.452**	0.096	-0.867 (x_2)
9	Mass media exposure (x_9)	0.476	.048	0.428	0.210 (x_7)
10	Distance from market (x_{10})	0.569	.362	0.207	-0.066 (x_2)
11	Land holding (x_{11})	0.119	.002	0.117	-0.06 (x_2)

Residual effect: 30.3%

also interesting to note that marital status (x_2) has enrooted the highest indirect effect as many as seven variables to ultimately characterize the dependent variable Entrepreneurial behaviour. So the role of marital status, either in providing time after enterprise or family considering number of kids to sustain by her, has got tremendous cohesive effect on entrepreneurial behaviour. The residual effect been 30.3 per cent, it is to conclude that even with the combination of 11 exogenous variables, 30.3 per cent variance in dependent variable could not be explained. This suggests the inclusion of more numbers of relevant and consistent variables for this framework of study.

CONCLUSION

Entrepreneur behaviour is the complex disposition of different system variable, within which a group or an individual is passing through entrepreneurial process and evaluations, the status of entrepreneurial capacity, the distance to access the strategic locations like market or training centres, interactions with cosmopolite extension personnel and also the communication networks are characterising together, what we called entrepreneurial behaviour. This empirical study reveals that without proper nurturing and monitoring of entrepreneurial behaviour, the economic and social success of SHG is not possible. So, every SHG needs to be dovetailed to the market, training institutions and cosmopolite extension personnel. The study offers thus a micro sociological implications while we would be framing up a policy on capacity building and mobilizing SHG through befitting and evolving entrepreneurial behaviour.

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Cultivation of Indigenous Vegetables in Containers Through Roof Based Gardening

Sharanbir Kaur Bal[1], Deepika Bisht[2]*, Sukhdeep Kaur[3] and Gurjit Singh[4]
[1]Associate Professor, [2]Scientist, Department of Family Resource Management, College of Community Science, Punjab Agricultural University, Ludhiana, Punjab
[3]Assistant Professor, Department of Extension Education and Communication Management, PAU, Ludhiana, Punjab
[4]Additional Director Horticulture, Mansa, Punjab

ABSTRACT

Due to increasing number of buildings and decreasing open space available in urban areas, home gardening in the backyard has now shifted to roof based gardening which is an excellent way of cultivating indigenous vegetables. Producing vegetables in containers kept on roof top is considered most viable and easy way as compare to other options available in terms of cost and installation including repair and maintenance that can be adopted by families to improve their nutritional needs. But rooftop gardening without proper knowledge and training may lead to frustrating outcomes and wastage of money and time which might result in unwillingness of the people in initiating this project. So, the present research was planned to suggest a suitable micro model of container gardening for its promotion among the urban population where households can easily grow vegetables in containers kept on roof top for personal consumption which will ultimately improve health, income and wellbeing of family members. For the present study, two rooftop vegetable gardening practitioners were purposively selected from Ludhiana city of Punjab state. The selected practitioners were actively growing few vegetables in containers without any technical knowledge and were willing for setting experiment trials at roof top of their houses. So, 25 vegetables that thrive well in containers were grown in both the seasons (12-13 vegetables in each season) and total twenty five containers of appropriate size and material were used in each season for growing these vegetables keeping in mind weight bearing capacity of the roof covering an area of 480sq.ft. Further, they were advised to use organic manures, i.e. FYM to meet the fertilizer requirement of vegetable and to practice hand hoeing for weed management. Yield was recorded weekly for every vegetable to calculate the average yield. Total expenditure for setting of container gardening with twenty five containers was calculated. The actual consumption of vegetables and expenditure on purchase of vegetables annually by each practitioner family before trials was also noted. Results revealed that the average annual consumption of vegetables by the families was 58.4 kg per person with total expenditure of Rs.14016/- on vegetables annually. Further based on the results of the study a micro model of container gardening for a family of 2-3 persons was suggested with total costs of Rs. 11211/ respectively.

Keywords: Container gardening, Organic vegetables, Space management, Sustainable living

INTRODUCTION

Indigenous vegetables are the cheapest source of vitamins, minerals and other biochemical factors which act as a barrier to most of the diseases including cancers and some degenerative diseases (Boeing *et al.,* 2012). Vegetables are the only source to increase not only the nutritive values of foods but also their palatability. For a balanced diet, an adult should have an intake of 85g of fruits and 300 g of vegetables per day according to the dietary recommendation of nutrition specialists (Singh and Singh, 2017). According to World Health Report 2003, insufficient vegetables and fruit consumption annually causes 1.7 million deaths worldwide and is one of the top 10 risk factors contributing to human mortality. The WHO has recommended a daily intake of at least 400 grams of fruits and vegetables excluding starchy tubers or five daily servings with an average serving size of 80 gram to prevent diet-related chronic diseases and micro-nutrient deficiencies.

*Corresponding author email id: deepikabisht@pau.edu

Besides being one of the largest producers of fruits and vegetables, India's consumption of these food items is less than the standard requirements and only 21.2 per cent Indians consume indigenous vegetables that are considered an essential source of phytonutrients (Pandey, 2016).

Considering the importance of vegetables and to meet the requirement of indigenous vegetables in our diet, the concept of home gardening is a viable option. This will not only facilitate successful production of family's requirement of vegetables and at the same time is a safe practice of producing pesticide free vegetables for the family. Households have labour power– the physical ability of household members to generate income (Christopher, 2006). When this labour power is used in the kitchen garden it has the ability to improve food security and nutritional diversity of the household. This practice also provides dual benefits of food and income generations especially for women (Galhena, 2013).

However, due to rising number of buildings and decreasing open space especially in urban areas, home gardening in the backyard has now shifted to roof based gardening which is an excellent way of cultivating indigenous vegetables (Eigenbrod and Gruda, 2015). Establishing and cultivating vegetables on rooftops provides numerous benefits such as energy conservation, mitigation of urban heat island effect, providing a more aesthetically pleasing environment in which to work and live besides production of fresh, toxin free and nutritious produce (Rowe, 2013). Besides, the benefit of recreation, fresh air and good ambience is an added bonus (Jha *et al.*, 2019). These roof gardens can be created on almost all kinds of buildings like residential flats, individual houses and factories (Van Cotthem, 2005).

Roof top farming methods throughout India includes hydroponics which is considered the appropriate farming option, as it has higher yield, lower labour requirement and needs only systems which can easily be assembled over an existing roof. But its higher initial cost can be a hindrance in its adoption. Other options includes benches which are constructed in the open, based on the bearing load of the roof top. For efficient utilization of roof spaces, an inward trough could be another option which is formed in the unutilized spaces of roof top i.e., like sunkened trough. Pots and containers of different materials like cement pots, damaged bowls / water tanks/ buckets, plastic jars, tin boxes, crates, paws, unused water cans, plastic barrels, wooden barrels, earthen pots, drums and different sizes, plastic covers, cement / fertilizer bags, damaged sink / wash basin can also be used for growing of fruits and vegetables on the roof gardening (Siva *et al.*, 2017).

In Ludhiana, one of the biggest industrial cities of Punjab, cultivable land has been converting to build up area and thus agriculture land has also been decreased at an alarming rate. Implementing roof top farming can be a possible solution to reduce the food and supply problems, make urban living more self-sufficient and make fresh vegetables more accessible to urban individuals (Safayet *et al.,* 2017). In some of the cities of Punjab, a small number of households are practicing rooftop gardening with the support and motivation of agriculture institutions who aims to enhance local food production and household waste management.

To start rooftop gardening without proper knowledge and training may lead to frustrating outcomes and wastage of money and time which might result in unwillingness of the people in initiating this project (Islam, 2004). Producing vegetables in containers kept on roof top is considered most viable and easy way that can be adopted by families with even little knowledge and expenditure to fulfil their needs of adequate vegetable consumption and reduces expenditure on purchase of vegetables with year round availability of fresh and toxic free vegetables. When considering technical aspects, container gardens are considered lighter systems and economical in comparison to other roof top systems in terms of weight bearing capacity, cost and installation including repair and maintenance. Especially in single and multi-storeyed buildings, roof gardening is the best option to grow fruits and vegetables by using the pots and containers known as container gardening (Deveza and Holmer, 2002). Considering the practical knowledge required, costs as well as other technical issues to establish roof top vegetable garden, the research was planned to suggest a suitable micro model of container gardening for its promotion among the urban population where households can easily grow vegetables in containers kept on roof top for personal consumption which will ultimately improve health, income and wellbeing of family members.

MATERIALS AND METHODS

Ludhiana is the largest industrial hub and considered as the most populated city of the Punjab state. The city is facing various environmental issues due to urban sprawl and unplanned growth and as a result has lost most of its

green spaces over a period of time due to construction of multi-storeyed buildings (Singh and Kalota, 2019). This has also led to a shortage of space for cultivation of household vegetables. For the present study, two roof based vegetable gardening practitioners each having family of four members, two adults and two children were purposively selected from Ludhiana city of Punjab state.

The selected practitioners had been actively growing few vegetables in containers without any technical knowledge for last more than five years and were willing for setting experiment trials on the roof top of their houses. The trials were performed in summer and winter of the year 2018 and 2019. Before the trials, the practitioners were given pre-requisite knowledge for establishing a suitable container garden on the roof top.

Based on the available literature as well as previous experience and interest of the practitioners, only those vegetables which thrive well in the containers were selected. Thus, in total 25 vegetables were grown in both the seasons (12-13 vegetables in each season) and total twenty five containers of appropriate size and material were used for growing these vegetables. Containers used for growing summer vegetables were again used for growing winter vegetables. Seed varieties of selected summer and winter vegetables were procured from Punjab Agricultural University, Ludhiana during both the seasons and provided to the practitioners. High density plantation was suggested to the practitioners and each vegetable was grown in two containers kept in rows with a row to row distance of 4 feet and container to container distance was kept as 3 feet covering an area of 480 sq. ft. Containers were placed in such a way so as to equally distribute the weight of containers over the whole roof (Figure 1). Further, practitioners were advised to use organic manures, i.e. FYM to meet the fertilizer requirement of vegetable and to practice hand hoeing for weed management. Yield was recorded weekly from all the containers for each vegetable to calculate the average yield. Total expenditure for setting of container garden with twenty five containers was calculated. The actual consumption of vegetables and expenditure on purchase of vegetables annually by each practitioner family was also noted before and after trials.

RESULTS AND DISCUSSIONS

General information about the practitioner's residence: The general information of the practitioner's residence is presented in Table 1. Both the practitioners

Specifications for container size, material, placement and initial cost

Container Size and number	Height- 45 cm Diameter-52 cm Number- Twenty five
Container Shape	Round
Container material	Plastic
Direction of Placement	South so that sufficient light can enter the rows
Row to Row distance	Four feet
Container to container distance	Three feet
Initial cost for setting up container garden	Rs. 11210/-

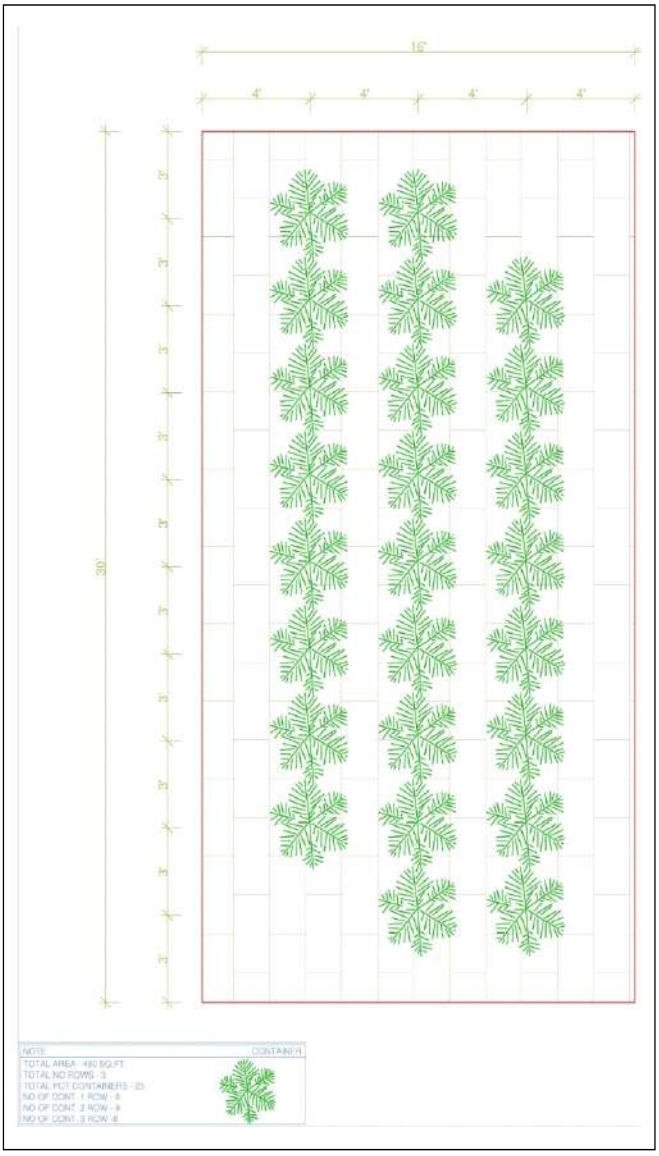
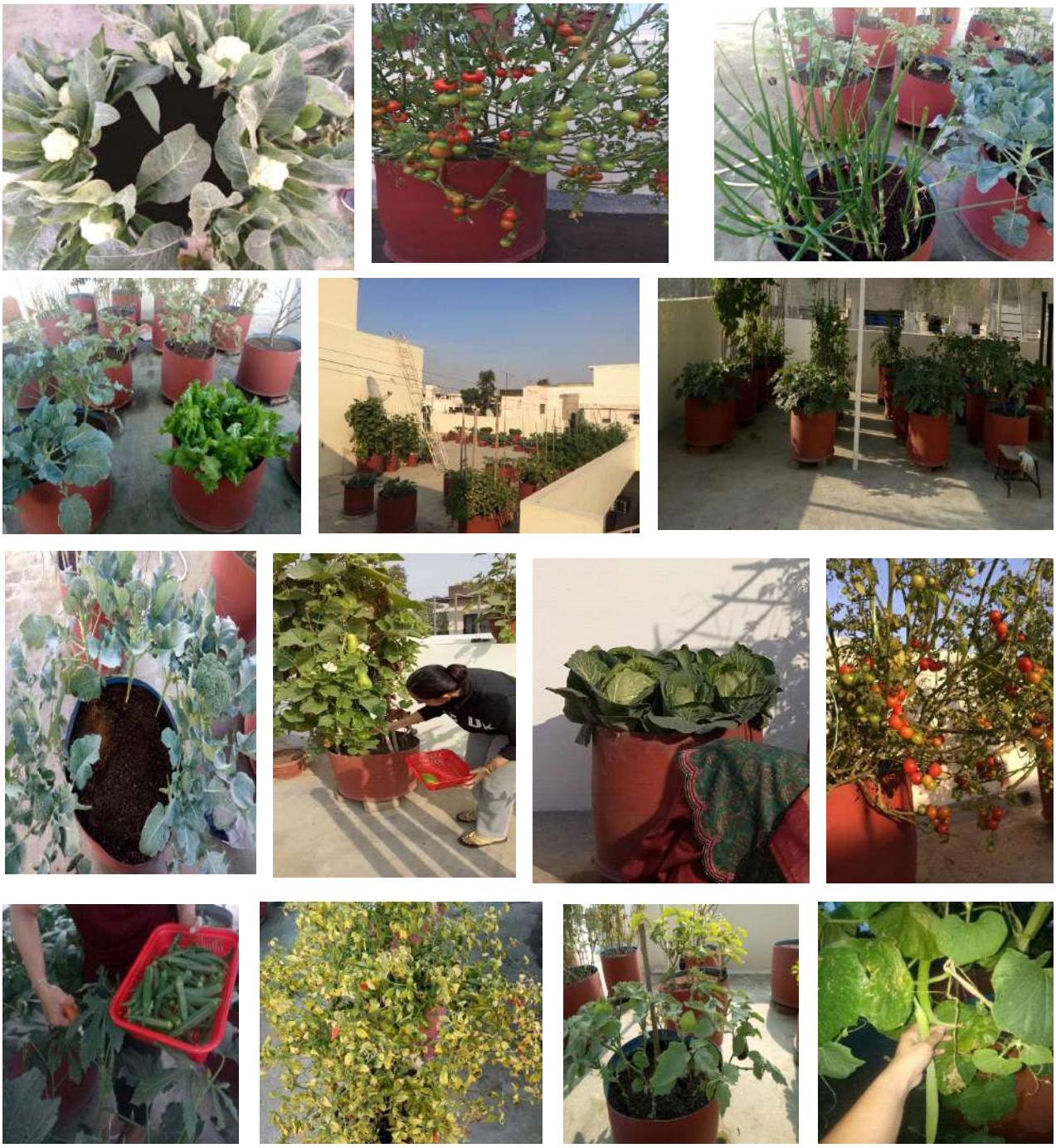


Figure 1: Model of roof top container garden in an area of 480 sq. ft



Pictures of roof top container gardens during trial period

had single storey buildings, used for residential purposes, facing east and north respectively. The total roof area for practitioners was 1500 sq.ft and for practitioner II was 1800 sq. ft but both the practitioners were using roof area of 480sq. ft for placement of containers. The containers were widely distributed on the south side of both the buildings to ensure 6-8 hours of sunlight throughout the day and were kept under net to withstand intense heat during summers.

Annual consumption and expenditure on vegetables by the practitioner's family: Information about vegetable consumption pattern and approximate annual expenditure on vegetables by both the practitioners is presented in Table 2. The annual vegetable consumption by family of practitioner I with two adults and two minor children was 219 kg approximately with 150 g of an average consumption per person per day whereas family of practitioner II with two adults and two teenaged

Table 1: General information about the practitioner's residence

Practitioner	I	II
Type of Building	Residential	Residential
No. of Storey in building	Single	Single
Total Roof area of building	1500 sq.ft	1800 sq.ft
Roof area used for container gardening	480 sq.ft	480 sq.ft
Direction of building	East facing	North Facing
Placement of containers	South side	South side

Table 2: Annual consumption and expenditure on vegetables by the practitioner's family

Practitioner	Approximate annual consumption of vegetables (kg)	Approximate annual expenditure on vegetables (Rs.)
Practitioner I	219	13140
Practitioner II	248.2	14892
Average	233.6	14016

children had annual consumption of 248.2 kg vegetables respectively with an average consumption of 170gm per person per day. This accounts for annual average consumption of 58.4 kg per person which is far less than annual vegetable consumption of approximately 110 kg/ person /day and daily consumption of 300gm per person per day as recommended by Indian Council of Medical Research. Further, the approximate annual expenditure on vegetables was Rs. 13140 and Rs. 14892 respectively by both the practitioners. All the vegetables were purchased at retail price from the market throughout the year.

Cost of setting up and maintenance of roof top container garden: Table 3 indicates the initial cost as well as the maintenance and miscellaneous costs of setting up container garden on the roof top. It is clear from the table that the average cost of setting up container garden with twenty-five containers was Rs. 11210/-. There is no difference in costs of containers as well as seeds/seedling costs among the practitioners as these were procured from the same place, however there was difference in irrigation and miscellaneous costs which might be due to difference in care and management techniques among the practitioners. Further, maintenance/miscellaneous costs per season was quite low as no external help/gardener was hired and complete care and management of container garden was done by practitioners themselves or by their family members.

Table 3: Cost of setting up and maintenance of roof top container garden

Particulars	Setting and Maintenance cost (Rs.) 800 sq.ft		Average cost (Rs.)
	Practitioner I	Practitioner II	
Containers (25)	6875	6875	6875
Filler and Compost	1250	1500	1375
Seeds	200	200	200
Seedlings/plants	850	900	875
Irrigation/season	600	670	635
Miscellaneous	1000	1500	1250
Total	10775	11645	11210

Planting and yield information of summer and winter vegetables grown in containers: Planting information and an average yield of summer and winter vegetables is presented in Table 4. Twenty five containers, two for each vegetable were used by both the practitioners for growing vegetables in summer and winter seasons. The containers were washed thoroughly and drainage holes were made at the bottom. All the containers were filled with good quality top field soil after properly sieving and FYM in the ratio of 1:1 leaving one inch of the container from the top for watering. The number of plants per container for each vegetable varied as shown in table 3 and practitioners were advised to go for high density plantation as plant density is an important variable in obtaining maximum yield and uniform maturity of vegetable crops (Bracy *et al.,* 1991). Also, studies with few vegetables such as broccoli, cauliflower (Default and Waters, 1985) and cabbage (Mulkey and Porter, 1987) have indicated higher yields with increased plant density. The seeds of vegetables which can be sown directly as shown in the Table 3 were sown directly in the selected containers. The depth of the seed sowing was kept as about two and a half times of the seed size. The seedlings of brinjal, green chillies, tomatoes, cherry tomatoes, capsicum, onion, cauliflower and other vegetables were transplanted in containers. The plants were given proper care and attention and were watered judiciously preferably early morning and after sunset according to the season. Staking was provided to tomatoes, bitter gourd, ridge gourd and bottle gourd plants depending upon their growth stage. In addition to the organic manures vermi-compost @ 100 grams/plant was applied at monthly intervals. Weeds were managed manually and a layer of fresh compost was added. The

Table 4: Planting and yield information of summer and winter vegetables grown in containers

Name of the Vegetable	Method of sowing/ planting	Time of sowing	No. of containers and seeds/ plants per container	Days to first harvest after sowing/ planting	Yield/vegetable (kg)		Average yield (kg)
					Pract I	Pract II	
Okra/Bhindi	Sowing	Feb-March& June-July	2/22	45-50 days	11	12	11.5
Brinjal	Transplanting	Feb & Aug	2/8	90-110 days	14	15	14.5
Bitter gourd	Sowing	Feb-March & June-July	2/10	55-60 days	7	8	7.5
Bottle gourd	Transplanting	Feb-March & June-July Nov-Dec	2/4	60-70 days	6	10	8.0
Ridge gourd	Sowing	Mid Feb to March & Mid May to July	2/3	45-60 days	6	6	6.0
Apple gourd	Transplanting	Feb-March & June-July	2/6	60-70 days	7	10	8.5
Long Gourd	Sowing	Feb- March	2/7	45-60 days	5	6	5.5
Cucumber	Sowing	Feb- March & June –July	2/7	50-70 days	4	4	4.0
Green chillies	Transplanting	Mid Feb & April End	2/5	70-75 days	2	2	2.0
Spring onions	Transplanting	June-July & Oct-Nov	2/25	75-80 days	10	12	11
Mint	Transplanting	March-July	1/all over	45-50 days	1	1	1.0
Capsicum	Transplanting	Mid Feb & End Nov	2/8	95-100 days	5	7	6.0
Cauliflower	Transplanting	Sept- Oct	2/6	110-120 days	13	14	13.5
Cabbage	Transplanting	Sept-Oct	2/7	90-100 days	11	13	12
Fenugreek	Sowing	Sept-Oct	2/22	30-40 days	2	2	2.0
Spinach	Sowing	Sept-Nov	2/25	35-50 days	3	3.5	3.25
Turnip	Sowing	Sept-Oct	2/10	40-45 days	5	5	5.0
Radish	Sowing	Aug & Jan	2/15	40-45 days	5	6.5	5.75
Carrot	Sowing	Oct-Nov	2/15	90-95 days	7	8	7.5
Brocolli	Transplanting	Aug-Sept	2/6	90-100 days	12	12	12
Lettuce	Transplanting	Sept-Oct	1/5	35-40 days	1	1	1.0
Tomatoes	Transplanting	June-Aug & Nov-Dec	2/6	110-115 days	6	8	7.0
Cherry tomatoes	Transplanting	June-Aug & Nov-Dec	2/12	100-110 days	4	4	4.0
Beet root	Sowing	Oct-Dec	2/10	90-100 days	5	5	5.0
Coriander	Sowing	Oct-Nov	1/40	75-90 days	1	1	1.0
Total					153	176	164.5

approximate days to harvest after sowing and planting for each summer and winter vegetable in containers were noted down as presented in the Table 3. Further yield of all the vegetables was recorded weekly. Total and average yield was obtained from summer and winter vegetables grown in containers by two practitioners.

Regarding yield, it is clear from the data that on an average, the selected practitioners were able to produce 164.5 kg of summer and winter vegetables. Accordingly, required number of containers could be arranged on the roof top keeping in account load bearing capacity of the roof as well as other factors to fulfil the recommended dietary intake of vegetables for a family of 2-4 numbers. If space permits few containers could also be placed on the ground floor at appropriate place receiving at least 6-8 hrs of sunlight. The numbers of containers can be increased or decreased according to the family size to get the required yield from the container garden. Further, it was observed that though each and every vegetable cannot thrive well in containers still majority of vegetables except few roots and tubers can be easily grown in containers.

Thus fulfilling the required needs of vegetable consumption besides numerous other health benefits of having fresh organic produce and making best utilization of available space on the roof top. Further, it was observed that yield may be less as expected due to the reason that practitioners were advised to use organic manures instead of any pesticides in these experiments as the produce is meant for their personal consumption. Another reason that affected the yield was lack of time resource in proper management of container garden as well as intense heat in summer season as reported by the practitioners.

Amount saved from summer and winter season vegetables grown in containers: Data presented in Table 5 clearly indicates that there was a total saving of Rs. 6452.5/- from summer and winter vegetables grown in twenty five containers with two containers of each vegetable. So, during the year 2018 and 2019, just having two containers of each vegetable almost half of the total amount spent on buying of the vegetables by the practitioners could be saved. Thus, by doubling the number of containers one can easily produce approximately 329 kg of vegetables annually in containers and can save Rs. 12905/- which is roughly 85 per cent of the total expenditure on vegetables by both the practitioners.

Table 5: Amount saved from summer and winter season vegetables grown in containers

Name of the vegetable	Average yield (kg)	Retail price (Rs./kg)	Amount Saved (Rs.)/Year
Okra/Bhindi	11.5	45	517.5
Brinjal	14.5	45	652.5
Bitter gourd	7.5	45	337.5
Bottle gourd	8.0	30	240
Ridge gourd	6.0	30	180
Apple gourd	8.5	30	255
Long Gourd	5.5	20	165
Cucumber	4.0	40	160
Green chillies	2.0	50	100
Green onions	11	50	550
Mint	1.0	20	20
Capsicum	6.0	70	420
Cauliflower	13.5	20	270
Cabbage	12	20	240
Fenugreek	2.0	15	30
Spinach	3.25	30	97.5
Turnip	5.0	20	100
Radish	5.75	20	115
Carrot	7.5	25	187.5
Brocolli	12	50	600
Lettuce	1.0	250	250
Tomatoes	7.0	35	245
Cherry tomatoes	4.0	200	800
Beet root	5.0	30	150
Coriander	1.0	40	40
Total	164.5		6452.5

CONCLUSION

It can be concluded that roof top container gardening model requires 480 sq. ft area to accommodate twenty five containers of size 45 cm height and 52 cm diameter placed in three rows with a row to row distance of 4ft and container to container as 3ft. This model will produce sufficient vegetables for a family of 2-3 persons, however depending upon the requirement of the family, available space and load bearing capacity of the roof, the number of containers can be increased accordingly. The annual yield of 164.5 kg was recorded from twenty five containers of vegetables (12-13 vegetables in each season) grown in both the seasons with an annual saving of Rs. 6452.5/-. The adoption of this model of container gardening proved very beneficial not only from point of view of reducing household expenditure on vegetable purchase but numerous other benefits such as availability of organic vegetables, good ambience, etc. The given model will be a complete guide for the families with no or little knowledge regarding setting up of container garden on roof top. The initial expenditure on establishing container garden is minimal as compared to other roof gardening methods/ systems and one time investment on purchase of containers can be easily recovered in terms of saving from the yield of vegetables in successive years. Besides, year round availability of fresh organic vegetables to some extent will solve the need for adequate vegetable requirement of the family which will ultimately have health benefits. The container garden set up on the roof top will definitely help in creating healthy atmosphere by improving air quality as well as the issue of space constraint in urban and semi-urban areas.

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Indigenous Technical Knowledge (ITK) Adopted by the Farmers of Hilly District Reasi of Jammu and Kashmir, India

Banarsi Lal[1]* and Vikas Tandon[2]
[1]I/C, Senior Scientist & Head, KVK, Tanda, Reasi (SKUAST-Jammu-182301), J&K
[2]Professor, SKUAST-J, J&K

ABSTRACT

Indigenous Technical Knowledge (ITK) has enormous potential for innovations. Many communities in India have their own unique indigenous technological knowledge. Many of these technologies are at par with the modern technologies and have provided comfort and self-sufficiency to these communities. This Indigenous Technical Knowledge (ITK) has played a crucial role in the overall socio-economic development of the communities. Indigenous technical knowledge is based on the experience of the farmers tested over a long period of use in local environment to increase the profits. The elder members of the society are the best sources of ITK. The present study was conducted in hilly district Reasi of Jammu and Kashmir. A sample of 20 per cent (150) farmers was selected randomly from the selected villages. Data was collected through personal interviews with participants at their farms. A total of 28 indigenous knowledge practices were identified which were practiced by the different farmers of the district. The purpose of the study was to know the implementation of ITK practices adopted by the farmers at their farms. During the course of the study, 28 ITK practices were documented and it was observed that although the farmers residing in hilly areas are using the modern technologies to increase their agricultural and allied sector production but still many farmers used to implement the indigenous technical knowledge. The per centage of farmers practicing different ITK practices were ranged from 7.33 per cent to 68.00 per cent. Majority of animals rearers are still using the ITK practices to treat their animals' diseases.

Keywords: Innovations, Indigenous, Knowledge, Technologies, Hilly areas

INTRODUCTION

Indigenous Technical Knowledge (ITK) is a significant component of the indigenous knowledge base. It refers to the cumulative and complex bodies of knowledge, know-how practices and representations that are maintained and developed by the local communities, who have long histories of interaction with the natural environment (UNESCO, 2012). Indigenous Technical Knowledge (ITK) is developed within a particular community and is maintained in a non-formal means of dissemination. This particular knowledge is collectively owned and is developed over several generations. It is subjected to adaptation and imbedded in a community's way of life as a means of survival. Indigenous Technical Knowledge (ITK) is the actual knowledge of a given population that reflects the experiences based on tradition and includes more recent experiences with modern technologies (Havekort, 1995). It is specifically concerned with actual application of the thinking of the local people in various operations of agriculture and allied areas. ITK is a community based functional knowledge system, developed, preserved and refined by generations of people through continuous interaction, observation and experimentation with their surrounding environment. It is a dynamic system, ever charming, adopting and adjusting to the local situations and has close links with the local culture, civilization and religious practices of the communities (Pushpangadan *et al.,* 2002). ITK is the social capital of the poor people, their main asset in the struggle for survival, to produce food, to provide shelter or to achieve control of their own lives practicing age-old farming in location specific situations since generations. India is rich in the traditional farming system because of diversity in agro-ecological habitats inhabited by diverse ethnic groups who have been

*Corresponding author email id: dr.banarsi2000@gmail.com

practicing age-old farming in location specific situations since generations. It is community based farming system that brings the local people closer and respects their environment (Chhetry and Belbahri, 2009).

The role of ITK is remarkable for the development of rural communities. Sometimes this knowledge plays an imperative role in the development of many other grass root level innovations. This knowledge brings improvement in many enterprises in the rural areas such as poultry, dairy, goatry etc. Every society has stock of knowledge developed within the social system in order to locally solve the problems. Such technologies are easily available in local conditions and are very cheap. Large varieties of indigenous technologies are restricted for the outsiders because of the local nature. ITK practices are passed from one generation to another generation. ITK is produced by keen observations over a long period of time. Its practices are used to increase the crops productivity and assist in sustainability. ITK has minimum risk factor. It exploits optimum utility of local resources. It is necessary to document and analyse the ITK practices. Innovation is the first attempt to carry out an invention in practice (Fegerberg, 2006). The Indigenous Technical Knowledge (ITK) is used widely in agriculture and allied sectors for the insect-pests management, diseases management, natural resource conservations etc.

MATERIALS AND METHODS

The present study was conducted in hilly district Reasi of Jammu and Kashmir which was selected purposively. Out of 12 C.D. Blocks only 4 C.D. Blocks namely Reasi, Painthal, Pouni and Thuroo were selected randomly. A sample of 20 per cent Gram Panchayats from each selected block was selected randomly. A sample of 20 per cent villages was selected randomly from each selected Gram Panchayat. A sample of 20 percent (150) farmers was selected randomly from the selected villages. A list of different indigenous technical knowledge practices was prepared and farmers were asked to indicate their response for each ITK practice. Then the frequency and percentage was find out. A structured interview schedule was used for the purpose of data collection.

RESULTS AND DISCUSSION

The data reveals that 65.33 per cent farmers used the ash to control the red pumpkin beetle in cucurbits. It could be due to fact that they considered as the effective insecticide to control the red pumpkin beetle. 37.33 per cent farmers used the ash in order to grow the cucurbits and other vegetables as a source of nutrients in their soil. They thought that it acted as a useful manure to increase the fertility of their soil. 62.00 per cent respondents responded that they control the weeds in their maize crop by ploughing with their indigenous plough when the crop is at knee high stage. Farmers considered it very effective method to control the weeds in the maize crop. This method is considered as the organic and cheap method to control the weeds in maize crop. 20.66 per cent respondents said that they sowed cucurbits and sorghum to control the insect-pests in their crops. It could be due to the fact that they considered sorghum as the insect repellent. 63.33 per cent farmers opined that they added trees rotten leaves in their soil to increase the fertility of their soil for the maize and wheat crops. It could be due to fact that they considered the rotten leaves of different trees as a very good source of soil nutrients which are essentially needed for the growth of plants. 54.66 per cent said that they used the leaves of Neem, Bana (*Vytus nigundu*) and Eucalyptus as store grain insecticides and pesticides in order to store their farm grains. It could be due to fact that the farmers considered them as effective stored grain pesticides and they are easily available in their area to store the grains. 26.00 per cent farmers used kerosene oil to protect their crops from termite attack. It could be due to fact that they considered it as a very cheap and effective method to control the termite in their crops.

50.00 per cent farmers said they used the white clothes and polythene sheets in their fields in order to control the rabbit attack in their wheat crop. 14.66 per cent farmers said that they do mix cultivation of cowpea and maize to protect their maize crop from the boars. It could be due to fact that cowpea crop is not liked by the boars and its intake might have affected their stomach. 37.33 respondents said that they used to stake their cucurbit crop, peas and tomato in order to increase the yield and quality of their crops. 48.66 per cent farmers said that they used the mixture of cow urine and dung to protect the crop from insect-pests especially in the maize crop. It could be due to fact that they considered as the organic and cheap method to control the insect-pests in their crops. 54.66 per cent farmers said that they used the boiled mixture of saunf, gur and mustard oil in order to control the bloating in the animals. 14.00 per cent farmers said they bleeded body parts of the animals in order to control the animal bloating. 11.33 per cent farmers opined that they used the mixture of cotton and ghee to control the diarrhoea in

Table 1: ITK practices used by the farmers of hilly areas (N=150)

S. No.	ITK Practice	Frequency	Percentage
1.	Use of ash to control red pumpkin beetle in cucurbits	98	65.33
2.	Use of ash to supply nutrients in cucurbits and vegetable crops to increase the yield	56	37.33
3.	Control of weeds in maize crop by ploughing in between the plants of maize crop	93	62.00
4.	Sorghum and cucurbits are sown together to control the insects-pests	31	20.66
5.	Leaves of trees are used to increase the fertility in maize and wheat crop	95	63.33
6.	Leaves of Neem plant, Bana (*Vytus nigundu*) and Eucalyptus sp. plant are used to store the wheat grains and protect from stored grain pests	82	54.66
7.	Use of kerosene oil to protect the field crops from termite attack	39	26.00
8.	Protection of wheat crop from rabbits attack by using the white clothes and polythene sheets on sticks	75	50.00
9.	Mixed cultivation of maize and cowpea to protect the maize crop from boars	22	14.66
10.	Staking in cucurbits, peas and tomato crops to increase the yield and also to get the good quality of crop	56	37.33
11.	Use of cow urine mix with the cow dung to control the insect-pests in maize crop	73	48.66
12.	Use of saunf, gur and mustard oil after boiling it and then filtering it to control bloating in animals	82	54.66
13.	Bleeding from certain parts of animals to control the bloating in animals	21	14.00
14.	Mixture of cotton and ghee to control the diarrhoea in animals	17	11.33
15.	Use of Methi and gur mixture to control the diarrhoea in animals in winters	89	59.33
16.	Gur and saunf mixture to control the diarrhoea in animals in winters	80	80.00
17.	Use of mixture of mustard oil and lassi to control the Diarrhoea in animals in summers	59	39.33
18.	Hooka (tobacco) water is used to save the animal if bitten by snake or any other poisonous organism	12	8.00
19.	Use of kerosene oil to control the ticks and mites in animals	47	31.33
20.	Use of Dhaman (Grevia) plant leaves to increase the yield of milk in animals	95	63.33
21.	Use of mixture of salt, mustard oil and turmeric to control the foot and mouth disease in animals	45	30.00
22.	Black ink and ghee or oil to protect the animals from wounds infection	68	45.33
23.	Use of ripening of mango by using the wheat straw	98	65.33
24.	Use of protein rich concentrate (mixture of wheat brawn, cotton cakes, mustard cakes, salt and chickpea bran) to increase the milk yield in animals	102	68.00
25.	Protect wheat crop from rabbits attack by sowing lentil in fields	17	11.33
26.	Protection of crops from rodents by giving the flour with ghee	21	14.00
27.	Management of purple blotch in onion by applying a sol of turmeric and lassi	18	12.00
28.	Ropes making by the hair of goat	11	7.33

the animals. 59.33 per cent farmers said that they used the mixture of methi and gur to control the animal diarrhoea specially in the winters. 80.00 per cent farmers said that they used the mixture of gur and saunf to control the animal diarrhoea specially in the winters. 39.33 per cent farmers said that they used the mixture of lassi and mustard oil to control the animal diarrhoea specially in the winters. 8.00 per cent farmers said that they used the hookah (tobacco) to save the animals when bitten by the snakes. 31.33 farmers responded that they used kerosene oil in order to control the ticks and mites in the animals. 63.33 per cent farmers said they fed their animals with Arjun, Dhaman (Grevia) and Lacinia leaves in order to increase the milk yield. 30.00 per cent farmers said that they used the mixture of salt, mustard oil and turmeric to control the foot and mouth disease in their animals. 45.33 per cent farmers said that they used the charcoal and ghee mixture in order to control the infection caused due to wounds. 65.33 per cent farmers said that they used wheat straw in order to ripen the mangoes. 68.00 per cent farmers said that they used the mixture of wheat bran, cotton cakes, mustard cakes, salt and chickpea bran to increase the milk yield of their animals. 11.33 per cent farmers responded that they used to protect their wheat crop from rabbits attack by sowing lentil in wheat field. 14.00 per cent farmers said that they control their crops from rodents' crops by

giving the pills of ghee and flour in the rodents' burrows in their crop fields. 12 per cent of respondents said that they control the purple blotch in onion by applying a mixture of lassi and turmeric. 7.33 respondents said that they make colourful ropes by the hair of their goats for bed and other domestic purposes. The study is in accordance with the studies of Gupta (1990); Chambers (1991); Mundy and Crompton (1991); Rolling (1992); Havelock (1993); Vivekanandan (1994); Mukherjee (1993); Gupta and Dubey (1994); Gogoi and Majumder (2001); Sharma Hemanta (2001); Bhuyam (2003); Sundarmari and Rangnathan (2003); Chandola *et al.* (2011); Sundarmari *et al.* (2011); Borthakur and Singh (2012); Mehta *et al.* (2012) and Lal & Singh (2015).

CONCLUSION

It can be concluded that although the present technologies are very effective in agriculture and allied sectors but still many farmers of hilly areas are depending on the traditional technologies. These technologies are easily available in the local conditions and are cost free or very cheap. Moreover, the traditional technologies very easy to apply and can be applied by the illiterate and unskilled persons.

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