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EDITORIAL

In order to build networks, deliberate on key ideas and bring to light insights on the challenges faced by extension personnel and researchers from private and public sectors for self-reliant India in wake of the pluralistic and innovative extension approaches has to be planned and collaborated for providing demand-driven and holistic services to farmers emerged as the best and sustainable extension mechanism. In the same wake the Indian Society of Extension Education took up the agenda in its National Seminar 2021 held at Banaras Hindu University, Varanasi during 4-6 October, 2021 where over 450 delegates deliberated on the major themes of seminar to bring out wonderful recommendations. Both the Organising Secretaries; Professor Basabaprabhu Jirli, Head, Department of Extension Education, IAS, BHU, Varanasi and team and Dr. Rashmi Singh, Secretary ISEE and Principal Scientist, ICAR-IARI, New Delhi along with her team in the leadership of President ISEE, New Delhi for meticulously planning the Seminar and implementing it in highly professional manner at a very short notice deserve applause .

It's my privilege to present the current issue (January-March, 2022) with coverage of 45 manuscripts from cross sectional authors and content reoriented in light of current situations. I am happy and extend my gratitude to the readers, authors and reviewers who have significantly contributed to this professional publication. As usual, it is again appealed to strive for higher level of professionalism in research conduction and reporting to compete with international standards. We, at our level are striving hard to make the Indian Journal of Extension Education (IJEE) at par with any other fully open access through online submission and management of its content. Although, publication with separate DOI to each article through Crossref and its inclusion by International indexing agencies has resulted in enhanced citations but still the citation in Scopus indexed journals is at lowest ebb which call for concerted efforts at all level.

I extend my sincere thanks to all the authors for making valuable contributions. I also extend sincere thanks to all the expert members in the editorial board for their painstaking efforts. The support extended by Executive Council is duly acknowledged. The sincere thanks are to Dr. Mahesh Chander, Dr. H.K. De, Dr. Kalyan Ghadei, Dr. Gurdeep Singh, Dr Jagjot Singh, Dr. D.K. Bose, Dr. Milind Ahire and Dr. V. K. J. Rao for timely reviewing the manuscripts.

Special thanks are extended to the President, ISEE; Dr. U.S. Gautam, Secretary ISEE; Dr. Rashmi Singh, Treasurer, ISEE; Dr. B. K. Singh and Joint Secretary, ISEE; Dr. J. S. Malik for providing insightful thoughts and guidance in bringing out this issue. Dr. Bhanu P. Mishra, Vice President (Central Zone) deserves special thanks for making committed efforts at all stages of ISEE matters.

(Manjeet Singh Nain)
Chief Editor

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Adoption of Chemical Pesticides Under Commercial Vegetable Cultivation in Sri Ganganagar District of Rajasthan

Ajit Singh¹, S. S. Jheeba², Pramendra³, B. L. Manjunatha⁴ and Dipika Hajong⁵

¹Assistant Professor, Agricultural Economics, Agriculture College, Garhwa, Birsa Agricultural University, Ranchi-834006, Jharkhand, India

²Retired Professor, Agricultural Economics, SKN Agriculture University, Jobner, Rajasthan, India

^{3,4,5}Scientist, ICAR-Central Arid Zone Research Institute, Jodhpur, Rajasthan, India

*Corresponding author e-mail id: ajitsingh15789@gmail.com

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ABSTRACT

The study was conducted in Sri Ganganagar district of Rajasthan to assess the extent of use of chemical pesticides under commercial vegetable cultivation. The primary data were collected from 100 farm households across 18 villages from 2016 to 2019. Chemical insecticides were used by all farmers whereas biopesticides and botanical pesticides were used by <5% for insect pest control in vegetables. The average number of chemical pesticide sprays in a crop cycle was 14, 15, 15 and 13 in cauliflower, cabbage, tomato and pea crops respectively. Average quantity of chemical pesticides used was 4.23, 3.87, 5.16 and 3.47 kg active ingredient per hectare in cauliflower, cabbage, tomato and pea crops respectively. The study highlights the overuse and misuse of chemical pesticides in vegetable crops where the economic part is edible unlike cotton where the economic part is non-edible. The direct negative impact of chemical pesticides on health of farm workers is estimated in the paper.

INTRODUCTION

It is reported that pathogens and pests cause global losses ranging from 10-28 per cent in wheat, 25-41 per cent in rice, 20-41 per cent in maize, 8-21 per cent in potato and 11-32 per cent in soybean (Savary et al., 2019). Pesticides are used for increasing the agricultural productivity and safeguarding the public health. The industrialization of agriculture has favoured the use of plenty of agrochemicals including fertilizers, pesticides, micronutrients and plant growth regulators in the agricultural fields. There are 299 insecticides/ pesticides registered in India as on 01/07/2021 (MoA, 2021a). During 2020-21, Maharashtra had the highest total pesticide consumption followed by Uttar Pradesh, Punjab and Haryana (MoA, 2021a). Punjab had the greatest per acre pesticide consumption (0.74 kg), followed by Haryana (0.62 kg), and Maharashtra (0.57 kg) during the year 2016-17 (Subash et al., 2017). However, per hectare use of pesticide in India is much lower as

compared to other countries like China (13.06 kg/ha), Japan (11.85 kg/ha), Brazil (4.57 kg/ha) and other Latin American countries (FAO, 2018).

Agrochemicals used to increase agricultural productivity, were also associated with many direct and indirect negative impacts on human health and environment. There are growing concerns of pesticide risks to human health, natural environment and ecosystems (Atreya et al., 2012). These effects are increasingly manifested in loss of working efficiency of farm workers resulting in higher cost of production. The increased use of pesticides, deteriorating ecosystem health has advocated the need to change traditional and external input use in agriculture towards safe and sustainable production (Bhurtyal et al., 2016). In this context, the present study was aimed at measuring the extent of use of pesticides in commercial vegetable production and its direct impact on human health.

METHODOLOGY

Sri Ganganagar district in Rajasthan state was purposively selected for the study owing to maximum area and commercial production of selected vegetables (cabbage, cauliflower, tomato and peas). These vegetables are being cultivated since late sixties and early seventies until now in the study area. In the second stage, two blocks namely Ganganagar and Raisinghnagar were selected based on highest area and production. From these two blocks, 18 villages were selected using stratified proportional sampling method. Hundred farm households were selected randomly from these 18 villages in proportion to the area under vegetables in each village. Cauliflower, cabbage, tomato and peas were cultivated by 50, 42, 37 and 34 farm households (HH) respectively among these 100 farm HHs. Interview schedule was developed specifically for this study. Primary data were collected from 2016 to 2019 using personal interview method on vegetable cultivation practices, plant protection techniques and other variables. The cumulative square root frequency method (Singh and Mangat, 1995) was used for the construction of strata. The farmers with land up to 2.5 ha were categorized as small farmers and those having land more than 2.5 ha as large farmers. 86 per cent farmers in Ganganagar block and 77 per cent farmers in Raisinghnagar block were small farmers. At the district level, 81 per cent farmers were small farmers and remaining 19 per cent were large farmers.

The primary data were corroborated/ validated through focussed group discussions with key informants in each village and scientists from Krishi Vigyan Kendra and agriculture officers working in Sri Ganganagar district. Published secondary sources were also used.

RESULTS AND DISCUSSION

Sri Ganganagar district in Rajasthan falls under Irrigated North West Plain Zone-1b (RJ-2) and is blessed with deep loamy soil (Agriculture Contingency Plan, 2021; KVK Sri Ganganagar, 2021). The mean rainfall in zone is 32.6 cm of which 75 per cent is received in the month of July to September. The major crops cultivated in the district are cotton (*Gossypium* sp.), groundnut (*Arachis hypogaea*), rice (*Oryza sativa*), pearl millet (*Pennisetum glaucum*), green gram (*Vigna radiata*) and guar (*Cyamopsis tetragonoloba*) in

kharif season and wheat (*Triticum* sp.), barley (*Hordeum vulgare*), gram (*Cicer arietinum*) and rapeseed and mustard (*Brassica* sp.) under *rabi* season. More than 80 per cent arable land is under irrigation. The major source of irrigation in the district is the canal water (supplied by Indira Gandhi Nahar Project, GANG Nahar and Bhakra Nangal dam) and a very small portion is irrigated through tubewells. The agriculture in the district is similar to the intensive cultivation in the neighbouring Punjab on account of access to irrigation. Diverse vegetables are being cultivated in the district since early 1970's for commercial sale. The area under cultivation of four vegetables (viz. cauliflower, cabbage, tomato and peas) selected for the study is given in Table 1.

Among these vegetable crops in Sri Ganganagar district, cauliflower occupied highest area followed by tomatoes and peas. Area under cabbage was low.

Pests and their management

Various pests and diseases were affecting these vegetable crops. Farmers reported that pest infestation was relatively higher in cole crops and tomato and was lower in peas. Farmers used all kinds of chemical pesticides as per package of practices. However, the use of non-chemical pest management options was limited.

Use of different pesticides

Use of different kinds of pesticides in the study area is given in Table 2. All the farmers in the study area used chemical insecticides for control of pests in all selected vegetable crops. The fungicides were used by 4 to 20 per cent farmers in different vegetables indicating that infestation of diseases was lower compared to insect pests. Biopesticides were used by <5% farmers. Botanical pesticides were used by <3% farmers cultivating cabbage and none of the farmers used them in other crops. The chemical insecticides were the most used pesticides on account of easy access and better efficacy. The chemical pesticides are easily available at agricultural input shops in each and every village whereas there is a lack of availability of range of biopesticides for different pests and diseases. Farmers have concerns on the use of biopesticides in commercial crops because of their efficiency and inconsistent results (Mawar et al., 2021).

Table 1. Area under cultivation of selected vegetables in Sri Ganganagar district of Rajasthan

Crops	Rajasthan		Sri Ganganagar		Share of Sri Ganganagar to Rajasthan in area (%)
	Area (ha)	Relative share (%)	Area (ha)	Relative share (%)	
Cauliflower	10644	25.52	330	53.75	3.10
Cabbage	1191	2.86	32	5.21	2.68
Tomato	18537	44.45	131	21.34	0.70
Peas	11331	27.17	121	19.71	1.06
Total	41703	100.00	614	100.00	1.47

Source: Krishi Vigyan Kendra, 2021; Agriculture Contingency Plan, 2021

Table 2. Use of different types of pesticides in vegetable cultivation by farmers (%)

Pesticide class	Cauliflower	Cabbage	Tomato	Peas	Total
Insecticides	100.00	100.00	100.00	100.00	100.00
Fungicides	20.00	9.52	6.00	4.00	20.00
Bio pesticides	4.00	4.76	0.00	2.00	2.00
Botanical pesticides	0.00	2.38	0.00	0.00	1.00

Trust for Advancement of Agricultural Sciences reported that the present pesticide use pattern in India is highest for insecticides followed by herbicides, fungicides + bactericides, other-pesticides, whereas the global pesticide use pattern was highest for herbicides followed by fungicides + bactericides, insecticides, other pesticides (TAAS, 2020). According to various studies, cotton is the most pesticide consuming agri-product (93.27%), followed by vegetables (87.2%), wheat (66.4%), millets (52.6%), and mustard (12.6%) (Maurya and Malik, 2016; Yadav and Dutta, 2019; Nayak et al., 2020).

Frequency and intensity of pesticide application

The frequency of pesticide spray in Sri Ganganagar district in the vegetable crops is provided in Table 3. The average number of chemical sprays ranged from 13-15 in each crop in a single crop cycle indicating that pesticides were sprayed at an interval of every 15 days. The total number of sprays by different farmers varied from minimum of 4 in cauliflower to as high as 22 in cabbages.

In cauliflower, about 60 per cent farmers had an average of 14 or less sprayings, while the remaining gave 14-17 sprayings. In cabbage, about 81 per cent farmers had on an average 15 or less sprayings, while the remaining applied 16 or more sprayings. In tomato, about 63 per cent farmers applied on an average 15 or less sprayings, while the remaining gave 16-19 sprayings. In peas, about 76 per cent farmers gave on an average 13 or less sprayings, while the remaining applied 13 or more sprayings.

In cauliflower, 44 per cent farmers applied 4 kg or less of technical grade pesticides per ha and the remaining 55 per cent used more than 4 kg of active ingredient (a.i)/ha. In cabbage, 71 per cent farmers applied 4 kg or less of a.i/ha and the remaining applied more than this quantity. In tomatoes, 38 per cent farmers applied

4 kg or less of a.i/ha and the remaining applied more than this quantity. In peas, 53 per cent farmers applied 4 kg or less of a.i/ha and the remaining applied more than this quantity (Table 4). The average use of chemical pesticides ranged from 5.16 kg a.i/ha in tomatoes to 3.47 kg a.i/ha in peas. There was a substantial variation among farmers ranging from 1 kg a.i/ha in cabbage to 6.48 kg a.i/ha in peas.

History of use of pesticides

Farmers were found using chemical pesticides since late 1960's and early 1970's. Upto 94 per cent farmers in Raisinghnagar block were using chemical pesticides for more than 20 years (as an agricultural year 2017-18) whereas only 59 per cent farmers in Ganganagar block fell in this category. Large farmers (with access to other resources as well) were found to have adopted the pesticides relatively earlier than the small farmers in both the blocks.

It was interesting to note that 60 per cent farmers had adopted IPM practices (atleast one practice other than the chemical pesticides for control of pests and diseases) in Ganganagar whereas only 38 per cent farmers did so in Raisinghnagar block. However, the adoption of IPM in totality was very low as evident from the number of sprays and quantity of chemical pesticides used (Tables 3 and 4). Study conducted in Banda district in Bundelkhand region of Uttar Pradesh reported that lack of knowledge of IPM technology, pesticides and their application pattern, bio-pesticides or other alternatives were the major constraints faced by vegetable growers in adoption of IPM technologies (Gupta et al., 2020).

In India, only 12 different kinds of biopesticides under the Insecticide Act of 1968 have been recorded (Kandpal, 2014), while the register for use as chemical pesticides is greater than 230 synthetics (Sharma et al., 2018). However, biopesticide use

Table 3. Distribution of farmers based on frequency of pesticide application*

Number of applications	Cauliflower		Cabbage		Tomato		Peas	
	% farmers	Cumulative %	% farmers	Cumulative %	% farmers	Cumulative %	% farmers	Cumulative %
<11	4	4	2.38	2.38	8.11	8.11	14.71	14.71
11	6	10	7.14	9.52	5.41	13.51	17.65	32.35
12	18	28	11.90	21.43	5.41	18.92	23.53	55.88
13	22	50	23.81	45.24	16.22	35.14	20.59	76.47
14	18	68	26.19	71.43	24.32	59.46	14.71	91.18
15	18	86	11.90	83.33	2.70	62.16	2.94	94.12
>15	14	100	16.67	100.00	37.84	100.00	5.88	100.00
Average	14		15		15		13	
Range	4-17		11-22		12-19		9-16	

*Insecticide applications included both spraying and dusting

Table 4. Distribution of farmers based on pesticide use intensity

Pesticide use intensity (kg a.i./ha)	Cauliflower		Cabbage		Tomato		Peas	
	% farmers	Cumulative %	% farmers	Cumulative %	% farmers	Cumulative %	% farmer	Cumulative %
<2	6	6	16.67	16.67	5.41	5.41	2.94	2.94
2-3	10	16	23.81	40.48	8.11	13.51	29.41	32.35
3-4	28	44	30.95	71.43	24.32	37.84	20.59	52.94
4-5	22	66	7.14	78.57	29.73	67.57	26.47	79.41
5-6	16	82	2.38	80.95	18.92	86.49	11.76	91.18
>6	18	100	19.05	100.00	13.51	100.00	8.82	100.00
Average (kg a.i./ha)	4.23		3.87		5.16		3.47	
Range	1.07-6.22		1.00-6.08		1.33-6.76		1.03-6.48	

Table 5. Experience (years) of spraying pesticides and adoption of IPM

Experience (years)	Ganganagar			Raisinghnagar		
	Small	Large	All	Small	Large	All
10-15	1.00	0.00	1.00	0.00	0.00	0.00
15-20	21.00	60.00	40.05	12.00	0.00	6.00
20-25	53.00	20.00	36.50	50.00	50.00	50.00
25-30	25.00	20.00	22.45	38.00	50.00	44.00
<i>Adoption of IPM</i>						
Yes	20.00	100.00	60.00	11.00	65.00	38.00
No	80.00	0.00	40.00	89.00	35.00	62.00

expanded significantly from 123 metric tonnes (MT) in 1994–1995 to 8110 MT in 2011–2012 (Mishra et al., 2020). According to Directorate of Plant Protection, Quarantine and Storage data, the overall consumption of biopesticides in India has increased from 7190 MT in 2014–2015 to 8645 MT in 2018–2019 (MoA, 2021b). There are currently 970 biopesticide products registered with the Central Insecticides Board and Registration Committee (CIBRC) (MoA, 2021c).

Farmers' perception about the effect of prolonged use of pesticides

Exposure to pesticides over a long period of time may lead to adverse effect on health. Around 85 per cent farmers in Ganganagar and 68.5 per cent farmers in Raisinghnagar were aware that prolonged use of pesticides can affect health adversely. Further, 70 per cent farmers in Ganganagar reported that prolonged use of pesticides can lead to very high and extremely high risks such as chronic diseases (Table 6). The high risk groups exposed to pesticides include production workers, formulators, sprayers, mixers, loaders and agricultural farm workers (Aktar et al., 2009). Study in Tamilnadu reported that 37.3 per cent farmers were

involved in other farming activities on the farms while pesticides were being sprayed. During the spraying operation, non-sprayers (40.1%), including women (19.3 per cent), continued to work in the same field, which exposed them to pesticides (Chitra et al., 2006). Only around 0.1 per cent of pesticides are believed to reach the intended organisms, with the rest polluting the environment and causing environmental harm (Carriger et al., 2006; Gill and Garg, 2014).

Monetary valuation of the adverse effects of pesticides on human health

It was found that a person engaged in pesticide spray lost 8 days in one season in Ganganagar and 7 days in Raisinghnagar (Table 7). Total monetary loss including days lost, loss in work efficiency in the event of not taking medicines and value of medical kit was Rs. 18143.10 in Ganganagar and Rs. 3553.83 in Raisinghnagar. Monetary loss was more on large farms in Ganganagar and small farms in Raisinghnagar. The cost per hectare on account of adverse effect on health amounted to Rs. 6760 in Ganganagar and Rs. 12887 was in Raisinghnagar. Farmers need to be protected for sub-standard products and programs for safe use

Table 6. Farmers' perception about the effect of prolonged use of pesticides

Particulars	Ganganagar			Raisinghnagar		
	Small	Large	All	Small	Large	All
Yes	90.00	100.00	85.00	71.00	66.00	69.00
No	11.00	0.00	5.50	28.00	33.00	30.50
<i>Degree of effects</i>						
Very little	6.00	0.00	3.00	12.00	0.00	6.00
High	22.00	20.00	21.00	75.00	15.00	45.00
Very high	72.00	60.00	66.00	14.00	76.00	45.00
Extremely high	0.00	20.00	10.00	0.00	6.00	3.00

Table 7. Monetary valuation of the adverse effects of pesticides on human health (persons/households)

Particular	Ganganagar			Raisinghnagar		
	Small	Large	All	Small	Large	All
Mandays lost (Days/Person)	8	9	8	10	6	7
Loss in monetary terms (Rs/person) (@ Rs. 300/manday)	2400	2700	2540.10	3000	1800	1900
Loss in work efficiency because of not taking medicines (Rs/person)	210	316	250	157	210	180.33
Cost of medical kit (Rs/person)	8	3	5	12	30	21
Medical expenditure (Rs/person)	2340	28340	15340	1122	1768	1445.50
Total	4966	31368	18143.10	4301	3814	3553.83
Area for spray (ha)	1.02	2.356	1.543	0.98	2.034	1.125
Rs./ha	2220	11300	6760	8344	17430	12837

of pesticides and reduction of potential health and environmental impacts should be undertaken. Possibility of sub-standard products cannot be ruled out and therefore, enforcement of point-of sale quality inspection and protection of farmers with consumer forums deserve emphasis (Subash et al., 2017).

It was evident that the use of chemical pesticides was very high in vegetable crops in the study region. Network of agricultural input dealers and retailers were used by the private companies to promote their inputs including pesticides. Paying a handsome commission to agriculture input dealers ranging from 15-20 per cent of the sale price to push their products was one of their most successful marketing strategies (Manjunatha et al., 2015; Manjunatha et al., 2018). Study conducted in Ludhiana district of Punjab revealed that in case of rice crop, 77 per cent farmers purchased pesticides from private dealers, 20 per cent from cooperative societies and only 3% purchased from government agencies such as agricultural department and IFFCO. Further, none of the farmers practised biological insect control methods (Sharma et al., 2020).

The economic part in vegetable crops is edible unlike in cotton where economic part is non-edible. IPM and Non Pesticidal Management (NPM) practices need to be promoted by all the stakeholders wherein chemical pesticides should remain as the last option. The awareness among farmers and consumers on safe food has increased. The need for paradigm shift from chemical inputs based agriculture to sustainable models has been acknowledged across the globe. India is promoting organic and natural farming through schemes like Paramparagat Krishi Vikas Yojana (PKVY), National Project on Organic Farming and Organic Value Chain Development for North East Region. Successful implementation of these schemes calls for sufficient budget allocation and reorientation of whole extension system to educate and facilitate the farmers towards sustainable environment friendly technologies and practices.

CONCLUSION

The study highlighted various aspects of pesticide use in vegetable cultivation. Use of chemical pesticides was the predominant pest control method practised by the farmers. Bio pesticides and botanical pesticides were used by a very limited number of growers in limited crops. Farmers were aware of IPM practices for pest control however, its adoption was limited. The primary motive of commercial vegetable cultivators was to control pests (in turn increase production). In the process, health of farmers/ farm workers themselves and consumers was jeopardized. Economic impact of overuse and misuse of chemical pesticides on biodiversity, natural resources and ecosystem as a whole needs to be assessed holistically to derive the breakeven point at the farmer, community and the society level.

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Farmers' Perception about Climate Change and Response Strategies

Bharat^{1*}, R. R. Chapke² and Shivanand Kammar³

¹Senior Research Fellow (SRF), ICAR-Indian Institute of Millets Research Rajendranagar Hyderabad-500030, Telangana, India

²Principal Scientist (Agricultural Extension), ICAR-Indian Institute of Millets Research Rajendranagar Hyderabad-500030, Telangana, India

³Assistant Professor (Agriculture Extension Education), University of Agricultural Sciences Raichur- 548104, Karnataka, India

*Corresponding author e-mail id: biradarbharat515@gmail.com

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ABSTRACT

The crop production response strategies to climate change and variability vis-à-vis their socio-personal characteristics in North-Eastern Karnataka region were identified and analysed. A multi-stage random sampling technique was employed to elicit information from 120 respondents. Ex-post-facto research design was adopted as manifestation of event was already accrued. Data were collected through a pre-tested semi-structured questionnaire. Total 52 strategies were collected from different literature, website, thesis etc., and tested among the respondents. The study revealed that there were eight commonly adopted crop production response strategies which were scrutinised from the 30 selected strategies using principal component analysis namely, soil-water retention and integrated farming, followed by, contingency crop planning, crop diversification and risk aversion strategies, seeking advice from extension personnel and others, improving irrigation facilities, maintaining livestock, crop insurance, and migration to cities. The farmers' education, mass media use and source of weather information were significantly contributed in their perception about climate change and variability at 5% level of probability.

INTRODUCTION

Climate change refers to any change in climate over the time either due to natural variability or as a result of human activity stated by Intergovernmental Panel on Climate Change (IPCC, 2007 and Fusel, 2007). The changes occur due to variation in different climatic parameters such as precipitation, temperature and increase in Green House Gases (GHGs) emission through human activities. Due to global warming climate is changing rapidly with adverse effects including excessive and uneven rainfall, floods, droughts and cyclones (Baul et al., 2013). The climate change is major threat to livelihood of rural people (Rakib et al., 2014).

In India, climate change is already being experienced by the communities in the form of irregular rainfall and snowfall, increasing temperature and decreasing moisture content. Crop productivity has been also decreased because of low soil fertility and higher incidences of diseases (Rawat et al., 2013). The adverse effects of

changing weather patterns and climate have extended beyond crop cultivation and influence livelihoods of people. Due to rising in temperature, agriculture production is expected to decline by 2050 in Himalaya region and will lead food insecurity (Dahal, 2008). Changes in weather patterns also result in reduction in availability of fuel wood, grass for fodder, spring water (Gene, 2012). Increasing disturbances of forests (forest fire, heavy lopping and logging, etc.) accompanied by increased human population resulting increasing in number of factories and motor vehicles, are some of the causes that lead to climate change and variability (Arya, 2010). Even the knowledge of extension professionals low to moderate in respect of climate change impacts on agriculture (Ghanghas et al., 2015). In order to support farm level decisions and minimize the losses in adverse climatic and weather conditions farmers' understanding about interaction of climate and agro-ecosystem need to be bridged through inclusion of farmers' communication network (Ravikumar et al., 2015) The perceptible change in climate due to anthropogenic

activities started with industrialization in the modern era has aggravated in recent times. The negative impacts of the climate change on human life, flora, fauna, seasons, water, and air is witnessed all over the world and discussions around controlling and combating the unabated climate change are taking place from school-village global level. It has been realized now that if the climate change phenomenon is left uncontrolled, the survival of human being and the globe is at stake. With the threat of climate change looming large on the crops' productivity, which have an important role in food, feed and fodder security in dryland agriculture (Chapke and Tonapi, 2018). However, before taking controlling measures, it is necessary to understand the phenomenon properly. Because, people vary with their perception about the change that is happening around them and sometimes attribute the causes for change to unrelated reasons. Hence, it is essential to understand level of farmers' awareness and perception about climate change parameters and nature of crop production response strategies were adopted by the farmer in view to climate change and variability to sustain their farming based livelihood.

METHODOLOGY

The research study on farmers' perception of climate change and variability vis-a-vis socio-personal characteristics were study to know the social condition of the farmers whether there are financially stable or not and agricultural adaptation strategies were responsive in North-Eastern Karnataka during the year 2018-19, which had impact on their agriculture. Multi-stage random sampling method was used. The data pertained to drought-affected blocks during 2001 to 2018 namely, Bellery and Hoovina hadagali in Bellery district; Kuthagi and Yelburga in Koappal district; Lingasugur and Manvi in Raichur district; Aland and Jewargi in Kalburgi district; Shahapur and Yadgir in Yadgir district; Aurad and Bhalki in Bidar district were collected from Karnataka State Natural Disaster Monitoring Center (KSNDMC) which was the base of selection of the districts. Ten respondents from each village were

selected based on simple random sampling procedure. This study comprises of 120 respondents. As which were selected from two villages of each district, total 12 villages. Ex-post-facto research design was adopted as manifestation of event was already accrued. Required data were collected using personal interview method with the help of semi-structured interview schedule, which was pretested with a few experts. In total 55 strategies were enlisted related to the crop production response strategies with respect to climate change and variability from the KSNDMC. Out of 55 strategies, 30 strategies were selected as they had more than 50 per cent response from the respondent farmers of the study area. Further, with an objective of reducing these 30 strategies to a few important one by allowing similar sources, there were clustered together using appropriate statistical tools like mean, principal factor analysis (PCA), correlation, frequency and percentage.

RESULTS AND DISCUSSION

Regression analysis of socio-personal characteristic of the respondents

To determine which socio-economic factors influencing to adopt strategies with respect to adverse climate change condition. The regression analysis was done with socio-economic characteristics of the respondents and their perception about climate change and variability (Table 1). The regression analysis ($R^2=0.438$) revealed Table 1 that 43.8 per cent variation in farmers perception about climate change parameters was explained by 15 independent variables selected under study. It could be observed that education of the respondents was found to be positive and showed significant contribution at 5.00 per cent level of probability followed by mass media usage by the respondents which was found to be positive and significant contribution at 5.00 level of probability and source of weather information was also found to be positive and showed significant contribution towards "perception of farmers towards climate change parameters". These findings were in line with the (Johnson et al., 2016).

Table 1. Regression analysis of socio-personal characteristics of the respondents and their perception about climate change parameters

S.No.	Model	Coefficients ^a				Sig.
		Unstandardized Coefficients		Standardized Coefficients	T	
		B	Std. Error	Beta		
	(Constant)	37.227	11.518		3.232	.002
1	Age	.016	.119	.022	.132	.895
2	Education	-1.510	.629*	-.374	-2.401	.018
3	Family size	-.024	.311	-.009	-.078	.938
4	Farming Experience	-.046	.130	-.058	-.354	.724
5	Occupation	-3.961E-6	.000	-.066	-.413	.681
6	Irrigation source	.629	.529	.116	1.189	.237
7	Land holding	-.070	.178	-.055	-.394	.694
8	Mass media use	1.260	.514*	.416	2.454	.016
9	Extension participation	-.294	.498	-.073	-.589	.557
10	Decision making	-.012	.238	-.005	-.050	.960
11	Source of weather information	-.691	.277*	-.288	-2.492	.014
12	Risk bearing ability	.022	.298	.007	.073	.942
13	Economic motivation	.096	.340	.027	.281	.779
14	Scientific orientation	.011	.037	.028	.310	.757
15	Social participation	.688	.529	.127	1.301	.196

A. Dependent variable: perception of the respondents and their perception about climate change parameters
 $R^2 = 0.438$

The hypothesis formulated based-on the objective was that “Farmers perception about climate change parameters was incomplete and erroneous”. The study revealed that most of the farmers were aware of the climate change and its impact on their farming but were found to be lacking to get complete understanding of whole phenomena of climate change. Hence, the hypothesis was accepted and prompted to have study in detail.

Crop production response strategies to climate change and variability

Thirty strategies were selected as they had more than 50 per cent response as mentioned earlier. These were tested with respondent farmers of the study area with three-point continuum scale *i.e.*, most suitable and adopted, suitable and adopted, and not suitable and adopted, with assigning score of 3, 2, and 1, respectively. Table 2 depict that, shifting from agriculture to other earning activities, migration to cities for livelihood earning, construction of rain water harvesting structure, deepening existing well/bore well, better relations developed with extension workers and de-silting of irrigation canal were the major crop production response strategies adopted by the farmers with respect to climate change. Similarly, same crop production response strategies were subjected to principal component analysis which is shown in (Table 3). Hence the hypothesis was accepted.

Factor analysis was used to reduce these 30 strategies further to a few. These 30 strategies were inter correlated and then 30×30

Table 2. Crop production response strategies to climate change and variability

S.No.	Strategies	Most suitable and adopted (%)	Suitable and adopted (%)	Not suitable and adopted (%)	RE
1	SAOEA	0	33	68	0.911
2	MCL	0	33	68	0.453
3	CRWHS	62	29	9	0.853
4	DEB	0	33	67	0.850
5	BREW	0	43	58	0.847
6	DIC	0	38	63	0.842
7	DNB	0	30	70	0.836
8	OFFP	0	28	73	0.828
9	AFA	0	33	67	0.808
10	BOFR	0	40	60	0.806
11	LIC	62	31	8	0.794
12	CLTOS	65	26	9	0.639
13	IS	0	28	73	0.475
14	CD	0	32	68	0.475
15	APA	52	36	13	0.467
16	DRV	0	43	58	0.458
17	EFPM	0	33	68	0.867
18	SCPC	54	34	12	0.447
19	OM	58	34	8	0.444
20	IQFA	68	25	8	0.444
21	CPD	53	42	13	0.442
22	IF	0	27	73	0.442
23	SL	56	30	14	0.442
24	UCLICF	0	32	68	0.439
25	ACI	75	21	4	0.433
26	LIAML	0	34	66	0.433
27	LOC	0	36	64	0.439
28	IEL	33	27	41	0.428
29	PRV	0	30	70	0.425
30	MSP	67	22	12	0.425

Table 3. Component crop production response strategies with factor loadings

S. No.	Component	Factor loadings
1	Soil-water conservation and integrated farming strategies	
	– Modifying soil structure through ploughing to retain soil moisture	.911
	– Building on-farm storage structure	.906
	– Following integrated farming	.795
	– Shifting from agriculture to other earning activities	.675
2	Contingency crop planning strategies	
	– Shifting from cereal crops to perennial crops	.844
	– Increasing seed rate	.689
	– Change in planting date	.684
3	Changing from long duration to short duration varieties	.678
	Crop diversification and risk aversion strategies	
	– Crop diversification	.876
	– Increasing quantity of fertilizer application	.843
4	– Low investment in agriculture to minimize losses	.757
	– Leased out land for cultivation	.660
	Seeking advice from extension personal and others	
	– Better relations developed with extension workers	.714
5	– Approaching other farmers for farm opinions	.651
	– Desilting of irrigation canal	.616
	Improving irrigation facilities	
	– Drilling new well/ bore well	.870
6	– Deepening existing well/bore well	.770
	– Construction of rain water harvesting structure	.621
	Maintaining livestock	
	– Using crops as livestock fodder	.911
7	– Addition of organic matter	.717
	Crop insurance	
	– Availing crop insurance	.771
	8	Migration to cities for livelihood
– Migration to cities for livelihood		.621

variable matrix of correlation coefficients was subjected to principal component analysis (PCA) with varimax rotation. The total variance strategies which had values more than or equal to 0.6 were selected from rotated component matrix and appeared in each component (Table 3). Cumulative variance was found 66.27% in the PCA analysis. It indicates that there was 66 per cent role of these factors in perception of farmers about climate change. Under PCA, of the rotated factors was achieved by selecting only those strategies, which possessed a significant factor loading (grater or equal to 0.6 absolute without regard to sign Table 3. The first component was named as “soil-water conservation and integrated farming strategies”. It consists of four strategies; modifying soil structure through ploughing had highest factor loading (.911) followed by, building of farm storage reservoir (.906), following integrated farming (.795) and shifting from agriculture to other activities (.675). Second component was entitled as “contingency crop planning” which includes shifting from cereal crop to perennial crops (.844), increase in seed rate (.689), changing from long duration to short duration varieties had the highest factor loading (.678) and change in planting dates (.684). Third component was named as “crop diversification and risk aversion strategies”. It had four strategies; crop diversification (.876), increase in quantity of fertilizer application (.843), low investment in agriculture (.757) and leased

out land for cultivation (.660). The farmers adopted crop diversification as a strategy against climate change in view to realize that growing single crop continuously year after year prone to risk and stagnated yields are over a period. Thus, crop diversification can help in gaining better yield than a single crop. Due to heavy rainfall, there is possibility of loss of fertilizers through leaching (Shah et al., 2008). The findings were in line with the (Sangeetha et al. 2018).

Fourth component was entitled as “seeking advice from extension personnel and others” in which highest factor loading was to strategy; better relations developed with extension workers (.714). The findings were in line with the (Raghuvanshi et al., 2020). It was followed by second highest factor loading; approaching other farmers for farm opinions (.651) and the last strategy was desilting of irrigation canal (.616). Under fifth component namely, improving irrigation facilities includes; drilling new well/ bore well (.870) followed by, deepening existing borewell/well had highest factor loading (.770) and construction of rainwater harvesting structure (.621). In sixth, “maintaining livestock”. consist of using crop as a livestock fodder (.911) and second one was addition of organic matter (.717). It was mainly named as “maintaining livestock” due to the reason that the probability of crop failure under the climate change condition had increased. The results were line with (Brar et al., 2020). If livestock’s are maintained, the losses arising out of crop failure can be compensated to some extent and leftover crops of the failure can be utilized as fodder for animals. The litter and the cow dung can be helped to add organic matter in the soil. Crop insurance (.771) and migration to cities for livelihood (.621) were named as seventh and eight components respectively, in the analysis, which had only one strategy as its named. The hypothesis formulated based-on the objective was “Crop production response strategies adopted by farmers in combating climate change was reactionary in nature” was proved false because study revealed that crop production strategies adopted by farmers in combating climate change were not reactionary in nature as most of the response strategies were mainly found to be precautionary and preparatory in nature. Hence, the hypothesis was nullified.

CONCLUSION

The perceived awareness knowledge and impact of climate change and variability by the farmers was well versed and realizing its effect in terms of economic fluctuations, changing agro-climatic factors affecting the crop nature, increased pest and diseases attack, impacting crops yields, water resources, animals, and farmers’ psychology in an adverse manner. The various crop production response strategies against climate change were adopted by the farmers were; soil-water conservation related strategies, irrigation facilities related, contingency crop planning related strategies. It need attention of the policy makers for emphasizing on these strategies along with the other recommended strategies in view to empower farmers to adapt to the climate changed scenario. Appropriate system for weather data collection, forecasting and early warning system for climatic extremities should be put in place by the concerned departments like Department of Hydrology and Meteorology. Climate based insect pest and disease forecasting system should be devised by the concerned Department of

Agriculture. A multi-pronged strategy needs to be adopted to support the farmers economically through crop insurance, input support, socially by building social capital, creating the farmers organization to facilitate adopting technology like short duration varieties and timely protection management practices, including psychological support so that farmers could cope-up with the climate change impact and earn their livelihood.

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Farmers' Perception towards Transformation of Rice-based Cropping System into Tea Garden

Monirul Haque^{1*}, S. K. Acharya² and Barsha Sarkar³

^{1,3}Ph.D. Research Scholar, ²Professor, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal, India

*Correspondence author email id: monirulhaque441@gmail.com

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ABSTRACT

Transformation of agricultural lands into non-farm lands or plantations has got tremendous ecological chaos and ripples. Northern part of West Bengal is undergoing rapid changes in rural areas where new opportunities are emerging in the form of demand-driven and market-driven agriculture. Due to persistent low returns from traditional rice cultivation, the transformation of paddy fields into tea gardens has been a recent trend for this part of West Bengal. The present study has been conducted by selecting purposively three blocks from Alipurduar district and sixty respondents through random sampling, those who have already transformed their crop field into tea gardens from these blocks. The farmers' perception towards transformation is taken as dependent variable along with a score of fourteen independent variables. The responses are collected through a structured interview schedule. The study envisaged that the farmers' education level, number of family members engaged in the garden, their economic motivation, sources of information, risk orientation behaviour and distance from the tea processing factory showed significant contribution towards the transformation behaviour. The future impact of such transformation on the ecological dynamics in terms of livelihood, biodiversity restoration and ecological resilience can be brought under policy frameworks.

INTRODUCTION

Agricultural transformation has been a powerful approach to eradicate poverty and promoting economic stability over a few decades. Farming sector has evolved from a subsistence based labour intensive economy to a modernized, capital and knowledge intensive system. The transformation of traditional agricultural lands into plantation viz., coffee gardens, tea gardens, cardamom gardens (Sreeja et al., 2021), rice-shrimp or grass-cattle based integrated farming systems and a move from on-farm to more off-farm or non-farm incomes (Thanh et al., 2021) has got tremendous ecological chaos and ripples.

Since the earlier few decades, rice-based farming experiences a drastic reduction in yield loss which increases urban migration of the labour and shifting towards other non-farm activities. This trend

has gone up with the gradual decline of income from agriculture, non-availability of labour for farming, an increase of cost of input in agriculture, and rising expectations for an occupation that will be away from agriculture. It becomes important to promote the rural transformation to create more employment opportunities in the local situation which helps in improving the social condition of the local people (Haque et al., 2020a) and to check the migration (Ge et al., 2020).

Tea gardens have a distinctive ecological behaviour and produce a promising return. It increases biological activity including addition of organic matter, changing biodiversity (Haque et al., 2020b), and improves the quality of surface and groundwater by reducing erosion and salinity (Wenner, 2011). Although increasing numbers of tea garden can hamper the supply of some ecosystem services with a risk of threat to sustainability and human well-being and economic

paybacks are fails to compromise the environmental cost (Su et al., 2017). It is important to facilitate the farmer as an entrepreneurial actor in the strategic decision-making process who interacts with the farm's socio-material context (Methorst et al., 2017). The farmers in their initial stage have to face some difficulties which can be overcome through the development of entrepreneurial skills such as innovativeness, risk-taking, and opportunity seeking behaviour (Deka & Goswami, 2020). Apart from the initial capital for planting and land preparation, it does not require substantial investments subsequently and the risk of crop failure is limited to very sporadic pest attacks and natural calamities (Tea Board of India, 2009).

Although 83.55 per cent of small and marginal tea growers having less than four hectares of landholdings (Hannan, 2019) they got success in generating income, not only for themselves but also for the unemployed mass populations around them (Borthakur, 2019). Henceforth a similar study also reveals that the newly formed tea growers are suffering from a lack of technical knowledge (Rahman et al., 2020).

The present study focuses on the drivers persuading the farmers to transform their established farming practices towards tea gardens. It may help in terms of planning and implementing measures to enhance output and economic return of small tea growers.

METHODOLOGY

The study is conducted in Falakata, Madarihata, and Alipurduar-1 blocks of Alipurduar district of West Bengal. Alipurduar district, as well as blocks, are selected purposively because these areas are one of the major tea cultivating regions in Dooars in North Bengal. Conversion of croplands to tea gardens is a typical occurrence in the studied region. The tea growers who are already engaged in the conversion of farmland into tea gardens are targeted for the study. The total number of sixty respondents, twenty from each block has been selected through random sampling method. Data are collected between January to March of 2019 through structured interview schedule using face to face interactions. The study of farmers' perception towards transformation of rice-based cropping system in tea garden being operationalized and measured in the following manner: (i) independent variables and (ii) dependent variable. The dependent variable, perception of farmers towards transformation (y) is computed through a five-point rating scale where score five defines the highest perception value and score one defines the lowest perception value respectively with six statements prepared by the researcher. The collected data are analysed through both descriptive and multivariate analysis. Statistical Package for the Social Sciences v20.0 (SPSS) of IBM and online statistical tool OPSTAT (Sheoran et al., 1998) are used for analysing the coefficient of correlation, multiple regression, stepwise regression, and path analysis.

RESULTS AND DISCUSSION

Farmers' perception towards transformation

It is well known fact that farmers' perception towards transformation of their farmlands into orchard based tea garden

depends on some predictor variables. For the present study, fourteen independent variables have been studied through a structured interview schedule which is shown in Table 1. The study reveals that the majority of the farmers belong to the middle age category (mean 43.267 years), education level is quite high (mean 9.650 years) at the almost secondary level. Most of the farmers belong to the category of small farmers as the average cultivated land area is 1.241 hectare. The study also reveals that the farmers who perceived to transformed their farming practices towards tea garden have a good experience in tea gardening, high economic motivation, and risk orientation attributes. So the farmers' entrepreneurial abilities are identified from the present study.

Table 1. Descriptive statistics with respect to mean and standard deviation of selected independent variables (x_1 - x_{14})

Independent Variables	Mean	SD
Age (x_1)	43.267	9.038
Education (x_2)	9.650	3.584
Family size (x_3)	6.767	2.020
No of family labour (x_4)	5.150	1.665
Cultivated land area (x_5)	1.241	0.267
Experience in tea garden (x_6)	9.000	3.184
Distance from tea processing factory (x_7)	6.342	3.194
Economic motivation (x_8)	12.933	3.560
Ancillary plant ratio (x_9)	4.498	1.866
Pesticides use ratio (x_{10})	1.715	0.720
Fertilizer use ratio (x_{11})	0.462	0.193
Garden age (x_{12})	9.633	2.923
Sources of information (x_{13})	2.317	0.965
Risk orientation (x_{14})	15.300	5.328

Standard deviation = SD

Relation between farmers' perception towards transformation and other selected variables

Perception is the process of transmission of stimulation through organized experiences (Epstein et al., 2018). Any kind of perception has a wide relationship between societal, economical as well as environmental factors. Conventional farming practices have felt to provide adequate income due to several factors. The degree of linear associations between the perception of farmers towards transforming their farmlands along with fourteen selected independent variables is presented in Table 2. The study revealed that there is a positive correlation between the perception of farmers and their education, economic motivation, source of information, and risk orientation. That means the farmers with higher education levels along with highly economically motivated, have the access to greater sources of information and the ability to take greater risk to have a higher perception level towards transformation. Apart from this, distance from the tea processing factory is negatively correlated with the perception also implies that the farmers who are nearer to tea factory have higher level of perception. A similar study also confirms that family size, distance to the market, economic motivation, risk orientation, innovativeness and scientific orientation are shows strongly positive correlation with crop diversification (Ghouse & Hassan, 2020).

Table 3 depicts the multiple regression analysis of perception of farmers towards transformation (y) vs. 14 independent variables (x_1 - x_{14}). The model shows that the independent variables can

Table 2. Coefficient of correlation between perception of farmers towards transformation (y) and selected independent variables (x₁-x₁₄)

Independent variables	r value	Remarks
Age (x ₁)	-0.007	
Education (x ₂)	0.415	**
Family size (x ₃)	0.132	
No of family labour (x ₄)	0.299	*
Cultivated land area (x ₅)	-0.027	
Experience in tea garden (x ₆)	0.070	
Distance from tea processing factory (x ₇)	-0.415	**
Economic motivation (x ₈)	0.350	**
Ancillary plant ratio (x ₉)	0.152	
Pesticides use ratio (x ₁₀)	0.075	
Fertilizer use ratio (x ₁₁)	-0.165	
Garden age (x ₁₂)	0.227	
Sources of information (x ₁₃)	0.582	**
Risk orientation (x ₁₄)	0.294	*

*Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level

explain almost 66.90 per cent (*R square* = 0.669) of the dependent variable. The variables education (*p*<0.01), garden age (*p*<0.05), and sources of information (*p*<0.001) significantly contribute to farmers' perceptions. The standardized coefficient beta value of these three explain that for one unit changes in these variables contribute 0.372, 0.281, and 0.499 unit changes in perception of farmers. To elaborate the study, stepwise regression analysis (Table 4) has been performed which depicts that sources of information (*p*<0.001), education (*p*<0.001), garden age (*p*<0.001), and distance from tea processing factory (*p*<0.05) are strongly significant with the farmers'

perception towards transformation. The stepwise regression model can explain 61.90 per cent of the dependent variable (*R square* =0.619). The findings from other studies also suggest that information from neighbours along with high relative income, and good marketing channels are the main actors of their transformation towards tea gardening (Ghosh et al., 2017).

Decomposition of total effects into direct and indirect effect of independent variables on perception of farmers towards transformation

The path analysis decomposes the total effects into direct, indirect, and residual effect on selected independent variables. Source of information presents the highest positive total effect (0.582) and direct effect (0.500), whereas no. of family labour shows the highest positive indirect effect (0.289) (Figure 1). The variable distance from tea processing factory and education represent the second highest total effect (-0.415, 0.415) but the former have negative and later have positive impact. Education (0.372) and garden age (0.282) comes under second and third ranks in terms of positive direct effect. The variables no of family labour (0.289) and risk orientation (0.261) ranks second and third in terms of positive indirect effect. Out of the fourteen independent variables, five variables each have highest indirect effect on perception of farmers towards transformation through education and Sources of information which are depict in Table 5. The sources of information are one of the crucial factors for any kind of perception. The study reveals that localite, as well as cosmopolite

Table 3. Multiple Regression analysis in predicting perception of farmers towards transformation (y) using selected independent variables (x₁-x₁₄)

Variables	Unstandardized Coefficients		Standardized Coefficients	t value	Sig.
	Reg. Coeff. B	S.E. B	Beta		
Age (x ₁)	-0.047	0.050	-0.091	-0.929	0.358
Education (x ₂)	0.481	0.130	0.372	3.699	0.001
Family size (x ₃)	0.040	0.300	0.017	0.134	0.894
No of family labour (x ₄)	0.028	0.398	0.010	0.071	0.944
Cultivated land area (x ₅)	-1.565	1.784	-0.090	-0.877	0.385
Experience in tea garden (x ₆)	0.054	0.147	0.037	0.368	0.715
Distance from tea processing factory (x ₇)	-0.284	0.161	-0.196	-1.769	0.084
Economic motivation (x ₈)	0.147	0.143	0.113	1.029	0.309
Ancillary plant ratio (x ₉)	0.117	0.240	0.047	0.486	0.630
Pesticides use ratio (x ₁₀)	-0.521	0.600	-0.081	-0.868	0.390
Fertilizer use ratio (x ₁₁)	-2.613	2.365	-0.109	-1.105	0.275
Garden age (x ₁₂)	0.446	0.175	0.281	2.555	0.014
Sources of information (x ₁₃)	2.398	0.471	0.499	5.092	0.000
Risk orientation (x ₁₄)	0.029	0.086	0.033	0.338	0.737

R square = 0.669, Adjusted R Square =0.566, Standard error of the estimate = 3.053

Table 4. Stepwise regression analysis in predicting perception of farmers towards transformation (y) using selected independent variables (x₁-x₁₄)

Variables	Unstandardized Coefficients		Standardized Coefficients	t value	Sig.
	Reg. coeff. B	S.E. B	Beta		
Sources of information (x ₁₃)	2.469	0.409	0.514	6.034	0.000
Education (x ₂)	0.495	0.112	0.382	4.403	0.000
Garden age (x ₁₂)	0.470	0.140	0.296	3.351	0.001
Distance from tea processing factory (x ₇)	-0.330	0.127	-0.227	-2.593	0.012

R square =0.619, Adjusted R Square =0.592, Standard error of the estimate = 2.962

Table 5. Decomposition of total effect into direct, indirect and residual effect perception of farmers towards transformation (y) vs. 14 independent variables (x_1-x_{14})

Variables	TE	DE	IE	HIE
Age (x_1)	-0.007	-0.091	0.084	0.083 (x_{12})
Education (x_2)	0.415	0.372	0.043	0.07 (x_{13})
Family size (x_3)	0.132	0.017	0.115	0.056 (x_{12})
No of family labour (x_4)	0.299	0.011	0.289	0.101 (x_{13})
Cultivated land area (x_5)	-0.027	-0.090	0.063	0.101 (x_2)
Experience in tea garden (x_6)	0.070	0.037	0.033	0.074 (x_{12})
Distance from tea processing factory (x_7)	-0.415	-0.196	-0.219	0.079 (x_{13})
Economic motivation (x_8)	0.350	0.113	0.237	0.117 (x_2)
Ancillary plant ratio (x_9)	0.152	0.047	0.105	0.059 (x_2)
Pesticides use ratio (x_{10})	0.075	-0.082	0.157	0.098 (x_{13})
Fertilizer use ratio (x_{11})	-0.165	-0.109	-0.056	0.053 (x_7)
Garden age (x_{12})	0.227	0.282	-0.055	-0.081 (x_2)
Sources of information (x_{13})	0.582	0.500	0.082	0.053 (x_2)
Risk orientation (x_{14})	0.294	0.033	0.261	0.116 (x_{13})

Total Effect = TE; Direct Effects = DE; Indirect Effects = IE; Highest Indirect Effects = HIE
Residual effect: 0.330 %

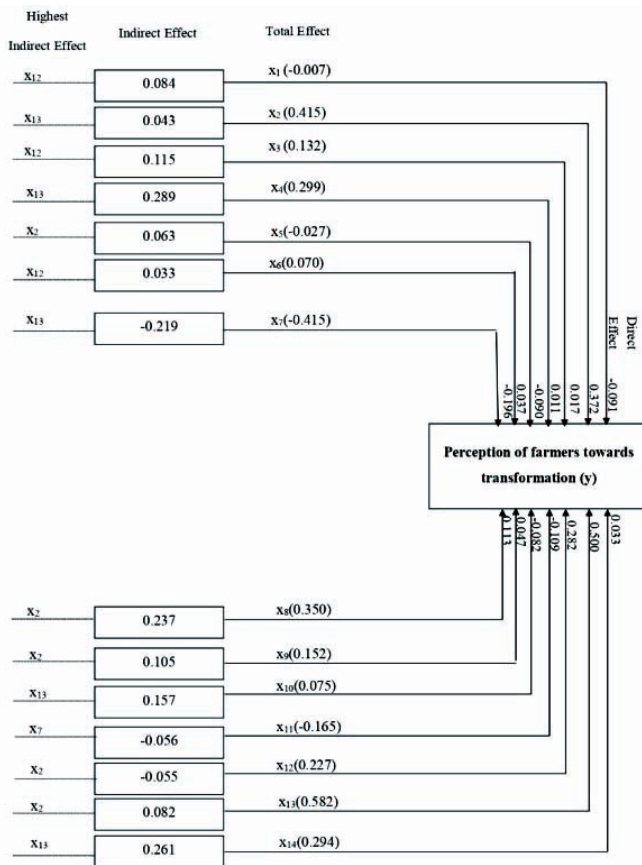


Figure 1. Path analysis showing direct, indirect effect and highest indirect effect of independent variables on perception of farmers towards transformation

sources, play an important role to motivate farmers to transform their traditional farming activities towards market driven orchard based tea garden farming whereas similar research on dairy farmers revealed that the entrepreneurial behaviour was played a crucial role in knowledge and adoption of scientific dairy practices in Maharashtra (Khode et al., 2021).

CONCLUSION

The present study has created an array of the platform to elucidate the factors responsible for changing the minds of rice-based farmers about the agri-entrepreneurship. It evinces shifting towards demand and market-oriented from the production oriented farming. Some major factors such as risk-taking ability, information seeking behaviour and most importantly the economic motivation may help some farmers towards certain transformation. The major part of educated youths of the farm families is looking forward to this type of transformation as more attractive than the old generation. Taking the transformation as a positive note towards self-employment in the farming sector, forecasting the future effect of such transformation on the ecological dynamics in terms of livelihood, biodiversity restoration and ecological resilience can be brought under policy frameworks. It may be suggested to take proper micro level policy measures to provide sufficient knowledge resources and marketing supply chain facility will be beneficial to emerge more agri-entrepreneurs.

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Is Organic Rice bean (*Vigna umbellata*) Farmers Economically better Off? An Empirical Analysis

Singyala Chiphang¹, Ram Singh^{2*} and S. M. Feroze³

¹Ph.D. (Agricultural Economics) ²Professor (Agricultural Economics), School of Social Sciences, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University (Imphal), Umiam, Meghalaya, India

³Associate Professor (Agricultural Economics), College of Agriculture, Central Agricultural University, Imphal, Manipur, India

*Corresponding author email id: ramsingh.cau@gmail.com

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ABSTRACT

The study was conducted in North Eastern Hill (NEH) region of India during 2018-2020. Multistage sampling technique was adopted. Sikkim was selected purposively as the control state and Nagaland was selected based on the highest area and production under pulses. 60 respondents each from organic adopter and non-adopter were selected making a total sample size of 120. The growth rate in area, production and productivity at the world, India and NEH states were found to be positive. However, higher growth rate were observed for the NEH region. Significance difference was observed only on cost of fertilizers. The total cost of rice bean cultivation was lower in organic adopter by 1.71 per cent. The average yield was significantly higher for the organic adopter. The gross income and net income were also higher for the organic adopter. Organic farming was found to be more profitable and it can enhance the farmer's income. Allocative efficiency indicates that all the resources used in the region need to be increase so as to achieve the maximum potential yield and henceforth increase the returns.

INTRODUCTION

Organic farming has a significant advantage in increasing farmers' income and reducing external input cost, increasing employment opportunities and enhancing food security by increasing the purchasing power of the people (Jouzi et al., 2017). Organic farming is promoted based on the multiple benefits it provides; healthier food, improved farm environment and a contribution to the rural economy (Pretty, 2002). It has also a significant advantage in lowering the cost of cultivation (Kumar et al., 2006), higher productivity and gross return (Laxmi et al., 2017; Issaka et al., 2016) and higher net returns (Singh and Grover, 2011). In India the inherited tradition of organic farming is an added advantage, it ranks 9th in terms of world's organic agricultural land and 1st in terms of total number of producers. India's organic share of total agricultural land is 0.7 per cent (FIBL & IFOAM, 2018).

The total area under organic certification was 5.71 million hectares during 2015-16 and the North Eastern Hill region (hereafter NEH) contributed about 6.53 per cent of the total area under organic certification in India (APEDA, 2017). Among the NEH region, Sikkim contributed 5.21 per cent of the organic land (since it is the organic state) and Nagaland (0.33%) respectively (APEDA, 2017).

India is the largest producer of pulse in the world producing 18.15 million tonnes with the percentage share of 22 per cent (GoI, 2018). Pulse plays an important role in Indian diet as larger part of the Indian population is vegetarian (Singh et al., 2010) and pulses constituted a richest source of protein (Singh et al., 2009) for the vegetarian diet. In India, frequency of pulses consumption is much higher than any other source of protein, which indicates the importance of pulses in their daily food habits (Singh et al., 2019). Like other *Vigna* species, rice bean (*Vigna umbellata*) is a multipurpose legume which are grown mainly as a dried pulse, it is

also important as a fodder and green manure. Sometimes it is considered as neglected and underutilised (Joshi et al., 2008). In Nagaland, rice bean is an important pulse crop and the cultivation of pulses is widely followed in the state with a total area of 38.65 thousand hectares. But despite of knowing the important benefits of organic farming and pulse as a whole, no systematic attempt has been made to understand the positive effects of the system in the organic hub of India *i.e.* NEH region. Efficiency studies help in understanding the current performance and opportunities to improve the production performance of the crop.

METHODOLOGY

The study was conducted in two states of the NEH region, India. Multistage sampling technique was adopted for the study. Since Sikkim has been declared as an organic state (www.thehindu, 15 March 2019), it was selected purposively as the control state. For the control district, East Sikkim district was selected randomly. Under pulses, Nagaland stood the highest in terms of area (38.65 thousand ha) and production (44.48 MT) in the NEH region. One major producing crop under pulses was selected. Since rice bean was one of the common pulses which was widely grown by the people in the study areas rice bean was selected. Kohima district was selected purposively under rice bean as it stood highest in terms of area (820 ha) and production (940 mt) (GoN, 2017). From the control district, Martam block was selected and two villages namely upper Marchak and lower Marchak were selected randomly. From Kohima, Chiephobozou block was selected randomly out of which Dihoma and Kijumetouma villages were selected. 60 respondents each from organic adopter and non-adopter were selected thus making a total sample of 120 respondents.

Primary data were collected from the sample respondent through personal interview on a well-structured schedule comprising of land preparation, labour cost, planting cost, farm yard manure (FYM), bio-fertilizers, chemical fertilizer, machinery use, harvesting, various implements used by the respondents and yield *etc.* were collected pertaining for the agricultural year 2018-19. Simple descriptive statistics and *t* test to know the significant difference between the organic adopter and non-adopter were applied. To know the growth performance of pulse, compound annual growth rate (CAGR) for area, production and productivity of pulse were calculated using time series data of 10 years *i.e.* from 2008-2017 of total pulse crops in the world, India and the NEH region (GoI, 2018; FAOSTAT, 2018). Before calculating the growth rate, the exponential function of area, production and yield was estimated.

$$\ln Y_t = A + \beta_t + u_t$$

Where, Y_t = Area/production/ productivity of pulse, t = Time variable (1, 2... n) for each period, A = Constant, β_t = Regression coefficient, u_t = Error term

Compound Growth Rate was estimated as:

$$r = [\text{antilog}(\beta) - 1] \times 100$$

Resource productivity

Specific functional form was selected based on economic criteria *i.e.*, sign and value of the estimated parameters, statistical criteria

like the statistical significance of estimated parameters and co-efficient of multiple determination (R^2). Log-log production function was found to be the best fit hence it was preferred over other production function.

Functional form for the organic adopter

$$Y = f(X_1, X_2, X_3, X_4) \dots (1)$$

Y = gross return, X_1 = wage of the human labour in rupee, X_2 = value of seed per hectare in rupee, X_3 = value of farm yard manure in rupee, X_4 = capital cost

In case of non-adopter,

$$Y = f(X_1, X_2, X_3, X_4, X_5) \dots (2)$$

where, Y = gross return, X_1 = wage of the human labour in rupee, X_2 = value of seed per hectare in rupee, X_3 = value of fertilizers used per hectare in rupee, X_4 = value of farm yard manure in rupee, X_5 = capital cost

Allocative efficiency

Allocative efficiency (AE) was determined by calculating the ratio of the marginal value product (MVP) to the marginal factor cost (MFC)

$$AE = MVP / MFC$$

$$MVP = MPP_i * P_y$$

Where, MVP = Marginal value product, MPP_i = Marginal physical product of the i^{th} input, P_y = Price of output

$$MPP_i = b_i \bar{Y} / \bar{X}_i$$

where, b_i = Elasticity coefficient of the i^{th} independent variable, \bar{Y} = Geometric mean of the output, \bar{X}_i = Geometric mean of the i^{th} input

RESULTS AND DISCUSSION

Compound Annual Growth rate of pulses

Perusal of Table 1 revealed that at the world level the growth performance in terms of area, production and productivity were positive. The area, production and productivity increased at 2.59 per cent, 3.92 per cent and 1.31 per cent respectively over the years. Similarly, for India, positive growth rate has been observed in area, production and productivity with 2.50 per cent, 4.74 per cent and 2.18 per cent respectively. However, the growth rate of production in India (4.74%) was found to be more compared to the growth rate of the world. The NEH region also encountered a positive growth rate in area, production and productivity with the annual growth rate of 4.99 per cent, 6.24 per cent and 2.33 per cent respectively. The productivity of pulses in NEH was found to be higher than the India level, signifying the greater prospect of pulses production in the region.

Table 1. Growth Performance of area, production and productivity of pulses

	CAGR (%)		
	Area	Production	Productivity
World	2.58	3.92	1.31
India	2.50	4.74	2.18
NEH	4.99	6.24	2.33

Cost of production

Table 2 depicted the total cost incurred in rice bean production per hectare for both the organic and inorganic adopter. Human labour was found to be a major cost component out of the total cost in both the farms (organic adopter and non-adopter) constituting 81.22 per cent and 77.54 per cent respectively. The rental charges were the second major cost component followed by seeds, manure, depreciation of farm assets. Fertilizer cost constituted 5.16 per cent of the total cost for the non-organic adopter. The per cent difference in various cost components have been worked out and observed that there was 100 per cent cost saving in fertilizers for the organic adopter. Cost incurred in human labour was higher for the organic

Table 2. Cost of rice bean Production

Particulars	Organic adopter	Non-adopter	Percent difference (over non-adopter)
Human labour (₹/ha)	24754.76 (81.22)	24160.00 (77.54)	2.46
Manures (₹/ha)	1100.79 (3.61)	688.89 (2.21)	59.79
Fertilizers (₹/ha)	0.00 (0.00)	1606.98 (5.16)	-100.00
Seeds (₹/ha)	1053.90 (3.46)	1029.78 (3.78)	2.34
Depreciation (₹/ha)	302.92 (0.99)	272.07 (0.87)	0.11
Rental charges of land (₹/ha)	3266.67 (10.72)	3251.67 (10.44)	0.46
Total cost	30479.04 (100.00)	31009.38 (100.00)	-1.71

Note: Figures in the parentheses indicates the percentage to the total

adopter (2.46%), manure (59.79%), seeds (2.34%), depreciation (0.11%) and rental charges (0.46%). The cost differences can be observed from the Table 3, where cost of fertilizer in organic rice bean production shows a significant difference over the inorganic rice bean production but the cost on human labour, manure and seeds were found to be statistically non-significant.

Returns

The rice bean yield was significantly higher for the organic adopter with the mean difference of 316.71 kg/ha (Table 4). The gross returns and net returns obtained by the organic adopter were higher compare to the non-adopter by ₹ 1028.67 and ₹ 720.26 but not significantly. The higher net returns for the organic adopter may be due to the lower cost incurred by them. Organic rice bean production has a higher potential in improving the economic life of the farmer as indicated by the higher net returns. Gills et al., (2021) pointed out that organic practices have more capacity of sustainability towards out that ecology, economic and social. Singh et al., (2019) also observed that organic farming based on local resources is good and profitable. It is an alternate form of agriculture which can improve their income.

Resource productivity

The resource productivity of inputs was also estimated and presented in Table 5. It was observed that for the organic adopter the labour cost (X_1) and manure (X_3) were significant at 5 per cent and 1 per cent level of significance indicating that with one per cent increase in the value of inputs, keeping other variables constant would result to an increase in the total value of production by 0.41

Table 3. Results of unpaired t test for mean difference of paid out cost

Inputs	Organic adopter	Non-adopter	Mean difference	t value
Human labour	24754.76	24160	594.76	0.3
Manure (FYM)	1100.79	688.89	411.9	1.41
Fertilizers	-	1606.98	-1606.98	4.09***
Seeds	1053.9	1177.56	-123.66	1.41
Total	26909.46	27633.42	-723.96	0.39

Note: *** indicate $p < 0.01$

Table 4. Results of unpaired t test of returns from organic and inorganic cultivation

Particulars	Organic adopter	Non-adopter	Mean difference	t value
Yield (kg/ha)	2276.03	1959.32	316.71	2.861***
Gross income/ha	36335	35306.33	1028.67	0.505 ^{NS}
Net income/ha	4869.44	4149.18	720.26	0.206 ^{NS}

Note: *** indicate $p < 0.01$

Table 5. Resource productivity of rice bean in NEH region

Variables	Coefficients		Standard error		p-value	
	OA	NA	OA	NA	OA	NA
Intercept	1.65	2.16	1.34	1.10	0.23	0.06
Labour	0.41**	0.59***	0.14	0.09	0.01	0.00
Seed	0.13	0.22***	0.12	0.07	0.32	0.00
Fertilizer	-	0.04	-	0.14	-	0.76
Manure	0.50***	0.01	0.12	0.06	0.00	0.82
Capital cost	0.03	0.06	0.09	0.10	0.72	0.55
R ²	74	82				

Note: ***&** indicates $p < 0.01$ and $p < 0.05$ respectively; OA-Organic adopter, NA- Non-adopter

Table 6. Allocative efficiency of rice bean cultivation in NEH region

Variables	Coefficients		MVP		MFC		MVC/MFC	
	OA	NA	OA	NA	OA	NA	OA	NA
Labour	0.41	0.59	57.14	68.14	1	1	57.14	68.14
Seed	-	0.22	-	30.92	-	1	-	30.92
Manures	0.50	-	63.39	-	1	-	63.39	-

Note: OA-Organic adopter, NA- Non-adopter

and 0.50 per cent respectively. The R^2 was 0.74 signifying that 74 per cent of the total variation in the return from rice bean was explained by the factors taken into consideration.

Similarly for the inorganic cultivation, variables like labour cost (X_1) and seed cost seed (X_2) were statistically significant at 1 per cent level indicating that with one per cent increase in the value of labour and seed, keeping other variables constant would result to an increase in the total value of production by 0.59 and 0.22 per cent respectively. The coefficient of multiple determinations (R^2) was 0.82 indicating that 82 per cent of the total variation in the return from rice bean cultivation were explained by the variables taken into consideration. The remaining variation might be due to others factors which were not considered in the model (Table 6).

Allocative efficiency

The allocative efficiency indicated the price response of the farmers. The allocative efficiency of less than 1 indicated the over utilization of that particular resource hence decreasing the amount or quantity use of that particular resource increase profits. The allocative efficiency of more than 1 indicated the under-utilization of that particular resource and scope in increase in its application. The allocative efficiency of 1 indicated that the resource is efficiently used and it is the point of optimum utilization of resource. Allocative efficiency ratio the NEHR was calculated for the significant inputs and are presented in Table 6. Variables labour cost, seed and farm yard manures show significant potential to use further as the efficiency ratios are greater than one for both the organic adopter and non-adopter, asserting that every additional rupee spent on these inputs would yield a return of ₹ 57.14 and ₹ 63.39 for the organic adopter while ₹ 68.14 and ₹ 30.92 for the non-adopter respectively.

CONCLUSION

The study revealed that the cost of cultivation of rice bean was lower for the organic adopter. The cost on human labour acted as one of the differentiating factors for cost differences between organic adopter and non-adopter. The yield was higher significantly for the organic adopter as compared to the non-adopter. The organic adopter was economically better off and have more resilient capacity for their livelihood indicated by their higher net profit. So far, the inputs usage is concerned there is still scope for increasing the usage of various inputs so as to increase the production and productivity of rice bean in the region. The study pointed out that the organic cultivation was a better option for the farmers in the study area. So, it is recommended that the farmers of other regions or other states within the region should also be encouraged to grow crops organically which will not only enhance their income and livelihood but minimize the environmental degradation due to non-usage of synthetic chemicals. Besides, efforts should be made from the respective state

government in providing proper trainings, awareness or educating the farmers in efficient use of resources so as to enhance the production.

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Competency of Faculty Members in Online Teaching of Agricultural Undergraduates during COVID-19 Pandemic: A study in North-East India

Progati Borah¹ and Loukham Devarani^{2*}

¹P.G Scholar, ²Associate Professor, School of Social Sciences, College of Post Graduate Studies in Agricultural Sciences (Central Agricultural University, Imphal), Umiam-793103, Meghalaya, India

*Corresponding author email id: loukham.d@gmail.com

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ABSTRACT

Quality education is crucial for growth and development of a nation. Teaching learning process worldwide which was disrupted by COVID-19 pandemic has found consolation through online remote teaching. Competency of teachers plays an important role in the success of online teaching. The study was conducted in North Eastern region (NER) of India to assess the faculty members' competency in online teaching of agricultural undergraduates. For the study, all the teachers of institutes in NER imparting undergraduate level degree course in Agriculture were selected. Online questionnaire was sent to all the teachers of which 75 responses were received, which formed the respondents of the study. Five online teaching competency dimensions were considered for the study. The respondents had highest mean competency score in Teaching Ethics and lowest in Content Facilitation. Online teaching competency had significant and positive correlation with online teaching experience; attitude towards online teaching; and organisational facilities & support. The study recommends providing organizational facilities and support in the form of adequate infrastructure and conducting trainings on awareness and usage of e-teaching resources and tools to improve the online teaching competency of the teachers.

INTRODUCTION

The Coronavirus Disease of 2019 (COVID-19) caused by the noble coronavirus, first reported in Wuhan province of China during December 2019 has created a crisis situation worldwide. Challenges posed by this pandemic have introduced all educational institutions to a new world of online learning and online remote teaching. Agricultural Universities in India are also continuing the teaching-learning experiences mostly through online methods. ICAR (Indian Council of Agricultural Research) has been promoting and supporting digital education in AUs (Agricultural Universities), through financial support for creation of infrastructure and capacity building of faculty members. A policy brief authored by Thammi-Raju et al., (2020) highlighted challenges faced by higher agricultural education in India during the pandemic and recommendations for uninterrupted learning

during the pandemic. Building competence of faculty members in digital technology for online teaching, course development & delivery and also on educational psychology to enhance effectiveness of online teaching was one of the recommendations.

Competency is a measurable, individual capability that distinguishes superior, effective accomplishment of a designated function according to a performance definition by an organization for its people; an interactive and complex combination of integrated attitudes, skills, knowledge and ability; behaviours and strategies; traits, motives, thought patterns, self-concepts, values and social roles (Cross, 2010). Teacher's competence in online teaching effects students' interest, motivation, engagement which is directly related to successful learning. Online teachers need to take on a multi-dimensional role and are required to possess a varied and wider

range of competencies (Bawane & Spector, 2014). As online teaching is still new to teachers and students, it is practically impossible for every faculty member to become an expert in online teaching. In context of agricultural education, such competencies are not delineated properly. Identification and assessment of competencies is the starting point for any capacity development intervention. The challenges of this sudden shift to online-teaching are immense and more so in the context of the remote North East Region of India (NER) which was already having many challenges related to higher education and ICT related infrastructure. Imparting undergraduate degree course in agriculture through online mode has its own specific challenges and needs in terms of number of students to handle, courses requiring laboratory and field works, collaborative learning among students etc. The study was taken up to assess the perceived online-teaching competency of faculty members in agricultural institutes of the region.

METHODOLOGY

1. Assam Agricultural University, Jorhat	<ul style="list-style-type: none"> o College of Agriculture, Jorhat o Biswanath College of Agriculture, Biswanath Chariali o Sarat Chandra Sinha College of Agriculture (SCSCA), Dhuburi
2. Central Agricultural University, Imphal	<ul style="list-style-type: none"> o College of Agriculture, Iroishemba, Manipur o College of Agriculture, Pasighat, Arunachal Pradesh o College of Agriculture, Kyrdemkulai, Meghalaya
3. Nagaland University, Zunheboto	<ul style="list-style-type: none"> o School of Agricultural Sciences & Rural Development (SASRD), Medziphema
4. Tripura University, Agartala	<ul style="list-style-type: none"> o College of Agriculture, Agartala
5. Private institutes	<ul style="list-style-type: none"> o Apex Professional University, Arunachal Pradesh o Pandit Deen Dayal Upadhyay Institute of Agricultural Sciences, Manipur o Arunachal University of Studies, Arunachal Pradesh

All the institutes of North East India including the private colleges offering B.Sc. (Agri) degree course form the sampling frame of the study. The institutes are:

Complete enumeration of all the faculty members involved in teaching on a regular or contractual basis was selected as respondents of the study. A list of all the faculty members of the colleges and teachers/ scientist from other colleges/ stations engaged in teaching students of the selected colleges, were made. E-mail addresses of the teachers were procured through the institute websites and other key sources.

Online teaching competency was measured by using a well constructed valid and reliable Likert type scale developed for the study (Borah, 2021). The scale consists of 23 competency items across 5 competency dimensions viz.; Technological; Teaching Facilitation; Teaching Ethics; Session Management and Content Facilitation. Respondents were to rate the competency items on a five (5) point continuum (1=Very Low, 2=Low, 3=Moderate, 4=High and 5=Very High) on the basis of their perceived

competency level in the particular item. Online teaching competency score of a respondent was computed as the sum of his/her competency score in all the competency items. Eleven (11) independent variables which were hypothesized to affect the online teaching competency were selected for the study.

The well constructed pre-tested online questionnaire (Google form) was used for data collection. The online questionnaire was sent to a total of 252 teachers. Within a span of 30 days, responses were received from 75 teachers. These 75 teachers were the final respondents of the study.

RESULTS AND DISCUSSION

More than half of the respondents (58.67%) were aged below 35 years, 29.33 per cent were aged between 35-50 years and remaining 9.00 per cent above 50 years. Responses were received from the younger faculty members who were more at ease with use of online questionnaires. Of the older lot, only few responded. This is also reflected in the fact that the mean age of the respondents was only 39.77 years. Osika et al., (2009) highlighted that senior or older academic members may lack the necessary knowledge or skills to use technology. For elderly or tenured faculty, this creates competency difficulties. The male female ratio of the respondents was 2:1. Nearly half of the respondents (46.67%) were of Assistant Professor or equivalent rank, 28.00 per cent were of Associate Professor or equivalent rank and 25.33 per cent were of Professor or equivalent rank. Majority (58.67 %) of respondents were from Central Agricultural University, Imphal followed by Assam Agricultural University, Jorhat (14.67%). Broad discipline wise distribution of the respondents was as: Social Sciences (24.00%); Horticulture (21.33%); Natural Resource Management (20.00%); Plant Protection (12.00%); Crop Improvement (12.00%) and remaining from basic sciences and other disciplines. The average teaching experience of the respondents was 8.21 years with a range of 2-31 years. Most of the respondents had no experience in online teaching prior to the pandemic so online teaching experience ranged from 2-17 months.

More than half of the respondents had medium level of attitude towards online teaching (64.00%); medium level of awareness and usage of e-teaching resources and tools (65.33%) and medium level of usage of media mix (61.33%). 60.00 per cent respondents stated that received technical assistance only sometimes and 16.00 per cent respondents stated that they never got access to technical support. Around two-third of the respondents (66.07%) expressed receiving medium level of facilities and support from their organisations in regard to online teaching.

Online-teaching competency

The descriptive analysis of the item-wise and dimension-wise online teaching competency scores are provided in Table 1. The results are discussed according to the competency dimensions.

Technological competency refers to a teacher's awareness, efficient utilisation and manipulation of technological tools and equipments (both hardware and software) needed for online teaching. Basic technological competency is pre-requisite for online teaching. Albrahim (2020), Faloon (2020) & Aydin (2005) also stated about technological competence as an important prerequisite for online

Table 1. Mean Competency score of the respondents

S.No.	Competency items	Item-wise mean score	Dimension-wise mean score	Dimension-wise rank score
<i>A Technological Competency</i>				
1.	I have the basic knowledge and skill in handling MS office, search engines, e-mails etc.	4.61	4.26	II
2.	I have skills in using online teaching platforms.	4.40		
3.	I explore and utilize the features of different online teaching platforms.	4.12		
4.	I choose and adapt technology to suit the learners' needs and ability.	4.06		
5.	I use multimedia (pictures, graphics, videos, audios etc) for enhancing my teaching.	4.26		
6.	I use different mix-media strategies (combination of different communication channels like email, WhatsApp, Google meet, YouTube) for maximum reach and impact.	4.36		
7.	I can easily conduct online exam for students (evaluation in the form of online quizzes, online interviews etc.) by using different online platforms.	4.01		
<i>B Teaching Facilitation</i>				
1.	I ensure two way communication and effective interpersonal interaction during online session/ offline sessions.	4.25	4.04	IV
2.	I have the ability to organize and facilitate students' participation in class.	4.20		
3.	I promote one-on-one conversations among students, as well as group/ class discussion.	4.05		
4.	I use different communication methods to ensure my accessibility to my students, & the students with their peers whenever needed.	3.82		
5.	I show sensitivity and empathy when communicating online/	4.16		
6.	I facilitate both asynchronous and synchronous online learning environments.	3.81		
<i>C Teaching Ethics</i>				
1.	I have the desire to teach well, to help facilitate student learn, to be very engaged, and dedicated to students and mission of the institution.	4.61	4.69	I
2.	I consciously try to be fair and unbiased to all students during teaching and evaluation.	4.72		
3.	I respect the cultural differences of students.	4.74		
<i>D Session Management</i>				
1.	I try to solicit & look for students' feedback.	4.18	4.21	III
2.	I provide clear, detailed feedback on assignments & exams that enhances the learning experience.	4.18		
3.	I have the ability to manage the session time and apply time-saving techniques.	4.24		
4.	I design and implement appropriate lesson plans for online teaching.	4.24		
<i>E Content Facilitation</i>				
1.	I provide additional resources that encourage students to go deeper into the content of the course.	4.06	3.86	V
2.	I give assignment to students to engage them in online learning.	4.28		
3.	I encourage students to try simple DIY experiments which can be done at home.	3.26		

teaching. Technological competencies includes ability to use different teaching platform, use of mix media strategies, knowledge in handling MS office, search engines, ability to solve basic technical problems etc. This dimension was ranked 2nd in terms of the mean competency score. There were seven competency items in this dimension and the range of the mean scores was 4.01 to 4.61.

As a facilitator a teacher makes learning the subject matter easy, effective and interesting by adopting different pedagogical methodologies for communication, motivation, attracting attention, fostering active participation, collaboration and learning evaluation. Albrahim (2020); Martin et al., (2019) and Bawane & Spector (2014) reported the importance of facilitating role of an online teacher. Teaching facilitation competencies include the ability to promote learning in an online setting by encouraging and supporting student involvement and interactive online teaching activities. This dimension had the second lowest (4.04) mean score among all the competency dimensions. This dimension has 6 competency items whose mean scores ranged from 4.25 to 3.81. Gupta & Sharma (2020) mentioned teacher's inability to check on each and every student, lack of transparency in conducting online examination and limited assessment and feedback as weaknesses of online teaching.

Ethics are vital for education system. The four primary values at the heart of education are dignity, truthfulness, fairness, and

responsibility and freedom (OAJ, 2021). Faloon (2020) mentioned about personal ethics in which include teaching and assisting students to use online resources in ethical way. Of the 5 competency dimension highest mean score was obtained for teaching ethics (4.69). There were three teaching ethics competency items with mean score range of 4.74 to 4.61.

Session management includes all the functions starting from planning of the session, organizing lessons, enroll learner, asking feedback, ability to manage time, design and implementation of lesson plan, setting classroom rules etc. Guash et al., (2010) and Klein et al., (2004) mentioned importance of management of environment and technology as a competency. There were 4 items under session management competency and as a dimension it ranked 3rd in terms of mean competency score. The competency score of the respondents for the items under session management varies from 4.24 to 4.18.

Content Facilitation is concerned with the ability of the teacher to facilitate content learning through utilisation of various available resources and ingenious techniques that students can employ at their home setting. Goodyear et al., (2001) and Berge (1995) mentioned about content facilitation role in online teaching. This dimension received the lowest mean competency score (3.86). There was three competency items under this dimension and the mean score ranged from 4.28 to 3.26. In a study conducted by Bhati et al., (2020), it

Table 2. Distribution of the respondents according to their online teaching competency (n=75)

Category	Dimensions					Overall competency
	Technological competency	Teaching facilitation	Teaching ethics	Session management	Content facilitation	
Lower quartile (Q ₁) (Low competency)	22(29.33)	23(30.66)	21(28.00)	37(49.33)	20(26.67)	21(28.00)
Inter quartile (Q ₂) (Medium competency)	37(49.33)	48(64.00)	10(13.33)	18(24.00)	27(36.00)	34(45.33)
Upper quartile (Q ₃) (High competency)	16(21.33)	24(32.00)	44(58.66)	20(26.67)	28(37.33)	20(26.67)

*Figure in parenthesis indicate percentage to the total number of respondents
Distribution of respondents according to their competency score

was reported that only one third of respondents were now aware of UGC's e-library (38%) and MOOC (36%) platforms for where e-teaching and learning contents are freely available.

The respondents were categorized according to the quartile deviation of their competency score into three categories as low, medium and high competency. The distribution of the respondents is presented in the Table 2. For technological competency and teaching facilitation competency, majority of the respondents (49.33% and 64.00%, respectively) belonged to medium competency category. In case of Teaching Ethics, more than half of the respondents (58.67%) had high competency score. 49.33 per cent respondents belonged to low competency category in Session Management dimension. There was a more or less equally distribution of respondents in medium (36.00%) and high (37.33%) competency category in Content Facilitation dimension. When the overall competency score was considered, of most of the respondents (45.33%) belonged to medium competency category.

Relationship of online teaching competency with independent variables

Spearman Rank-Order Correlation was employed since some of the variables were not normally distributed and few were in ordinal level of measurement. Results of the test are presented in Table 3. The competency score of the respondents was positively and significantly correlated with online teaching experience; attitude towards online teaching and organisational facilities & support at 0.05 level of significance. Osika (2006) emphasized the importance of support of the entire institution in successful technology programme. The influence of online teaching experience on attitude towards technology and in turn, to effective teaching was described by Osika et al., (2009). The independent variables age; gender; rank; teaching experience; awareness and usage of e-teaching resources and tools; and access to technical support were not observed to

Table 3. Relationship of online teaching competency with independent variable(n=75)

Independent variables	r _s value
Age	-0.022
Gender	0.100
Faculty rank	-0.048
Teaching experience of UG courses	0.011
Online teaching experience	0.242*
Attitude towards online teaching	0.267*
Awareness and usage of e-teaching resources and tools	0.190
Access to technical support	0.014
Organisational facilities and support	0.260*

*Significant at the 0.05 level

have significant relation with competency. This contradicts the report of Osika et al., (2009) and Spotts (1997) that there may be variation in technology use competency according to age and gender respectively. The non-significant correlation with age may however be due to low response from older faculty members due to inability to respond the online questionnaire which is also a technological challenge. A positive relationship between technical assistance and the quality of e-learning in higher education was reported by Elumalai et al., (2021).

CONCLUSION

Online teaching requires competencies distinct from conventional teaching and most teachers are ill-equipped with the sudden shift amid the COVID-19 pandemic. The study assessed the online teaching competencies possessed by faculty members in NER in teaching agricultural undergraduates. It is encouraging to find most of the faculty members were found to have medium level of competency in online teaching. However, generalisation of the results for the entire North-Eastern region would be faulty because response percentage was low and most of the respondents were younger faculty members. Responses from the older faculty members were limited. Moreover, the respondents' competency level was based on self-evaluation and hence may not accurately reflect actual competency. However, it can be recommended that providing organizational facilities and support in the form of adequate infrastructure and conducting trainings on awareness and usage of e-teaching resources and tools will enhance the online teaching competency of the faculty members.

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Adoption Behaviour of Sericulture Farmers Regarding Improved Technologies of Jorhat District of Assam

Dipankar Hatibaruah^{1*}, Lohit Chandra Dutta², Sajib Borua³ and Hemanta Saikia⁴

¹M.Sc. (Agri.) Student, ²Professor and Head, Department of Sericulture, ³Assistant Professor (SG), Extension of Education Institute, ⁴Assistant Professor, College of Sericulture, Assam Agricultural University, Jorhat-785013, Assam, India

*Corresponding author email id: dipankarhatibaruah39@gmail.com

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ABSTRACT

The research study was undertaken in the purposively selected Jorhat and Majuli (undivided) districts of Assam during the year 2018-19 with an objective to analyze the adoption behaviour of sericulture farmers regarding improved technologies and their socio-economic relationship with the adoption behaviour for enhancement of production and productivity at farmers level. Sericulture has been practiced traditionally and a large portion of rural people earn their livelihood from sericulture sector in this region. The present findings revealed that adoption of improved sericulture technologies was in medium category for majority of the respondents 76.67 per cent in eri culture, 66.67 per cent in muga culture and 76.67 per cent in mulberry culture. Due to lack of awareness of improved sericulture technologies as well as poor living conditions the adoption level of sericulture technologies among the seri farmers of Jorhat district was very low. There was gap in dissemination and adoption of improved sericulture technologies in pre and post cocoon sector for growth and development of sericulture in acreage of food plants, rearing of silkworm and production and productivity of cocoon and silk. Hence, the study recommends that adoption of scientific technologies among the seri farmers has significant impact on growth and development of sericulture as well as economic benefit of the farmer.

INTRODUCTION

Sericulture is an agro-based industry and one of the prominent enterprise and it involves a series of on-farm, off-farm and industrial activities. Sericulture plays an important role in the development of rural community both economically and socially. It is an excellent household activity which brings consequential change both in social and economic condition of the rural and semi-urban areas by adopting all the necessary improved sericulture technologies (Priyadarshini and Kumari, 2013). Proper adoption of improved sericultural technologies by the farmers is vital for obtaining higher yield. The potential of sericulture remains unexplored due to problems in conventional production practices (Jayaram and Indumati, 2010). The success of any technology largely depends on its effective adoption and utilization in the field. A wide gap

exists between the recommended sericultural technologies and their adoption by the farmers. To fill this gap and plan for suitable intervention strategy, it is necessary to understand farmers' knowledge and adoption level for improved technologies.

Sericulture is predominantly practiced in North East India by small and marginal farmers. Assam enjoys a unique distinction by producing all the four commercial natural silks *viz.*, muga, eri, mulberry and tasar. The raw silk production in Assam during the year 2016-17 was 3811 MT which accounted for 12.55% of the country's total raw silk production (Anon., 2016-17). The Jorhat district of Assam plays a major role in silk production. Sericulture has been practiced traditionally in the district and a large portion of rural people earn their livelihood from the sericulture sector. Presently, the sericulture is practiced in about 492 seri-villages of the district covering an area of 638 hectare under silkworm food

plants cultivation with engagement of nearly 10 thousand families in various sericultural activities. The district produced 84.81MT raw silk during the year 2016-17 which include 82.24 MT eri raw silk, 0.29 MT muga raw silk and 2.28 MT mulberry raw silk (Anon., 2017). Majuli, the largest inhabited river island of the world is located in the Brahmaputra river of Assam. It was a subdivision of the Jorhat district. In 2016 it became the first island to be made a district in India and declared as the 33rd districts of Assam. This area is one of the most prolific sericulture growing area in the regions in which 125 hectares area is under host plantation and about 55,635 families are directly engaged in sericulture sector. Among sericulture farmers 9030 are seri rearers, 7572 are muga rearers and 14,441 are mulberry rearers (Mili, 2019). Despite this, majority of the silkworm rearers are still inclined to follow their traditional practices for silkworm culture and production of silk in Jorhat district. In order to examine the potentiality of increasing adoption of improved sericulture practices an effort was made to assess the adoption behaviour of sericulture farmers towards improved technologies and relationship of socio- economic characteristics with the adoption behaviour in Jorhat district of Assam.

METHODOLOGY

The study was conducted in the purposively selected Jorhat and Majuli (undivided) districts of Assam. The primary data was collected from 120 sericulture farmers following the personal interview method. Three development blocks namely Baghchung (Jorhat), Titabar (Jorhat) and Jengrai (Ujoni Majuli) were selected because sericulture has been traditionally practiced in this region. From each selected development block, two villages and 20 sericulture farmers were selected randomly from each of the villages namely Tamulbari, Pangiria from Jorhat, Kochukhat and Lahong Kachari Gaon from Titabar under Jorhat district, Kumarbari and Chawreikia Gaon from Majuli (undivided) district. The adoption behaviour of silkworm rearers was measured by developing standardized structured interview schedule on the basis of package and practices of eri, muga and mulberry rearing. Two response categories namely 'adoption' and 'non adoption' were given for each of the practices with score 1 and 0 respectively. The respondents were categorized into 3 categories by computing the mean and standard deviation. The three groups were - low adoption level ($< \text{Mean} - \text{SD}$), medium adoption level (between $\text{Mean} \pm \text{SD}$) and high adoption level ($> \text{Mean} + \text{SD}$). In order to assess the extent of relationship between the selected dependent and independent variables correlation coefficient (r) were calculated with the help of Pearson's formula of correlation coefficient.

RESULTS AND DISCUSSIONS

Adoption level of improved sericulture technologies

Data presented in Table 1 revealed that majority 76.67 per cent of the rearers exhibited medium level of adoption of improved eri culture, 66.67 per cent in muga culture and 76.67 per cent in mulberry culture respectively. Sonowal (2016) reported that majority 61.25 per cent of the respondents had medium level of adoption regarding extend of adoption of scientific ericulture practices. Pegu (2018) also reported that majority 69.16 per cent had medium level of adoption while conducting her study on the traditional knowledge and cultural practices of muga silk production in North Lakhimpur district. Reddy et al., (2020) mentioned that 61 per cent of sericulture farmers possessed medium level of adoption of improved mulberry cultivation practices.

Eri culture

It was evident from the Table 2 that majority (58.33%) of the rearers adopted high yielding host plant varieties, integrated pest management practices for collection and destruction of affected plants and shoots (73.33%) and used pest and disease resistant varieties (56.66 %). Rearers adopted improved method of seed production technology for disinfection of grain age house (55.00%), surface sterilization of eggs (33.33%) and use of nylon net bag for oviposition was only (25.00%). Regarding silkworm rearing technology 100 per cent rearers adopted late age rearing, use of traditional spinning machine takli (93.33%), bed cleaning (91.66 %), early stage rearing (88.33%), transportation and marketing of cocoons (75.00%), timely brushing of worms (73.33%), used hybrid variety of eri silkworm for rearing (53.33%), disinfection of the rearing room and appliances (46.67%), separate rearing house (45.00%), use of bed disinfectant (21.67%), improved spinning machine (21.67%), bamboo strip type moutage for cocooning (20.00%) and maintaining optimum requirement of temperature and humidity was only (10.00%). The identical findings were reported by Sonowal (2016). Whereas 41.67 per cent of the rearers adopted crop insurance policy under scheme Assam Agribusiness and Rural Transformation Project (APART). Further rearers adopted various ITK practices like kharika (100%), semi dried banana leaves (88.33%), khar (76.66%), chakori – para (68.33%) and rice straw (63.33%).

Muga culture

It can be observed from Table 3 that majority of the rearers selected their rearing area away from road side (83.33%), prepared

Table 1. Distribution of silkworm rearers based on adoption level of improved technologies

Sericulture technologies	Level of adoption	Percentage (%)	Mean	S.D.
Eri culture (n=60)	Low (<12)	8.33	15.33	3.20
	Medium (In between 12 -18)	76.67		
	High (>18)	15.00		
Muga culture (n=30)	Low (<17)	10.00	20.90	3.49
	Medium (In between 17-24)	66.67		
	High (>24)	23.33		
Mulberry culture (n=30)	Low (<11)	6.66	11.13	3.27
	Medium (In between 11-17)	76.67		
	High (>17)	16.67		

Table 2. Adoption Behaviour of sericulture farmers with respect to improved eri culture technologies n=60

Technologies	Adoption Percentage
<i>Host plant cultivation technologies</i>	
Use of high yielding host plant varieties	58.33
<i>Integrated pest management</i>	
Collection and destruction of affected plants and shoots	73.33
Use of pest and disease resistant varieties	56.66
<i>Use of improved method seed production technology</i>	
Disinfection of grain age house	55.00
Use of nylon net bag for oviposition	25.00
Surface sterilization of egg	33.33
<i>Silkworm rearing technology</i>	
Use of hybrid variety of eri silkworm	53.33
Use of separate rearing house	45.00
Early stage rearing	88.33
Late stage rearing	100.00
Bed cleaning	91.66
Timely Brushing of worms	73.33
Disinfection of the rearing room and appliances	46.67
Use of bed disinfectant	21.67
Use of bamboo strip type moutage for cocooning	20.00
Maintenance of optimum requirement of temperature and humidity	10.00
Transportation and marketing	75.00
Use of improved spinning machine	21.67
Use of traditional spinning machine (takli)	93.33
<i>Crop insurance</i>	
Crop policy	41.67
<i>ITK used</i>	
Chakori – pera	68.33
Kharika	100.00
Semi dried banana leaves	88.33
Rice straw	63.33
Khar	76.66

bamboo fences around their rearing area (73.33%) and classified som leaves according to the shape of leaves (66.66%). Regarding seed cocoon selection and preservation, 100 per cent adopted the practice of preservation of seed cocoon at chokori pera, transportation of seed cocoon at dusk (56.66%) and selected healthy brood by observing behaviors of silkworm (50.00%). On the other hand, it is seen that during copulation of moth, rearers used to hang kharika in jori (63.33%), in chak (36.67%) and used the process of jumuthi (60.00%). In case of rearing of silkworm 100 per cent adopted brushing of kharikas during the morning hours of the day, avoided use of cosmetics, scented products, and cutting nails, etc., during rearing period, used chaloni for transferring the muga larvae from one host plant to another, transferred mature worms to jalties and used khora or bamboo basket for collection of mature worms, spreading banana leaves on the base of the host plants (66.66%), banana pseudo stem as a barrier (66.66%) and banana leaf (53.33%). Regarding disease and pest management practices 100 per cent used batolu guti and dhenu to drive away the birds and predator, sprayed cow dung solution to bordering area of the rearing field (66.66%), dusted ash on and around the base of the tree (63.33%), dusted turmeric powder to protect from red ants(50.00%), hanged kochu twigs on the tree (40.00%), clean water kept in a transparent polythene bag and hang in the trees to protect the worms from uzi fly infestation (26.67%) and plastered the hole with mud in tree

trunk to protect form stem borer infestation (16.67%). During post rearing operation 100 per cent of the rearers adopted both the practice of stifling by keeping the cocoons on a bamboo made tray over the fire smoke in the kitchen (dhowachang) and through sun drying, rearers used dhankhar as a degumming agent during cocoon cooking (93.33%), kolakhar (40.00%), hingori leaves for preparation of jali (73.33%), mango leaves (63.33%) and som leaves (26.67%). It further revealed that 100 per cent used bhir or bhowri for reeling

Table 3. Adoption Behaviour of sericulture farmers with respect to improved muga culture technologies n=30

Technologies	Adoption Percentage
<i>Selection of the rearing area and host plants</i>	
Rearing area away from roadside	83.33
Preparation of bamboo fences around the rearing area	73.33
Classification of som leaves according to the shape of the leaves	66.66
<i>Seed cocoon selection and preservation</i>	
Selection of healthy brood by observing the behaviour of silkworm	50.00
Transportation of seed cocoon at dusk	56.66
Preservation of seed cocoon at chokori pera	100.00
<i>Copulation of moth</i>	
Hanging of kharika-Chak	36.67
Jori	63.33
Using the process called Jumuthi	60.00
<i>Rearing of silkworm</i>	
Brushing of kharikas during morning hours of the day	100.00
Spreading of banana leaves on the base of the host plants	66.66
Avoid use of cosmetics, scented products, cutting of nail, etc. during rearing period	100.00
Barrier tied around the tree trunk by-	
Banana pseudo stem	66.66
Banana leaf	53.33
Use of chaloni for transferring the muga larvae	100.00
Transferring of mature worms to jalties	100.00
Use of bamboo basket (khora) for collection of mature worms	100.00
<i>Disease and pest management</i>	
Dusting of ash on and around trees	63.33
Dusting of turmeric powder around the base of the trees	50.00
Spraying of cow dung solution to boarding area of the field	66.66
Clean water kept in a transparent polythene bag and hang in the tree	26.67
Hanging of kochu twigs on the tree	40.00
The rearers cover the infestation of stem borer hole by plastering with mud on the tree	16.67
Use of pellets (batolu guti) and bow (dhenu) to drive away birds and predators	100.00
<i>Post rearing operation</i>	
Stifling of cocoon-	
Use of dhowachang (smoke stifling)	100.00
Sun drying	100.00
Cocoon cooking-	
Use of Kolakhar	40.00
Use of Dhankhar	93.33
Types of jali for cocooning-	
Hingori	73.33
Mango	63.33
Som	26.67
Reeling Machine-	
Bhir	100.00
Improved Machineries	26.67

of muga cocoons and improved machines (CSR&TI motorized cum pedal operated reeling cum twisting machine) was (26.67%).

Mulberry culture

Table 4 reveals that regarding mulberry cultivation technology 100 per cent of the rearers used vermi-composting, adopted high yielding host plant varieties (63.33%), prepared nursery bed management practices (56.66%), wider spacing (30.00%) and pruning and training (23.34%). Rearers adopted integrated pest management practices for collection and destruction of affected plants and shoots (56.66%) and control of uzifly (26.67%). Findings revealed that in case of improved method of seed production technology, disinfection of grain age house (66.66%), surface sterilization of eggs (43.34%) and used nylon net bag for oviposition (20.00%). Regarding silkworm rearing technology 100 per cent of the rearers adopted late stage rearing practices, timely brushing of worms and cocoon harvesting and brushing, bed cleaning (93.33%), early stage rearing (90%), disinfection of the rearing room and appliances (60.00%), used traditional reeling machine (60.00%), used hybrid variety for rearing (46.67%), transportation and marketing (43.34%), separate rearing house (40.00%), bamboo strip type moutage for cocooning (26.67%) and maintained optimum requirement of temperature and humidity was only (13.34%). Further rearers adopted the ITK practices like rice straw (63.33%) and tea branches

Table 4. Adoption Behaviour of sericulture farmers with respect to improved mulberry culture technologies n=30

Technologies	Adoption Percentage
<i>Mulberry cultivation technology</i>	
Use of high yielding varieties	63.33
Wider spacing	30.00
Recommended fertilizer dose and application followed	0.00
Vermi-composting	100.00
Preparation of nursery bed and management	56.66
Pruning and training	23.34
<i>Integrated pest management</i>	
Use of pesticides	0.00
Collection and destruction of affected plants and shoots	56.66
Use of pest and disease resistant varieties	0.00
Control of Uzifly	26.67
<i>Use of improved method of seed production technology</i>	
Disinfection of grain age house	66.66
Use of nylon net beg for oviposition	20.00
Surface sterilization of eggs	43.34
<i>Silkworm rearing technology</i>	
Use of hybrid variety	46.67
Use of Separate Rearing House	40.00
Early stage rearing	90.00
Late stage rearing	100.00
Bed cleaning	93.33
Brushing of worms	100.00
Disinfection of rearing room and appliances	60.00
Use of bamboo strip type moutage for cocooning	26.67
Maintaining optimum temperature and humidity	13.34
Cocoon harvesting and brushing	100.00
Transportation and marketing	43.34
Traditional machines for reeling	60.00
<i>ITK used</i>	
Use of tea branches	43.34
Rice straw	63.33

(43.34%) as a moutage for cocoon spinning. There was no single mulberry rearers who adopted recommended fertilizer dose and applications, use of pesticides and use of pest and disease resistant varieties. Qadri et al., (2010) reported that majority of the farmers had poor rate adoption of method and quantity of application of fertilizers, manure, recommended varieties, spacing and plant protection measures. It could be observed from the present data that the reason for poor rate of adoption of method and quantity of application of fertilizes, use of pesticides, use of disease and pest resistant varieties attributed lack of knowledge and poor extension contact. It has been reported that lack of knowledge and poor extension contact is the primitive factor for non adoption of improved sericultural technologies (Mir et al., 2018).

Relationship between the adoption behaviour and socio-economic characteristics

It is evident from the Table 5 that out of seven independent variables the variable annual family income ($r = 0.481$) had positive and significant relation with the adoption behaviour of eri silkworm rearers. Age ($r = -0.022$), education ($r = -0.093$) and size of operational land holding ($r = -0.009$) had negative and non significant relation but extension contact ($r = 0.245$), decision making ability ($r = 0.061$) and training exposure ($r = 0.055$) had positive and non-significant relation with the adoption behaviour of eri rearers. Variable annual family income had significant relationship with the composite technological gap in adoption of sericulture practices (Dakhani et al., 2013). Patra et al., (2018) in their study observed annual family income to be significant and positively correlated with adoption behaviour of mandarin growers. Shasani et al., (2020) observed that education level and land holding did not have any significant relations with the level of adoption of groundnut cultivation technology. Results also revealed that out of seven independent variables no single variable had positive and significant relation with the adoption behaviour of muga rearers, whereas size of operational land holding ($r = -0.106$), annual family income ($r = -0.036$) and training exposure ($r = -0.089$) had negative and non significant relation with the adoption behaviour of muga rearers. Age ($r = 0.274$), education ($r = 0.125$), extension contact ($r = 0.046$) and decision making ability ($r = 0.098$) had positive and non significant relation with adoption behaviour. Kumar et al., (2012) found that age, education and extension participation had non-significant relationship with knowledge of sericulturists on organic

Table 5. Correlation between the adoption behaviour with socio-economic characteristics of the silkworm rearers

Variables	Correlation coefficient (r) value		
	Eri rearers (n=60)	Muga rearers (n=30)	Mulberry rearers (n=30)
Age	-0.022 ^{NS}	0.274 ^{NS}	-0.171 ^{NS}
Education	-0.093 ^{NS}	0.125 ^{NS}	-0.392*
Size of operational land holding	-0.009 ^{NS}	-0.106 ^{NS}	-0.195 ^{NS}
Annual family income	0.481*	-0.036 ^{NS}	-0.058 ^{NS}
Extension contact	0.245 ^{NS}	0.046 ^{NS}	0.038 ^{NS}
Decision making ability	0.061 ^{NS}	0.098 ^{NS}	-0.389*
Training exposure	0.055 ^{NS}	-0.089 ^{NS}	0.033 ^{NS}

*Significance at 0.05 level of probability NS –Non-Significant

farming practices. The variable education ($r = -0.392$) and decision making ability ($r = -0.389$) had negative but significant relation with the adoption behaviour of mulberry rearers. Age ($r = -0.171$), annual family income ($r = -0.058$) and size of operational land holding ($r = -0.195$) had negative and non significant whereas extension contact ($r = 0.038$) and training exposure ($r = 0.033$) had positive and non significant relation with adoption behaviour of mulberry rearers. Mishra et al., (2020) reported that variable education was found to be significant with adoption of improved apiculture practices in Arunachal Pradesh. Shasani et al., (2020) also revealed that education level had a significant relation with the level of adoption of the scientific practices of composite carp culture technology.

CONCLUSION

The present findings indicated that sericulture in this region is regarded as a very limited and traditional technology which is adopted by the farmers and still remain as a backward venture. It facilitated in accessing various training needs of farmers to enhance their qualities and characteristics for promotion of sericulture in selected region. Several improved technologies, in pre and post cocoon sector have been developed by the various research organizations for increasing production and productivity of silk. The Department of Sericulture, Govt. of Assam has created sufficient infrastructure for sericulture development with state fund and also financial support from Govt. of India is available through Central Silk Board. Further loans, grants, subsidies and other inputs are generously distributed to the rearers through various developmental schemes. Effective extension intervention may aid the process of intensification for full scale commercialization of silk production by facilitating adoption of recommended package of practices Hence, in order to extend the adoption rate in these areas, action plan needs to be taken by the extension personnel by identifying the progressive rearers and train them in the use of improved technologies, which will go in a long way in enhancing income of sericulture farmers.

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Appraisal of Cluster Front Line Demonstration on Rapeseed and Mustard in Bihar and Jharkhand

Anjani Kumar¹, Amrendra Kumar^{2*}, Sudeepa Kumari Jha³ and Sumit Kumar Singh³

¹Director, ²Principal Scientist, ³SRF, ICAR-Agricultural Technology Application Research Institute (ATARI), Zone-IV, Patna-801506, Bihar, India

*Corresponding author email id: amrendra14d@gmail.com

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ABSTRACT

Performance of ten varieties of rapeseed and mustard were assessed through cluster front line demonstration (CFLD) under different agro-climatic condition of Bihar and Jharkhand continuously for four years (2017-18 to 2020-21) by the KVKs of Bihar and Jharkhand. Among the agro-climatic zones of Bihar, highest yield was recorded in the demonstrated plot from zone III (B) i.e. South-West alluvial plain in case of variety RH 0749 (15.29 q/ha) and in Jharkhand state from zone I (Central and North eastern plateau) with variety NRCHB 101 (13.31 q/ha). Lowest technology index was observed for variety Rajendra Sufalam in all the zone (-4.96, 5.53, 7.18 and 22.92 % in zone I, III (B), III (A) & II) of Bihar and NRCHB 101 (23.15% in zone I) in Jharkhand. The range of extension gap was 1.38 to 4.37 and 1.13 to 4.86 q/ha under the agro-climatic zone of Bihar and Jharkhand, respectively. Pooled data shows that in Bihar, maximum net return (Rs. 46986 /ha) was obtained in variety Rajendra Sufalam in agro-climatic zone III A of Bihar with benefit cost ratio 3.85:1 whereas under agro-climatic condition of Jharkhand maximum net return (Rs. 39598 /ha) was recorded from variety NRCHB 101 with benefit cost ratio 2.80:1.

INTRODUCTION

Rapeseed and mustard is one of the important sources of edible oil in India, Canada, China, Australia and European Union and other countries. The main reason of its popularity is its availability and cultivation in irrigated as well as rain-fed condition as a sole crop or mixed crop and simultaneously, it offers high net return with low cost of cultivation. It contains 37 to 49 per cent oil. After extraction of oil its cake is used as protein rich feed of cattle and in decomposed form as farm manure. The crushed seed and oil are also used as condiment in the preparation of pickles, vegetables, hair oils, medicines and in industry as lubricants. The tender leaves mustard is used as green vegetables. Green stem and leaves are a good source of green fodder for cattle during winter. India holds fourth ranks in area and production of rapeseed and mustard and accounts 17.19 per cent of global area but only 8.54 per cent contribution in production. In India after soybean, rapeseed and

mustard are leading oilseed crop with 23.33 per cent share in area and 26.24 per cent in production (DRMR). In the rainfed area of the country it is a major source of income especially for small and marginal farmers (Sangwan et al., 2021). Rapeseed and mustard was cultivated on only 0.08 mha area in Bihar with production 0.10 mt which covers only 1.32 and 1.17 per cent of total area and production of India. Relatively Jharkhand has more area (0.31 mha) and production (0.22 mt) than Bihar and it contributes 5.10 and 2.59 per cent in national area and production but average productivity of Bihar (12.45 q/ha) was higher than Jharkhand (7.15 q/ha) (DAC & FW). Unavailability of critical inputs particularly high yielding variety and lack of scientific cultivation practices are the possible reasons for lower productivity (Ranawat et al., 2011; Rai et al., 2016). Katare et al., (2011) stated that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity. But available agricultural technology does not show fruitful reaches

and not adopted by the farmers in mass level. Cluster front line demonstration (CFLD) is a novel approach to provide a direct interface between researcher and farmer for the transfer of technologies developed by scientist/ researcher and to get direct feedback from farming community from large cluster. Keeping this in view the present study was undertaken to know the effect of demonstrations on farmer's field under different agro-climatic conditions of Bihar & Jharkhand along with critical inputs provided.

METHODOLOGY

The study involves the data from 2017-18 to 2020-21 from the jurisdiction of ATARI, Patna (Bihar and Jharkhand) regarding CFLDs on mustard. From each cluster ten hectare of farm lands were selected and twenty-five farmers for the demonstration. During the four years total 11212 demonstrations were conducted at farmer's field covering 4509.5 ha land with ten varieties and bunch of technological inputs including specific package of practices recommended by the agricultural university or research station for that agro-climatic zone. Three varieties of Indian mustard (*Brassica juncea*) viz; Rajendra Sufalam, RH 0749 and RGN 48, one variety of toria (*Brassica rapa* var. Toria) viz; Uttara and one variety of yellow sarson (*B. rapa* var. yellow sarson) viz; NRCYS 05-02 were demonstrated in different agro-climatic zones of Bihar. Rajendra Sufalam was studied in all the agro-climatic zone whereas variety RH 0749 in north and south alluvial plain (zone I and III B), RGN 48 in south east and south west alluvial plain (zone III A and III B), Uttara in north east alluvial plain (zone II) and NRCYS 05-02 in south west alluvial plain (zone III B) with 4740, 1763, 1253, 153 and 300 demonstrations, respectively. Total five varieties of Indian mustard appraised under the agro-climatic situation of Jharkhand. Pusa mustard 30 was studied under all the three zone with 1483 demonstration whereas Pusa mustard 26 studied in central and north eastern plateau and western plateau (zone I and II) with 601 demonstrations. Pusa mustard 28 and NRCHB 101 were studied in in central & north eastern plateau (zone I) with 618 and 154 demonstrations whereas Pusa mustard 27 in south eastern plateau (zone III) with 412 demonstrations. The critical inputs required for demonstration were provided by the KVKs under project on cluster front line demonstration (CFLD) and concerned subject matter specialist regularly monitored the demonstrated plot and recorded the data periodically. Before organizing of CFLD baseline information regarding package of practice of rapeseed and mustard cultivation adopted by the farmers were collected by the KVKs as suggested by Choudhary (1999). The farmer's field maintained by the farmers according to their own practices and considered as control plot. Immediately after harvesting of crop yield data were recorded from both demonstration plot and farmer's field and extension gap, technology gap and technology index were worked out as suggested by Samui et al., (2000) along with per cent increase over control to assess the impact of cluster front line demonstration on yield. Economic analysis was based on the value of crops and required inputs in local market. Benefit cost ratio of demonstration and farmer's plot were calculated to check the economic viability of demonstration.

RESULTS AND DISCUSSION

Positive effect of critical input and technology intervention on the demonstration plot and farmer's field in terms of grain yield

were recorded and related data viz; technology gap, extension gap, per cent increase over control and technology index were calculated and presented in Table 1. Result revealed that average yield in demonstration ranged from 7.48 to 15.29 and 7.58 to 12.64 q/ha under different agro-climatic zone of Bihar and Jharkhand respectively whereas the respective farmer's field yield was 5.89 to 11.86 and 4.70 to 8.73 q/ha.

Demonstration yield of varieties

Data presented in Table 1 indicate that highest demonstration yield was recorded from var. RH 0749 (15.29) in south west alluvial plain (zone III B) and followed by the same var. in north alluvial plain (zone I) i.e. 14.80 q/ha under agro-climatic condition of Bihar. Among ten demonstrated varieties only variety Rajendra Sufalam had shown higher demonstration yield (13.75 q/ha) which was higher than the potential yield (13.10 q/ha) in zone I (Bihar). In zone III of Bihar demonstration yield (12.16 & 12.38 q/ha in III A & III B) were nearer to potential yield. Lower demonstration yield (10.10 q/ha) in comparison to potential yield was recorded in var. Rajendra Sufalam under north east alluvial plain (zone II) of Bihar. Differences in demonstration yield of the same variety in different agro-ecological zones may be due to variation in soil health and other climatic conditions. These findings are in accordance with the finding of Khavse et al., (2014) who also found variation in yield of mustard at three different location of Chhattisgarh. Indian mustard var. RGN 48 almost performed equally in terms of demonstration yield (13.42 and 13.56 q/ha) in south alluvial plain of Bihar. Yield of yellow mustard var. NRCYS 05-02 (12.79 q/ha) was almost parallel with yield of Indian mustard var. Rajendra Sufalam and RGN 48 under demonstration in the zone III (B) but little lesser than the demonstration yield of var. RH 0749 of that zone. Toria var. Uttara had demonstration yield (7.48 q/ha) in north east alluvial plain and was poorest performed variety. Under the agro-climatic condition of Jharkhand state maximum demonstration yield (13.31 q/ha) was recorded in var. NRCHB 101 under central and north eastern plateau (zone I) followed by variety. Pusa mustard 28 (12.64 q/ha). Variety Pusa mustard 30 (12.01 q/ha) had shown better performance in zone I than other zones followed by Pusa mustard 26. Yield enhancement in CFLD was also reported by many workers in different crops (Hiremath et al., 2007; Dhaka et al., 2015).

Technology gap

Technology gap refers to difference between potential yield and demonstration yield. Under the different agro-ecological condition of Bihar variety Rajendra Sufalam had least technology gap in comparison to other demonstrated variety. Among the comparison of zones, the negative technology gap (-0.65 q/ha) was obtained in north alluvial plain and least technology gap was in south alluvial plain (0.73 & 0.94 from zone III B & III A) and maximum gap was in north east alluvial plain in Bihar state. This indicates that the agro-climatic condition of north and south alluvial plain (zone I and III) are most congenial condition to perform the var. Rajendra Sufalam at par or even better than its potential yield. Though the variety RH 0749 performed better than the other variety but its potential yield could not be achieved. Similar trend

Table 1. Effect of demonstration on grain yield and gap analysis

State	Agroclimatic Zone	Variety and year of release	KVKS	Area (ha)	No. of Demonstration	Yield (q/ha)		Farmer's field	Technology gap (q/ha)	Extension gap (q/ha)	% increase over control	Technology index (%)	
						Potential	Demonstration						
Bihar	I	Rajendra Sufalam (2007)	Darbhanga (4)*, E. Champaran (3), Muzaffarpur (4), Muzaffarpur II (2), Samastipur (4), Shehoar (3), Saran (3), Madhubani (2), Siwan (2), W. Champaran (2), Gopalganj (2), Begusarai (2), Vaishali (2)	1320	3230	13.10	13.75(9.25-21.37)**	10.42	-0.65	3.33	31.94	-4.96	
				130	295	34.00	14.80 (14.35-15.20)	11.73	19.20	3.07	26.14	56.47	
	II	Rajendra Sufalam (2007)	Araria (3), Saharsa (4), Supaul (3), Madhepura (2), Kishanganj (2)	430	1079	13.10	10.10 (7.63-13.83)	7.64	3.00	2.46	32.17	22.92	
				60	153	20.00	7.48 (6.85-8.12)	5.89	12.52	1.59	27.04	62.59	
	III (A)	Rajendra Sufalam(2007)	Banka (3), Bhagalpur (4), Lakhaisarai (3), Sheikhpura (2)	320	669	26.39	13.42 (8.65-19.30)	10.57	12.97	2.85	26.95	49.13	
				130	330	13.10	12.16 (11.00-14.01)	8.58	0.94	3.58	41.72	7.18	
	III (B)	Rajendra Sufalam(2007)	Kaimur (3), Rohtas (2), Nawada (2), Buxar (2), Bhojpur (2)	580	1468	34.00	15.29 (12.59-18.15)	10.93	18.71	4.37	39.95	55.03	
				230	584	26.39	13.56 (8.66-16.70)	11.86	12.83	1.70	14.37	48.61	
	Jharkhand	I	Rajendra Sufalam (2007)	Patna (4), Arwal (2), Nalanda (4), Jehanabad (2)	110	300	24.03	12.79 (9.99-14.25)	9.67	11.24	3.12	32.24	46.77
					40	101	13.10	12.38 (12.00-12.75)	11.00	0.73	1.38	12.50	5.53
I		Pusa Mustard 30 (2013)	Chatra (4), Ranchi (3), Sahibganj (2)	340	850	31.25	12.01 (6.15-15.06)	7.94	19.24	4.07	51.27	61.57	
				232.5	618	30.03	12.64 (10.40-15.70)	8.73	17.39	3.92	44.91	57.90	
II		Pusa Mustard 26 (2010)	Dhanbad (3), Bokaro (2)	200	520	23.53	8.79 (7.80-9.60)	5.70	14.74	3.09	54.21	62.64	
				50	154	17.32	13.31 (10.00-16.62)	8.46	4.01	4.86	57.42	23.15	
III		Pusa Mustard 27 (2010)	Lohardaga (2), Latehar (2)	80	221	31.25	9.70 (7.66-12.50)	6.80	21.55	2.90	42.68	68.95	
				30	81	23.53	7.88 (7.50-8.25)	6.75	15.66	1.13	16.67	66.53	
III		Pusa Mustard 30 (2010)	Latehar (2)	52	147	22.38	7.58 (4.38-9.50)	4.70	14.81	2.88	61.17	66.15	
				175	412	31.25	10.0 (6.15-12.80)	6.93	21.25	3.08	44.48	67.98	
Total				4509.5	11212								

O *: number of year for during which demonstration conducted by the respective KVK O **: range of yield

Agro-climatic zone of Bihar
 I : North alluvial plain
 II : North east alluvial plain
 III (A) : South east alluvial plain
 III (B) : South west alluvial plain
 Agro-climatic zone of Jharkhand
 I : Central and north eastern plateau
 II : Western plateau
 III : South eastern plateau

in case of variety RGN 48 was also observed. For the state of Jharkhand minimum technology gap was recorded in variety NRCHB 101 (4.01 q/ha) under central and south eastern plateau. Higher value of technology gaps indicates that there exists wide scopes to improve demonstration yield through improvement in technology intervention. These finding are in partial agreement with the finding of Chaudhary et al., (2018); Sangwan et al., (2021).

Extension gap

Extensions gap is the difference between yield of demonstration plot and yield under existing farmer's practice and it can be reduced with the help of different extension activities like cluster demonstration, training awareness programmes, *kisan gosthis* etc. For the state of Bihar among the demonstrated variety least extension gap was found in var Rajendra Sufalam (south west alluvial plain) followed by variety Uttara (north east alluvial plain) and RGN 48 (south west alluvial plain) with corresponding values 1.38, 1.59 and 1.70 q/ha, respectively. Under the agro- ecological condition of Jharkhand relatively less extension gap was recorded from western plateau region (zone II). The variety Pusa mustard 30 had more extension gap than other variety in the entire agro-ecological zone. Lower value of extension gap indicates that farmers of that area are aware about the scientific technology of cultivation and took benefits from the activities of KVKs regularly.

Per cent increase among the five different varieties of rapeseed and mustard demonstrated under agro-climatic zone of Bihar the *per cent* increase over control ranged from 12.50 to 41.72. The maximum increase over control was recoded from variety Rajendra Sufalam in south east alluvial plain (41.72%) followed by var. RH 0749 in south west alluvial plain (39.95%). Relatively per cent increase over control was higher for the agro-climatic zone of Jharkhand than Bihar which may be due to poor performance of farmer's choice varieties and it ranged 16.67 (PM 26 in zone II) to

61.17 (PM 27 in zone III). Similar type of the findings was obtained by Kumar et al., (2010); Jha et al., (2020).

Technology index

Technology index referred to the ratio between technology gap and potential yield and expressed in terms of per cent. The lower value of technology index shows the efficacy of better performance of technological interventions. In all the agro-climatic region of Bihar variety Rajendra Sufalam had lowest technology index in comparison to other demonstrated varieties of that zone. It was negative in north alluvial plain (-4.96) and lower in south west alluvial plain (5.53%). It shows the feasibility and performance of the demonstrated technology at the farmers' field. In other variety yellow sarson var. NRCYS 101 got most acceptability of the demonstration at farmer's field. Under the agro-climatic condition of Jharkhand lowest technology index was recorded in var. NRCHB 101 (23.15%) and followed by Pusa mustard 28 (57.90%) in zone I. These results are in line with the results of Sangwan et al., (2021).

Economic analysis

Economic analysis of the demonstrated plot and farmer's field in terms of gross cost, gross return, net return and benefit cost ratio are depicted in Table 2. The data revealed that among all the agro-ecological zone of Bihar highest net return (Rs. 46986 /ha) was recorded from Indian mustard var. Rajendra Sufalam demonstrated in south east alluvial plain (zone III A) followed by yellow sarson var. NRCYS 05-02 with Rs. 45288/ha. The benefit cost ratio also followed almost similar trends with maximum benefit cost ratio in Rajendra Sufalam (3.85:1) from zone III (A) followed by NRCYS 05-02 (3.32:1). This finding is supported by the finding of Kalita et al., (2019), Singh and Kumar (2012); Saravanakumar (2018). Among the agro-climatic zone of Jharkhand maximum benefit from demonstrated plot was obtained from var. NRCHB 101 with net income of Rs.

Table 2. Economic analysis of demonstration and farmer's plot

State	Agro-climatic zone	Variety	Demonstration plot				Farmer's field			
			Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C	Gross cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C
Bihar	I	Rajendra Sufalam	21351	56079	34728	2.63	19139	39651	20511	2.07
		RH 0749	23267	61525	38258	2.64	21250	48775	27525	2.30
	II	Rajendra Sufalam	20307	48816	28509	2.40	18679	35883	17203	1.92
		Uttara	12632	28149	15517	2.23	11406	20877	9471	1.83
	III (A)	RGN 48	29527	64144	34617	2.17	29034	50444	21411	1.74
		Rajendra Sufalam	16496	63482	46986	3.85	15260	40750	25490	2.67
	III (B)	RH 0749	22731	65359	42628	2.88	20031	44650	24619	2.23
		RGN 48	25021	48539	23518	1.94	24252	40244	15993	1.66
		NRCYS 05-02	19504	64792	45288	3.32	17831	42098	24267	2.36
		Rajendra Sufalam	19806	49681	29875	2.51	18773	41173	22400	2.19
Jharkhand	I	Pusa Mustard 30	21387	48740	27353	2.28	18035	32281	14245	1.79
		Pusa Mustard 28	22031	53981	31950	2.45	20725	37179	16454	1.79
		Pusa Mustard 26	18440	40720	22280	2.21	14020	25830	11810	1.84
		NRCHB101	22052	61650	39598	2.80	25344	42734	17390	1.69
	II	Pusa Mustard 30	19274	49324	30049	2.56	16000	33528	17528	2.10
		Pusa Mustard 26	16500	34625	18125	2.10	12250	25500	13250	2.08
	III	Pusa Mustard 27	21080	46852	25772	2.22	18665	32019	13354	1.72
		Pusa Mustard 30	15525	43261	27736	2.79	13915	31780	17865	2.28

39598/ha followed by Pusa Mustard 28 (Rs. 31950/ha) in central and north eastern plateau and Pusa mustard 30 (Rs. 30049/ha) in western plateau. The benefit cost ratio was also highest for NRCHB 101 (2.80:1) followed by PM 30 in south eastern plateau (2.79:1) and western plateau (2.56:1). These results are in accordance with the findings of Kumbhare et al., (2014); Singh et al., (2018); Jayalakshmi et al., (2018). Data from Table 2 revealed that benefit cost ratio for the demonstration plot was always higher than farmers plot which may be due to higher yield obtained by use of technology bunch (improved seed, seed treatment, micro nutrient, pest control and training to the farmers) and marketable value of crop due to good crop health. Higher benefit cost ratio of demonstrated plot shows economic feasibility of the demonstration and maximum chance of acceptability among the farmers' community.

CONCLUSION

Based on the study of four-year data on yield (q/ha), technology gap, extension gap, per cent increase over cornel and economics of cluster front line demonstration of rapeseed and mustard under different agro-climatic zone of Bihar and Jharkhand it may be concluded that productivity and economic return in rapeseed and mustard can be enhanced by proper utilization of critical inputs and recent technological intervention. This study observed that CFLD programmes were very effective in motivating and changing the attitude of other farmers to adopt improved cultivation practices and crop management though newer technologies. Higher yield of demonstration plots not only reduced technology gap but it also creates interest of farmers in demonstration technology ultimately it bridged extension gap.

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Integrated Crop Management Practices of Wheat through Frontline Demonstration in Bundelkhand Region

Anil Kumar Singh

Senior Scientist, Krishi Vigyan Kendra, Datia, Madhya Pradesh, India
Email id: aksingh_kvkv@rediffmail.com

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ABSTRACT

Krishi Vigyan Kendra, Datia, Madhya Pradesh conducted 365 demonstrations on wheat varieties GW-366 and RVW-4106 during 2017-18 to 2020-21 at farmers' field in Datia district to find out the worth of the improved technology. The parameters like technological impact, economical impact and extension gap were analyzed and the feasibility of demonstrated technologies at grass root levels was assessed. The results of four years of studies revealed that the yield under demonstration plots was 4684 kg/ha as compared to 3875 kg/ha in traditional farmer practices plots. This additional yield of 809 kg/ha and the increase in average wheat productivity by 21.43 per cent may contribute to the present wheat requirement on national basis. The average technology gap, extension gap and technology index were found to be 376.50 kg/ha, 807.75 kg/ha and 7.40 per cent respectively. An additional investment of Rs. 1470 per ha coupled with scientific monitoring of demonstrations and non-monetary factors resulted in an additional net return of Rs. 13531 per ha. Fluctuation in the sale price of wheat during different years influenced the economic returns per unit area. On four years overall average basis incremental benefit cost ratio was found as 3.41. The results indicate the positive effects of FLDs over the existing practices.

INTRODUCTION

Wheat (*Triticum aestivum* L.), a leading cereal grain that belongs to the Gramineae family, is a staple food of billions of people in the world; used to make flour for leavened, flat and steamed bread, cookies, cakes, pasta, noodles and couscous; for fermentation to make beer and alcohol (Khan & Habibi, 2003). In India, wheat is the second most important food crop after rice being cultivated on 31.45 m ha with a production of 107.59 m tons with average productivity of 34.21 q/ha (Ministry of Agriculture and farm, 2020). In Madhya Pradesh, it is grown on a 5.52 m ha area with a production of 15.47 m tons and productivity of 28.02 q/ha (Directorate of Economics & Statistics, DAC & FW, 2019). However, in the past decade, a general slowdown in the increase in the productivity of wheat has been noticed, particularly under

environments relatively unfavorable for the growth and development of wheat (Nagarajan, 2005). During the past few years, More than 50% area of wheat sowing gets delayed and goes up from last December to early January causing a substantial loss in grain yield due to late harvesting of preceding *kharif* crops like rice, which ultimately results in poor seed yield due to unavailability of sufficient irrigation water. Moreover, poor agronomic practices such as higher seed rate, unsuitable varieties, faulty nutrient management as well as weed control etc. are responsible for the low productivity of wheat in Datia district of Madhya Pradesh and also in India (Tiwari et al., 2014).

KVKs are grass root level organizations meant for the application of technology through assessment, refinement and demonstration of proven technologies under different micro-farming situations in a district (Das, 2007). Front line

demonstrations (on farmer's fields) on wheat were conducted to demonstrate the production potential and economic benefits of improved varieties with the latest technologies and also convincing the farmers to adopt the improved production technologies of wheat for enhancing the productivity of wheat in the region. Keeping these in view, FLDs of improved production technology on wheat was conducted to enhance the productivity and economic returns and also convincing the farmers for adoption of improved production technologies in wheat crop.

METHODOLOGY

The study is a part of the mandatory programme of Krishi Vigyan Kendra, Datia, Madhya Pradesh. Front-line demonstration with the improved package of practices on wheat (0.2 ha. each) was conducted at 365 farmers' fields during *rabi* season of four consecutive years of 2017-18 and 2020-21 in different villages i.e. Kharag, Sanora, Barodi and Rajpur of Datia district (Madhya Pradesh). The soils of the farmer fields were Sandy-loam in texture and medium to low in NPK. FLD plot was kept for assigning farmers practices. Before conducting FLDs, group meetings and specific skill training were given to the selected farmers regarding the package of practices of wheat crop. Improved variety seed (GW-366 and RVW-4106), with a seed rate of 100 kg/ha along with a recommended dose of fertilizer 120:60:40 kg of NPK/ha and weed control measures were used. The crop was sown between 18th to 25th November in the demonstration field, with 20 cm row spacing. The crop received a full dose of P₂O₅ and K₂O and a half dose of nitrogen as basal dose and remaining nitrogen in 2 equal splits i.e. at tillering and at boot stage. The source of fertilizer was urea, single super phosphate and muriate of potash for N, P and K, respectively. A mixture of Sulfosulfuron 75% + Metsulfuron Methyl 5% WG @ 40 g/ha was applied as post emergence after first irrigation at 25-30 days of sowing for weed management. Fields were irrigated at the critical stages of the crop and the crop was harvested from 29th March to 9th April during all the years of the demonstration. Farmer's practice constituted the seed of an age-old variety of Lok 1. The crop was sown at the same time as a demonstration, broadcasting method of sowing, higher seed rate (125 kg/ha), imbalance dose of fertilizers applied (100:40:0 kg NPK/ha), no seed treatment, no plant protection measures and applied of 2,4-D @ 750g a.i./ha for weed management. The crop was harvested at the same time as harvesting demonstration plots. Harvesting and threshing operations had done manually and by a thresher, respectively. Before conducted the demonstration training to farmers of respective villages was imparted for envisaged technological interventions. All other steps like site selection, farmer's selection,

the layout of demonstration, farmers participation *etc.* were followed as suggested by Choudhary (1999).

The average yield of each FLD and farmer practice was taken in all the years for interpretation of the results. The extension gap, technology gap and technology index were calculated using the following formula as suggested by Samui *et al.*, (2000).

$$\begin{aligned} \text{Extension gap} &= \text{Demonstration yield} - \text{farmers' yield (control)} \\ \text{Technology gap} &= \text{Potential yield} - \text{Demonstration yield} \\ \text{Technology index (\%)} &= \text{Technology gap} \times 100 / \text{Potential yield} \end{aligned}$$

The data were collected through personal contact with farmers at farmer's fields and after that tabulated and analyzed with percentage.

RESULTS AND DISCUSSION

A comparison of the productivity level between front line demonstrations and local checks is shown in Table 1. It is evident from the results that under the demonstrate plot, the performance of Wheat (yield) was sustainable higher than that in the local check in all the years of the study (2017-18 to 2020-21). The cumulative results of four years revealed that the average yield of wheat was recorded at 4684 kg/ha under demonstrated plots as compared to farmer practice 3876 kg/ha. The highest yield in the front line demonstration plot was 4875 kg/ha in 2020-21 and farmers' practices 4447 kg/ha during 2020-21. The lowest yield of front line demonstration was 4518 kg/ha in 2017-18 and farmers' practice was recorded 3587 kg/ha in 2019-20. The increase in grain yield under demonstration was 9.62 to 29.11 per cent than farmers' local practices. Based on four years, 21.43 per cent yield advantage was recorded under demonstrations carried out with improved cultivation technology as compared to farmers' traditional way of wheat cultivation. The results indicated that the front line demonstrations have given a good impact on the farming community of Datia district as they were motivated by the new agricultural technologies applied in the Front Line Demonstration plots (Table 1). However, the obtained seed yield in FLD's was low as compared to the potential yield of the varieties and year-to-year fluctuations in yield due to soil fertility level and uncertain weather situations. The results were found to be in close conformity with the research results of Nain *et al.*, (2012); Sharma *et al.*, (2016); Singh (2017); Mukherjee (2019).

Gap analysis

An extension gap of 428 to 1086 kg/ha was found between demonstrated technology and farmers' practices during different four years. On an average basis, the extension gap was 807.75 kg/ha (Table 1). The extension gap was lowest (428 kg/ha) during *rabi* 2020-21 and it was highest (1086 kg/ha) during *rabi* 2018-19 (Table

Table 1. Grain yield and gap analysis of front line demonstrations on wheat at farmers' field from 2017-18 to 2020-21

Year	No. of Demo	Variety	Potential yield	Demo yield (kg)	Farmers practice yield (kg)	Yield increase (%)	Extension gap (kg)	Technology gap (kg)	Technology index (%)
2117-18	100	GW-366	5180	4518	3738	20.87	780	662	12.78
2018-19	125	RVW- 4106	5020	4817	3731	29.11	1086	203	4.04
2019-20	120	RVW- 4106	5020	4524	3587	26.12	937	496	9.88
2020-21	20	RVW- 4106	5020	4875	4447	9.62	428	145	2.89
			5060.00	4683.50	3875.75	21.43	807.75	376.50	7.40

Table 2. Economic analysis of front line demonstrations on wheat at farmers' field from 2017-18 to 2020-21

Year	Cost of cultivation		Selling price (MSP) Rs./kg	Gross return		Increase in gross return (%)	Net Return		Increase in net return (%)	B: C ratio	
	Improved technologies	Local farmers practices		Improved technologies	Local farmers practices		Improved technologies	Local farmers practices		Improved technologies	Local farmers practices
2117-18	24800	23500	17.35	78387	64854	20.87	53587	41354	29.58	3.16	2.76
2018-19	24800	23500	18.40	88633	68650	29.11	63833	45150	41.38	3.57	2.92
2019-20	26200	24500	19.25	87087	69050	26.12	60887	44550	36.67	3.32	2.82
2020-21	26940	25360	19.75	96281	87828	9.62	69341	62468	11.00	3.57	3.46
	25685	24215	18.69	87597	72596	21.43	61912	48381	29.66	3.41	2.99

1). Such gap might be attributed to the adoption of improved technology in demonstrations which resulted in higher grain yield than the traditional farmers' practices. The cumulative extension gap of four years emphasized the need to educate the farmers through various extension means i.e. front line demonstration, for the adoption of improved production and protection technologies to revert the trend of wide extension gap. More and more use of the latest production technologies with high-yielding varieties will subsequently change this alarming trend of galloping extension gap. Singh et al., (2017) showed in their study on extension gap also agrees with the present observation.

Technology gap

A wide technology gap was observed during different years and this was lowest (145 kg/ha) during *rabi* 2020-21 and was highest (662 kg/ha) during *rabi* 2017-18. On the basis of four years, the technology gap of the total of 365 demonstrations was found as 376.50 kg/ha (Table 1). The observed technology gap may be attributed to dissimilarity in soil fertility status, timely sowing, rainfall distribution, disease and pest attacks as well as the change in the locations of demonstration plots every year. The difference in technology gap during different years could be due to more feasibility of recommended technologies during different years. Lower the value of the technology gap more is the feasibility of the technologies which could be easily adopted by the farmers as they are user friendly. These findings are similar to the findings of Patel et al., (2013).

Technology index

The technology index shows the feasibility of the evolved technology at the farmer's fields and the lower the value of the technology index more is the feasibility of the technology. The technology index for all the demonstrations during different years was in accordance with the technology gap. The highest technology index per cent of 12.78 was recorded in the year *rabi* 2017-18 and the lowest was observed in the year *rabi* 2020-21 which is 2.89 per cent (Table 1). The average technology index was observed at 7.40 per cent during the four years of front line demonstration programmes, which shows the efficacy of the good performance of technical interventions. This will accelerate the adoption of demonstrated technical intervention to increase the yield performance of Wheat. This result was in conformity with the result of Dhaka et al., (2010) and Singh (2017).

Economic return

The input and output prices of commodities that prevailed during the demonstrations were taken for calculating gross return, cost of cultivation, net return and benefit-cost ratio. Use of pricey seeds for crop sowing, seed treatment, the recommended dose of chemical fertilizers, proper pest management etc., all is the main reasons for the high cost of cultivation in demonstration fields than local check. Therefore, the average cost of cultivation of four years increased in demonstration practice (Rs.25685/ha) as compared to Local check (Rs. 24215 /ha) (Table 2). The data reveal that the net returns from the demonstration plots were substantially higher than control plots during all the years. An average net return was observed to be Rs. 61912.00 in comparison to the control plot i.e. Rs. 48381.00. Thus on an average additional income of Rs. 13531.00 (29.66 per cent more) is attributed to the technological intervention provided in demonstration plots. Economic analysis revealed that the benefit-cost ratio in demonstration plots was comparatively higher than control plots. The highest benefit-cost ratio (3.57) was observed in the year 2018-19 and 2020-21 followed by 3.32 in the year 2019-20. The variation in the benefit cost ratio could be due to price variation and grain yields obtained during the study years. The average benefit cost ratio of demonstration and control plots was 3.41 and 2.99 respectively during the study period (Table 2). Hence favorable benefit cost ratio proved the economic viability of the intervention made under demonstration and convinced the farmers of the utility of intervention. Similar results were reported by Sreelakshmi et al., (2012); Joshi et al., (2014); Singh (2017); Layek et al., (2021).

CONCLUSION

The results showed that the integration of improved technology along with the active participation of farmers has a positive effect on increase the grain yield and economic return of wheat crop production. The suitable technology for enhancing the productivity of wheat and the need to conduct such demonstrations may lead to the improvement and empowerment of farmers. These demonstration trails also enhance the relationship and confidence between farmers and KVK scientists. The recipient farmers of front line demonstration also play an important role as the source of information and quality seeds for wider dissemination of the improved varieties of the crop for other nearby farmers. It is concluded that the front line demonstration programme is a successful tool in enhancing the production and productivity of Wheat through changing the knowledge, attitude and skill of farmers.

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Extent of Knowledge and Adoption of Recommended Wheat Production Practices among Wheat Growers in Malwa Region (M.P.)

Mangi Lal Jat¹, D. K. Jaiswal² and Y.S. Saharawat³

¹PG Scholar, ²Professor, Department of Extension Education, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur-482004, Madhya Pradesh, India

³Principal Scientist and Program Manager, International Fertilizer Development Center (IFDC), New Delhi, India

*Corresponding author email id: mangilalgodara9546@gmail.com

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ABSTRACT

Wheat is an important source of nutrition in our staple diet. Although farmers in northern India are growing wheat for a long time many farmers are lacking good knowledge of wheat and its new varieties production practices. The study was conducted to know the extent of knowledge and adoption of recommended wheat production practices among wheat cultivating farmers of the Malwa region. Nine farmers (3 big, 3 medium and 3 small farmers) were selected randomly from each (thirty-six) selected village of nine blocks of Hosangabad, Hadra and Sehore districts making a total of 324 wheat growers. Among the practice-wise level of knowledge regarding recommended wheat production technology; method of storage (mean score- 2.30) was ranked first and selection and preparation of land (mean score- 2.25) was ranked second. On the whole, the highest number of the wheat growers (46.29%) had a medium knowledge level of recommended wheat production practices while 41.66% had a medium level of adoption on the basis of their level of adoption of recommended technological practices of wheat crop cultivation.

INTRODUCTION

Wheat (*Triticum aestivum*) is an important and strategic cereal crop for the majority of the world's population. It is the most important staple food of about two billion people (36% of the world population). It exceeds in acreage and production of every other grain crop (including rice, maize, etc.) and is, therefore, the most important cereal grain crop in the world. Wheat is the most important source of carbohydrates in a majority of countries. Wheat also contains a diversity of minerals, vitamins and fats (lipids). With a small amount of animal or legume protein added, the wheat-based meal is highly nutritious. In India wheat is grown over 30.60 million hectares with total production of 98.38 million tonnes with an average yield is 3216 kg/hectares (DAC & FM, 2017) and in Madhya Pradesh, it is grown over an area of 6.03 million hectares with a total production of 17.94 million tonnes with the average yield 2976 kg/ha (FWADD, 2017). Considering the importance of

the wheat crop it is imperative to study it from different viewpoints so that we can get more and more knowledge about it, which can help our research system to improve the productivity and efficiency of agricultural sector. In our country, the set-up of our agricultural system is mainly divided in three components i.e. research, education and extension (ICAR Handbook of Agriculture). Extension plays a large role in bridging the gap between farmers and research which can be validated with the success of green revolution programmes of the late 1960s. The extension service in the country has a huge network of professional extension workers at the national, state district, sub-division, and block and village level. Several programmes for increasing knowledge of farmers and motivating the farmers for adoption of new technologies are in operation throughout the country. But still, there is a wide gap between the technology available with the researchers in research institutes and its adoption in farmer's fields particular in wheat. The adoption of improved technology of wheat crop by the farmers

is not uniform due to several reasons i.e. lack of mechanization, non-availability of quality seeds, lack of irrigation facilities, lack of market facilities (Kumar, 2016; Shitu et al., 2018). So this study was designed to study the extent of knowledge and level of adoption of recommended Wheat Production Practices by Wheat Growers in the Malwa region of Madhya Pradesh.

METHODOLOGY

The exploratory research design was followed in this study. This study was carried out in Hoshangabad, Harda and Sehore districts of Madhya Pradesh State during 2018-19 to know the extent of knowledge and adoption of recommended wheat production practices by different categories of wheat growers. A total of 36 villages were selected with the help of a stratified random sampling method from 9 blocks namely Hoshangabad, Pipariya, Itarsi, Harda, Timarni, Khirkiya, Sehore, Ichhawar and Narsullaganj (4 villages from each block) on account of the maximum area covered under wheat crop. A total of 324 wheat growers, 9 farmers (3 big, 3 medium and 3 small farmers) were selected with simple random sampling from each selected village under the study. The primary data was collected personally through group discussion and a pre-tested interview schedule which was prepared on the basis of objectives of the study.

For determining knowledge level a questionnaire was prepared as per recommended package of practices of wheat crop. The responses were recorded on a three-point continuum as complete, partial and no knowledge and were given 3, 2 and 1 score, respectively. The knowledge level possessed by individual respondents was measured by computing knowledge index. On the basis of scores gained by each respondent the respondents were categorised into low (up to 41), medium (42 to 57) and high (above 57).

For appraising the extent of adoption the responses were recorded on a three-point continuum as complete, partial and no adoption and were given 3, 2 and 1 scores, respectively. The total score obtained by the respondents from all practices was the adoption score of the individual respondent. Finally, the raw adoption score obtained by the individual respondent was converted into an adoption index. On the basis of scores gained by each respondent the respondents were categorised into low (up to 28.33), medium (28.34 to 31.66) and high (above 31.66).

RESULTS AND DISCUSSION

Knowledge plays an important role in decision making process at the individual level. It is the precursor to the adoption of any

innovation. It might be difficult to presume the level of adoption of technology unless it is first known to the person who is going to adopt it. Ascertaining the level of knowledge and adoption among farmers was done to know their perception about the sustainability of wheat crop. Knowledge and adoption were perceived as the level up to which different practices were known and adopted by the sampled farmers. Further, practice-wise knowledge and adoption were also calculated to see the extent of knowledge and adoption. Results from Table 1 has reflected the knowledge level of different categories of wheat growers regarding different wheat cultivation practices. Regarding the recommended practice 'selection and preparation of land', 46.29 per cent of wheat growers had medium knowledge followed by high (39.81%) and low (13.88%). 60.80% Wheat growers had medium knowledge in 'seed and sowing method' followed by high (27.46%) and low (11.72%). About knowledge of the practice 'fertilizer management', majority of the wheat growers (50.92%) had medium knowledge followed by high (29.62%) and low (19.44%) respectively. The 44.75 per cent wheat growers had medium knowledge about 'irrigation management' followed by high (32.71%) and low (22.53%). 40.43% wheat growers had medium knowledge level regarding the practice 'weed management' was found among followed by high (35.49%) and low (24.07%). In case of 'insect pest & disease management' 43.20% wheat growers had medium knowledge, followed by high (31.79%) and low (25%) knowledge. 44.44% wheat growers had medium knowledge of 'time and method of harvesting' practice followed by high (34.56%) and low (20.98%) knowledge. 44.75% of the wheat growers had high knowledge regarding 'method of storage' followed by medium (40.74%) and low (14.50%) knowledge. In case of mean score of the practices, 'method of storage' (mean score 2.30, Rank I) followed by 'selection and preparation of land' and 'Seed and sowing method' (mean score 2.15, Rank II) which was equal overall mean score 2.15. followed by 'time and method of harvesting' (mean score 2.13, Rank III), 'weed management' (mean score 2.11, Rank IV), 'fertilizer management' and 'irrigation management' (mean score 2.10, Rank V), 'insect-pest and disease management' (mean score 2.06, Rank VI). Thus it may be reported that, overall mean score of 2.15 level of knowledge regarding recommended wheat production technology among respondents was found.

Results from Table 2 revealed that in case of small farmers, 45.37% wheat growers had medium level of knowledge regarding recommended wheat production practices, followed by high (32.40%) and low (22.22%) knowledge. In case of medium farmers,

Table 1. Practice wise level of knowledge regarding recommended wheat production technology

S.No.	Recommended Production Practices of Wheat Crop	Low F(%)	Medium F(%)	High F(%)	Mean score	Rank
1.	Selection and preparation of land	45(13.88)	150(46.29)	129(39.81)	2.25*	II
2.	Seed and sowing method	38(11.72)	197(60.80)	89(27.46)	2.15	III
3.	Fertilizer management	63(19.44)	165(50.92)	96(29.62)	2.10	VI
4.	Irrigation management	73(22.53)	145(44.75)	106(32.71)	2.10	VI
5.	Weed management	78(24.07)	131(40.43)	115(35.49)	2.11	V
6.	Insect-pest & disease management	81(25)	140(43.20)	103(31.79)	2.06	VII
7.	Time and method of harvesting	68(20.98)	144(44.44)	112(34.56)	2.13	IV
8.	Method of storage	47(14.50)	132(40.74)	145(44.75)	2.30*	I
Overall Mean					2.15	

F= frequency, %= Per cent, Figures in parenthesis shows the percentage, * higher than overall mean score

Table 2. Knowledge level of recommended wheat production practices

S.No.	Level of Knowledge	Frequencies of farmers			Overall farmers
		Small	Medium	Big	
1.	Low (25 to 41)	24(22.22)	27(25.00)	20(18.51)	71(21.91)
2.	Medium (42 to 57)	49(45.37)	43(39.81)	58(53.70)	150(46.29)
3.	High (Above 57)	35(32.40)	38(35.18)	30(27.77)	103(31.79)
	Total	108(100.00)	108(100.00)	108(100.00)	324(100.00)

*Figures in parenthesis are percentage

39.81% wheat growers had medium level of knowledge, followed by high (35.18%) and low (25%). In case of big farmers, 53.70% wheat growers had medium level of knowledge, followed by high (27.27%) and low (18.51%) about the improved wheat cultivation practices. The pooled data of overall farmers has revealed that 46.29 per cent of the wheat growers had medium level of knowledge regarding recommended wheat production practices, followed by high (31.79%) and low (21.91%). Thus, it may be inferred from the data that the higher percentage i.e. about 78.08 per cent of wheat growers had medium to high level of knowledge regarding recommended wheat production technology. The results of this study are supported by the study of Verma & Yadav (2011); Kumar et al., (2012); Chaudhary et al., (2013); Painkra et al., (2014).

Results from Table 3 has given insights about the distribution of the adoption respondents according to their practice wise extent of adoption of recommended wheat production technology. Regarding the practice 'selection and preparation of land', 48.45 per cent wheat growers had high adoption level followed by medium (36.11%) and low (15.43%). for practice 'seed and sowing method' 44.75 per cent of wheat growers had medium adoption level, followed by high (28.39%) and low (26.85%). For the practice 'fertilizer management', (46.91%) wheat growers had medium adoption level followed by high (31.79%) and low (21.29%) respectively. About the practice of 'irrigation management' the majority of the wheat growers (42.90%) had high adoption level followed by medium (42.59%) and low (14.50%). For the practice

of 'weed management' (37.65%) wheat growers had medium adoption level, followed by high (34.25%) and low (28.08%). Regarding adoption of the practice 'insect-pest & disease management' majority of the wheat growers (50.30%) had medium adoption level followed by high (29.01%) and low (20.67%) adoption. For 'time and method of harvesting' practice (47.22%) wheat growers had medium adoption level of adoption, followed by high (41.04%) and low (11.72%) respectively. Regarding 'method of storage' practice, 43.20 per cent of the wheat-growers had high adoption level followed by medium (40.43%) and low (16.35%). In the case of mean score of adoption, the 'selection and preparation of land' had a mean score of 2.33 (Rank I) followed by 'time and method of harvesting' with a mean score of 2.29 (Rank II) followed by 'irrigation management' with mean score 2.28 (Rank III), followed by the 'method of storage' with mean score 2.26 (Rank IV), all of which are higher than the overall mean score 2.18, followed by 'Fertilizer management' with mean score 2.10 (Rank V) followed by 'insect-pest and disease management with mean score 2.08 (Rank VI) followed by 'weed management' with mean score 2.06 (Rank VII) and at last followed by 'seed and sowing method' with lowest mean score 2.01 (Rank VIII). Thus it may be reported that, overall mean score of 2.18 of practice wise adoption regarding recommended wheat production technology among respondents may be found.

Results from Table 4 has revealed that in the case of small farmers, (41.66%) wheat-growers had medium level of adoption regarding recommended wheat production practices, followed by

Table 3. Practice wise level of adoption regarding recommended wheat production technology

S.No.	Technological practices of wheat crop cultivation	Level of adoption			Mean score	Rank
		Low F(%)	Medium F(%)	High F(%)		
1.	Selection and preparation of land	50(15.43)	117(36.11)	157(48.45)	2.33*	I
2.	Seed and sowing method	87(26.85)	145(44.75)	92(28.39)	2.01	VIII
3.	Fertilizer management	69(21.29)	152(46.91)	103(31.79)	2.10	V
4.	Irrigation management	47(14.50)	138(42.59)	139(42.90)	2.28*	III
5.	Weed management	91(28.08)	122(37.65)	111(34.25)	2.06	VII
6.	Insect-pest & disease management	67(20.67)	163(50.30)	94(29.01)	2.08	VI
7.	Time and method of harvesting	38(11.72)	153(47.22)	133(41.04)	2.29*	II
8.	Method of storage	53(16.35)	131(40.43)	140(43.20)	2.26*	IV
	Overall Mean				2.18	

F= frequency, %= Per cent, Figures in parenthesis shows the percentage, * higher than the overall mean score

Table 4. Adoption of recommended production practices by wheat growers

S.No.	Categories of adoption level	Frequencies of farmers			Overall Farmers
		Small	Medium	Big	
1.	Low (25 to 41)	40(37.03)	45(41.66)	25(23.14)	110(33.95)
2.	Medium (42 to 57)	45(41.66)	35(32.40)	55(50.92)	135(41.66)
3.	High (Above 57)	23(21.29)	28(25.92)	28(25.92)	79(24.38)
	Total	108(100.00)	108(100.00)	108(100.00)	324(100.00)

Figures in parenthesis are percentage

low (37.03%) and high (21.29%). In the case of medium farmers, (41.66%) wheat-growers had low adoption, followed by medium (32.40%) and high (25.92%) respectively. In the case of big farmers, 50.92% wheat-growers had a medium level of adoption, followed by low (23.14%) and high (25.92%). All the pooled data has revealed that 41.66 per cent of the wheat-growers were had a medium level of adoption regarding recommended wheat production practices; followed by low (33.95%) and high (24.38%). Thus, it may be inferred from the data that the higher percentage of wheat growers had medium to high adoption level of recommended wheat production technology. The reason might be that, majority of the farmers had medium extension contact, medium material possession, medium economic motivation, medium scientific orientation and medium level of knowledge regarding recommended wheat production technology. Hence, all these factors might have influenced them to fall under the medium adoption category. Further, as the landholding and income increase naturally and they prove towards economical returns. The Extension programme may have played an effective role in changing the attitude, skill and knowledge of wheat growers toward recent technology for disease and pest management of wheat including their adoption. This result of this study is supported by the study of Bhagat et al., (2002); Kumar et al., (2012); Meena (2012); Nain et al., (2012); Painkra et al., (2014); Singh et al., (2014); Ashok Kumar et al., (2018).

CONCLUSION

It is concluded from the study that the majority of the wheat grower had a medium level of knowledge regarding technological practices of wheat crop cultivation while a majority of the wheat grower had a medium level of adoption regarding technological practices of wheat crop cultivation and it becomes very important for extension agencies to play a role to create awareness among farmers about the recommended practices of wheat cultivation through training and group discussion as well as field trips. As wheat crop has much importance to us, so there is a need to create a viable and sustainable agricultural system with the judicious use of resources so that our upcoming generations do not feel deprived of their sustenance need i.e. food.

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Attributes of Farm Income Operating on Conservation Agriculture: The Multivariate and ANN Analytics

Cornea Saha¹, S. K. Acharya^{2*}, Monirul Haque³, Riti Chatterjee³ and Anwesha Mandal³

¹PG Scholar, ²Professor, ³Ph.D. Research Scholar, Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal, India

*Correspondence author email id: acharya09sankar@gmail.com

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ABSTRACT

Conservation agriculture (CA) is the combination of environmental management, modern and scientific agriculture, which employs farmers' ability to utilize, innovate, and adapt to changing situations, as well as their holistic acceptance of knowledge along with ensuring sustainability. Farm-level adoption of CA is related to reduced labour and agricultural inputs, more consistent yields, and increased soil nutrient exchange capacity. A good quality land yields good results to everyone, confers good health on the entire family, and causes growth of money, cattle, and grain. The present study depicts hard evidences by identifying marker variables impacting income augmentation through conservation agriculture. A score of 50 farmers has been selected from two blocks of Cooch Behar district of West Bengal, by non-probability snowballing sampling techniques with a total of eighteen independent variables along with income from major crop is used as the dependent variable through a structured interview schedule. A basket of multivariate analytical techniques has been applied along with Artificial Neural Network (ANN) as well. The results depict that a blend of diversified farming and farming experiences in CA contributed immensely to scale up income from conservation agriculture approaches.

INTRODUCTION

The good earth has her own and the sweetest music of ecological resilience and rhythm, as if, the symphonies of Beethoven or Mozart are on their best of melodies. Agriculture, once upon a time, has been the pristine child of nature with all music of traditional knowledge, praxis, and natural sciences. The explosion of population and industrialization, consumerism, and urbanization have driven us to a compulsion of making ecosystems denuded, depleted, and polluted with all kinds of disruptions inflicted into the soil, water, and biodiversity. Conservation Agriculture (CA) is a comprehensive approach to sustainable practices that include minimum to no mechanical soil disturbance, biomass mulch soil cover, and crop species diversification, as well as other associated farming practices such as integrated crop and production

management (Kassam et al., 2019). Currently, CA is practiced on all continents, in a range of agro-ecosystems, and on farms of various sizes (Friedrich et al., 2012). The adoption of CA practices resulted in better economic and productive returns as compared to traditional agricultural practices along with significant environmental benefits (Tambo & Mockshell, 2018; Kiran Kumara et al., 2020).

For a few decades, maize (*Zea mays* L.) takes part of the component crop very promptly in the choice of the South Asian farmers in rice-based cropping system. In smallholder farming systems, CA-based rice-maize crop rotation is one of the feasible alternatives to improve crop and water productivity and farm revenue while also preserving natural resources (Jat et al., 2019) and also to attain high energy-use efficiency, biomass productivity, and bio-energetic based adult equivalent yield (Parihar et al., 2018a). It is an all-season growing crop and requires less amount of moisture.

It has the potential to be a viable alternative to rice and a driver for rice-wheat system diversification. In recent years, maize production has increased in both conventional and conservation agriculture-based cereal systems in India (Das et al., 2018). A majority of the maize growing farmers are knowledgeable about sowing time, land preparation, hybrid variety, insect pest, and disease identification, water management, and harvesting stage (Parkash & Peshin, 2020). Adoption of CA practices in maize cultivation encourages higher crop production, income, and soil fertility restoration (Nyirenda & Balaka, 2021).

The approach of CA in an agrarian economy like India has to face more challenges from income insecurity for farmers rather than its ecological sustainability for the same farm units. In this context, diversification towards high-value crops has the potential to boost up the agricultural growth and well-being of the farm situations (Priscilla et al., 2021). Due to most of the farmers being small and marginal, they show more interest in cultivating more profitable crops such as maize at a lower cost than capital intensive high-value crops. The present study tried to find out the answer to the strong commitment to conservation agriculture deeply inculcated into the technology socialization behaviour attributed to operational farm incomes.

METHODOLOGY

The study was conducted in Cooch Behar district of West Bengal during 2020-21. The study sample encompassed 50 farmers selected by the snowballing sampling method (Cochran, 2007) from purposively selected two blocks namely Dinhata I and Dinhata II. A score of twenty-five respondents from each block was taken into consideration by selecting a few farmers and asking them for the farmers who performed the same cultivation practices. This type of sampling method was adopted due to the lower availability of CA practicing farmers in the COVID-19 pandemic situation. The study on farm income operating from conservation agriculture operationalized through two sets of variables (i) independent

variables (x_1 - x_{18}) and (ii) dependent variable (y). Change in income from major crop (y) by the farmers is collected through a pre-tested structured interview schedule and relationships among selected eighteen variables are analyzed through quantitative methods i.e. Coefficient of Correlation, Multiple Regression, Stepwise Regression, Path Analysis, and Artificial Neural Networking (ANN) with the help of IBM SPSS v20.0 and the web-based application OPSTAT (Sheoran et al., 1998).

Variables which are quantified changes were calculated by the following formula:

Change in income from major crop (y) = (Farm income at present - Farm income at 10 years back) / (Farm income at 10 years back) \times 100

Change in number of irrigation (x_{12}) = (No. of irrigation at present - No. of irrigation 10 years back) / (No. of irrigation 10 years back) \times 100

Change in number of tillage operations (x_{14}) = (No. of tillage at present - No. of tillage 10 years back) / (No. of tillage 10 years back) \times 100

Change in number of CA crops (x_{15}) = (No. of crops under CA at present - No. of crops under CA 10 years back) / (No. of crops under CA 10 years back) \times 100

Change in labour requirement (x_{17}) = (No. of labour required at present - No. of labour required 10 years back) / (No. of labour required 10 years back) \times 100

Change in level of inputs used (x_{18}) = (No. of inputs used at present - No. of inputs used 10 years back) / (No. of inputs used 10 years back) \times 100

RESULTS AND DISCUSSION

Relation between farmers' income and selected variables

Table 1 presents the coefficient of correlation and multiple regression between income from CA crop and selected eighteen independent variables. It depicts that two variables, farming experience of CA (x_4) and change in number of CA crops (x_{15}) have recorded a significant correlation at 5 per cent level of significance

Table 1. Coefficient of Correlation and Multiple Regression Analysis of change in income from major crop vs. selected causal variables (x_1 - x_{18})

Independent Variables	r Value	Unstandardized Coefficients		Standardized Coefficients	t value
		Reg. Coeff. B	S.E. B	Beta	
Age (x_1)	-0.126	-0.005	0.008	-0.105	-0.573
Family size (x_2)	0.001	0.019	0.074	0.052	0.257
Education (x_3)	0.020	0.013	0.036	0.060	0.346
Farming experience of CA (x_4)	0.342*	0.146	0.071	0.372	2.070
Size of homestead land (x_5)	-0.008	-0.011	0.057	-0.075	-0.191
Size of cropland (x_6)	0.038	0.014	0.041	0.093	0.335
Land under zero tillage (x_7)	0.009	-0.025	0.072	-0.077	-0.340
Number of livestock (x_8)	0.278	0.057	0.059	0.169	0.969
Average volume of cow dung produced (x_9)	-0.082	-0.014	0.017	-0.177	-0.827
Volume of manure applied in farm land (x_{10})	0.243	0.057	0.036	0.272	1.585
Land under vegetables cultivation (x_{11})	0.184	0.017	0.087	0.045	0.199
Change in number of irrigation (x_{12})	-0.003	0.074	0.474	0.028	0.156
Cropping intensity (x_{13})	-0.058	-0.001	0.002	-0.102	-0.388
Change in number of tillage operation (x_{14})	-0.231	0.092	0.334	0.052	0.275
Change in number of CA crops (x_{15})	-0.299*	-0.079	0.057	-0.274	-1.381
Energy consumption (x_{16})	0.145	0.001	0.003	0.087	0.442
Change in labour requirement (x_{17})	0.122	0.011	0.417	0.005	0.027
Change in level of inputs used (x_{18})	0.129	0.094	0.400	0.038	0.235

*Correlation is significant at the 0.05 level; R square: 37.50%; The standard error of the estimate: 0.542

with the dependent variable, change in income from major crop. It has been found that with the progress in conservation agriculture in area and intensity, the income from maize has been substantially improved along with the inclusion of more numbers of crops in CA practices can equally contribute to the farm income from other crops as well. A similar study also revealed that crop diversification is also had a positive and significant association with family size, distance to the market, economic motivation, risk orientation, innovativeness, and scientific orientation which can be used as an approach to increase farmers' income as well as agricultural sustainability (Ghouse & Hassan, 2020). The CA farms having more years of experience have got a substantive impact on change in income. That is how the farmers in North Bengal, following CA enterprises, are more interested in maize. Nevertheless, there has been a steady and performing market link between the maize growers and the Farmers Producers Organization (FPO). That is how the farmers are getting a steady income from maize for ten years. The R square value being 37.50 per cent, it can be inferred that these eighteen causal variables together had contributed to 37.50 per cent variance in the consequent variable, change in income from major crop.

Predicting farmers' income from selected variables

Farming experience of CA (x_4) and change in number of CA crops (x_{15}) including maize have been retained at the last stage of stepwise regression analysis (Table 2), which has already been justified by the above interpretation. So, it can be considered the most important determinant in the income from the major crop in CA. It is also observable that from the last ten years the area under maize is increasing like anything. The reason being, good market

price, operating support from FPOs, huge biomasses are produced which can add value to the soil health, as the source of fodder to the livestock, low water consumption. A related study also says that Crop rotations under a CA-based system are one strategy to increase crop productivity, water productivity, and farm revenue while reducing the risk of excessive temperature and moisture stress and preserving natural resources (Parihar et al., 2018b).

Table 3 presents the path analysis and, it has decomposed the total effect (r value) into direct (beta value), indirect and residual effects. The highest direct effect has been exerted by years in CA. More numbers in years, better will be the experience and market network. That is coming in favour of the farmers helping them access better income from maize. Interestingly, the highest indirect effect has been routed through the variable change in the numbers of tillage. The residual effect being 62.50 per cent, it can be inferred that even with the combination of these 18 exogenous variables, 62.50 per cent variance embedded in change in income from major crop could not be explained.

Artificial neural network analysis

Artificial Neural Network Analysis (ANN) depicts (Figure 1) three layers viz. Input layer, hidden layer and an output layer with two biases. The interaction network shows that cropping intensity (x_{13}), change in number of tillage operation (x_{14}), change in number of CA crops (x_{15}) have exerted (as depicted by the blue and bolder line) substantive and dominant effect output variable change in income from major crop (y). ANN helps to understand that family size (x_2), farming experience of ca (x_4), size of homestead land (x_5) got precise and decisive effect (as depicted by blue and bold lines), passing through respective hidden layers, have substantially impacted change

Table 2. Stepwise Regression Analysis: Change in income from major crop vs. selected causal variables (x_1 - x_{18})

Independent variables	Unstandardized coefficients		Standardized coefficients	t value
	Reg. Coeff. B	S.E. B	Beta	
Farming experience of CA (x_4)	0.145	0.051	0.369	2.864
Change in number of CA crops (x_{15})	-0.095	0.037	-0.329	-2.555

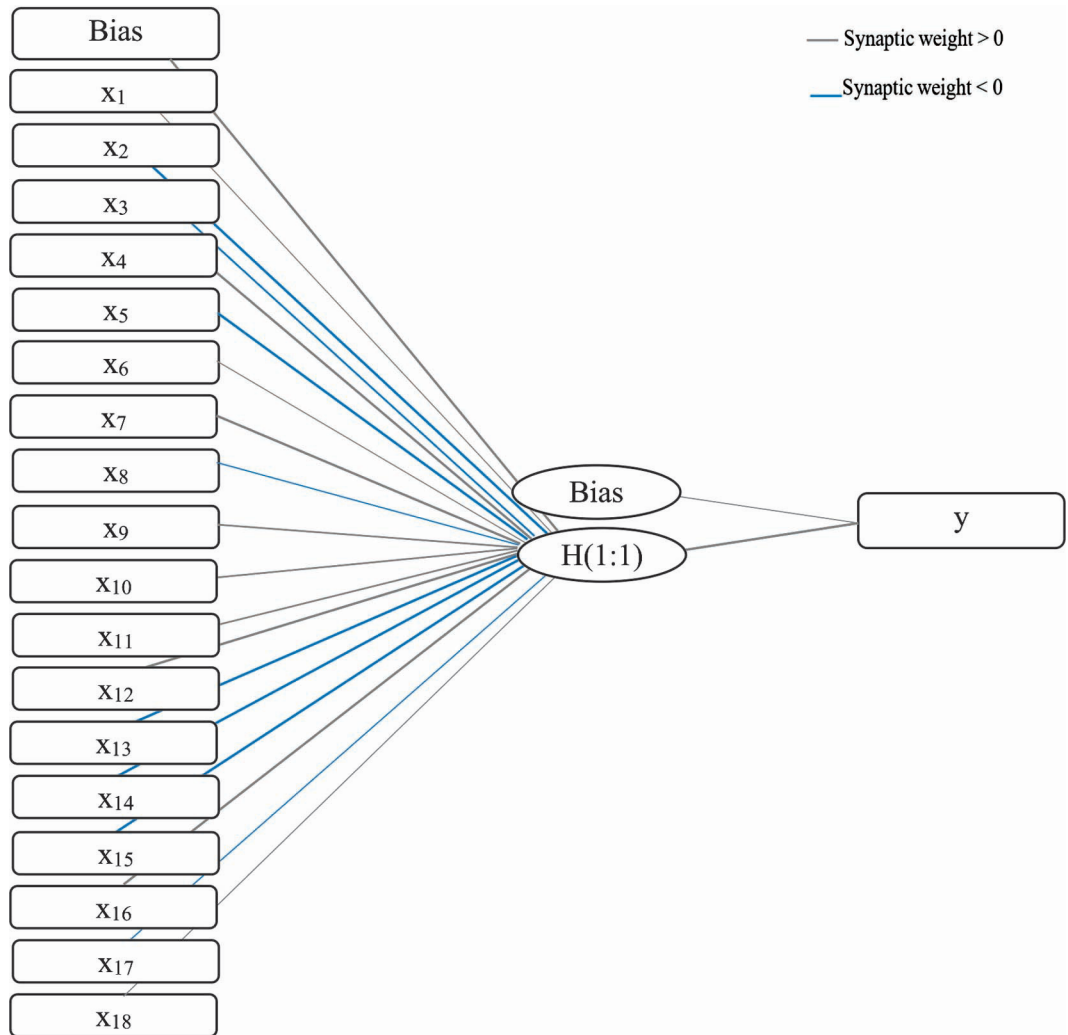
R square: 22.50%; The standard error of the estimate: 0.491

Table 3. Path Analysis: Decomposition of Total Effect into Direct, Indirect and Residual Effect: Change in income from major crop (y)

Independent variables	TE	DE	IE	HIE
Age (x_1)	-0.126	-0.105	-0.021	-0.048(x_4)
Family size (x_2)	0.001	0.052	-0.051	-0.055(x_{15})
Education (x_3)	0.020	0.059	-0.039	0.031(x_1)
Farming Experience of CA (x_4)	0.342	0.372	-0.030	-0.032(x_6)
Size of homestead land (x_5)	-0.008	-0.073	0.065	0.121(x_4)
Size of cropland (x_6)	0.038	0.092	-0.054	-0.069(x_6)
Land under zero tillage(x_7)	0.009	-0.078	0.087	0.117(x_4)
Number of livestock (x_8)	0.278	0.169	0.109	0.075(x_{15})
Average volume of cow dung produced (x_9)	-0.082	-0.177	0.095	0.067(x_4)
Volume of manure applied in farm land (x_{10})	0.243	0.272	-0.029	-0.030(x_6)
Land under vegetables cultivation (x_{11})	0.184	0.045	0.139	0.118(x_4)
Change in number of irrigation (x_{12})	-0.003	0.027	-0.030	-0.057(x_{10})
Cropping intensity (x_{13})	-0.058	-0.103	0.045	-0.033(x_5)
Change in number of tillage operation (x_{14})	-0.231	0.052	-0.283	-0.105(x_{10})
Change in number of CA crops (x_{15})	-0.299	-0.274	-0.025	-0.047(x_8)
Energy consumption (x_{16})	0.145	0.087	0.058	-0.060(x_{10})
Change in labour requirement (x_{17})	0.122	0.006	0.116	0.152(x_{15})
Change in level of inputs used (x_{18})	0.129	0.038	0.091	0.042(x_9)

TE= Total effect; DE = Direct effect; IE = Indirect effect; HIE = Highest Indirect effect; Residual effect: 0.625

Figure 1. Artificial Neural Network for depicting the dominant impact of input variable on change in income from major crop



in income from major crop (y). The inclusion of vegetable crops in conservation agriculture and effective socialization of input use has generated a conjunctive impact on the income augmentation for small and marginal farmers of North Bengal. It can be concluded that the type, number, cost and rationalization of input are exerting the highest effect on yield. Land under vegetables, which has been instrumental in socialization and entrepreneurial socialization of CA. Because vegetables help earn a better income and it needs less water to retain groundwater level. It aims to enhance the interconnection between individual smallholder production systems and integrates production areas, forests, and ecological corridors, supporting agro-ecosystems (Folke, 2006).

CONCLUSION

The dialectics of sustainable agriculture are embedded with the classical conflicts between ecology and economy. In an attempt to augment farmers’ income, we have disrupted ecological resilience; on the other hand, it’s really difficult to balance ecological resilience with seamless increment in farmers’ income and livelihood. The present study, conducted in a very promising agro-ecological zone for conservation agriculture, the Dooars region of North Bengal, elicits the fact that conservation agriculture without income

upscaling for farmers can go futile. It further shows that a blend of crop diversification along with vegetable enterprises, exposure to experiential learning have substantially impacted entrepreneurial success from conservation agriculture. To save the planet and civilization, we have to go for conservation agriculture, albeit, the economic security needs to be blended with the restoration of ecological resilience.

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Evaluation of Refresher Training Programme on Conservation Agriculture Practices

B. C. Sharma¹, Rakesh Kumar^{2*}, P. S. Slathia³, Ramphool Puniya⁴ and Amrish Vaid⁵

¹Professor and Head, ⁴Assistant Professor, Division of Agronomy; Faculty of Agriculture, SKUAS&T-Jammu, Chatha-180009, J&K, India

²Ex-Ph.D. Scholar, ³Professor, Division of Extension Education, Faculty of Agriculture, SKUAS&T-Jammu, Chatha-180009, J&K, India

⁵Professor & Head, Division of Plant Pathology, Faculty of Agriculture, SKUAS&T-Jammu, Chatha-180009, J&K, India

*Corresponding author email id: rkthakyal76@gmail.com

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ABSTRACT

Human behavior consists of knowledge, skill and attitude and timely up gradation of these three components is must for better human resource development. Training is medium for modification of human behavior to efficiently discharge one's own duties and responsibilities at their respective work place. The paper attempts to evaluate the impact of 10 days training programme entitled "Conservation agriculture practices for enhancing productivity and resource use efficiency in major cropping pattern" conducted in the Division of Agronomy, SKUAST-Jammu on knowledge of the participants regarding different aspects of conservation agriculture as well as their opinion towards overall organization of training programme. Gain in knowledge was taken as indicator for assessing the immediate output of the training programme. Participants were exposed to pre and post knowledge test and the results of two sample paired t-test ($p=.000$) so applied revealed that there was significant gain in knowledge about different aspects of conservation agriculture after attending the training programme. Overall majority of the respondents were of opinion that training programme was well planned and very effective and they had learned different practical aspects of conservation agriculture.

INTRODUCTION

Conservation agriculture is a way of farming that conserves, improves, and ensures efficient use of natural resources. It aims to help farmers achieve profits with sustained production levels while conserving the environment. Conservation agriculture boosts productivity and contributes to reducing land degradation and increase food security (Sustainet, 2010). Probably one of the major benefits of CA, which makes it popular with farmers, is it costs less in terms of money as well as time. Once again in the RW systems of South Asia (Hobbs & Gupta, 2004) no-till wheat significantly reduced the costs of production; farmers estimate this at about 2500 rupees/ha (\$60/ha). CA results in more biotic diversity in the soil as a result of less soil disturbance and the mulch. This also results in higher surface soil organic carbon than when soils are tilled (Roldan et al., 2003; Alvear et al., 2005; Riley et al., 2005; Madari et al.,

2005; Diekow et al., 2005). Two necessary components for the establishment of effective conservation agriculture systems are building of multidisciplinary scientific and technical capacity; and close collaboration with farming communities – rather than only with farmers to capitalize on their existing and traditional knowledge. Agriculture, including Conservation Agriculture, is not a single or uniform technology that can be immediately applied anywhere in a standard manner. Rather, it represents a set of linked principles that encourage the formulation of locally adapted practices, approaches and methods (Corsi and Muminjanov, 2019). Farming community need appropriate skills to practice conservation agriculture. Farming community mainly receives their agricultural technology related inputs from extension system of agricultural universities and field extension functionaries of State Department of Agriculture. Training is the most powerful medium for sharpening and up- gradation of skills of technology providers as well as

technology consumers. Training constitutes a basic concept in human resource development. It is concerned with developing a particular skill to a desired standard by instruction and practice.

Training is the process of acquiring specific skills to perform a job better (Jucious, 1963). It helps people to become qualified and proficient in doing some jobs (Dahama, 1979). Van Dorsal (1962) defined training as the process of teaching, informing or educating people so that they may become as well qualified as possible to do their job efficiently and perform in positions of greater difficulty and responsibility. In-service training, on the other hand, is offered by the organization from time to time for the development of skills and knowledge of the incumbents (Halim and Mozahar, 1997). Evaluation is an in-built mechanism in extension and training system to find the worth of a programme by providing feedback. It assists for taking corrective measures by the course/training coordinator for effectiveness of training programmes (Kumar et al., 2005). Model developed by David Kirkpatrick (1994) is probably the best known model for analyzing and evaluating the results of training programs. It takes into account any style of training, both informal and formal, to determine aptitude based on four levels criteria including; *Reaction* (e.g., satisfaction), *Learning* (e.g., increase in knowledge, skills or experience?), *Behavior* (e.g., change in behaviors?), and *Results* (if the material had a positive impact on the organization). Evaluation provides information for decisions concerning future training programmes. This information is highly useful to fine tune the training programme and is used to communicate important facts to concerned individuals/groups or agencies. Besides, evaluation results are useful for formal reporting (Singh et al., 2007). Keeping in view the importance of conservation agriculture and the process of training the present study was undertaken.

METHODOLOGY

A ten days training programme entitled “Conservation agriculture practices for enhancing productivity and resource use efficiency in major cropping pattern” was organized by Division of Agronomy, Faculty of Agriculture, Sher-e-Kashmir University of Agriculture Sciences and Technology of Jammu w.e.f. 04.02.2020

to 13.02.2020 with financial assistance from ICAR, New Delhi. The sample consisted of all the 25 numbers of trainees from states of Maharashtra, Andhra Pradesh, Jharkhand, Himachal Pradesh, Punjab and UT of Jammu and Kashmir. First two levels of Kirkpatrick model were applied i.e. reaction and learning for evaluating training programme. Reaction of participants towards different aspects of training programme was recorded by using different opinion statements immediately after the training programme. Learning of the participants was assessed by exposing them to pre and post knowledge test developed to ascertain the knowledge of the trainees. Items for knowledge test were finalized after reviewing varied literature concerned with conservation agriculture and consultation with concerned experts. Final knowledge test consisted of 40 knowledge items having one score for each item thus total score of knowledge test was 40. The gain in knowledge was operationalized as the difference between the knowledge regarding various aspects of conservation agriculture before and after exposure of training package. SPSS software was used for statistical analysis of data for finding out the value of paired t-test, standard deviation and co-efficient of variation (%).

RESULTS AND DISCUSSION

Status of trainee’s knowledge during pre-test and post test

The existing preliminary level of knowledge of the respondents was judged on selected aspects of conservation agriculture. Table 1 show that the highest score obtained by the trainees was 31 and lowest score was 14 with knowledge range of 17 having co-efficient range of 0.37. Standard deviation of knowledge score in pretest was 4.02 and co-efficient of variation was found to be 13.29. Knowledge of participants about different aspects of conservation agriculture was not satisfactory before the initiation of training programme. Similar findings was also supported by Corsi and Muminjanov, 2019 in which they reported that lack of knowledge about Conservation Agriculture systems exists both among extension and technical staff, and at decision-making levels. Same test was again administered to trainee for recording the change in knowledge after the completion of training programme and their responses were recorded. Data

Table 1. Status of trainee’s knowledge score during Pre and post-test

	Range of knowledge	Coefficient of range	Average score	Standard deviation	Variance	Coefficient of variation (%)
Pre test	17	0.37	25.00	4.02	16.19	13.29
Post test	11	0.16	34.00	3.15	9.95	9.27

Table 2. Output of paired t-test for showing significance of change in knowledge of participants after training

Paired Samples Correlations

	N	Correlation	Sig.
Pair pre & post	25	.359	.078

Paired Samples Test

	Mean	Std. deviation	Std. error mean	Paired differences		t	df	Sig. (2-tailed)
				95% confidence interval of the difference				
				Lower	Upper			
Pair 1 pre -post	-8.72000	4.12836	.82567	-10.42410	-7.01590	-10.561	24	.000

indicate that in post test, highest score obtained by the respondents was 38 and lowest score was 27 with a range of 11 and co-efficient of range of 0.16. Standard deviation of knowledge score in post test was 3.15 and co-efficient of variation was found to be 9.27.

Overall gain in knowledge

Data on overall gain in knowledge presented in Table 2 indicate that there was significant difference in the pre-test and post-test scores of the respondents as 't' value (.000) of paired t-test so applied was found to be significant at 1% level of significance. After the exposure of content of training programme a significant improvement was found in knowledge of the respondents. Similar findings were also reported by Singh and Soni (2014).

It is clear from Table 3 that majority (88 per cent) of trainees were of opinion that training programme was highly effective. However, only 12 per cent respondents reported that training was effective. However none of the trainees expressed that training was less effective and not effective. Similar findings were also reported by Koshti & Vijayaragavan (2007); Paul et al., (2015); Arunkumar et al., (2021).

Table 3. Overall level of training effectiveness (N=25)

Level of Effectiveness	Frequency	Percentage
Highly effective	22	88
Effective	03	12

Close scrutiny of data given in Table 4 reveal that 100 percent participants were of opinion that by participating in training programme their knowledge had enhanced about various aspects of conservation agriculture. They reported that trainers had rich knowledge of their subject matter. All the participants were satisfied with the duration of training programme, refreshment and sitting arrangement. Further cent percent participants were satisfied with the learning environment and they want to participate in such trainings in future also. Majority of respondents (84%) admitted that equal emphasis was given to theory and practical in all the sessions of training programme and 80 per cent participants were of opinion that by participating in training programme their attitude changed towards concept of conservation agriculture in particular and towards their routine job in general and different audio-visual

Table 4. Opinion of trainees towards different aspects of training

S.No.	Opinion Statements	Agree		Undecided		Disagree	
		F	%age	F	%age	F	%age
1	Enhanced my knowledge about various aspects of conservation agriculture	25	100.00	-	-	-	-
2	Learned new skills to efficiently apply at my work place for better utilization of resources.	18	72.00	4	16.00	3	12.00
3	Changed my attitude towards concept of conservation agriculture in particular and towards job in general.	20	80.00	2	8.00	3	12.00
4	Various A.V. aids used by the trainers were helpful in enhancing the learning.	20	80.00	-	-	5	20.00
5	Interaction during the lectures and after every training session was very fruitful	18	72.00	3	12.00	4	16.00
6	Trainers had rich knowledge of subject matter	25	100.00	-	-	-	-
7	Equal emphasis was given to theory and practical	21	84.00	-	-	4	16.00
8	Duration of training was satisfactory	25	100.00	-	-	-	-
9	Excellent learning environment	25	100.00	-	-	-	-
10	Training has improved my job proficiency	17	68.00	5	20.00	3	12.00
11	Refreshment was satisfactory	25	100.00	-	-	-	-
12	Want to participate in such trainings in future also.	25	100.00	-	-	-	-

aids used by the trainers were helpful in enhancing the learning. Almost three-fourth (72%) of participants expressed that they learned new skills to efficiently apply at their work place for better utilization of resources and interaction during the lectures and after every training session was very fruitful. More than half of the participants (68 percent) were of opinion that by participating in training programme they had improved their job proficiency. Similar findings were also reported by Kumar et al., (2005); Manhas et al., (2010); Paul et al., (2015); Kobba et al., (2020).

CONCLUSION

On the basis of results it is concluded that trainees experienced a satisfactorily change in their existing level of knowledge, skill and attitude towards different domains of conservation agriculture and impact of training programme was highly significant in terms of overall gain in knowledge. Trainees were given sufficient practical exposure by way of field visits and different demonstrations to sharpen their skills regarding various practical aspects of conservation agriculture. Participants rated this training programme as highly effective and it will help them in better transfer of conservation agriculture technology to farming community. Overall such type of training programmes foster and strengthen the Research-Extension-Farmer (R-E-F) linkages It is therefore suggested to replicate such type of innovative training programmes for field extension functionaries for better human resource development so that they may contribute in conservation of natural resources which is need of the hour in the era of dwindling farming resources.

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Mediating Role of School Variables in Anticipating Blocks and Consequences Creativity among Rural Adolescents

Sumit Sheoran¹, Bimla Dhanda² and Joginder Singh Malik^{3*}

¹Ph.D. Scholar, ²Dean & Professor, Department of Human Development & Family Studies (HDFS), I.C. College of Home Science, CCSHAU, Hisar-125004, Haryana, India

³Professor, Department of Extension Education & Communication Management, College of Agriculture, CCSHAU, Hisar-125004, Haryana, India

*Corresponding author email id: jsmalik67@gmail.com

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ABSTRACT

Each developmental stage upholds new and its own unique competency requirements, challenges, struggles and opportunities for personal human growth. When an individual is in their early adolescence phase, his/her creativity is greatly influenced by its surroundings and school environment is one of those crucial factors. Hence, the present study was planned to explore the mediating role of school environment in students' blocks and consequences creativity. The primary data was collected from 300 academically bright rural young adolescents. Z-test and ANOVA were administered to discover the influence of independent variables (school environment) on the dependent variables (blocks and consequences creativity). Results elucidated significant differences in blocks fluency, consequences originality and consequences creativity across school type, academic class and teaching method employed by the teachers. Blocks flexibility had significant differences across school type and academic class. Blocks originality was observed to have significant differences across academic class and consecutive academic record. It was revealed that blocks creativity had significant differences across all the independent variables. Consequences fluency of the students had significant differences across school type, academic class and consecutive academic record.

INTRODUCTION

Each period of human development comes up with its own new competency necessities, challenges and prospects for personal growth. For the successful functioning of each stage of life it offers certain prototypic challenges and competency demands. According to Bandura (2006), there are several pathways through life and, at any given phase, people differ substantially in how successfully they handle their lives. The child on his own journey to becoming an adult, during adolescence learns the various tasks of adulthood and forms a unique identity for himself (Erikson, 1963). Adolescence is not just a time period, rather it is process of achieving the desired growth, development, attitude, beliefs and methods for valuable contribution in society as an emerging adult.

The manner in which adolescents develop and apply their personal inherent efficacy during this transitional period plays a key role in setting the course their life follows. Hence, adolescents require managing foremost biological, educational and social role transitions parallel (Bandura, 2006). The transition of childhood to middle schools involves major environmental changes that levy personal efficacy. Despite that, in our country adolescence is never considered as a distinct stage and hence the adolescents' needs are not given any special attention over and above their childhood needs. But it is empirically proven that in the process of human development, adolescence marks an important time in the passage between childhood and adulthood [National Association of Social Workers (NASW), 2003]. When an individual is in the phase of adolescence, his quest for self-identity, creativity and personality is being

molded by various surrounding human ecological factors such as, home and school environments (Bronfenbrenner, 1979).

Creativity is never ending aspect of any person's life starting from conception onward through adulthood. Creativity can be described as the ability to see things in a new manner, to view and solve problems in different ways, which are still not invented, untried, unusual and unique or different from the existing ones (Edwards, 2012). Creative students are as achievement-oriented as their less creative counterpart accomplishes (Beghetto & Kauffman, 2009; Siswono, 2011). Achievement in the area of education is considered very important for children, especially during adolescent years as in this competitive era, educational achievement has become an index of success. In today's world, academic excellence is marked as safe zone for anyone successful future and career security. Therefore, creativity in education is required in providing students' adequate opportunities to extend their current knowledge and possibility to create new ideas (Louca et al., 2014). The capacity to think creatively is influenced by various environmental factors and school environment is the one of these important variables. Although the creativity has elements of spontaneity, many investigators have emphasized on the relevant role that teachers and school environment all together may play in the onset of such creative processes through appropriate environment and the special strategies. By keeping in view such studies, the present research study was designed to assess the influence of students' school environment on their creative potential.

METHODOLOGY

This study was performed on 300 rural young adolescent boys and girls of age group 12 to 14 years from Hisar District of Haryana, India. The participants were selected on criterion-basis and the criterion was their academic brightness. The independent variables (type of school, academic class, consecutive academic record, teaching method employed by teachers and role of teachers in adolescents' creativity enhancement) and dependent variables (sub-aspects of blocks creativity and consequences creativity i.e., fluency, flexibility and originality) were examined in order to determine the differences in young adolescents' creative abilities based on their school environment. Type of school was categorized as Government school and private school. Academic brightness of the young adolescents was defined as 12 to 14 years old students who scored more than 85% from the last three consecutive academic classes. Consecutive academic record denoted the cumulative academic performance of the respondents from the last three academic classes consecutively. Academic class represented the class in which participants were studying at the time of data collection.

Teaching method employed by teachers depicted the particular teaching approach based on any learning theory that aims to achieve maximum learning such as, theoretical, demonstration and mixed method. Role of teachers for creativity enhancement of students was assessed on the basis of the teachers' support which involved delivering classroom instructions, preparing effective lessons, using appropriate teaching method, grading students' work and offering timely feedback, such as appreciating, encouraging, giving physical reward and timely organizing various activities to enhance their creativity. Blocks creativity was studied under four sub-aspects i.e.,

fluency, flexibility, originality and creativity. Consequences creativity was studied under three sub-heads i.e., fluency, originality and creativity. Fluency means generating as many ideas as possible in any given situation. Flexibility can be described as generating varieties of ideas that are different from each other. Originality can be understood as ideas and thoughts that are new and not simply extension of something already existing. Creativity is the ability to produce something innovative as well as valuable and problem solving based on any given situation.

All the participants were personally interviewed by the researcher. Primary data regarding all independent variables was gathered with self-developed questionnaire-cum-interview schedule. While, the data pertaining to dependent variables was assembled by using standardized Passi Test of Creativity developed by Passi (2006). The data was analyzed and interpreted by using Statistical Package for the Social- Science (SPSS) to calculate Z-test, ANOVA, Mean and Standard Deviation (S.D.).

RESULTS AND DISCUSSION

Highly significant differences were observed in adolescents' consequences fluency ($Z=3.64, p<0.01$), consequences originality ($Z=3.83, p<0.01$), consequences creativity ($Z=4.11, p<0.01$), blocks flexibility ($Z=3.61, p<0.01$) and blocks creativity ($Z=3.57, p<0.01$). Significant differences were elucidated in respondents' blocks fluency ($Z= 2.64, p<0.05$). The research results were supported by other researchers' research findings such as Pany (2014), Vaida (2012); Tasaduq & Azim (2012) who revealed that creativity scores differed significantly among Govt. and private school students (Table 1). Private school students performed significantly better in blocks fluency (Mean = 5.83), blocks flexibility (Mean = 11.41), blocks creativity (Mean = 37.29), consequences fluency (Mean = 20.76), consequences originality (Mean = 17.97) and consequences creativity (Mean = 38.71). The probable reasons behind this performance difference can be various facilities such as, school infrastructure, art activities, sports amenities and other co-curricular activities which are only provided in private schools along with this teacher in private schools also pays more attention towards students. Research results were supported by Singh & Rana (2016) who revealed that overall creativity was highest among private school students. Whereas, contradictory results were obtained by Sharma (2014), who found that level of creativity was highest among Govt. school students as compared to the private school students.

Table 2 revealed highly significant differences for blocks originality ($F = 9.09, p< 0.01$), consequences fluency ($F = 8.29, p< 0.01$), consequences originality ($F = 6.32, p< 0.01$) and consequences creativity ($F= 8.24, p< 0.01$), whereas, significant differences were elucidated in blocks fluency ($F = 4.89, p< 0.05$), flexibility ($F = 5.72, p< 0.05$) and creativity ($F = 4.56, p< 0.05$).

The ninth graders were better in blocks fluency (Mean=6.03), blocks flexibility (Mean = 11.44), blocks creativity (Mean = 36.94), consequences fluency (Mean = 21.74), consequences originality (Mean = 17.96) and consequences creativity (Mean=39.69), while eighth graders performed significantly better in blocks originality (Mean = 14.60). The research results were also in line with the research findings of the study conducted by Reddy et al., (2015),

Table 1. Mean differences in adolescents creativity on the basis of school type

Variables	Type of School				Z-value
	Govt. School (n= 150)		Private School (n= 150)		
	Mean	S.D.	Mean	S.D.	
Blocks Fluency	05.17	02.12	05.83	02.21	2.64*
Blocks Flexibility	08.99	05.63	11.41	05.98	3.61**
Blocks Originality	12.37	08.27	13.70	08.79	1.35
Blocks Creativity	29.77	17.18	37.29	19.21	3.57**
Consequences Fluency	16.92	08.46	20.76	09.77	3.64**
Consequences Originality	14.17	07.41	17.97	09.58	3.83**
Consequences Creativity	30.96	14.22	38.71	18.18	4.11**

*, **: Significant at 0.05 and 0.01 percent level of probability, respectively
 S.D.: Standard Deviation; n: Sample size

Table 2. Comparison of creativity across academic class

Variables	Academic Class						F-Value
	Eighth (n=131)		Ninth (n=105)		Tenth (n=64)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Blocks Fluency	05.21 ^a	02.29	06.03 ^b	02.13	05.22 ^a	01.90	04.89*
Blocks Flexibility	10.12 ^{ab}	05.79	11.44 ^b	06.35	08.31 ^a	04.94	05.72*
Blocks Originality	14.60 ^b	08.79	13.39 ^{ab}	09.10	09.23 ^{ab}	05.52	09.09**
Blocks Creativity	33.41 ^{ab}	18.44	36.94 ^b	20.30	28.16 ^a	14.38	04.56*
Consequences Fluency	17.46 ^{ab}	09.70	21.74 ^b	09.20	16.91 ^a	07.52	8.29**
Consequences Originality	16.00 ^{ab}	09.27	17.96 ^b	09.04	13.11 ^a	06.08	06.32**
Consequences Creativity	33.47 ^{ab}	18.03	39.69 ^b	16.72	29.69 ^a	11.38	08.24**

*, **: Significant at 0.05 and 0.01 percent level of probability, respectively
 Note: Means in the same row that do not share superscripts differ at p<0.05 using Duncan multiple difference comparison
 S.D.: Standard Deviation; n: Sample size

Table 3. Comparison of creativity across consecutive academic record

Variables	Consecutive Academic Record						F-Value
	85% to 87% (n=130)		88% to 90% (n=103)		91% & more (n=67)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Blocks Fluency	05.25	02.24	05.72	01.98	05.63	02.34	1.45
Blocks Flexibility	09.55	06.03	10.94	05.38	10.31	06.44	1.62
Blocks Originality	11.52 ^a	07.34	14.14 ^{ba}	09.16	14.27 ^b	09.37	3.65*
Blocks Creativity	30.45 ^a	18.66	35.58 ^{ba}	17.46	36.34 ^b	19.45	3.23*
Consequences Fluency	16.82 ^a	09.65	21.38 ^b	08.30	18.45 ^{ab}	09.96	6.98**
Consequences Originality	15.50	08.22	17.15	09.09	15.52	09.22	1.18
Consequences Creativity	33.24	16.64	37.42	15.92	33.97	17.93	1.92

*, **: Significant at 0.05 and 0.01 percent level of probability, respectively
 Note: Means in the same row that do not share superscripts differ at p<0.05 using Duncan multiple difference comparison
 S.D.: Standard Deviation; n: Sample size

which divulged that participant’s academic class had significant impact on their blocks creativity.

Table 3 portrayed highly significant differences in only one domain of creativity i.e., consequences fluency (F = 6.98, p< 0.01), whereas, significant differences were revealed in blocks originality (F = 3.65, p< 0.05) and blocks creativity (F = 3.23, p< 0.05) across consecutive academic record. Respondents who had consecutive academic record of 88 percent to 90 per cent performed better in consequences fluency (Mean = 21.38), while students who scored more than 91 per cent were significantly better in blocks originality (Mean = 14.27) and blocks creativity (Mean = 36.34). The research results were also supported by the two different research studies i.e. Awamleh et al., (2019) and Sumangala (2014), which revealed significant differences for adolescents’ creative abilities across their grade point average (GPA). While another study conducted by

Anwar et al. (2012) presented contradictory results i.e., there were no significant difference between high and low achievers in terms of their creative thinking.

Another study conducted by Qadir (2014) to investigate the impact of varying personality traits on the academic achievement of male and female adolescents elucidated that personality traits affected their school performance significantly in various subjects including mathematics and general science. Another similar research study conducted by Patil et al., (2018) revealed that various factors such as, family income, parental occupation, lack of expected cooperation from family members, health problems and lack of concentration were probable risk factors leading towards academic backwardness among adolescents.

Table 4 displayed significant differences in blocks fluency (F = 3.84, p< 0.05), blocks creativity (F = 5.19, p< 0.05) and

Table 4. Comparison of creativity across teaching method employed by teachers

Variables	Teaching Method Employed by Teachers						F-Value
	Theoretical (n=126)		Demonstration (n=129)		Mixed (n=45)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Blocks Fluency	05.90 ^b	02.15	05.16 ^a	02.21	05.36 ^a	02.10	3.84*
Blocks Flexibility	10.93	06.43	09.59	05.39	09.89	05.80	1.71
Blocks Originality	13.29	09.42	12.76	07.77	13.09	08.24	0.13
Blocks Creativity	38.39 ^b	20.38	31.70 ^{ab}	17.36	30.76 ^a	15.70	5.19*
Consequences Fluency	18.69	09.37	18.81	09.30	19.33	09.43	0.08
Consequences Originality	16.75 ^{ab}	09.24	14.83 ^a	08.17	17.73 ^b	08.71	7.72**
Consequences Creativity	35.42 ^{ab}	17.47	33.57 ^a	15.94	36.84 ^b	17.02	5.14*

*, **: Significant at 0.05 and 0.01 percent level of probability, respectively

Note: Means in the same row that do not share superscripts differ at $p < 0.05$ using Duncan multiple difference comparison
S.D.: Standard Deviation; n: Sample size

Table 5. Comparison of creativity of respondents based on role of teachers for enhancement of creativity

Variables	Role of Teachers in Adolescents Creativity Enhancement						F- value
	High (n=33)		Medium (n=110)		Low (n=157)		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Blocks Fluency	05.70	02.72	05.28	02.15	05.61	02.09	0.86
Blocks Flexibility	10.00	05.00	10.24	06.14	10.21	05.98	0.02
Blocks Originality	13.70	07.62	12.46	08.10	13.29	09.05	0.41
Blocks Creativity	30.39 ^a	16.96	32.42 ^{ab}	19.31	38.96 ^b	18.35	5.49*
Consequences Fluency	16.82	08.63	19.05	09.30	19.11	09.48	0.87
Consequences Originality	14.12	05.44	16.45	08.91	16.21	09.20	0.94
Consequences Creativity	30.94	12.61	35.50	16.93	35.19	17.35	1.01

*, **: Significant at 0.05 and 0.01 percent level of probability, respectively

Note: Means in the same row that do not share superscripts differ at $p < 0.05$ using Duncan multiple difference comparison

consequences creativity ($F = 5.14$, $p < 0.05$) across teaching method employed by teachers, whereas, highly significant differences were revealed in consequences originality ($F = 7.72$, $p < 0.01$).

The participants whose teachers adopted theoretical teaching method performed significantly better in blocks fluency (Mean = 5.90) and blocks creativity (Mean = 38.39), while, the students whose teachers used combination of both teaching methods (theoretical and demonstration) were significantly better in consequences originality (Mean = 17.73) and consequences creativity (Mean = 36.84). Clark (2012) examined the impact of school environment on adolescents' creativity and results elucidated that the creative abilities may be inhibited due to various factors such as, school deadlines, supervisory restrictions, evaluation techniques, reward structure and teachers' attitude towards carving students' creative potential. Along with, Hari et al., (2013) found that socio-cultural factors influenced the educational and occupational aspirations of rural youth. Certain social factors such as teachers, relatives, neighbors, media and social acceptance played important role in the youth' educational and occupational preferences.

Significant differences were elucidated in blocks creativity ($F = 5.49$, $p < 0.05$), whereas, no differences were revealed in the remaining sub-aspects of creativity. The students whose teachers made high level efforts were significantly better in blocks creativity (Mean= 38.96). Contradictory results were observed by Rose (2016), Budsankom et al., (2015); Devi (2015), who also found that positive student-teacher relationship and better school environment encouraged students in their creative endeavors.

CONCLUSION

On the basis of school type, highly significant differences were revealed in young adolescents' consequences fluency, consequences originality, consequences creativity, blocks flexibility and blocks creativity, whereas, significant differences were elucidated in blocks fluency. Private school students performed significantly better in blocks fluency, blocks flexibility, blocks creativity, consequences fluency, consequences originality and consequences creativity as compared to the Govt. school students. Results showed highly significant differences for blocks originality, consequences fluency, consequences originality and consequences creativity against students' academic class, whereas, significant differences were elucidated in blocks fluency, blocks flexibility and blocks creativity. The ninth graders were better in blocks fluency, blocks flexibility, blocks creativity, consequences fluency, consequences originality and consequences creativity as compared to eighth and tenth graders. Highly significant differences were revealed in only one domain of creativity i.e., consequences fluency across consecutive academic record and significant differences were revealed in blocks originality and blocks creativity. Students who scored more than 91 percent were significantly better in blocks originality and blocks creativity as compared to their low achiever counterparts. Significant differences were displayed in blocks fluency, blocks creativity and consequences creativity across teaching method employed by teachers, whereas, highly significant differences were revealed in consequences originality. Respondents whose teachers adopted theoretical teaching method performed significantly better in blocks

fluency and blocks creativity, while, the students whose teachers used combination of both teaching methods (theoretical and demonstration) were significantly better in consequences originality and consequences creativity. Significant differences were elucidated in blocks creativity across role of teachers in creativity enhancement of the students. The students whose teachers made high level efforts were significantly better in blocks creativity.

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Determinants of Skill Levels of Farm Youth with regard to Agripreneurship: A Multinomial Regression Approach

Pranoy Ray^{1*}, R. S. Panigrahi² and Simantini Shasani¹

¹Ph.D. Research Scholar, ²Professor, Department of Extension Education, Odisha University of Agriculture and Technology, Bhubaneswar, Odisha
*Corresponding author email id: pranoy-ee@pau.edu

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ABSTRACT

This study investigated various determinants of the differential level of skill as perceived by farm youth engaged in agripreneurship. The existing agripreneurial skill levels were delineated by developing a composite index constituting of 5 skill dimensions. Purposive sampling was adopted to select the rural youth belonging to farming background and involved in agripreneurship for higher income in five districts of Odisha representing five different agro-climatic zones. A total of 250 farm youth was sampled from the selected 10 blocks. The findings of the study revealed that, annual income from primary occupation, agripreneurial training, social media exposure and agripreneurship experience have significantly affected the existing level of skill possessed by farm youth with regard to agripreneurship. The findings affirm the need for extension personnel to understand the existing skill level, capacities, abilities of farm youth along with the factors determining them in order to create awareness and build capacities required for agripreneurship.

INTRODUCTION

Entrepreneurship has been widely acknowledged as an effective means for economic transformation (Kasabov, 2016; Bhuyan & Ivlevs, 2019). In present times, with the viability of small and marginal scale farming dampening due to the rising cost of cultivation, declining market returns and degradation of natural resources, entrepreneurship development in agriculture has become an important area of research as well as policy and development initiative. Agripreneurship development focuses on creating an exciting breed of farmers with core business skills in undertaking farm-based businesses for enhancing their income, who undertakes a variety of activities in agriculture sector in order to be an entrepreneur. The term agripreneurship is defined as generally sustainable, community oriented and directly marketed agriculture. Sustainable agriculture denotes a holistic, system-oriented approach to farming that focuses on social, economic and environmental process.

A shift from agriculture to agribusiness is an essential pathway to revitalize Indian agriculture. The demands, opportunities, and

challenges of the changing business environment in the agricultural industry has necessitated farmers to become entrepreneurial (Sinyolo & Mudhara, 2018). The combined effects of factors such as market liberalisation, climate change, increased dominance and penetration of modern food chains have forced producers to develop new skills and capabilities in order to survive or remain competitive (Díaz-Pichardo et al., 2012; Pindado & Sánchez, 2017). Entrepreneurial options that farmers have employed include implementing selective product specialisation, enterprise diversification, market orientation, production up-scaling, product development, processes innovation, and vertical integration (McElwee & Bosworth, 2010). According to Hansson et al., (2013), the definition of agripreneurship also incorporates other income-generating strategies such as off-farm employment and multiple business holdings. Due to the evolving production and business environment in the twenty-first century, efforts to enhance the participation of younger generations in agriculture have been increasing.

Rapid population growth in developing countries like India is projected to lead to an unprecedented rise in number of youths

entering the labour market in the next few years. The empowerment of youth and their role in agriculture, or the agri-food sector, has received increased interest as a potential pathway to provide employment opportunities for young job seekers. (FAO et al., 2014). Encouraging agripreneurship in rural area among the farm youths would be instrumental in changing the face of the country as majority of the population still lives in rural India. Many young farmers have taken up agriculture seriously and have been evolving several farm innovations in an effort to solve their specific farm problems. Engagement of farm youths as young agripreneurs is critical for livelihoods in rural areas where millions of youth are unemployed and face many barriers in agriculture sector (Santiago et al., 2017). The current state of global economic meltdown, economic crises or recession around the world has created the need to develop proper agripreneurial skills or training among youth for proper opportunity utilisation in order to turn economy capacity towards more productive youth. The skill of the youth entrepreneur might be improved through conducting effective capacity building programmes related to the sector where they lack required expertise (Arunkumar et al., 2021). Many youths of nowadays possess business ideas but only few have the capacity and ability to turn it into viable businesses (Shane et al., 2012). So, it is essential to understand the skillsets, capacities, abilities and the determinants of the greater skill levels of farm youth with regard to agripreneurship.

METHODOLOGY

It is important to assess the profile of the farm youth who are already engaged in agripreneurship and analyse the degree of existing agripreneurial skills possessed by them. The study was quantitative and descriptive analytical in nature, descriptive in terms of proper identification of facts, profile and skill level at field setting, non-experimental in terms of control of variables and quantitative in terms of data collection method. The experts having notable work in terms of publications and mentoring in areas of youth agripreneurship were considered for delineating and finalising the indicators of agripreneurial skills for farm youth in terms of their relevancy. The youth in the age range of 15-34 years constitute the research population who belongs to farming background in rural areas. The state of Odisha comprised of 10 agro-climatic zones which are broadly classified into two distinct regions viz. Highland region and coastal region. In order to have a proper representative sample of entire Odisha, two highland regions and two coastal regions from different directions of Odisha and one region which is a combination of highland and coastal region was randomly selected. Five districts were selected randomly from five different agro-climatic zones. These are Kalahandi (Western undulating zone), Mayurbhanj (North central plateau), Ganjam (North-Eastern ghats), Puri (East and south eastern coastal plains) and Balasore (North eastern coastal plains). Two blocks were selected from each of the five districts through simple random sampling. Thus, a total of 10 blocks namely Junagarh and Dharmagarh (Kalahandi), Chikiti and Digapahandi (Ganjam), Pipili and Sakhigopal (Puri), Badasahi and Gopabandhu nagar (Mayurbhanj), Balasore Sadar and Remuna (Balasore) were selected. Twenty-five respondents were selected from each of the ten blocks purposively through consultation and

discussion with field level extension personnel at block level. Thus, the sample size is composed of 250 farm youth representing five different agro-climatic zones of the Odisha state. The farm youths already engaged in any agripreneurial enterprise for enhancing their income were considered for the study. The agripreneurial enterprise includes horticulture, mushroom cultivation, poultry, fishery, animal husbandry, integrated farming system, apiculture, vermicomposting.

An interview schedule was used to check the actual status of farm youth prevalent in terms of agripreneurial skills by developing a composite index. The index consisted of 5 agripreneurial skill dimensions and each comprising of five indicators. A total of 25 indicators forms a part of the index which was used to assess the existing skill level of farm youth. The face and content validity of the questionnaire was confirmed by an expert panel. To estimate the reliability of the questionnaire, a pilot study was carried out on 30 non-sample farm youths outside the research area. Then, the coefficient of Cronbach's alpha was calculated for different sections of the questionnaire to be 0.71–0.91, showing the acceptable reliability of the research variables. Finally, the collected data were analyzed by multinomial logistic regression analysis in the SPSS₂₁ software package where the explanatory variables were age, agripreneurship experience, training, social media exposure, agripreneurship income while dependant variables were low, medium and high skill level. In the developed index, the index scores under each indicator were categorized into low, medium and high based on the range method.

RESULTS AND DISCUSSION

The agripreneurial skills which were categorised into five different types in the developed index viz. personal skills, creative thinking skills, agri-business management skills, psychological and strategic thinking were assessed among the 250-farm youth. The personal skills of farm youth essential for the success of agricultural enterprise, taken were perseverance, community leadership, effective communication, network building and lifelong learning which were essential for the success of agricultural enterprise. The results in Table 1 revealed that a considerable majority (58.80%) of farm youth were having low skill level in perseverance. This is mainly because young agripreneurs possess lot of innovative business ideas for success in their farm but they lack proper skills to continue their enterprise in long run and to manage it after facing obstacles. Due to their proactiveness and involvement in community welfare activities, young agripreneurs possess greater degree of leadership activities, this is significantly visible with 58 per cent of youth in higher level. Communicating effectively with stakeholders is a critical ability for entrepreneurial success. This is where many farm youth lag with only 8.4 per cent in higher category and 22 per cent with low skill level. Large number of farm youth possess higher skill level in developing working relationship for success of enterprise viz. network building and ability to learn from everyday experiences viz. lifelong learning with 58 per cent and 56 per cent respectively.

Farm youth are extremely important target group for agricultural development perspective in rural areas, as their dissociation from farming will deprive the sector from next generation successor. So, it is essential to understand the constraints

Table 1. Distribution of the skill level of the farm youth in terms of agripreneurial skill (n=250)

S.No.	Agripreneurial skills	Low	Medium	High
<i>I</i>	<i>Personal Skills</i>			
1	Perseverance	147 (58.80)	68(27.20)	35(14.00)
2	Community leadership	46(18.40)	59(23.60)	145(58.00)
3	Effective communication	55(22.00)	174(69.60)	21(8.40)
4	Network building	39(15.60)	66(26.40)	145(58)
5	Lifelong learning	43(17.20)	66(26.40)	141(56.40)
6	Creative Thinking skill			
7	Innovativeness	64(25.6)	133(53.20)	63(25.2)
8	Analytical and critical thinking	64(25.6)	142(56.80)	44(17.60)
9	Idea generation	100(40)	125(50)	25(10)
10	Decision making	38(15.2)	57(22.8)	155(62)
11	Problem solving	77(30.8)	95(38)	78(31.2)
<i>II</i>	<i>Agri-business management skill</i>			
1	Agri-logistics management	34(13.6)	210(84)	6(2.4)
2	Fund management	74(29.6)	18(7.2)	158(63.2)
3	Negotiation	62(24.8)	34(13.6)	154(61.6)
4	Capturing market	73(29.2)	135(54)	42(16.8)
5	Risk management	69(27.6)	122(48.8)	59(23.6)
<i>III</i>	<i>Psychological skill</i>			
1	Motivation	52(20.8)	28(11.2)	170(68)
2	Internal locus of control	56(22.4)	127(50.8)	67(26.8)
3	Resilience	64(25.6)	29(11.6)	157(62.8)
4	Self-efficacy	55(22)	88(35.2)	107(42.8)
5	Agripreneurial orientation	43(17.2)	66(26.4)	141(56.4)
<i>IV</i>	<i>Strategic thinking skill</i>			
1	Opportunity recognition	54(21.6)	50(20)	146(58.4)
2	Agribusiness planning	78(31.2)	20(8)	152(60.8)
3	Demand forecasting	62(24.8)	83(33.2)	105(42)
4	Vigilance	55(22)	12(4.8)	183(73.2)
5	Information seeking	2(0.8)	182(72.8)	66(26.4)

*Figures in parentheses represent percentages

faced by them with regard to agripreneurship. Entrepreneurship climate and enabling environment need to be created that will ignite the spirit of entrepreneurship among young entrepreneurs (Kobba et al., 2020). Multinomial logit (MNL) was used to determine the various determinants of differential level of skill among the farm youth with regard to agripreneurship in rural Odisha. In this multinomial regression analysis, the first category i.e., lower skill level was considered as the reference level. Statistical software SPSS 21 has been used to calculate the LOGIT coefficients and the results has been presented in the Table 2. The results of the MNL model indicates that different socio-economic factors viz. age, agripreneurship experience, training, social media exposure and annual income from primary occupation of farm youths affect the ability to perceive skill level with regard to agripreneurship. The estimated coefficients of multinomial logistic model provide only the direction of the effect of the independent variables on the dependent variables, and they do not represent the actual magnitude of change or probabilities. Thus, the marginal effect from MNL determines the expected change in probability of a particular outcome being made with respect to unit change in independent variable are discussed.

From Table 2, it is depicted that in case of medium skill level category, training related to agripreneurship and social media exposure were significantly (both at $p < 0.01$) contributing to medium skill level. It also clearly revealed that, with every one unit increase in training related to specific agripreneurship, the odds ratio to have medium skill level compared to lower skill level increases by 2.351

times. Generally, it is also pertinent that greater number of training exposure related to agripreneurship enhances the ability of the farm youth through capacity building. The odds ratio of farm youth possessing medium skill level increases by 0.491 times with every one unit increase in exposure to social media compared to low skill level category. In the present digital age, social media have grown into immense importance for various information needs of farm youth and has huge potential to act as an essential tool for behavioral change. Additionally, farm youth get attracted to the innovative techniques in farming through social media and if they are effectively utilized, it can act as a boon for farm youth engaged in agripreneurship. Hence, it may be a cause of being a significant determinant. In case of high skill level, low level of annual income and medium level of annual income from the primary occupation significantly (both at $p < 0.01$) contributed to high skill level. It was also found that, with one unit increase in low and medium level of annual income from primary occupation, the odds ratio to have higher skill level enhances by 0.007 times and 0.222 times respectively. Annual income from primary occupation acts as essential support in terms of much needed capital support for secondary source of income and to do well in agripreneurship. It was also observed that, agripreneurship experience was significantly (at $p < 0.05$) contributing to the higher skill level. The table clearly reveals that increase of experience in agripreneurship by one unit increases the probability of a farm youth having higher skill level by 0.913 times. Generally, the farm youth gain their expertise with greater experience in agripreneurship and they attain much needed

Table 2. Estimated multinomial logit Coefficients of factors determining skill level of farm youth

Skill Level	Explanatory Variables	B	Std. error	Sig.	Exp (B)	95% Confidence interval for Exp (B)	
						Lower	Upper
Medium	Intercept	20.708	4.055	.000			
	Age	-.194	1.213	.873	.824	0.76	8.880
	Agripreneurship experience	-.112	.125	.370	.894	0.700	1.142
	Training	.855	.312	.006	2.351*	1.275	4.335
	Social media exposure	-.711	.251	.005	.491*	0.300	0.803
	Low agripreneurship income	-19.467	2.696	.000	0	0	0
	Medium agripreneurship income	-19.426	1.361	.000	0	0	0
High	Intercept	22.750	1.491	.000			
	Age	.352	.324	.276	1.422	0.754	2.682
	Agripreneurship experience	-.091	.043	.032	.913**	0.840	0.992
	Training	.272	.139	.051	1.312***	0.999	1.723
	Social media exposure	-.068	.080	.395	.934	0.798	1.7
	Low income (Primary occupation)	-4.967	1.202	.000	.007*	0.001	0.074
	Medium income (Primary occupation)	-3.836	1.120	.001	.022*	0.002	0.194
	Low income from agrienterprise	-22.446	1.762	.000	0	0	0

The reference category is lower level of skill

* Significant at 10% level ** Significant at 5 % level *** Significant at 1% level

skill level with growing years of experience. In case of higher skill level farm youth, training contributes at 10% level of significance. With every one unit increase in training, the odds ratio of farm youth attaining higher skill level enhances by 1.312 times in comparison to the lower skill level. From these results, it may be concluded that capacity building efforts like training and social media exposure are major factors determining skill level of farm youth along with agripreneurship experience and annual income from primary occupation which provides much needed support to the agri-enterprise. Maurya et al., (2021) in their study also recommended that there is a need for special efforts to attract, train and retain the rural youth in agriculture as a whole by developing more favourable attitude towards agriculture by transforming and making it more agribusiness oriented, scientifically attractive and economically profitable. There is a necessity of hands on-training programmes which must be prioritized for rural youth and young agripreneurs through proper assessment of their training needs (Sajeev et al., 2021).

CONCLUSION

From the study it can be concluded that, majority of the farm youth were having low skill level under the dimension of perseverance. It might be because of lack of proper management skill to sustain the enterprise in a long run. Though they are involved in leadership activities proactively, their communication ability with the stakeholders is still a constraint. Among the determinants of the medium skill level of rural youth, the effect of exposure to training programme and social media were found significant in contributing towards enhancing the skill level. In case of farm youth having high skill level, it was found that agripreneurship experience and training were the major determinants for increasing the skill level. It might be because of applying proper expertise from the experience and utilisation of required skill from the training programmes. They need to be updated and upgraded with modern agripreneurial skills in order to derive the maximum out of the agri-enterprise undertaken.

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Economics of Small Tea Farming System (STFS): An in-depth Study of North Bengal, India

Subhrajyoti Panda^{1*}, Avrajyoti Ghosh², Litan Das³, Satarupa Modak⁴, Sabita Mondal³, P. K. Pal⁵ and M. S. Nain⁶

¹Assistant Professor, Faculty of Agriculture, Sri Sri University, Cuttack, Odisha, India

²Research Scholar, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, India

³Assistant Professor, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, India

⁴Assistant Professor, Centurion University of Technology and Management, Odisha, India

⁵Professor, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, West Bengal, India

⁶Principal Scientist, Division of Extension Education, ICAR-Indian Agricultural Research Institute, New Delhi

*Corresponding author email id: subhrajyotip1992@gmail.com

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ABSTRACT

The study was conducted to find out the pattern of labour engagement (both family and hired labour), price realization of different type of small tea growers and economic analysis of the small tea growing system. Small tea growers of Jalpaiguri and Uttar Dinajpur district of West Bengal were selected purposively. The present study mainly considered primary data for analysis and a small amount of secondary data was also collected from records of Confederation of Indian Small Tea Growers' Association (CISTA) and Self-Help Group (SHG) registers. It has been found that there is a variation in price of green leaves in both districts and higher rates are observed in the month of March. SHGs with own processing units were found to fetch higher prices compared to other units because of their collective bargaining power, absence of middlemen and owing co-operative processing units. Number of such SHGs, with processing units were found in Jalpaiguri district whereas, Uttar Dinajpur district recorded no SHG with own processing units. The economic analysis also presented a clear picture about fixed and operational cost, gross return with or without dividend and benefit cost ratio.

INTRODUCTION

India is the second largest producer and exporter of tea in the world after China since 2014 (Anonymous, 2015). It is also the world's largest consumer of tea, uses nearly one third of the global output (Basu et al., 2011). It was forecasted from the last baseline survey that India's tea industry is expected to grow from its current turnover of Rs. 19,500 crores to Rs. 33,000 crores by the end of 2015 (Executive Summary of Study on Domestic Consumption of Tea in India, 2018). Presently, tea is being cultivated in 14 states across the country. The major contributors are Assam and West-Bengal in North India and Tamil Nadu, Kerala and Karnataka in South India. The Indian tea industry has harvested its highest tea crop of 1,350 million kg in 2019, wherein North India itself has

contributed 1,124 million kg. Tea cultivation on small holding was initiated (1930's) beyond the traditional tracts of cultivation in Nilgiris of Tamil Nadu. In the late 1980's or early 1990's this cultivation practice spread to the unconventional tea producing states of India like Assam and West Bengal. The Tea Board of India (TBI) formally adopted the concept of Small Tea Grower (STG) during the eighth five-year plan (Hannan, 2008). The small tea growers now have the half of the total share in the country's tea output with West Bengal's *Terai* region. This part of India is contributing the highest share of 73.6 per cent, whereas Tamil Nadu contributes 61.2 per cent only (Share of small tea growers in harvest, 2019). There are 37,365 such small tea growers (around 33711 ha area) in West Bengal (State Wise Tea Growers, 2019), contributing around 91 million kgs of production, and 43 per cent of West

Bengal's total tea production (357 million kg). In West Bengal, history of small tea growing started from North-Bengal area, transforming traditional pineapple fields into tea plantation. These Small Tea Growers (STGs) being small and marginal category of farmers having limited resources were considered to be the most vulnerable group in the system (Baruah & Taparia, 2004) and small tea growing system is gradually emerging as a promising sector and being substitutable to the traditional crop production system. The present study was conducted with objective of assessing the employment generation through tea cultivation and to analyze the benefit cost ratio of the tea growing system.

METHODOLOGY

Random sampling was employed to select the respondents. 100 respondents from each district from the study areas were selected randomly of which 50 respondents associated with SHG and 50 respondents with non-SHG. So, altogether 200 small tea growers (100 SHG and 100 non-SHG growers) were chosen randomly from the two districts that was Jalpaiguri and Uttar-Dinajpur. Hence, the study was conducted in high concentrated, small tea growing districts of Jalpaiguri and Uttar Dinajpur of West Bengal. Wherein, the state and the districts were selected purposively for the study. The respondents were selected purposively as per the recommendation made by the personnel of CISTA (Confederation of Indian Small Tea Growers Association). Focused group discussion and individual interview method with structured schedule are used for primary data collection and CISTA records and SHG registers are referred for secondary data collection. Collected data were than analyzed to find out the benefit cost ratio with and without dividend. Regression analysis was also done. An attempt has also been made to find out the dividend received by the small tea growers from various stakeholders. Here, dividend means the extra profit/remuneration gained by the SHG members due to their own processing units or lack of middlemen in their value chain system.

RESULTS AND DISCUSSION

Employment generation scenario in the small tea growing system (STGS)

The section represents findings regarding employment generation scenario in small tea growing systems through labour engagement round the year interms of mandays per acre per year. As a consequence of the emergence of such a system, it was found that local laborer were being engaged in different activities so, migration to other areas has been reduced (Chowdhury, 2016; Laskar, 2015). Table 1 depicted the operation wise labour days engaged in the small tea sector per acre per year. From the figure, it is found that highest man days needed in plucking operations which is a round the year activity. 164.15 man days on an average out of total of 301.76 man days required per year was engaged in plucking. Second largest operation in respect of labour requirement is irrigation (46.31) followed by fertilization (36.50) and spraying (35.75). It is depicted that on an average under direct manual labouring activities, family labour contributes only 10.75 man days per acre per year. Family labour engaged maximum in case of

Table 1. Labour Requirement (Men days per acre per year)

Operation	Family labour	Hired labour	Total
<i>Operation based direct manual labour</i>			
Fertilizer application	2.92	33.58	36.50
Irrigation activities	1.23	45.08	46.31
Weeding work	3.10	8.35	11.45
Spraying activities	1.25	34.50	35.75
Plucking	0.35	163.80	164.15
Post harvest operation	1.90	5.70	7.60
Sub-Total	10.75	291.01	301.76
<i>Overall management and supervision</i>			
All the activities	39.74	0	39.74
Grand Total	50.49	291.01	341.50

weeding (3.10) and minimum in case of plucking activities (0.35). Hired labour engagement observed to be higher in plucking activities (163.80) followed by irrigation activities (45.08) but it is observed lowest in post-harvest operation (collecting, storing and disposal of harvested green leaves activities).

Actual contribution of the family workforce was found to be in management and in the overall supervision of the garden. The unprofitability of traditional crops has forced them into tea cultivation and has given them the opportunity to transform themselves from job seekers to job providers. They have oriented themselves as entrepreneurs from mere cultivator peasants. The satisfaction and gratification associated with tea growing system might also be a strong factor for sustenance of this system. Figure 1 reveals a clear picture about the number of man days required at different stages of plantations. Minimum labour requirement was observed in the 2nd year age of plantation (257.50) and maximum requirement was found to be in the 12th year of plantations (321.88). The regression equation clearly shows that there is an increasing trend of man days requirement/ac/yr. R² value indicates the variability which is due to variation of age of the tea garden.

The Table 2 depicted month wise labour requirements for the small tea sector of North-Bengal. The highest labour requirement was observed in the month of October and lowest in the month of February. The low labour requirement was found in the first two months of the year because this is found to be the lean period of leaf production hence, plucking activities during this period remains almost negligible. Only some maintenance works like weeding, cleaning etc. are found to be done during this time which requires

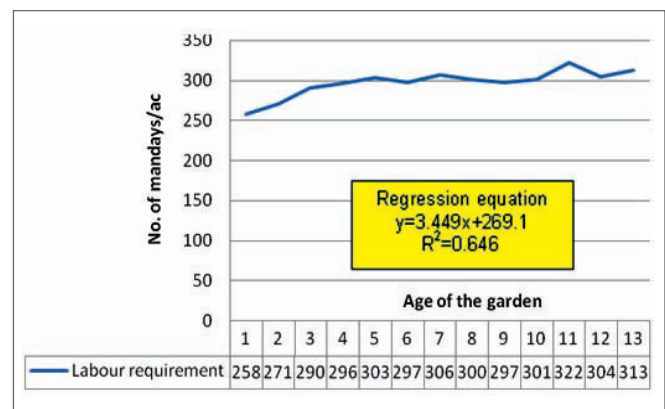


Figure 1. Labour requirement at different ages of the tea garden

Table 2. Month wise labour requirement/acre/year

Month	No. of labours / acre/year
January	15.33
February	14.23
March	24.53
April	25.88
May	31.49
June	32.35
July	33.67
August	32.88
September	32.95
October	35.53
November	24.69
December	19.57

less man days. New flashes start from March-April; labour requirement thus found to start increasing during this time however during September-October, the leaf yield as well as labour requirement to pluck them found to be the highest. It has also been observed that requirement for labour remains high during the months of May to October. October being the lean period requires lower man days which found to remain low up to the month of February. Plucking was found to be the indicator of labour requirement and almost 60 per cent labourer were found to be engaged in plucking activities throughout the year. The results are in line with Kadavil (2012); Laskar (2015), who opined that quality tea production is one of the most, labour (65% of total input cost) intensive activities.

Price realization trend during the year

Table 3 illustrates the rate of variation of green leaves in both the districts. It is shows that the rate of the green leaves was found to be high in the month of March in both the districts. In all the cases under observation high rates managed by SHGs with own processing units compared to SHGs without any processing unit reason being the absence of middleman in the process of marketing. The data also revealed that the price of green leaves of Jalpaiguri district was higher than the those of Uttar-Dinajpur district and same fact was also being reported by Tea Board of India (2007). This might be due to the reason that in Uttar-Dinajpur district, farmers are not much quality conscious. It was also observed that the SHGs are getting higher rate for tea leaves due to the power of

collective bargaining as well as direct marketing, avoiding middlemen brokerages because of the possession of own processing units by the SHGs. Regarding the tea leave harvesting round the year, November and December months have recorded the lowest yield for both Jalpaiguri and Uttar Dinajpur districts. It may be due to the seasonal variations as less growth of green leaves observed during winter season. Furthermore, the Table 3 Shows that the maximum rate for green leaf (Rs. 22.25/kg) was fetched in the month of March by SHG members of Jalpaiguri district with own processing units, whereas SHGs without own processing units could fetched Rs. 21.67/kg, almost similar to non-SHG members fetching Rs. 21.00/kg for the green leaves. The results could establish that farmers having own or cooperative processing unit have the highest control over value chain and also could able to maintain better quality of green leaves as well as could control market rate. This result is in line with Mansingh & Johnson (2012); Hazarika & Borah (2013); Chowdhury (2016). Baruah (2003) enlightened that SHGs with own brand name can also enjoy fair price realization.

Economic analysis of the system

The ultimate aim of any tea cultivation system is to gain economic surplus from it. The study has also attempted to analyze the small tea growing system from the economic point of view find out the profit growers could gain out of it. The Table 4 presents the fixed and operational cost, gross return with or without dividend as well as the B:C ratio. Dividend here indicates the extra remuneration earned by the respondents (mainly SHGs) due to the possession of own processing units and marketing of the processed tea. From this table only fixed cost is observed in the first year, *i.e.* Rs. 47,400/ acre which was incurred for different activities required for the establishment of the garden like cost of land preparation, purchase of seedlings and sowing operation. It was also observed that the operational cost varied from the third year to 12th year. Maximum operational cost was found to be Rs. 71,148 *i.e.* during the 12th year the garden whereas minimum was observed in third year *i.e.* Rs. 60, 570/acre. In case of dividend, first year it was found to be nil because of no production, maximum dividend of Rs. 17,958/acre was observed in the 10th year of plantation. The minimum dividend *i.e.* Rs. 13,726/acre has been seen in the third year because of the minimum leaf production. Thus, it can be said

Table 3. Rate of green tea leaves in Jalpaiguri and Uttar Dinajpur district (Rs/kg basis)

Months	Jalpaiguri			Uttar Dinajpur*	
	Non-SHG	SHG without own processing unit	SHG with own processing unit	Non-SHG	SHG without own processing unit
January	9.50	10.08	10.75	8.12	7.83
February	10.00	9.83	10.50	8.00	7.83
March	21.00	21.67	22.25	16.90	16.23
April	15.50	15.93	16.50	14.93	14.63
May	16.75	16.87	17.13	14.90	14.67
June	15.75	16.05	16.25	14.38	13.87
July	12.85	12.98	13.50	11.37	11.52
August	11.10	11.08	11.35	9.37	9.32
September	11.85	11.27	12.63	9.52	9.52
October	11.75	11.92	12.00	9.73	9.07
November	9.55	9.70	10.63	8.17	7.77
December	7.80	9.15	9.08	7.77	7.50

*in Uttar Dinajpur, there was no SHG with own processing unit

Table 4. Economic analysis of small tea growing system

Age of the garden (Yr.)	Fixed Cost (Rs./acre)	Oper. Cost (Rs./acre)	Dividend (Rs./ac)	Gross return without dividend (Rs./acre)	Gross return with dividend (Rs./acre)	B/C ratio without dividend	B/C ratio with dividend
1	47400.00	61740.00	0.00	0.00	0.00	NA	NA
2	0.00	61740.00	14400.00	86400.00	100800.00	1.40	1.63
3	0.00	60570.00	13726.00	82356.00	96082.00	1.36	1.59
4	0.00	65274.00	13880.00	83280.00	97160.00	1.28	1.49
5	0.00	65508.00	14316.00	85896.00	100212.00	1.31	1.53
6	0.00	65025.00	15064.00	90384.00	105448.00	1.39	1.62
7	0.00	65283.00	15818.00	94908.00	110726.00	1.45	1.70
8	0.00	65715.00	17172.00	103032.00	120204.00	1.57	1.83
9	0.00	66210.00	16592.00	99552.00	116144.00	1.50	1.75
10	0.00	68370.00	17958.00	107748.00	125706.00	1.58	1.84
11	0.00	67986.00	15952.00	95712.00	111664.00	1.41	1.64
12	0.00	71148.00	14780.00	88680.00	103460.00	1.25	1.45
13	0.00	68820.00	14750.00	88500.00	103250.00	1.29	1.50
14	0.00	65271.00	15484.00	92904.00	108388.00	1.42	1.66

that the dividend was found to be decreasing after the 10th year of plantation due to the decreasing production trend after the 10th year (Figure 2).

Table 4 depicts that the maximum and minimum gross return without dividend has been observed in the 10th year i.e. Rs. 1,07,748/acre and in the third year i.e. Rs. 82,356/acre respectively. In case of the gross return with dividend maximum return of Rs. 1,25,706/acre was observed in the 10th year and minimum return i.e. Rs. 96,082/acre was observed in the third year of the plantation. In case of B:C ratio without dividend, maximum ratio i.e. 1.58 was observed in the 10th year of the plantation, followed by 1.57 in 8th and 1.50 in 9th year age. From the age of 8th year to 10th year of small tea plantations, B:C ratio without dividend was found to be the maximum and minimum in the 12th year of plantation. On the other hand, B:C ratio with dividend was found to be maximum i.e. 1.84 in 10th year of plantation followed by 1.83 in the 8th year of plantation and minimum 1.45 in 12th year of plantation. A similarity was observed in these two kinds of B:C ratios as both remained high in 8th to 10th year of age of plantation and was found to be below in the 12th year of plantation (Figure 3).

The trend line for operational cost and B:C ratio generalizes the picture with regression line depicted that there is an increasing trend of operational cost over the years with a base cost of Rs. 60,831/ year/ acre and an incremental cost of Rs. 563.20/ year/ acre (Figure 3). The R² value (65.2% variability in operational cost)

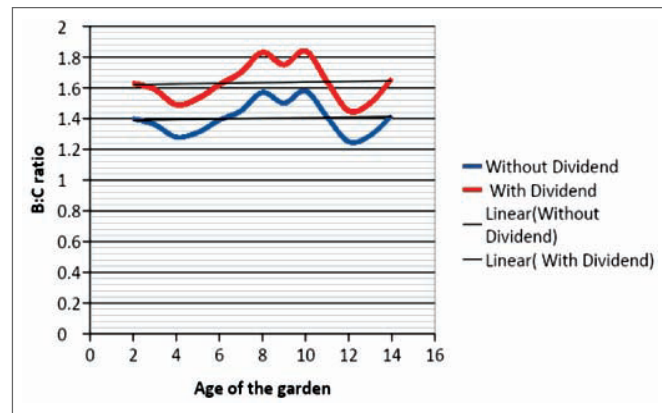


Figure 3. B:C ratio with and without dividend (Age wise)

explains that it happened due to the variation in the age of the garden. In case of the B:C ratio, no variation over the ages of the garden was found. Though yield increases with the age of the garden, B:C ratio was found to be more or less same due to high operational cost. Value of R² also supported the fact that there is actually no change in B:C ratio over the ages of the garden. This result is in line with Yogish (2017) indicated B:C ratio varies as per the age of the garden for plantation crops.

The Figure 4 is a graphical representation of the cumulative net profits (with or without dividend) found over the age of the

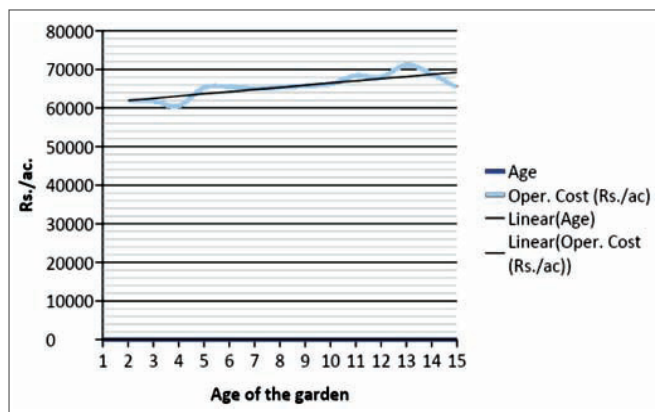


Figure 2. Age wise variation in operational cost

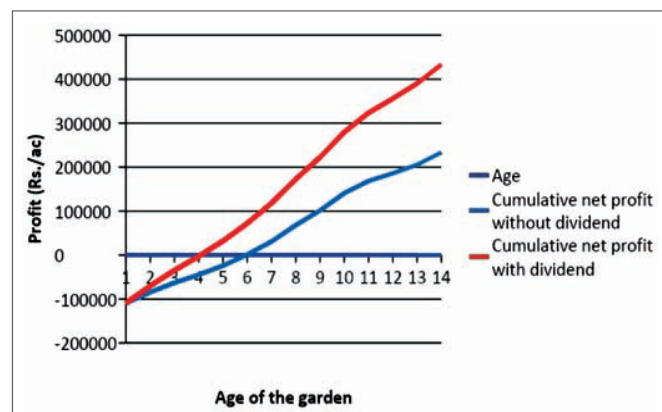


Figure 4. Cumulative profit trend in small tea sector

gardens. It was found that the cumulative net profit with dividend starts from 4th year and profit without dividend starts from 6th year onwards. Cumulative net profit touches approximately Rs. 4,50,000 per acre after 14th years of the age of the garden in case of with dividend and without dividend only Rs. 2,50,000 per acre. It was observed that the dividend usually comes from their processing units (on cooperative basis) hence, its' establishment might be an important policy implication for profit maximization of the small tea growers of North Bengal.

CONCLUSION

Farmers of Uttar Dinajpur and Jalpaiguri districts have adopted small tea growing system as an economically beneficial option over other existing cropping systems. This tea growing system is found to be capable of generating huge employment prospects as it requires high man-days round the year. It could be a highly viable enterprise among the farm families of North Bengal if the Tea Boards of India and other intervening institutions would extend their support in the form of training regarding the set-up of co-operatives or community processing units and spreading awareness about the quality parameters of green leaves. Facilitation should be extended to them to get high remunerative prices for green harvests as well as for processed tea leaves. Hence, if the lean period is taken care of, this system can be adopted by the small and marginal farmers as a profitable venture for livelihood generation and farm diversification.

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Investment and Resource Use Pattern followed by Dairy Farmers in Haryana

Suman Ghalawat¹, Manju Loura², Joginder Singh Malik³, Dalip Kumar⁴ and Anamika^{5*}

¹Assistant Professor, ^{2,5}Research Scholar, Department of Business Management, CCS HAU, Hisar, Haryana, India

³Professor, Department of Extension Education, CCS HAU, Hisar, Haryana, India

⁴Assistant Scientist, Department of Agricultural Economics, CCS HAU, Hisar, Haryana, India

*Corresponding author email id: anusingh93anu93@gmail.com

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ABSTRACT

Dairy sector plays a critical role in growth of rural India by providing livelihood opportunities to millions of people. The present study was conducted in Zone-I and Zone II of the Haryana state. District Kaithal and Karnal were selected from Zone I whereas Sirsa and Hisar districts represented Zone II to study the investment and resource use pattern followed by the dairy farmers. To achieve the objective the primary data from the 200 sampled dairy farms (divided into three categories i.e. small, medium and large herd size of milch animals) were collected through survey method. The study revealed that the total investment per milch animal per day in small, medium and large herd size group was Rs.175.50, 178.40 and 181.80, respectively, in Zone-I and Rs.170.08, 174.30 and 175.86, respectively, in Zone-II. From total investment, major proportion was covered by investment on feed and fodder, followed by concentrates and labours in both the Zones. It may be suggested that providing feed concentrates and high yielding seeds of green fodder crops at cheaper rates and credit facility should be strengthened.

INTRODUCTION

Livestock farming is important for sustenance and to supplement the income of the farmer. India ranks first with 22 percent of the total world milk during 2018-19 with 198.4 million tonnes of milk (Basic Animal Husbandry Statistics, DAHD&F, G.O.I Report, 2019). The government and different agencies needed to work in coordination with each other for proper and timely supply of technologies, services and facilities to farmer which ultimately helps in proper utilization of scarce resources (Dixit et al., 2018). Dairy farming helps in reducing risk for farmers through diversification as livestock and dairy complements each other and it improves the financial and social well-being of farmers (Sen et al., 2018).

Haryana state possesses a high milk production potential due to its favourable resource's endowments and receptive farming community. Haryana is having higher per capita availability of milk i.e. 930g as compared to our whole country. Basically, milk

productivity depends on four dimensions of animal husbandry practices i.e. breeding, feeding, health-care and management practices. There should be harmonious relationship between demand and delivery of veterinary services with prospects of monitoring and supervisory support to improve the potential of dairy farming (Kumar & Meena, 2021). Farm training significantly contributes in knowledge and positively influenced the adoption and income of dairy farmers by improving their knowledge and skills (Khode et al., 2021). The expenditure on fodder and concentrates formed the major part in total cost of buffalo milk production (Deoghare & Bhattacharyya, 1994). In all the herd size groups, feed constituted the most important item accounting for about 53 to 74 per cent followed by labor with nearly 10 to 25 per cent of the total cost in the different season (Jha et al., 1983). The expenditure sustained on fodders and concentrates constituted about 60 per cent followed by the cost of labour (26%), depreciation and interest charges (12%) and (2%) of veterinary expenses (Rao 1985). The per litre cost of buffalo milk production was highest (Rs. 7.95) in small herd size

milk producers followed by medium and large producers (Hymajothi et al., 2003). The concentrates leads more more productivity in milk yield (Grover and Sankhayan, 1992). Majority (51%) of farmers belonged to medium (14.27-70.66 l) milk producers, followed by 36 per cent and 13 per cent had small (<14.27 l) and large (above 70.66 l) milk producers' day/household, respectively (Birader et al., 2013). The fodder and feed accounted for 67.76 and 12.23 per cent followed by labour charges with 14.21 per cent (Pathania and Sharma, 2015). The total Feed and fodder cost was accounted for 83.84 per cent out of the total variable cost. The major part of investment is for the feed and fodder for the dairy (Kashish et al., 2016). The cost of labour was highest for all the groups of the dairy farmers followed by the cost of concentrates. The net revenue realized by all the three types of dairy units varied positively with herd size (Shoba and Venkatraman, 2020). Feed and fodder form the major part of investment i.e. 68.62 per cent followed by labour and veterinary and artificial insemination (Singh et al., 2012).

METHODOLOGY

The Haryana state was divided into two agro-climatic regions i.e. eastern region and western region. The eastern region is comparatively wet with the annual rainfall of about 600-1100 mm as compared to western region which is dry with annual rainfall of about 300-450 mm. The dry and wet regions were denoted as Zone-I and Zone-II respectively, in this study. From Zone-I districts of Kaithal and Karnal whereas from Zone-II Sirsa and Hisar districts were selected. Two blocks from each district were selected namely: Hisar (Adampur, Hisar), Sirsa (Dabwali, Sirsa), Karnal (Karnal, Nilokheri), Kaithal (Kaithal, Kalayat) for the present study. Twenty-five farmers practicing dairy farming were selected randomly from each block as respondents for the study making a total of 200 dairy farmers. To achieve the specific objectives, the primary data from the sample dairy farms were collected through

survey method on pre-structured schedules designed for the purpose. The data were collected to work out the investment and resource use pattern in dairy production. A multi-stage stratified random sampling was designed to collect relevant information from the dairy farmers. The relevant data were collected with the help of well-structured and pre-tested schedule by personal interview method for the year 2019-20 to achieve the stipulated objectives. The data on various aspects of socio-economic status of dairy owners and investment on animals, machinery and equipment, cattle sheds and stores and building, etc. were collected from all the 200 selected respondents in both the zones. The information was also recorded on the various inputs like quantity and expenditure on green fodder, dry fodder and concentrates, mineral mixture, veterinary expenses, labour employed in different dairy operations and farming, electricity, water charges and other miscellaneous items.

RESULT AND DISCUSSION

Investment pattern in dairy farms

The investment pattern on different categories of dairy farms of zone I is presented in Table 1. The investment on an average dairy farm in Zone-I was Rs. 591131 per herd and an average investment per milch animal was Rs. 65176 and an average investment per milch animal per day was Rs. 178.56. Out of total average investment, milch animal alone accounted for about 84 per cent. Majority of the dairy farmers had 'Murrah' and 'Sureti' breeds of buffaloes. The proportionate investment on cattle sheds and stores, machinery and equipments was found to be 8 and 1 per cent, respectively. It was also observed that the proportion of investment on milch animals increased with the increase in size of dairy farm. The overall investment on an average dairy farm on cattle sheds and stores was Rs. 46581, while investment on cattle sheds and stores was Rs. 37161 in small herd followed by Rs. 43084

Table 1. Investment Pattern in Dairy Farms in Zone-I and Zone-II of Haryana (Rs.)

S.No.	Particulars	Zone I				Zone II			
		Small	Medium	Large	Overall	Small	Medium	Large	Overall
A.	Animals								
1.	Milch animals	348259 (82.75)	508682 (84.18)	635396 (84.81)	496669 (84.02)	279798 (81.65)	396130 (84.83)	539768 (81.07)	378408 (82.69)
2.	Young stocks and heifers	21000 (4.99)	24473 (4.05)	25123 (3.35)	24059 (4.07)	17853 (5.21)	18118 (3.88)	24562 (3.69)	19494 (4.26)
3.	Bulls	6186 (1.47)	10151 (1.68)	10862 (1.45)	9044 (1.53)	4728 (1.38)	5323 (1.14)	8520 (1.28)	5766 (1.26)
4.	Draft animals	3072 (0.73)	10756 (1.78)	10814 (1.44)	7448 (1.26)	2227 (0.65)	5230 (1.12)	11382 (1.71)	5171 (1.13)
5.	Total (1+4)	378517 (89.94)	554062 (91.69)	682195 (91.06)	537220 (90.88)	304606 (88.89)	424801 (90.97)	584232 (87.76)	408839 (89.34)
B.	Cattle shed and stores	37161 (8.83)	43084 (7.13)	57311 (7.65)	46581 (7.88)	35467 (10.35)	36750 (7.87)	69026 (10.37)	43153 (9.43)
C.	Machinery & equipments	5176 (1.23)	7130 (1.18)	9664 (1.29)	7330 (1.24)	2604 (0.76)	5416 (1.16)	12380 (1.86)	5628 (1.23)
	Total investment (A+B+C)	420854 (100)	604276 (100)	749170 (100)	591131 (100)	342677 (100)	466967 (100)	665638 (100)	457620 (100)
	Total capital investment per milch animal	64057	65116	66357	65176	62079	63619	64188	63294
	Total capital investment per milch animal per day	175.50	178.40	181.80	178.56	170.08	174.30	175.86	173.41

Figures in parentheses indicate percentage to total capital investment.

and 57311 in medium and large herd size, respectively. It was clearly revealed that the investment on cattle sheds and stores increased with the increase in herd size in different proportions. Same pattern was followed in case of investment on machinery and equipments as more animals required more buildings and sheds. The investment on machinery and equipments was Rs. 5176 in small herd followed by Rs. 7130 and 9664 in medium and large herd size, respectively. Average investment on an average herd size was Rs. 7330 in Zone-I. The total investment on a dairy farm varied from Rs. 420854 on a small farm to Rs. 604276 on a medium and Rs. 749170 on a large dairy farm. It can also be concluded that the cost involved in the purchase of milch animals was the important component of the total fixed capital investment. We also revealed that total fixed cost was increasing with increase in herd size in Zone-I of Haryana. These findings were supported by (Kashish et al., 2016). During her study in Amritsar district in Punjab it was concluded that total fixed cost was increasing with increase in herd size it was found to be highest in small dairy farms followed by medium and large dairy farms.

As per Table 1 it can be revealed that the investment on an average dairy farm in Zone-II was Rs. 457620 per herd and an average investment per milch animal was Rs. 63294 and average investment per milch animal per day was Rs.173.41. Out of total, an average investment milch animal alone accounted for about 89 per cent. The proportionate investment on cattle sheds & stores, machinery and equipment was found to be 9 and 1 per cent, respectively. It was also observed that the proportion of investment on milch animals increased with the increase in size of dairy farm. The investment on an average dairy farm on cattle sheds and stores was Rs. 43153, while investment on cattle sheds and stores was Rs. 35467 in small herd followed by Rs. 36750 and 69026 in medium and large herd size, respectively. It can also be concluded that investment on cattle sheds and stores increased with the increase in herd size in different proportions. Same pattern was followed in case of investment on machinery and equipment. The investment on machinery and equipment was Rs. 2604 in small herd followed by Rs. 5416 and 12380 in medium and large herd size, respectively. An average investment on an average herd size was Rs. 5628 in Zone-II. The total investment on a dairy farm varied from Rs. 342677 on a small farm to Rs. 466967 on a medium and Rs. 665638 on a large dairy farm. From Table 1, we can conclude that the cost involved in the purchase of milch animals was the important component of the total fixed capital investment, as now a day's cost of milch animals is very high. We also revealed that total fixed cost was increasing with increase in herd size in Zone-II of Haryana.

These findings were supported by (Kashish et al., 2016). The study in Amritsar district of Punjab concluded that total fixed cost was increasing with increase in herd size it was found to be highest in small dairy farms followed by medium and large dairy farms.

Resource utilization pattern

The income on a dairy farm depends primarily on the entities of various factors of production used in the production process and the output (level of milk production). The pattern of use of major factors of production such as feed and fodder, labour, water & electricity, medicines and transportation cost have been analyzed and discussed in this section as follows:

From Table 2, it can be concluded that the overall cost of all the resources was Rs. 115.57 per milch animal per day, among all the investments major proportion was covered by cost of feed and fodder as now-a-days land for fodder is decreasing day by day which leads to high prices of green and dry fodders. The proportion of investment for green fodder was 28 per cent followed by cost of concentrates and dry fodder 30 and 26 per cent, respectively. Labour cost was 11 per cent followed by transportation cost i.e. 1 per cent. Along with this, cost of medicines, water and electricity also covered less proportion of investment. Cost of medicines, cost of water and electricity accounted for 1 per cent each in Zone-I of Haryana. We can conclude that maximum proportion of cost was covered by feed and fodder followed by cost of human labour, water & electricity, transportation cost and medicines cost in Zone-I of Haryana. Similar finding were revealed in the study that in all the herd size groups, feed constituted the most important item of cost accounting for about 53 to 74 per cent of the total cost. Labour accounted for nearly 10 to 25 per cent of the total cost (Jha 1982) and the feed and fodder accounted for major share i.e. 59.52 percent followed by labour cost i.e. 33.95 percent of total cost (Kumawat et al., 2014).

From Table 3, it can be revealed that the overall cost of all the resources was Rs.128.62 per milch animal per day, among all the investments, major proportion was covered by cost of feed and fodder. The proportion of investment for concentrates was 46 per cent followed by cost of green fodder and dry fodder 24 and 23 per cent, respectively. The average labour cost was 13 per cent followed by transportation cost i.e. 2 per cent. Along with this cost of medicines, water and electricity cost also covered less proportion of investment. The average cost of water and electricity was 2 per cent and medicines were 1 per cent of the total cost of all the resources in Zone-II of Haryana. We can conclude that maximum proportion of cost was covered by feed and fodder

Table 2. Resource Utilization Pattern in Dairy Farms in Zone-I of Haryana (Rs./Milch animal/day)

S.No.	Particulars		Small	Medium	Large	Overall
1.	Raw material	Green fodder	36.29(29.08)	33.11(28.67)	32.95(29.76)	32.80(28.38)
2.		Dry fodder	32.70(26.20)	28.95(25.07)	30.22(27.29)	30.62(26.49)
3.		Concentrates	36.55(29.28)	36.61(31.73)	32.76(29.58)	35.30(30.54)
4.	Human labour		13.81(11.10)	12.41(10.76)	10.76(9.73)	12.23(10.58)
5.	Water & electricity		1.80(1.44)	1.60(1.38)	1.20(1.08)	1.53(1.33)
6.	Medicines		1.75(1.40)	1.65(1.42)	1.15(1.03)	1.51(1.32)
7.	Transportation		1.88(1.50)	1.12(0.97)	1.69(1.53)	1.58(1.36)
	Total		124.78(100)	115.45(100)	110.73(100)	115.57(100)

Figures in parentheses indicate percentage to total cost of all resources.

Table 3. Resource Utilization Pattern in Dairy Farms in Zone-II of Haryana (Rs./milch animal/day)

S.No.	Particulars		Small	Medium	Large	Overall
1.	Rawmaterial	Green fodder	33.75(25.26)	32.51(25.40)	24.90(20.24)	30.41(23.64)
2.		Dry fodder	24.32(18.18)	28.25(22.07)	35.07(28.51)	29.50(22.93)
3.		Concentrates	50.00(37.38)	43.42(33.92)	43.03(34.98)	45.57(35.42)
4.	Human labour		18.97(14.18)	17.48(13.65)	14.38(11.69)	16.94(13.18)
5.	Water & electricity		2.25(1.68)	2.55(1.99)	2.68(2.17)	2.49(1.96)
6.	Medicines		1.94(1.46)	1.65(1.28)	1.04(0.85)	1.54(1.19)
7.	Transportation		2.50(1.86)	2.12(1.65)	1.90(1.56)	2.17(1.68)
	Total	133.73(100)	127.98(100)	123.00(100)	128.62(100)	

Figures in parentheses indicate percentage to total cost of all resources.

because now-a-days cost of green as well as dry fodder are very high, followed by cost of human labour, water & electricity, transportation cost and medicines cost in Zone-II of Haryana. Similar finding were supported by the study that in all the herd size groups, feed constituted the most important item of cost accounting for about 53 to 74 per cent of the total cost. Labour accounted for nearly 10 to 25 per cent of the total cost (Jha, 1982) and feed and fodder accounted for major share followed by labour (Kumawat et al., 2014).

CONCLUSION

The Indian dairy farmers in recent years have shown encouraging signs of changing from traditional to improved one. It is recognized that, if progress has to be achieved in dairy farmers, they are to be modernized in knowledge, adoption and other personal, social and economic characteristics. It is revealed that from total investment, major proportion was covered by investment on feed and fodder, followed by concentrates in both the Zones of Haryana. Proportion of investment on milch animals increased with increase in herd size in both zones. The major part of income is invested in feed and fodder followed by concentrates and human labour in both Zone I and Zone II. On the basis of our results we can suggest to provide feed concentrates and high yielding seeds of green fodder crops at cheaper rates which may reduce the feeding cost of milch animals. It also helps in decreasing the maintenance cost and improve the milk quality and productivity. The proper training for dairy farming should be organised by government and other agencies.

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Usages of Mobile Application Developed by Krishi Vigyan Kendra Banavasi

M. Jayalakshmi^{1*}, G. Prasadbabu², B. H. Chaithanya³, A. Lavanya⁴ and T. Srinivas⁵

¹Subject Matter Specialist (Crop Production), ²Subject Matter Specialist (Agriculture Extension), ³Subject Matter Specialist (Plant Protection), ⁴Subject Matter Specialist (Veterinary), ⁵Programme coordinator, Krishi Vigyan Kendra, Banavasi-518360, Acharya N.G. Ranga Agricultural university, Kurnool, Andhra Pradesh, India

*Corresponding author email id: jayalakshmitnala@gmail.com

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ABSTRACT

A survey was conducted to assess the impact of mobile applications developed by the Krishi Vigyan Kendra Banavasi with 150 farmers in Kurnool district of Andhra Pradesh in the year 2020. KVK Banavasi developed three mobile applications namely ANGRAU-ATARI CFLD, ANGRAU *Pashu Poshan* and Fertilizer Calculator for benefiting farming community. Majority (64.67%) of the respondents were found in medium usage of mobile applications, in agriculture. Fertilizer Calculator mobile application was found highest usage (74.50%) among the farmers when compared with other two applications. ANGRAU ATARI CFLD application was used by an average of 46.83 per cent farmers for information on new improved varieties, 75 % for control measures of pest and diseases and 29 per cent for market related information. ANGRAU *Pashu Poshan* application was used by 75 per cent livestock farmers for sheep management, 56 per cent for cattle management and 45 per cent for poultry related information. Fertilizer calculator application was used by 80 per cent farmers for recommended dose of fertilizers and 10 per cent for soil test based fertilizer application.

INTRODUCTION

Providing right agricultural information to farmers at a right time is a challenge and a key tool to the agriculturalist. The traditional ways of providing information to the farmers has become inoculated, untimed and features a method communication. Research, extension, literacy and infrastructure have been identified as the most important sources of growth in productivity in literature (Mittal & Kumar, 2000; Kumar & Rosegrant, 1994). Worldwide agriculture has witnessed a shift in the past few decades and extension mechanism need to stay ahead and equip the farmers by enhancing their management and decision making skills (Singh et al., 2018; Singh et al., 2020). Many nations are arising with the innovative ideas for an equivalent. With a replacement era of Digital India Movement the introduction of the new technologies have connected people round the world and altered the way people conduct business. Among ICTs, impressive penetration of mobile

phones in many of the developing countries changing the agricultural communication process and mobile phones have made personal communications readily accessible, for the first time, to women and men, poor and prosperous, rural and urban dwellers in developing as well as in industrial countries (Colle, 2011). The Government is taking effort to develop many mobile applications in India to assist farmers in several ways and supply assistance through mobile application in different field of agriculture. In this existing scenario, it is expected that the integration of ICTs in agricultural extension will provide much needed impetus to agricultural sector and ICTs can complement the traditional extension system for “Knowledge Resource” delivery to the millions of the farmers (Saravanan, 2010). Information is vital in agricultural development because it is a tool for communication. Extension services are required to improve agricultural productivity by providing farmers with requisite information helping them to optimize use of limited resources (Muyanga & Jayne, 2006; Singh et al., 2017). In India, large numbers

of positions in public extension system are vacant, resulting in overload for extension personnel and thus, lowering their efficiency (Mukherjee & Maity, 2015). Keeping this in view Krishi Vigyan Kendra Banavasi developed three mobile applications viz.: ANGRAU-ATATRI CFLD application which covers the production technologies of pulses and oil seeds, ANGRAU PASHU POSHNA application developed for livestock farmers to cater the information needs of livestock which covers aspects like cattle management, sheep and goat management, poultry (layer & broiler), strategies that help in doubling farmer's income some best management practices and technologies along with good quality pictures and Fertilizer Calculator app imparts knowledge in Soil test based fertilizer application as well as recommended dose of fertilizer for different crops which helps in use of crop specific correct dose of fertilizers in the form of direct or complex fertilizer forms to reduce the indiscriminate and excessive use so as to reduce the cost of cultivation and to avoid the soil pollution. These mobile applications were developed with a aim to disseminate timely and user friendly information to the agricultural as well as livestock farmers.

METHODOLOGY

The study was conducted during the year 2019-20 by with objective of the usage of the mobile applications developed by Krishi Vigyan Kendra Banavasi. The investigation was carried out in Kurnool district of Andhra Pradesh. Kurnool district consists of 54 mandals / blocks. Among the 54 blocks, Gonegandla and Yemmiganur blocks were selected for the study. Among the 20 villages of Gonegandla Block, three villages were selected, and from 39 villages of Yemmiganur Block, three villages were selected. Ten respondents were selected from each identified village by random sampling technique, thereby, making a sample of 150 respondents. The data was collected by a pre-tested structured interview schedule through personal interview method. To measure the extent of use of mobile applications for seeking information on agriculture among the respondents, a tool was developed. A total of 3 mobile applications were included to find out the usage of these mobile apps. The responses were recorded on a three point continuum i.e. frequently, occasionally, and seldom which were assigned 3, 2 and 1 score respectively. To find out level of mobile application use overall score for each respondent was calculated and respondents were categorized into three groups on the basis of calculated mean and standard deviation of the scores obtained by the respondents. Frequency and percentage of respondents in each category i.e. less use, moderate use and high use were calculated. To determine the extent of use of each mobile application mean per cent score was worked out and ranked accordingly. Z' test was carried out in order to find out the difference between the respondents of Yemmiganur and Gonegandla mandals about usage of mobile application in agriculture.

RESULTS AND DISCUSSION

Among the different modes of communications, nearly 85 per cent of farmers accessed the agriculture information through mobile phones followed by Newspapers (60%). However, the information received through personal contact was limited to 20-25 per cent

Table 1. Source of agricultural information to farmers

S. No.	Particulars	Yemmiganur (%)	Gonegandla (%)
1	Radio	10	15
2	TV	20	25
3	Mobile	85	85
4	News Papers	60	45
5	Neighbour farmers	30	35
6	Personal contact with Agriculture Department & KVK	20	25

farmers (Table 1). Similar trend was reported by Joshi et al., (2019) on social media and on WhatsApp messenger by Nain et al., (2019) whereas different trends were reported by Bhagat et al., (2004)

Data presented in Table 2 depict that majority (64.67%) of the respondents were found in medium usage of mobile applications, whereas 17.33 percent respondents were in low group and 18.00 per cent farmers were in the high group of mobile applications usage in agriculture. The results are in accordance with Jat et al., (2021).

Table 2. Use of Mobile applications for seeking Agricultural Information

S. No.	Level of mobile application use	Yemmiganur (%)	Gonegandla (%)	Total (%)
1	Less (up to 12)	16.00	18.67	17.33
2	Medium (13 to 21)	65.33	64.00	64.67
3	High (above 21)	18.67	17.33	18.00
Total		100	100	100

The data depicted in Table 3 indicate that use of "Fertilizer Calculator" mobile application was highest (74.50%) among the farmers and this tool was ranked first. Similarly the utilization of "ANRAU-ATARI CFLD" (35.25%) was accorded 2nd rank followed by, 'ANGRAU PASHUPOSHAN' (28.85%) respectively in Yemmiganur mandal. In Gonegandla mandal same trend was observed in the usage of mobile applications. Further, it was noted that respondents of Yemmiganur mandal had more use of mobile applications than respondents of Gonegandla mandal. There was no significant difference in the usage of mobile applications between the farmers of Yemmiganur and Gonegandla mandals.

From Table 4 it can be inferred that majority (85.00%) of the farmers were using this application for varietal information on groundnut indicated as rank I, plant protection as rank II, varietal information on bengal gram as rank III, crop production related information IV, varietal information on blackgram crop as rank V, market related information VI, varietal information on redgram crop as rank VII and varietal information on safflower crop as rank VIII. The plausible reasons for the above trend might be due to the fact that the majority of the farmers were in need of knowledge and source of improved and high yielding varieties of oil seeds especially groundnut followed by varietal information on pulses mainly on bengal gram, plant protection measures and market related aspects.

ANGRAU PASHU POSHAN mobile application was used by majority (75%) of famers for sheep and goat management as rank 1. This might be due to the Sheep and goat population is more in Kurnool district as compare with other animals. Cattle management

Table 3. Utilization of mobile applications by the farmers for seeking agricultural information

S.No	Name of the mobile application	Yemmiganur		Gonegandla		Total	
		Percentage	Rank	Percentage	Rank	Percentage	Rank
1	ANGRAU-ATARI CFLD	35.25	II	34.55	II	36.75	II
2	ANGRAU PASHU POSHAN	28.85	III	26.75	III	27.50	III
3	Fertilizer Calculator	75.12	I	76.50	I	74.50	I
	Mean	46.41		45.93			
	SD	20.47		21.84			
	'Z' value		1.95 ^{NS}				

Table 4. Usage of Mobile Application by Farming community

S. No.	Information in the mobile application	Usage means score (%)	Rank
A) ANGRAU ATARI CFLD			
1	Varietal information on ground nut crop	85	I
2	Plant protection	75	II
3	Varietal information on Bengal gram crop	65	III
4	Crop production related information	48	IV
5	Varietal information on Black gram crop	43	V
6	Market related information	29	VI
7	Varietal information on Redgram crop	25	VII
8	Varietal information on safflower crop	15	VIII
	Mean	48.125	
	SD	25.04	
B) ANGRAU PASHU POSHAN			
1	Sheep & goat Management	75	I
2	Cattle Management	56	II
3	Poultry Management	45	III
4	Doubling farming Income strategies	10	IV
5	Best Management practices in live stock	8	V
6	Other useful Information	5	VI
	Mean	33.16	
	SD	27.01	
C) Fertilizer Calculator			
1	Recommended doses of fertilizers without soil test	80	I
2	Fertilizer doses for major nutrients	70	II
3	Fertilizer doses for secondary nutrients	25	III
4	Fertilizer doses for micro nutrients	15	IV
5	Soil Test Based Fertilizer application	10	V
	Mean	40	
	SD	29.15	

as rank II, Poultry management as rank III, Doubling farming Income strategies as rank IV, Best Management practices in livestock as rank V and Other useful Information as rank VI. Panda et al., (2019) stated that the benefits extracted by the farmers by using ICT tools mostly for communication and for general information but very low to get higher price of produce with significance level of influence on benefit extraction. The present findings are also contradictory to the findings of Rajput et al. (2009). Fertilizer Calculator was used for recommended doses of fertilizers without soil test by majority (80%) of farmers as rank I, Soil Test Based Fertilizer application, fertilizer doses for major nutrients as rank II, fertilizer doses for secondary nutrients as rank III, Fertilizer doses for micro nutrients rank IV and soil Test Based Fertilizer application as rank V.

The trend might be due to farmers are slowly getting knowledge about soil health and importance of soil testing. However after getting soil test report they are unaware of its interpretation

and use of STBF accordingly. Hence most of farmers depend on recommended doses of fertilizers instead of soil test based fertilizer application. This app imparts knowledge in soil test based fertilizer application as well as recommended dose of fertilizer for different crops which helps in use of crop specific correct dose of fertilizers in the form of direct or complex fertilizer forms to reduce the indiscriminate and excessive use so as to reduce the cost of cultivation and to avoid the soil pollution. These findings were in accordance with Aker, 2011 who also stated low-cost information and communication technology tools possess the ability to deliver timely, relevant, and actionable information to farmers at lower costs than traditional extension services.

CONCLUSION

From the study it can be concluded that mobile applications developed by Krishi Vigyan Kendra Banavasi are very useful which saved the time and expenses by getting ready solution on day to day farm activities. Immediate solution to the farmers on mass level through this Apps could have been achieved by KVK and need & time based service to the farming communities were served. The mobile applications were user friendly and meet the needs of agriculture and livestock farming community. There is large scope for mobile applications to disseminate the information in local languages. Hence it can be concluded that as of mobile applications, as an omnipresent tool in future extension.

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Adoption Status of Direct Seeded Rice Technology by the Farmers of Punjab

Ramandeep Kamboj*, Dharminder Singh and Lakhwinder Kaur

Department of Extension Education, Punjab Agricultural University, Ludhiana-141004, Punjab, India

*Corresponding author email id: ramankamboj0786@gmail.com

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ABSTRACT

Direct-seeded rice (DSR) is a possible alternative to conventional puddled transplanted rice, where rice crop is seeded directly in non-puddled fields. The study was conducted to ascertain the adoption status of recommended practices of DSR. Personal interviews were conducted to collect data from randomly selected 210 farmers from three districts representing different agro-climatic regions of Punjab. Study revealed that selected farmers had adopted DSR on 49.20 per cent of their total area under paddy cultivation. Slightly higher number of selected farmers had adopted *Tar-Wattar*, a new technique of DSR over dry soil method. Only 18.52 per cent respondents had applied first irrigation as per recommendations of *Tar-Wattar* method, whereas majority (67.59%) had applied first irrigation before 21 days. 26.67 per cent farmers had adopted most suitable variety PR-126 and sown it at recommended time. However, in case of other varieties, majority of farmers did not follow recommended time of sowing. A smaller number of farmers have applied zinc, iron and sulphur fertilizers to ameliorate micro nutrient deficiencies. Average yield of others varieties and PR 126 were found to be nearly identical, but due to lesser cost of cultivation in DSR as compared to transplanted rice, adopter farmers' fetched higher net return.

INTRODUCTION

Rice (*Oryza sativa* L.) is staple food for more than 60 per cent of the global population (Bista, 2018; Ashraf et al., 2006). India is the second largest producer of rice in the world being superseded only by China in the gross annual output (Dhillon et al., 2010). In India, Rice crop is grown on an area of 43.79 million hectares with a total production of 112.91 million tons (Anonymous, 2019). Punjab state plays an important role in rice production and has highest productivity of rice in India. The area under paddy during *kharif* season in 2020 was 31.42 lakh hectares in the state with a record production of 189.18 lakh tonnes of paddy (Bhardwaj, 2017; Anonymous, 2021). Rice is a water guzzler crop and has 1800 mm irrigation requirements (Baweja et al., 2017). The conventional puddled transplanting of rice (PTR) is water, capital, energy and labour-intensive practice (Bhatt et al., 2021). Punjab is one of the most fertile land on the earth. To meet the food requirements of

country, the area under rice and wheat was increased in Punjab, but more extraction of water from the groundwater leads to underground water depletion. It is apparent that underground water in the major rice growing areas of the state is declining at the rate of 0.23m per year causing serious concern and raising doubt about the future sustainability of the rice-based system (Humphreys et al., 2010). The average water table depth in the state was 7.32 m in 1998 which has been decreased to 12.79 m in 2012 (Gupta et al., 1995; Baweja et al., 2017). Looming water crisis, water-intensive nature of rice cultivation and rising labour costs drive the search for alternative management methods to increase water productivity in rice cultivation. Direct seeded rice (DSR) has received much attention because of its low-input demand. Direct-seeded rice is a possible alternative to conventional puddled transplanted rice, where rice crop was sown through direct seeding in non-puddled fields, these fields were suitable approaches for water saving and labour (Singh et al., 2009). Direct seeded rice technology also

decreased green-house gas emissions and adapt to climate risks (Sebastian et al., 2017). *Tar-wattar* direct seeded rice is an improved version of existing DSR technology, in which the pre-sowing irrigation is applied after laser levelling the field. Field is cultivated and prepared When it attains good soil moisture condition and paddy seeds are sown immediately. An important variation from the earlier direct seeded rice technology is delaying the first irrigation to 21 days (Singh et al., 2021). Thus, the present study was planned to analyzed adoption status of direct seeded rice in Punjab state.

METHODOLOGY

The study was conducted in three agro-climatic regions i.e. sub-mountain undulating, central plain and south-western regions of Punjab state. One district from each agro-climatic region was selected for the study. Sangrur district from central plain, Gurdaspur from sub-mountain undulating and Fazilka from south western region were selected for the study. List of farmers practicing DSR were obtained from Department of Agriculture and Farmer Welfare and respective Krishi Vigyan Kendras. Further, 70 farmers were selected randomly from each selected district for the present study. Thus, total sample size for study was 210 farmers. Punjab Agricultural University has research and recommended *tar-wattar*, a new technique of DSR in the year 2020. A well-structured and pre-tested, interview schedule was developed for eliciting data from the farmers incorporating all the items on which information was required by keeping in view of the objectives. The data were collected on adoption of recommended cultivation practices of direct seeded rice i.e. sowing method, time of sowing, seed treatment, fertilizers use pattern, herbicides and irrigations etc. The data were analysed with the help of package SPSS. Economic analysis was done by calculating the gross income considering the minimum support price provided for rice crop by the government. Net income was calculated by formula as a difference of gross income and variable cost. Cost Benefit Ratio (CBR) was calculated by dividing gross income (Kumar & Meena, 2021) by total cost of production.

RESULTS AND DISCUSSION

Adoption of DSR

Total area under paddy crop was 1429.6 ha whereas DSR technology was adopted on 809.8 ha by the respondents. It was further revealed from data in Table 1 that area under DSR was maximum in Fazilka district (68.89%) followed by Gurdaspur (53.69%) and Sangrur (48.68%). The increase in adoption can be attributed to the facts that during Covid pandemic period there was severe shortage of labour and machineries necessitate the farmers to adopt DSR technologies. In Gurdaspur district, 17.57 per cent

of sown area was ploughed by the farmers however, 12.59 per cent area was ploughed by the respondents of Sangrur district. Only 9.98 per cent area was ploughed by the farmers of Fazilka district. Discussion with farmers inferred that the ploughed area was severely affected by weeds which caused poor performance of direct seeded rice in weed-crop competition there by coercing the farmers to plough their fields.

Direct seeded rice is mainly practiced by two methods i.e. dry soil method and *Tar-wattar* method. *Tar-wattar* DSR is a novel technique developed and recommended by PAU in 2020 to reduce water footprints in rice cultivation. In this technique, pre-sowing irrigation is applied and primed seed is sown in a *Tar-wattar* condition. A major difference from conventional dry-DSR is delay in applying first irrigation which is applied at three weeks after sowing (21 days). Data regarding method of sowing in DSR cultivation in Table 2 reveals that slightly higher number of respondents (51.43%) used *Tar wattar* method for sowing than the dry soil method. *Tar wattar* method is advantageous over dry soil method in weed management and water consumption. It is also evident that majority of the respondents (94.76%) used DSR drill. Further survey revealed that 60.48 per cent of them used it on custom hiring basis. It might be due to the reason that DSR drill was expensive to purchase and farmers preferred to hire it for sowing. Few farmers (5.23%) have made some modifications in their happy seeder machine to directly sow the rice crop. It is evident from data in Table 2 that farmers have grown more than one variety at their farms. It was found that 26.67 per cent of farmers had adopted most suitable variety PR-126 recommended by Punjab Agricultural University for DSR. PR-126 is a short duration variety and advantageous for weed management. Variety PR 111 was grown by 13.33 per cent of respondents. Pusa 44 is a long duration variety

Table 2. Adoption of sowing methods and variety in DSR technology by the farmers

Practice	Category	Percentage*
Sowing Method	<i>Tar wattar</i> (recommended)	51.43
	Dry soil method	48.57
Implement used	DSR Drill	94.76
	Modified happy seeder	5.24
Paddy variety*	PR111	13.33
	PR114	11.91
	PR 121	4.76
	PR 122	0.95
	PR126	26.67
	PR 127	6.19
	PR 128	11.91
	PR 129	9.05
	PUSA 44	41.42

*Multiple Response

Table 1. Adoption of direct seeded rice technology by the farmers

District	Total area under paddy (Area in ha)	Area under DSR (%)	Ploughed area (%)	Net area under DSR (%)
Fazilka	448	308.6 (68.89)	30.8 (9.98)	277.8 (62)
Sangrur	515.2	250.8 (48.68)	31.6 (12.59)	219.2 (42.55)
Gurdaspur	466.4	250.4 (53.69)	44 (17.57)	206.4 (44.25)
Total	1429.6	809.8 (56.65)	106.4 (13.14)	703.4 (49.20)

Figures in Parentheses are indicated percentage to their respective total

Table 3. Adoption of agronomic practices by the respondents under DSR technology

S.No.	Agronomic parameter	Categories	Percentage	Average	S. D
1	Seed rate (kg/ha)	Less than recommended (14-19)	39.05	22.64	2.51
		Recommended (20-25)	54.29		
		More than recommended (26-30)	6.67		
2	Seed treatment	Treated	91.91	-	-
3	Spacing between row to row (inches)	Less than recommended (7)	2.86	8.84	0.44
		Recommended (8)	10.48		
		More than recommended (9)	86.67		
4	Depth of sowing (inches)	Less than recommended (<1.25)	37.62	1.39	0.79
		Recommended (1.2-1.5)	59.05		
		More than recommended (>1.5)	3.33		
5	Time of sowing (Others than PR-126 variety) (n=209)	Before 15 June	51.19	-	-
		Recommended (1-15 June)	47.37		
		After 15 June	5.26		
	Time of sowing (PR 126) (n=56)	Before 16 June	26.79	-	-
		Recommended (16-30 June)	67.86		
		After 30 June	5.36		
6	Number of irrigations	18-23	19.05	24.95	4.52
		24-29	75.24		
		30-34	5.71		
7	Scheduling of first irrigation in dry soil (n=102)	Recommended (Immediately after sowing)	81.37	1.23	2.30
		After 2-3 days	18.63		
	Scheduling of first irrigation in <i>Tarr-wattar</i> (n=108)	Before 21 days	67.59	18.70	8.51
		Recommended (21 days)	18.52		
		After 21 days	13.89		

and hence not recommended for DSR. However it was grown by 41.42 per cent of respondents under direct seeding technology.

Almost half of respondents (54.29%) used recommended seed rate of 20-25 kg/ha (Table 3). Most of the farmers (91.91%) have done seed treatment before sowing. Majority of the respondents (86.67%) sown their crop at wider spacing and only 10.48 per cent of the respondents has adopted recommended plant spacing. Majority of the respondents has adopted recommended depth of sowing whereas 3.33 per cent of respondents sown seeds more than recommended depth of sowing. Major reason for increase in depth of sowing was found to be lack of knowledge to operate the machine. The machine should be operated by trained person in order to avoid this situation. The recommended time of sowing PR 126 variety is 16-30 June while recommended time of sowing for others varieties is 1 to 15 June (Anonymous, 2021a). In the case of PR 126 variety around 67.85 per cent of respondents has adopted the recommended sowing time whereas 26.78 per cent of respondents sown the paddy seed before recommended time. Only 5.35 per cent of respondents sown their paddy seeds after the recommended time. Majority of the respondents (75.24%) had applied the 24-29 number of irrigations, however 19.05 per cent of respondents had applied 18-23 irrigations. It is clear from table 3 in dry soil method that majority of respondents (81.37%) applied first irrigation as per recommendations. In *Tarr-wattar* method only 18.52 per cent of the respondents applied first irrigation as per recommendations and 67.59 per cent apply first irrigation before 21 days.

The respondents were using both pre-emergence and post-emergence herbicides. Data in Table 4 showed that the recommended herbicide i.e., Stomp 30 EC (Pendimethalin) was used by 97.14 per cent respondents. However, majority of them (77.45%) used recommended dose of herbicides. As many as 52.85 per cent of respondents used Sathi 10 WP (Pyrazosulfuron Ethyl) and out of them 51.35 per cent respondents used the recommended dose of

this herbicide. In case of post-emergence herbicides, Nominee Gold 10 EC (Bispyribac) was the most preferred herbicide used by majority of the respondents. Although most of them (51.65%) were using recommended dose of Nominee Gold 10EC (Bispyribac) but considerable percentage (41.21%) were using higher than recommended dose of herbicide. Similar pattern was observed in case of Ricestar 6.7 EC (Fenoxaprop), which was used by 5.71 per cent of respondents, out of which only one fourth was using recommended doses of this herbicide and 25 per cent of them were using more than recommended dose. Almix 20 WP (Metasulfuron Methyl + Chlorimuron Ethyl) was applied by 7.61 per cent of respondents and many of them were found to be using more than recommended doses of herbicide.

Usage pattern of fertilizers in DSR

DSR cultivation practice requires more precision as compared to puddled rice cultivation. As for the nitrogen requirement is concerned, all of the respondents had used urea and most of them (43.81%) applied it in recommended dose while 40.95 per cent of farmers has applied more than recommended dose of urea fertilizer (Table 5). Only 15.24 per cent of respondents used them in less than recommended dose. Majority of the respondents (73.78%) applied 63-72 kg/ha DAP fertilizer at their fields, whereas 19.51 per cent of respondents applied 50-62 kg/ha DAP at their fields. The requirement of potash was met with the application of muriate of potash, whereas only 7.14 per cent of respondents applied muriate of potash at their fields. It is evident from the data that lesser number of farmers applied micronutrient fertilizers like zinc, iron and sulphur to ameliorate their deficiency in crop. Importance of judicious use of fertilizers in rice crop was also emphasized in the studies conducted by Sidhu et al., (2014); Jayalakshmi et al., (2021).

Table 4. Adoption of weed management practices in DSR by the farmers

S.No.	Name of herbicides	f(%)	Dose (per/ha)	%*
1	Stomp 30EC (Pendimethalin)	204(97.14)	Less than recommended (<2500 ml)	17.16
			Recommended (2500 ml)	77.45
			More than recommended (>2500 ml)	5.39
2.	Sathi 10WP (Pyrazosulfuron ethyl)	111(52.85)	Less than recommended (<150 g)	10.81
			Recommended (150 g)	51.35
			More than recommended (>150 g)	37.84
1	Nominee Gold 10EC (Bispyribac)	182(86.67)	Less than recommended (<250 ml)	7.14
			Recommended (250 ml)	51.65
			More than recommended (>250 ml)	41.21
2	Ricestar 6.7EC (Fenoxaprop)	12(5.71)	Less than recommended (< 1000 ml)	50
			Recommended (1000 ml)	25
			More than recommended (>1000 ml)	25
3	Almix 20WP (Metsufuronmethyl + chlorimuron ethyl)	16(7.61)	Less than recommended (<20 g)	12.50
			Recommended (20 g)	31.25
			More than recommended (>20 g)	56.25

* Multiple Response

Table 5. Fertilizer use in DSR technology by the farmers

Fertilizers	Dose (kg/ha)	Percentage
Urea	Less than recommended	15.24
	Recommended (325)	43.81
	More than recommended	40.95
DAP	50-62	19.51
	63-72	73.78
	73-87	6.71
	Not applied	21.90
Potash	Applied	7.14
Zinc	Applied	45.83
Iron	Applied	37.50
Sulphur	Applied	9.05

Yield obtained and average expenditure under DSR technology

Average yield of Pusa 44 variety was found to be 74.75 q/ha whereas average yield realized by the farmers from PR 126 was found to be 74.60 q/ha (Table 6). The others varieties including (PR111, PR114, PR121, PR122, PR127, PR128 and PR129) contributed to an average yield of 74.50 q/ha at farmers fields under DSR technology. The difference in yield between all varieties as shown in table is almost the same even though Pusa 44 has slightly higher yield than other varieties.

Cost benefit ratio

Among the DSR and transplanted puddle rice, the maximum gross return was obtained with the conventional transplanting

Table 6. Average yield and Cost benefit analysis of DSR in comparison to transplanted rice

Particulars	DSR	PTR
<i>Average yield (q/ha)</i>		
Pusa 44 (n=87)	74.75	79.90
PR 126 (n=56)	74.60	80.40
Others varieties (PR111, PR114, PR 121, PR 122, PR 127, PR 128, PR 129) (n=122)	74.50	82.30
Overall	74.61	80.86
<i>Returns (Rs./ha)</i>		
Cost of Cultivation	28780	37737
Gross Return	137825	146150
Net Return	109045	108413
Cost benefit ratio	4.78	3.87

technology (Rs. 146150) as compared to DSR (Rs. 137825). Gross returns among sowing technology were higher due to higher grain yield obtained. The net return was maximum in DSR technology (Rs. 109045) as compared to conventional transplanting (Rs. 108413). Higher net return with DSR technology was due to its lesser cost of cultivation (Rs. 28780) as compared to conventional transplanting (Rs. 37737). The increased labour cost, puddling operation and repair of machinery increases cultivation cost in transplanted rice. The benefit cost ratio was higher with DSR technology (4.78:1) as compared to conventional transplanting (3.87:1). Higher B:C ratio with DSR technology was also due to its lesser cost of cultivation as compared to mechanical transplanting and conventional method of paddy cultivation/ transplanting (Table 6). DSR technology was also found to beneficial and economical by Mishra et al., (2017).

CONCLUSION

Although few farmers started the DSR from the year 2007, the number of respondents gradually increased in successive years but in 2020, there was huge jump in adoption of DSR during COVID period. It can be attributed to the facts of labour shortage during COVID period compelling farmers to search alternatives to the conventional transplanting method of rice cultivation. Study concluded that farmers seem enthusiastic in adopting DSR technology; however there are significant adoption gaps in recommended cultivation techniques at farmer fields. DSR technology proved its potential to provide higher net returns in comparison to conventional puddled transplanted rice. Although average yield of rice under DSR technique was found to be almost similar to that of transplanted rice, but still immense potential exists for yield maximization by the adoption of recommended crop production practices. Study underlines the importance of extension interventions to disseminate DSR practices like *Tar-wattar* method of sowing, efficient weeds management practices and enhancement of grower skills through trainings for its adoption at farmers' fields.

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Household Level Assessment of Climate Change Vulnerability of North Bank Plains Zone Farmers of Assam

Trilochan Karki Chetri¹, Pabitra Kr. Das^{2*}, Misha Madhavan M.¹, Indrajit Barman² and Dipankar Saikia³

¹ICAR-National Research Centre on Pig, Rani, Guwahati-781131, Assam, India

²Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali-784176, Assam, India

³Dr. Rajendra Prasad Central Agricultural University, Pusa-848125, Samastipur, Bihar, India

*Corresponding author email id: pabitradas_assam@rediffmail.com

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ABSTRACT

The study was carried out to assess the vulnerability of farmers to climate change in north bank plains zone of Assam. For this 2 districts were selected randomly from the north bank plains zone of Assam i.e., Sonitpur and Udalguri. A household level survey was carried out with the selected farmers to obtain the primary data. For this, total 120 farmers were selected from 6 different villages through proportionate random sampling. Vulnerability index was worked out by considering 10 different indicators. Findings revealed that 69.17 per cent of farmers belonged to medium vulnerability category followed by 16.67 per cent and 14.17 per cent in high and low vulnerability category respectively. The mean vulnerability score was 0.455 indicating that, on an average, respondents had medium vulnerability to climate change. Most of the respondents are belonged to medium category.

INTRODUCTION

The impacts of climate change are likely to be a great extent in tropical regions. Developing countries are generally more vulnerable to the effects of climate change than the more developed countries, mainly due to their low capacity to adapt to the climate induced changes. Among the developing countries, India may be the most vulnerable to climate variability and change. High levels of vulnerability and low adaptive capacity in India have been linked to factors such as a high reliance on natural resources mainly agriculture, inability to adapt financially and institutionally, low per capita GDP and extreme poverty. In developing countries like India, climate change would represent an additional stress on ecological, cultural, political and socio-economic systems that are already facing tremendous pressures due to rapid urbanization, industrialization, privatization, globalization and economic development. Agricultural activities are among those sectors which are very sensitive to climate and weather conditions. Most interestingly climate change affects the agriculture sectors to a great extent and in turn it contributes to climate change. So, there is a reciprocal relationship between them. Further this

climate change induced effects would accelerate the existing stresses due to non-climate factors, such as changes in land use pattern and the unsustainable use of natural resources. Climate change has the potential to affect everyone, but one particular vulnerable group is farmers. India is more vulnerable in view of the large population depending on agricultural as well as natural resources. In India, significant negative impacts have been implied with medium-term (2010-2039) climate change, predicted to reduce yield by 4.5 to 9.0 per cent, depending on the magnitude and distribution of warming. IPCC (2001) defined vulnerability to climate change as “the extent to which a natural or social system is susceptible to sustaining damage from climate change, and is a function of the magnitude of climate change, the sensitivity of the system to changes in climate and the ability to adapt the system to changes in climate”. Although many useful steps have been taken in the direction of ensuring adequate adaptation to climate change in developing countries, much work still remains to fully understand the need for future adaptation (Brar et al., 2020). Understanding the importance of farmers’ perception towards changing climate is extremely important in developing

adaptation strategies to overcome the increasing effect of climate change and variability (Dupdal et al., 2021). In this background, the study aimed to assess the vulnerability to climate change among the farmers of north bank plains zone of Assam.

METHODOLOGY

The study was conducted in purposively in North Bank Plains Zone of Assam as it is the highly flood affected and drought prone areas of Assam. The study was carried out in 2 randomly selected districts form this zone i.e., Sonitpur and Udalguri. Total 120 farmers were selected from 6 different villages of these 2 districts through proportionate random sampling. The primary data were collected using a structured interview schedule during the period from February to March, 2019. Drawing from the approaches of TERI (2003) and UNDP (2002), a composite vulnerability index was worked out. A total of ten indicators were considered in this study to work out the vulnerability index. The ten indicators were awareness about the consequences of climate change, perception towards climate change, attitude towards climate change, fatalism, egalitarianism, perceived knowledge of adaptation practices, ownership of physical resources and assets, livelihood diversification, access to climate information and social participation. Different scales developed by the researchers Trivedi and Pareek (1964), Leiserowitz (2006) and Thornton (2009) were used to measure the indicators. The formula for working out the vulnerability index for each respondent was:

$$VI = \sum_{i=1}^n (I_i \times W_i)$$

VI = Vulnerability Index, I_i = Value of i^{th} sub index, W_i = Weight of the i^{th} sub index, $i = 1$ to n , n = No. of sub index

All indicators were standardized following the UNDP (2002) procedure of standardizing indicators for life expectancy index. Appropriate weights were assigned to the indicators based on the judgement survey conducted among the experts. An unequal weighting system, based on relative importance attached to each indicator by a sample of 35 progressive farmers, 5 extension functionaries and 45 agricultural scientists was used, where they were asked to rank the five most important indicators that they considered to have biggest impact on farmer's vulnerability to climate change. The number of times a particular indicator was cited was used to generate the weights of indicator. Data were analyzed using frequency, percentage, mean, standard deviation, coefficient of variation and Pearson correlation coefficient.

RESULTS AND DISCUSSION

Vulnerability to climate change

The results revealed (Table 1) that majority of the respondents (69.17%) belonged to medium vulnerability category. The findings

are in line with Maiti et al., (2014) who revealed that majority of the livestock rearers of coastal Odisha were in medium vulnerability category. The findings are also in conformity with Raghuvanshi and Ansari (2020). Aparna et al., (2017) conducted a similar study in Karnataka and reported that majority of the dairy farmers of Sagara region were in medium vulnerability category. Majority of dairy farmers in Thirthahalli region and Bhadravathi region were in low and high vulnerability category respectively. The mean vulnerability score was 0.455 indicating that, on an average, respondents had medium vulnerability to climate change. The co-efficient of variation (23.60%) indicated that the respondents were relatively homogeneous with respect to their vulnerability.

The distribution of respondents on different indicators of vulnerability (Table 2) revealed that on most of the indicators like awareness, risk perception, favorable attitude, fatalism, egalitarianism, perceived knowledge of adaptation practices, ownership of physical resources and assets, livelihood diversification and access to climate information, majority of the respondents were in medium category. This might be the reason that majority of the respondents belonged to medium vulnerability category. The distribution of respondents based on their awareness revealed that majority of the respondents (70.00%) belonged to medium awareness category. The mean awareness score was 21.16. The medium vulnerability of most of the respondents can be attributed to their awareness level (Adebayo et al., 2012). With respect to risk perception, the majority of the respondents (62.50%) belonged to medium perception category. The mean risk perception score was 23.19 indicating that, on an average, respondents had medium risk perception which in turn affected their vulnerability as observed by Lee (2018). The risk perception translate into responses that achieve short term gains only rather than contributing in reducing long term vulnerabilities (Rühlemann and Jordan, 2021).

Regarding the attitude towards climate change, majority of the respondents (65.00%) had moderately favourable attitude. The mean attitude score was 63.19 indicating that, on an average, respondents had moderately favourable attitude toward climate change. With respect to fatalism, it can be observed that majority of the respondents (60.00%) belonged to moderately fatalistic category. The mean fatalism score was 15.92 indicating that, on an average, respondents were moderately fatalistic. For the egalitarianism, majority of the respondents (70.00%) belonged to medium egalitarianism category. The mean egalitarianism score was 25.33. For perceived knowledge of adaptation practices, majority of the respondents (63.33%) belonged to medium perceived knowledge category. The mean perceived knowledge score was 11.01 indicating that, on an average, respondents had medium perceived knowledge on adaptation practices. These findings are in line with Zarafshani et al., (2020).

Table 1. Distribution of respondents according to their vulnerability to climate change

Category	Range	Number (%)	Mean score	SD	CV
Low vulnerability	0.126-0.348	17 (14.17)			
Medium vulnerability	0.349-0.562	83 (69.17)	0.455	0.107	23.60
High vulnerability	0.563 -0.647	20 (16.67)			

Table 2. Distribution of respondents according to different indicators of vulnerability

Category		Score range	Number (n=120)	Percentage	Mean	S.D.	CV
1. Awareness	Low	14.00-17.75	17	14.17	21.16	3.41	16.09
	Medium	17.76-24.57	84	70.00			
	High	24.58-29.00	19	15.83			
2. Risk Perception	Low	17.00-20.44	18	15.00	23.19	2.75	11.88
	Medium	20.45-25.94	75	62.50			
	High	25.95-29.00	27	22.50			
3. Favourable Attitude	Low	47.00-56.81	18	15.00	63.19	6.38	10.09
	Medium	56.82-69.57	78	65.00			
	High	69.58-77.00	24	20.00			
4. Fatalism	Low	8.00-11.99	18	15.00	15.92	3.93	24.71
	Medium	12.00-19.85	72	60.00			
	High	19.86-24.00	30	25.00			
5. Egalitarianism	Low	18-22.34	19	15.83	25.33	2.99	11.82
	Medium	22.35-28.32	84	70.00			
	High	28.33-33	17	14.17			
6. Perceived knowledge of adaptation practices	Low	6.00-8.37	22	18.33	11.01	2.64	23.98
	Medium	8.38-13.65	76	63.33			
	High	13.66-17.00	22	18.33			
7. Ownership of physical resources and assets	Low	8.00-10.44	52	43.33	13.09	2.65	20.22
	Medium	10.45-15.74	62	51.67			
	High	15.75-20.00	6	5.00			
8. Livelihood diversification	Low	1.00-1.49	19	15.83	2.70	1.21	44.68
	Medium	1.50-3.91	70	58.33			
	High	3.92-5.00	31	25.83			
9. Access to climate information	Low	5.00-7.80	16	13.33	10.68	2.88	27.00
	Medium	7.81-13.56	81	67.50			
	High	13.57-18.00	23	19.17			
10. Social participation	No membership	0	50	41.67	0.82	0.87	106.47
	One organization member	1	50	41.67			
	More than 1 organization member	2	12	10.00			
	Office bearers	3	8	6.67			

Regarding ownership of physical resources and assets, majority of the respondents (51.67%) belonged to medium level. With respect to livelihood diversification, majority of the respondents (58.33%) had medium livelihood diversification. These findings are in line with Devi et al., (2021) who revealed that high level of livelihood diversification leads to the low level of vulnerability. Further, regarding the access to climate information, majority (67.50%) of the respondents had medium level of accessibility to climate information. About social participation, an equal number of respondents (41.67%) were non-members of any organization as well as same number of respondents were members of one organization. The value of co-efficient of variation of all the indicators indicated that the respondents were homogeneous with respect to their awareness, risk perception, attitude, fatalism, egalitarianism, perceived knowledge of adaptation practices, ownership of physical resources and assets, livelihood diversification and access to climate information except social participation.

Pearson's correlation analysis

The results revealed that (Table 3) educational level, size of operational land holding, gross annual income, farm mechanization, credit seeking behavior, degree of information exposure, scientific orientation, risk orientation, economic motivation, innovativeness

Table 3. Correlation analysis between different factors and vulnerability of farmers to climate change

S.No.	Independent Variables	Correlation coefficient (r)
1	Age	0.111 ^{NS}
2	Education level	-0.484**
3	Family type	-0.008 ^{NS}
4	Family size	0.032 ^{NS}
5	Size of operational land holding	-0.610**
6	Occupation	-0.115 ^{NS}
7	Farming experience	-0.095 ^{NS}
8	Gross annual income	-0.647**
9	Farm mechanization	-0.404**
10	Credit seeking behaviour	-0.469**
11	Degree of information exposure	-0.452**
12	Scientific orientation	-0.713**
13	Risk orientation	-0.551**
14	Economic motivation	-0.497**
15	Innovativeness	-0.558**
16	Adaptability to climate change	-0.508**

** Significant at 0.01 level of significance

and adaptability have significant and negative relationship with the vulnerability of farmers to climate change at 0.01 level of significance. The findings are in line with Doswald & Osti (2011) who believed that low-income areas are the most vulnerable to future climate change. The variables age, family type, family size, occupation and farming experience had no significant relationship

with the vulnerability of farmers to climate change. As the education level increases farmers will have better knowledge regarding the climate change and the ways to cope up with that which reduces their vulnerability. As the land holding and annual income increases, the farmers becomes more equipped to adopt the mitigation practices hence shows less vulnerability. The factors like credit seeking behavior, degree of information exposure, scientific orientation, risk orientation, economic motivation and innovativeness are desirable as they reduces the risk of being more vulnerable.

CONCLUSION

The results showed that majority of the farmers from north bank plains zone of Assam, had medium vulnerability to climate change. It calls for adequate measures for their preparedness and adaptation to climate change. The variables like farmer's educational level, size of operational land holding, annual income, farm mechanization, credit seeking behavior, degree of information exposure, scientific orientation, risk orientation, economic motivation, innovativeness and adaptability showed significant relationship with the vulnerability of farmers. Hence there is a possibility for the extension agencies to improve these crucial factors in order to reduce the vulnerability of farmers to climate change and these factors should be considered while preparing the adaptation strategies. The extension and advisory services should focus on providing scientific knowledge which helps the farmers to cope with the changing climate conditions. Findings implied that the extension functionaries and agricultural scientists should promote some agricultural management practices among the farmers to enable them to cope with changing climate conditions like use of organic manure, summer deep ploughing, conservation tillage, bunds and change in variety etc.

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Assessment of Farmers' Perception about Crop Residue Burning in Haryana

Anuradha Choudhary^{1*}, K. S. Kadian² and M. S. Meena³

¹Senior Research Fellow, National Food Security Mission on Pulses at ICAR-ATARI, Zone-II, Jodhpur, Rajasthan, India

²Head, Division of Dairy Extension, National Dairy Research Institute, Karnal, Haryana, India

³Principal Scientist (Agricultural Extension), ICAR-ATARI, Zone-II, Jodhpur, Rajasthan, India

*Corresponding author email id: choudharyanu9928@gmail.com

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ABSTRACT

The study was conducted in 2019-2020 to assess the perception of the farmers on crop residue burning (CRB) in Haryana. A total of 180 farmers from three purposively selected districts, namely Karnal, Kurukshetra, and Fatehabad from Haryana, were chosen to collect data. Stratified random sampling was employed in the selection of blocks, villages, and respondents. For measuring farmers' perception, a scale was constructed using Likert's method of summated ratings. Farmers perceived CRB as an economical and viable option and considered it an efficient practice. Most farmers did not perceive the happy seeder as feasible since it needed a high horsepower tractor. Farmers' perception was positively and significantly correlated with education, operational land holding, and annual income ($P < 0.05$). Hence, there is a need to promote community-based approaches like custom hiring centre, bio-mass-based power plants, mushroom cultivation, etc., through extension and advisory services. It may lead to adopting alternative crop residue management options and mitigating residue burning in the long run.

INTRODUCTION

Green revolution through the introduction of improved varieties and synthesized fertilizers made Indo-Gangetic Plain (IGP) self-sufficient to fulfil food demands (Pingali, 2012; Goutam, 2021). This boom in food grain came with many negative consequences caused due to intensive mono-cropping and indiscriminate use of synthesized input (Haidar, 2013; Singh & Kaskaotis, 2014). Therefore, with a significant amount of agricultural production, naturally, a huge amount of crop residue is generated. This problem led to intentionally setting fire to crop residue in open fields which became a bottleneck for sustainable environment and agricultural production.

Asian countries account for 34 per cent of all biomass burnt in the world and India accounts for 18 per cent of the total residue burning of Asian countries (Shaik et al., 2019). In India's Indo Gangetic region, around 24 per cent of generated residues were being burned in an open field (Ravindra et al., 2019; Ram et al., 2016).

Specifically, in Haryana state 9.08 MT surplus crop residue was burned in the field (NPMCR, 2017). It gives rise to the emission of heavy metals (HM) & dioxin. The combustion of biomass emits a variety of pollutants into the atmosphere, contributing to the degradation of air quality. Punjab and Haryana alone provide 48 percent of India's 13915 Gg (Giga gram=10 billion gram) rice straw surplus, which is vulnerable to open field burning (Gadde et al., 2009).

Other than the environmental impact, it also imposes a negative impact on rural people including respiratory problems, tuberculosis, and reduced visibility. In addition, it affects soil productivity by burning the essential nutrients inside the soil (Singh et al., 2018), reduces organic carbon content in the soil, and depletes beneficial microorganism populations. There are so many management alternatives available including in-situ and ex-situ management of crop residue (Singh et al. 2020). Still, farmers perceive CRB as the easiest & most economically feasible option for quick preparation of the field for next sowing. The major drivers to CRB are the short

time interval between the harvesting of Kharif (Rice) & sowing of Rabi (Wheat) crops, Scarcity of labour, less industrial demand for crop residue, etc. (Anuradha et al., 2021). Under Section 144 of the Civil Procedure Code (CPC) crop residue burning is prohibited. Farmers are well aware of detection, ban, imposed penalties on burning activities (Anuradha et al., 2021) despite all lucrative and punitive approaches to combat residue burning; it is widely practiced in the rice wheat-growing belt of India. Hence, there is a need to understand farmers' perceptions about crop residue burning and factors that are affecting the perspective of farmers.

METHODOLOGY

The study was undertaken during 2019-2020 at purposively selected Haryana province of India. Haryana is frequently referred to as the "Food Mine" of the country. Hence, it is obvious to produce a high volume of crop residue (27.83 MT) with grain production (NPMCR, 2017).

Haryana Space Applications Centre (2018) reported that major paddy stubble burning was found in Karnal, Kurukshetra, Fatehabad, Kaithal, and Sirsa districts in the previous five years. Based on this observation report, the top three districts viz; Karnal, Kurukshetra, and Fatehabad were selected purposively for study. Further, stratified random sampling was applied; two blocks were selected from each district, i.e. Nissing and Indri from Karnal, Sahabad, and Thanesar from Kurukshetra and Fatehabad, and Ratiya from Fatehabad Districts. From each block, three villages were selected randomly. Farmers were chosen based on criteria that had at least one acre of land and had been producing rice and wheat crops for the previous five years. Then ten farmers were selected from each village, constituting a sample size of 180 for the investigation. Interview schedules for socio-personal variables were developed. Socio personnel variables were all used to categorize the respondents using the cumulative square root frequency technique. A perception scale with 19 items was designed to measure farmers' perspectives regarding crop residue burning. The reliability of the total test was worked out by applying the Spearman-Brown prophecy formula.

The split-half method was used for testing the reliability of the perception scale. The empirical type of validity determination was used to calculate the scale's validity and was worked out by using the square root of its reliability. The reliability of the scale was 0.91 and validity was 0.89 which was significant at one percent level of probability. Farmers were asked to respond on a Likert-type five-point continuum scale. The score was designed as 5=Strongly Agree, 4=Agree, 3=Undecided 2=Disagree; 1=Strongly Disagree.

$$r_{(x,y)} = \frac{N\sum XY - \sum X\sum Y}{\sqrt{[N\sum X^2 - (\sum X)^2] - [N\sum Y^2 - (\sum Y)^2]}}$$

Karl Pearson's product-moment correlation coefficient (r) was employed to assess the degree of relationship between personal variable (x) & perception of the farmer about crop residue burning (y).

RESULTS AND DISCUSSION

Perception of farmers regarding crop residue burning

Table 1 shows the weighted mean percentage of each statement. Crop residue burning is an economically viable option for the farmers followed by the farmers for efficient straw management statement had the highest weighted mean percentage followed by every farmer is not able to use happy seeders because it requires very high power tractors for functioning with comprising of 89.33 per cent and 85.89 per cent, respectively. Farmers perceived that due to crop residue burning in Punjab and Haryana is often blamed for worsening air quality in the Delhi National Capital Region, this statement ranked 3rd with an 85.33 weighted mean. Followed by the statement that farmers perceive weeds can be controlled by open straw burning ranked 4th with 83.67 weighted means. The same results were shown by Lyngdoh (2018) that 80 per cent of respondent farmers and 66 per cent of extension personnel were agreed that weeds can be controlled by open straw burning. More than three fourth (86.66%) of the respondents agreed that crop residue burning depletes essential soil nutrients. This is why farmers

Table 1. Farmers' perception regarding crop residue burning

S.No.	Statements	Weighted mean (%)
1.	Loose straw creates a microenvironment that is susceptible to pathogen infection in the field	75.22
2.	Crop residue burning is an economically viable option for the farmers	89.33
3.	The role of the state pollution control boards should be more stringent	84.44
4.	Bailing is the most common practice followed by the farmers for efficient straw management	71.22
5.	Usage of paddy straw is limited to certain uses only	58.78
6.	The burning of straw depletes the important soil nutrients	64.11
7.	Stubble burning is the leading cause that results in a decline in soil fertility	49.11
8.	Intercropping is a valuable alternative for effective crop residual management.	76.78
9.	Weeds can be controlled by open straw burning	83.67
10.	Pest and pathogens can be controlled by straw burning	77.89
11.	Additional value of the stubble will create an economic impact for the farmers	52.78
12.	Open straw burning reduces organic carbon content in the soil	76.22
13.	Giving Rs. 2500/acre as compensation for small and marginal farmers for not burning stubble is a good initiative by the Government	81.11
14.	Linking the Panchayat for claiming compensation enhances the area covered.	81.11
15.	Crop residue burning in Punjab & Haryana is often blamed for worsening air quality in the Delhi National Capital Region	85.33
16.	Biofuel plants emerging to combat stubble burning are a sustainable solution.	65.22
17.	Custom hiring centers and straw bale units can also help in recovering the operational costs of the farmers.	79.44
18.	Paddy straw can be used as an alternative fuel option to meet local energy demands.	38.22
19.	Every farmer is not able to use Happy seeders because it requires very high capacity tractors for functioning	85.89

Table 2. Overall perception regarding the effects of crop residue burning

S.No.	Items	Positive effects f (%)	No effects f (%)	Negative effects f (%)
1.	Plant health	0 (0)	12 (6.66)	168 (93.33)
2.	Air	0 (0)	10 (5.65)	170 (94.45)
3.	Human health	0 (0)	33 (18.33)	147 (81.66)
4.	Animal health	0 (0)	56 (31.11)	124 (68.89)
5.	Biodiversity	0 (0)	51 (28.33)	129 (71.67)
6.	Vehicular traffic	0 (0)	55 (30.56)	125 (69.44)
7.	Soil health	0 (0)	47 (26.11)	133 (73.89)

have to increase the dosages for fertilizers for the next crop, which has been depleted through the burning of straw in the previous season. The findings were similar to Heard et al., (2006). With an 81.11 weighted mean, nearly three of the respondents agreed that granting rupees twenty-five hundred per acre as compensation for small and marginal farmers for not burning stubble is a good government initiative. Nearly 71 per cent of the respondents agreed that bailing is the most common practice used by farmers recently. Paddy straw can be used as an alternative fuel option to meet local energy demands statement had the lowest level of weighted mean percentage followed by stubble burning is the leading cause that results in a decline in soil fertility, comprising 38.22 per cent and 49.11 per cent, respectively.

The overall perception of farmer respondents regarding effects of crop residue burning

The data in Table 2 depicted that majority of the farmer respondents agreed that crop residue burning harms plant health, air, human health, animal health, biodiversity, vehicular traffic, and soil health. The respondents mentioned that crop residue burning had no positive effect along with this it revealed that the negative effect of the crop residue burning was not constant which usually last only for a few days after rice harvesting. The study's findings were similar to Roy and Kaur (2015) reported that crop residue burning leaves a negative impact on the environment in the long run. And Dupdal et al., (2021) also revealed that Farmers have experienced a variety of climatic conditions, including decreased and erratic rainfall, rising temperatures in recent years, and frequent monsoon failures, all of which are impacting our agriculture productivity.

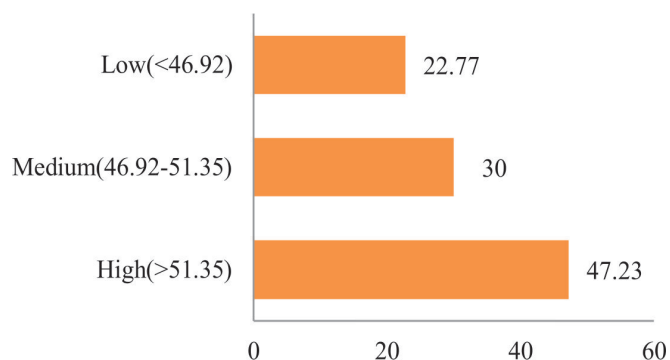
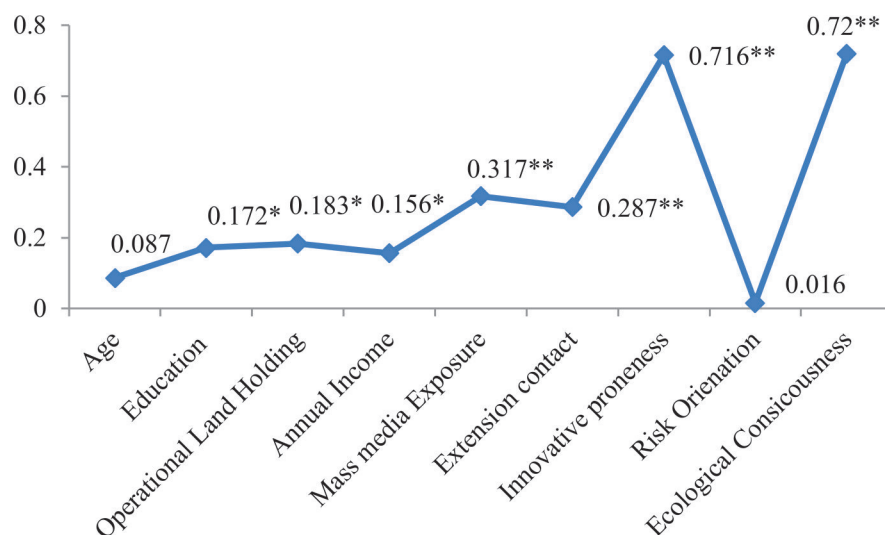
Figure 2. Relationship of various independent variables with the perception of the farmer regarding crop residue burning**Figure 1.** Perception level regarding crop residual burning
** $P < 0.01$ * $P < 0.05$

Figure 1 shows that less than half (47.23%) of the respondents had a positive perception because they know residue burning imposes a harmful effect. Out of 180 respondents, only 22.77 per cent of the farmers had a less positive perception about crop residual burning.

Factors influencing perception level of farmers regarding crop residue burning

The relationship of various independent variables with the farmer respondents' perception has been presented in Figure 2. The perception score of respondent farmers was not significantly correlated with age. Similar studies reported by Baksh et al., (2015) that the age of farmer respondents was non-significant with perception. It implies that age does not affect perception level

because perception is all about knowing or viewpoints about certain things. The respondents' perception scores were positively and significantly correlated with education, operational land holding, and the annual income of respondents at a 5 percent level of significance ($P < 0.05$). A study by Roco et al., (2015) also found that the farmer respondents' education was significant with perception. The findings revealed that more educated and more landholding had a clearer perception of the environment. A positive and significant relationship was found between the farmer respondents' perception and variables viz. mass media exposure, extension contact, innovative proneness, and ecological consciousness at 1 percent level of Significance ($P < 0.01$). The result shows that more mass media exposure had a more positive effect on perception level about the effect of crop residue burning on the environment. This result contradicts Lyngdoh (2018), who reported that operational land holding, annual income, mass media exposure, extension contact, and innovative proneness were not significantly correlated with the perception of farmers.

CONCLUSION

Farmers perceived that crop residue burning negatively affects the plant, soil, air, and human health. The majority of the farmers perceive that crop residue burning is economically feasible and requires fewer efforts to manage and burning helps to reduce weed, insect pest infestation in the field. As education was significantly correlated with perception, it is recommended for approaches that make farmers well aware of the harmful long-term effect of crop residue burning on soil environment and human health. It will lead to the adoption of alternative options to manage crop residue in their farms. Also, there is a need to provide management machinery, technical backup and financial assistance at the village or community level for better access.

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Challenges of Agri-Start-ups in Post-Harvest Cold Storage Technologies

Alok Kumar¹, T. B. Ganesha², B. P. Mishra³, P. Venkatesan⁴, Sanjiv Kumar⁵, P. C. Meena⁶, Satya Prakash⁷ and B. K. Gupta⁸

^{1,2,4,5,6}ICAR-National Academy of Agricultural Research Management (NARM), Hyderabad-500030, Telangana, India

^{3,8}Banda University of Agricultural & Technology, Banda-210001, Uttar Pradesh, India

⁷Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur-848125, Bihar, India

*Corresponding author email id: bhanumishrabhu@gmail.com

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ABSTRACT

Agri-startups are developing new products through a value chain, supply chain solutions, packaging, processing systems, infrastructure, warehousing, logistics, protection of foodstuffs, communications, e-commerce, delivery and retail models. The study aims to document the challenges of Agri-startups working in post-harvest and storage parameters of fruits and vegetables. To get the insight, primary and secondary survey was carried out and data was used to provide suggestions to capture the customer and market. The data indicated that different units required different temperature range to store a different kind of commodity in their cold storage unit. 86.15 per cent of units were using the backup generators. 53.84 per cent of units were getting the commodities directly from farmers, 30.76 per cent from traders, 9.24 per cent from both and 6.15 per cent from others. 50.76 per cent of units were desired to get low electricity bill and 10.76 per cent of units were desired to come out of usage of generator whereas 32.3 per cent of units were willing to get both i.e. low electricity bill and without dependency on generator and 6.15 per cent of units were willing to reduce other costs like operation cost, maintenance cost etc. 70.76 per cent of cold storage units having a cooling tower.

INTRODUCTION

India has created a thriving start-up community and has solidified its status as the world's third-largest start-up ecosystem. This is evident in our food processing sector and environment, which has seen a surge in entrepreneurship with innovative and forward-thinking ideas, especially in the last five years. Technology and logistics support enhanced the self-life of products which add more income to the pockets of the entrepreneur. To take maximum benefit of the existing infrastructure and to build a robust business model, a transformation among the traditional farmers /youth is inevitable (Chandraker et al., 2021). Agriculture is the one of the oldest economic sector in the world and serves as a primary source of livelihood for about 58 per cent of the Indians Population (Dutia, 2014). The Indian Council of Agricultural Research estimates that

in 2030 demand for food grains would rise to 345 million tons and it is necessary to increase the production of food grains (FICCI, 2018). The Indian government has realized that Indians are hard to work, but only a promising start is necessary. Many people want to start their own business but are unable to do so because of financial or other similar problems (Patel, 2019). A successful Startup cannot start a business just with passion and an idea. It faces many challenges too. So, to cope up with the problems of startups, one should have a high level of leadership skills with a clear understanding of the market and excellent communication skills. It is believed that fostering start-ups, which add dynamism, creative thinking, and job creation, is critical to India's economic future. It is essential to understand the complexities of the start-up world to seize the opportunity for the industry. In the global start-up community, India has made a strong name for itself. India is among

the top five countries in the world concerning the number of start-ups (Munshi, 2019). The good harvest of many producers in developing countries does not translate into profit as most are lost after harvest (Arah et al., 2016).

Young entrepreneurs are more likely to take a risk and try innovations and strategies that could overcome the barriers and limitations (Kobba et al., 2020). With new strategies for agricultural growth and development, there is a need to explore the areas of rural entrepreneurship development in agriculture and allied sectors. The profit-making ability can be delineated with the help of the net profit of the enterprise (Kharga et al., 2021). For fruit quality during storage, post-harvest technologies such as chemical and non-chemical treatment are used. For example, the chemical therapy for the preservation of mango fruit quality with 1-MCP and Nitrogen Oxide (NO) has been demonstrated as efficient (Bambalele et al., 2021). Postharvest cooling is critical for providing the best quality products to the customer. Refrigeration with or without a changed oxygen-carbon dioxide atmosphere will prolong the postharvest life of fruits. The study focuses on challenges faced by Agri-startups for post-harvest management of fruits and vegetables in India.

METHODOLOGY

The study was purposively conducted in Maharashtra, Andhra Pradesh, Telangana and Karnataka due to availability of Agri-startups for post-harvest management of fruits and vegetables in this region. The purposive and random sampling procedures were followed to select the samples from cold storage units, wholesalers and food processing units and a sample size for this study was sixty-five units. The sample consisted of start-ups associated with the food production value chain to develop new products, supply chain solutions, packaging, processing technology, infrastructure, storage and logistics, food protection, communications, e-commerce models, delivery, and retail. Primary and secondary survey were conducted to find the solutions to the challenges. The primary data were collected with the help of semi structured interview schedule through personal interview method. The data thus generated were analyzed with suitable statistical tools like percentage and mean. The data was then used to make better suggestions to the institutions about how to join the market and capture the consumer and market.

RESULTS AND DISCUSSION

Start-ups in post-harvest cold storage technologies

According to the data, different units required varied temperature ranges in order to store various commodities in cold storage units (Table 1). 6.15 per cent of the units maintained a temperature of -18 to 0°C, and these units typically store frozen products (fish, meat, poultry, dairy products, and processed fruits and vegetables); 16.92 per cent of the units maintained a temperature of 0°C, and these units typically store temperate fruits such as apple and strawberry; and 18.46 per cent of units kept the temperature between 1 to 5°C and stored fish, chocolates, flowers, snacks etc. 49.24 per cent of units kept the temperature between 5 to 10°C and stored dry chilly, potato, mango, potato etc., 3.07 per cent of units kept mango, copra, etc. at a temperature of 10 to

Table 1. Temperature maintenance for different commodities in cold storage units

S.No.	Temperature ranges	No. of cold storage units	Percentages
1	-18 to 0°C	4	6.15
2	0°C	11	16.92
3	1 to 5°C	12	18.46
4	5 to 10°C	32	49.24
5	10 to 20°C	2	3.07
6	above 20°C	4	6.15

20°C, while 6.15 per cent kept onion, ginger, and garlic at temperatures above 20°C (Table 1).

Use of backup generator by cold storage units

A total of sixty-five units responded about the usage of backup generator in their cold storage units and among these units, 86.15 per cent having backup generators and 13.85 per cent not having backup generators (Table 2).

Table 2. Backup generators available in cold storage units

S.No.	Backup generators	No. of cold storage units	Percentages
1	Available	56	86.15
2	Not available	09	13.85

Customers of cold storage units

The study revealed about their cold storage customers and it was indicated that 53.84 per cent of units received their commodities from farmers, 31 per cent of units received their commodities from traders, 8.5 per cent of units received commodities from both farmers and traders, whereas 5.6 per cent of units received commodities from others (own, research purpose, military application and retailers) (Table 3).

Table 3. Customers of cold storage units

S.No.	Customers	No. of cold storage units	Percentages
1	Farmers	35	53.84
2	Traders	20	30.76
3	Both farmers and traders	6	9.24
4	Others	4	6.15

Requirements of cold storage units to change

The study revealed the requirements and willingness of cold storage units, and it indicated that 50.76 per cent of units desired a low electricity bill, 10.76 per cent desired to eliminate their reliance on generators, 32.30 per cent desired to obtain both, i.e. a low electricity bill and the elimination of their reliance on generators, and 6.15 per cent desired to reduce other costs such as operation and maintenance costs (Table 4).

Cooling tower and its maintenance period in cold storages

A total of sixty-five units responded about the cooling tower, and among them, 70.76 per cent of units had cooling tower whereas 29.24 per cent of units were without cooling tower (Table 5). The

Table 4. Requirements of cold storage units to change

S. No.	Customers	No. of cold storage units	Percent-ages
1	Low electricity bills	33	50.76
2	Without dependency on generator	07	10.76
3	Both low electricity bills & with out dependency on generator	21	32.30
4	Others	4	6.15

Table 5. Cooling tower available in cold storage units

S.No.	Cooling tower	No. of cold storage units	Percentages
1	Available	46	70.76
2	Not available	19	29.24

cooling towers are maintained once a month by 43.08 per cent of the units, 32.30 per cent of the units maintained once in two months, 10.76 per cent of the units maintained once in three months, 6.15 per cent of the units maintained once in four months, 6.15 per cent of the units maintained once in five months (Table 6).

The cooling tower maintenance cost was responded by the units, and 13.84 percent of units spent more than Rs. 10000, 20.0 per cent spent between Rs. 7000 to 10000, 24.61 per cent spent between Rs. 4000 to 7000, 33.84 per cent spent between Rs. 2000 to 4000, 3.07 per cent spent between Rs. 1000 to 2000, and 4.62 per cent spent less than Rs. 1000 (Table 7).

SWOT analysis of leading agri-start-ups in post-harvest cold storage technologies

Entrepreneurship is a feasible approach for upward mobility, as a 1 per cent increase in entrepreneurial activities decreases the poverty rate by 2 per cent. Among the many characteristics of entrepreneurship development, the profit-making ability of the enterprise also plays a vital role in its sustainability and well-developed linkages among stakeholders lead to profit-making (Singh et al., 2014). Lee & Tsang (2001) suggested that most studies confirmed a positive relationship between the entrepreneur's prior experience and the survival of their businesses. Singh et al. (2016); Nain et al., (2019) also suggested institutional support for

Table 6. Maintenance period of cooling tower in cold storage units

S.No.	Maintenance period	No. of cold storage units	Percentages
1	Once in a month	28	43.08
2	Once in two months	21	32.30
3	Once in three months	7	10.76
4	Once in four months	4	6.15
5	Once in five months	4	6.15

Table 7. Maintenance cost of cooling tower in cold storage units

S.No.	Maintenance cost	No. of cold storage units	Percentages
1	More than Rs 10000	9	13.84
2	Rs. 7000 to 10000	13	20.0
3	Rs. 4000 to 7000	16	24.61
4	Rs. 2000 to 4000	22	33.84
5	Rs. 1000 to 2000	2	3.07
6	Less than Rs. 1000	3	4.62

maximizing farm profits and entrepreneurship development in agriculture. Small businesses play an important role in generating growth and employment in both developing and developed economies (Hoffman et al., 2012). The sudden increase in the investment in Agri-tech companies indicates the increase in awareness of business houses towards the importance of agriculture and food and its life-supporting role. These made significance of the creation of jobs and opportunities for youth in Agri-techs and fuel the Agri-preneurship ideas of young farmers and agriculturists (Horo, 2020). Youths, now turning to start-ups including Ecozen, Cold Star, Promethean and Coolify for connections to solar and hybrid-powered cold storage systems to prevent wasting of the harvest. A SWOT analysis was attempted on few leading Agri-Start-ups in post-harvest cold storage technologies.

Ecozen solutions

Ecozen Solutions, founded in 2010 by Devendra Gupta, Vivek Pandey, and Prateek Singhal, provided to the farmers with solar cum hybrid cold storage technologies. The product is used as backup electricity for solar power and thermal storage. Ecozen's goal is to protect farmers from price volatilities while also serving as a link in the national food supply chain. Ecofrost App collects real-time data using IoT to assist in tracking and predictive maintenance. Customers also connected with them through their in-house built smartphone and web application. Ecofrost had a low maintenance expense since it does not need a chemical battery or fuel. For optimal compressor use, a unique thermal energy-based technology provides up to 30 hours of battery-free backup at a low rate. Coolify is another Agri start up of Rajat Sethi, a MIT undergraduate, co-founded Coolify, a next-generation cold storage system aimed at the back end of India's fruit and vegetable supply chain. It is an IT-enabled solution in which a farmer with a smartphone unlock the storage container and set the temperature, was awarded the most creative business concept by the US Department of Agriculture. Coolify having the Cheaper cost of materials and equipment's, its micro cold storage for less quantity is a great solution, need to increase their brand awareness, whereas high competition exists in the market which is a big threat. Cold Star provide refrigerated storage to international corporations and large farms, who then pass it on to farmers to preserve the quality of perishable produce. Cold Star links the transport network with a network of large-scale storage hubs that cover more than 40 locations. Cold Star Logistics provides tailored cold storage and refrigerated shipping solutions in India. Tuscan Ventures, one of India's only logistics-focused investment companies, promotes Cold Star Logistics. Cold Star's approach is driven by its Construct principles, which identify the basic goals needed to achieve the company's long-term aim of transforming India's cold chain logistics system to obtain a competitive edge. The major strengths are ISSO, FSSAI, Food and Drug Administration certifications, Customized services, specialized warehousing and distribution facilities, Complex handling equipment, Pan India expansion is an expandable business, Non-availability of skilled labour, competition is the threat to the organization. Promethan Power Systems was created in 2007 by Sorin Grama and Sam White to solve a wide consumer need with a groundbreaking approach that benefit millions of citizens.

Promethean is involved in this sector, providing rapid milk chillers to broad dairies like Amul and Mother Dairy, as well as regional players like Chitale in Maharashtra. This technology provides a cooler-supply capacity - from day to day, to energy bills decreased and energy efficiency increased - for areas with inadequate grid power, instant cooling capacity for the quick cooling of fruit, vegetables, milk and other preservatives food products and load shifts. Since 2013, hundreds of village-level collection centers have been equipped with Promethean's systems. Via their Fast and Traditional Chilling solutions, they have successfully helped their customers chill milk without using a single drop of diesel throughout India, Bangladesh, and Sri Lanka. It's Thermal Storage System (Patented), Efficient targeting, Eco friendly, Easy to operate were the major strength of the organization, they have a comparatively less innovative model, and dealing with only one niche market dairy farmers, export, adoption of new technologies and adopting rapidly is a great opportunity, government restrictions existing the market are the threats related to it.

CONCLUSION

Harvested fruits and vegetables require advanced post-harvest processing technology to reduce both qualitative and quantitative losses after harvesting. Postharvest cooling is critical for providing the best quality products to the customer. The study consists of start-ups who work through the food production value chain to develop new products, supply chain solutions for many subtropical and tropical fruits. Most temperate-zone fruits can be successfully stored at 0 to 5 degrees Celsius, but many subtropical and tropical fruits, such as lemon, avocado, banana, and mango, exhibit symptoms of damage from excessive cold storage and fail to ripen properly. Postharvest cooling technology providing quality products to the customer and it help to capture more market share in areas where the farmers are growing the commodities through number of Agri-start-ups involvement. The SWOT analysis of startups helpful for their success areas, failures, opportunities they had and the possible threats, how to handled it. Agri-start-ups, cold storage plants and equipment, as well as technology, must be updated to address the issue of the food value chain, and it opens up a lot of possibilities for creating new technologies and possible solutions for agro-based industries.

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Economic Analysis of Parawilt Management in *Bt-Cotton* (*Gossypium hirsutum* L.) in Mansa District of South-western Punjab, India

Gurdeep Singh^{1*}, Pritpal Singh², Kulwant Singh³, Gurjinder Pal Singh Sodhi⁴ and Bhallan Singh Sekhon⁵

^{1,3,5}Krishi Vigyan Kendra, Mansa-151505, Punjab, India

²Farm Advisory Service Centre (FASC), Bathinda-151001, Punjab, India

⁴Directorate of Extension Education, P.A.U., Ludhiana-141001, Punjab, India

*Corresponding author email id: gurdeepsingh@pau.edu

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ABSTRACT

Parawilt characterized by a sudden drooping of leaves followed by death of plants within few hours after rainfall or heavy irrigation has been the major physiological disorder affecting productivity of Bt-Cotton (*Gossypium hirsutum* L.). We studied the effect of foliar application of cobalt chloride (@10 mg L⁻¹ water) within 24-36 hours after appearance of symptoms on recovery rate, seed cotton yield and economics at farmers' fields in Mansa district of south-western Punjab. The results of front line demonstrations revealed that foliar application of cobalt chloride resulted in significantly ($p < 0.05$) higher seed cotton yield by ~9.1 per cent, compared with the control (no-spray). The mean gross returns (MGRs) increased significantly by Rs. 9620/- ha⁻¹ in the demonstration plots. The higher benefit-cost (B:C) ratio of 2.38 was observed for the demonstration plots, against 2.15 for the control (no-spray). The foliar application of cobalt chloride resulted in higher average production efficiency of 1.1 kg seed cotton yield ha⁻¹ d⁻¹ and average economic efficiency of Rs. 65.7 ha⁻¹ d⁻¹, compared with the control. These results therefore, revealed that farmers can effectively manage parawilt in Bt-cotton using foliar application of cobalt chloride and may increase seed cotton yield and economic returns.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is globally the most important commercial fiber crop and is a commodity of international trade, is by 75 per cent of worlds' population for textile purpose (Agbenyegah, 2012; Yadav et al., 2018; Singh et al., 2021a). Its cultivation predominates in arid and semi-arid environments under rainfed and irrigated conditions (Roth et al., 2013; Kumar et al., 2021). Cotton has high temperature and radiation requirements (Constable and Bange, 2015), and is cultivated during summer season after wheat (*Triticum aestivum* L.) in an annual cotton-wheat cropping system (Singh et al., 2018a; Singh et al., 2021b). In south-western Punjab (India), cotton-wheat is the second largest cropping system only next to rice-wheat which is practiced mainly on light

textured, low fertility soils and under poor quality under-ground irrigation water conditions (Singh et al., 2018a; Sharma et al., 2020). High temperature range of 45-48°C particularly during early growing season limits potential yield of the cotton crop (Ahmad et al., 2014). Poor plant population due to high seedling mortality under prevailing high temperature conditions lead to a significant set-back on cotton productivity (Ahmad et al., 2014; Tariq et al., 2017). On the other side, rainfall particularly during flowering and bolting stage negatively impacts the cotton yields (Cetin and Basbag, 2010). Besides, severe attack of cotton whitefly (*Bemisia tabaci*) resulted in a drastic decline in Bt-cotton yield as was during the year 2015 (Singh and Sharma, 2016). Similarly, parawilt is another physiological disorder which affect seed cotton yield of Bt-cotton and thus, economic returns. The prolonged drought, high

temperature and bright sun light followed by heavy irrigation or heavy rains favors the appearance of parawilt. This sudden wilting is characterized by drooping of leaves followed by collapse of plants within a few hours after rainfall (Hebbar and Mayee, 2011). Where parawilt occur near to crop maturity, bolls may open forcefully but do not ripen fully leading to poor and unmarketable cotton quality (Hebbar and Mayee, 2011). The incidence of parawilt in *Bt*-cotton was first reported in Punjab (India) in *kharif*-2004 in a research trial (Sarlach et al., 2008). Cotton plants could be saved from parawilt with timely foliar application of cobalt chloride (ethylene production inhibitor) at initial wilting stage. The foliar application of cobalt chloride is effective only at initial stage and the affected plants recover within a week of spray without any loss in seed cotton yield (Sarlach et al., 2008; Economic Times, 2011). Sarlach & Kaur (2013) observed that among different *Bt*-cotton cultivars, the incidence of parawilt varied from 0.5-8.5 per cent during 2009-10 with a recovery of ~80-97 per cent during 2009 and ~90-98 per cent during 2010 following timely foliar application of cobalt chloride (@ 10 mg L⁻¹ water). In south-western Punjab, parawilt has been severely affecting the cotton crop following moderately to heavy rainfall after a long dry spell. Most of the farmers in the region are unaware about the parawilt symptoms and its management in *Bt*-cotton. Thus, the present study was conducted at farmers' fields to demonstrate the effect of foliar application of cobalt chloride (@ 10 mg L⁻¹ water) on recovery rate of *Bt*-cotton crop against parawilt, seed cotton yield and economic impacts in Mansa district of south-western Punjab.

METHODOLOGY

The field treatments consisted of foliar application of cobalt chloride (@ 10 mg L⁻¹ water) within 24-36 hours of appearance of symptoms of parawilt termed as demonstration plot vis-à-vis control (no-spray of cobalt chloride). The control (check) plots were kept small (~4 m²) to minimize economic loss to the farmers. Demonstrations were conducted during two consecutive years (*kharif*-2018 and *kharif*-2019) at farmers' fields in different villages in Mansa. A total of 72 demonstrations (22 during 2018 and 50 during 2019) were conducted on an area of 40 ha. All other crop production and plant protection measures except for the foliar application of cobalt chloride were same at farmers' fields. The data about the percent recovery of crop against parawilt and the seed cotton yield harvested in the demonstration and the check plots were recorded from the farmers. The economic analysis viz. cost of cash inputs, gross returns, net returns and the benefit-cost ratio (B-C ratio) were based on data collected at farmers' fields in a structured schedule. The mean cost of cultivation (MCCs), mean gross returns (MGRs) and mean net returns (MNRs) were calculated separately for demonstration and check plots (Gupta et al., 2021). The mean cost of cash inputs (MCCIs) for cotton cultivation at different study sites were estimated as sum of expenditure incurred for the purchase of various inputs and human labor. The MGRs were calculated as a product of seed cotton yield and selling price using Eq. 1. The MNRs were calculated as the difference in MGRs and MCCIs.

$$\text{MGRs (Rs ha}^{-1}\text{)} = \text{Seed cotton yield} \times \text{Selling price} \quad \dots (1)$$

The B:C was calculated as a ratio of MGRs and MCCIs (Eq. 2).

$$\text{B-C ratio} = \text{MGRs} / \text{MCCs} \quad \dots (2)$$

The production efficiency was estimated as a ratio of seed cotton yield (kg ha⁻¹) and the crop duration (days, d). Average crop duration of 165.8 days was considered for estimating the production efficiency of *Bt*-cotton (Eq. 3) (Singh et al., 2020).

$$\text{Production efficiency (kg ha}^{-1} \text{d}^{-1}\text{)} = \frac{\text{Seed cotton yield (kg ha}^{-1}\text{)}}{\text{Average crop duration (d}^{-1}\text{)}} \quad \dots (3)$$

The economic efficiency was determined from a ratio of MGRs and average crop duration (d) (Eq. 4).

$$\text{Economic efficiency (Rs. ha}^{-1} \text{d}^{-1}\text{)} = \frac{\text{MNR (Rs. ha}^{-1}\text{)}}{\text{Average crop duration (d)}} \quad \dots (4)$$

The statistical analysis of seed cotton yield was carried out by analysis of variance in randomized block design (RBD). Mean separation for different treatments was performed using Duncan's Multiple Range Test (DMRT) test at $p < 0.05$. Statistical analysis was performed with SPSS for Windows 16.0 (SPSS Inc., Chicago, USA).

RESULTS AND DISCUSSION

Seed cotton yield in demonstration and check plots

The highest seed cotton yield with foliar application of cobalt chloride varied between 23.0 and 24.5 q ha⁻¹ at different farmers' fields during two years (Table 1). The lowest seed cotton yield in plots with foliar application of cobalt chloride application varied between 18.7 and 20.8 q ha⁻¹. However, average seed cotton yield in check (no-spray) varied between 19.5 and 21.2 q ha⁻¹ during two years. These results showed that foliar application of cobalt chloride resulted in a significant ($p < 0.05$) yield increase by ~10.4 per cent during *kharif*-2018, and ~7.7 per cent yield increase during *kharif*-2018, compared with the control (no-spray). The pooled data for two years revealed that foliar application of cobalt chloride resulted in a significant yield increase of ~9.1 per cent at different farmer's fields, compared with the check (no-spray). The increase in seed cotton yield following foliar application of cobalt chloride could be ascribed to the recovery of cotton crop against parawilt.

Foliar application of cobalt chloride and recovery rate

The recovery rate of cotton crop against parawilt reported by farmers varied between 85 per cent and 95 per cent during *kharif*-2018 and between 75 per cent and 95 per cent during *kharif*-2019 (Table 2). Sarlach and Kaur (2013) also reported that recovery rate of cotton crop against parawilt varied between 80-98 per cent in parawilt affected plants, which recovered following application of cobalt chloride. The effect of foliar application of cobalt chloride was higher in the fields with moderate wilting and where the spray was done within 24 hours following appearance of dropping symptoms on top leaves. However, recovery rate declined in parawilt affected *Bt*-cotton fields, where application of cobalt chloride was delayed. The difference in recovery rate could be ascribed to varying tolerance of *Bt*-cotton hybrids for parawilt (Hebbar and Mayee, 2011).

Table 1. Cotton hybrids, farming situation and seed cotton yield under demonstration (foliar application of cobalt chloride) and check (no-spray) during different years (2018-19) at farmers' fields in Mansa, south-western Punjab (India)

Year	Hybrids	Farming situation/ Irrigation source/ Soil type	Seed cotton yield (q ha ⁻¹) †				% Increase in seed cotton yield over demonstration average
			Demonstration plots			Check plots	
			Highest	Lowest	Average	Average	
2018	RCH 773, RCH 776, SP 7172, US 91	Irrigated/Canal and underground/ Sandy loam	24.5	20.8	23.4b	21.2a	10.4
2019	RCH 773, RCH 776, SP 7172, US-81	Irrigated/Canal and underground/ Sandy loam	23.0	18.7	21.0b	19.5a	7.7
Mean	-	-	23.8	19.8	22.2b	20.4a	9.1

†Mean values followed by different letters are significantly different by Duncan's Multiple Range Test (DMRT) at $p < 0.05$.

Table 2. Effect of foliar application of cobalt chloride on recovery rate against parawilt during different years (2018-19) at farmer's fields in Mansa, south-western Punjab (India)

Year	Cotton hybrids	No. of farmers responded	Per cent plant affected	Recovery rate (%)
2018	RCH 773, RCH 776, US 91	05	<3	85-90
		12	3-5	
		05	>5	
2019	RCH 773, RCH 776, SP 7172, US 81	15	<3	75-95
		28	3-5	
		07	>5	
Mean	—	—	—	92

Table 3. Economic analysis of *Bt*-cotton using cobalt chloride in Mansa, south-western Punjab

Economic parameter	2018	2019	Mean†
<i>Demonstration plots (Rs. ha⁻¹)</i>			
Mean cost of cash inputs (MCCIs) (Rs. ha ⁻¹)	49400	47250	48325
Mean gross returns (MGRs) (Rs. ha ⁻¹)	121680	109200	115440b
Mean net returns (MNRs) (Rs. ha ⁻¹)	72280	61950	67115b
B:C	2.46	2.3	2.38b
<i>Check plots (Rs. ha⁻¹)</i>			
MCCIs (Rs. ha ⁻¹)	50200	49000	49600
MGRs (Rs. ha ⁻¹)	110240	101400	105820a
MNRs (Rs. ha ⁻¹)	60040	52400	56220a
B:C	2.2	2.1	2.15a

†Mean values followed by different letters are significantly different by Duncan's Multiple Range Test (DMRT) at $p < 0.05$.

Economic analysis of foliar application of cobalt chloride vis-à-vis control

The MCCIs for demonstration plots with foliar application of cobalt chloride varied between Rs. 49400/- ha⁻¹ and Rs. 47250/- ha⁻¹ during *kharif*-2018 and *kharif*-2019 (Table 3). The pooled data for two study years revealed an average difference of Rs. 1275/- ha⁻¹ in MCCIs leads to significant ($p < 0.05$) difference of Rs. 9620/- ha⁻¹ in MGRs. The average MNRs were significantly increased by Rs. 10895/- ha⁻¹ following foliar application of cobalt chloride, compared with the control (no-spray). The B-C ratio of 2.38 was observed for demonstration plots against 2.15 for the control (no-spray) plots.

Production and economic efficiency

The production efficiency of demonstration plots with foliar application of cobalt chloride and the control (no-spray) plots was 13.4 and 12.3 kg ha⁻¹ d⁻¹, respectively (Figure 1a). Similarly, economic efficiency for cotton in demonstration plots with foliar application of cobalt chloride was Rs. 404.8 ha⁻¹ d⁻¹ compared to

Rs. 339.1 ha⁻¹ d⁻¹ for the control (no-spray) plots (Figure 1b). Earlier, Singh et al., 2018b reported economic efficiency of Rs. 201 ha⁻¹ d⁻¹ for *Bt*-cotton. The effect of foliar application of cobalt chloride on the production and economic efficiency of cotton cultivation was similar with variable magnitude during the two study years. Thus, the data clearly indicates higher economic returns for cotton cultivation following management of parawilt with foliar application of cobalt chloride.

CONCLUSION

The drooping of cotton leaves (parawilt) and plant death after heavy rainfall or heavy irrigation particularly after a long dry spell has been a serious constraint in cultivation of *Bt*-cotton in south-western Punjab (India). Most often, farmers in the study region confuse this disorder with fungal diseases or pest attack and generally apply fungicide or insecticide for its management. It has been observed that in the fields where foliar application of cobalt chloride is delayed, the recovery rate of cotton crop against parawilt is reduced. These results of the study indicate that timely application of cobalt chloride against parawilt has been the most

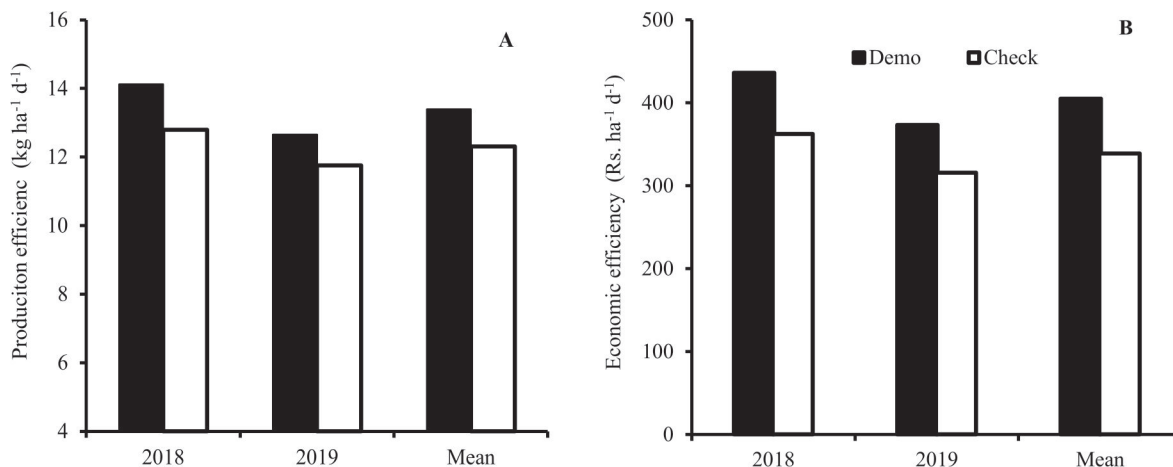


Figure 1. Production efficiency (a) and economic efficiency (b) of *Bt*-cotton following parawilt management using cobalt chloride in Mansa, south-western Punjab (India).

efficient management measure with high economic impact. The timely foliar application of cobalt chloride helped in getting higher seed cotton yield and higher economic returns due to increased production and economic efficiency.

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Comparing the Profile Characteristics for Evaluation of the Effectiveness of the Agri-business Incubators

Sushil Kumar¹, Rashmi Singh^{2*}, M. S. Nain² and Pramod Kumar³

¹Ph.D. Scholar ICAR-IARI & Indian Police Service, Rajasthan, India

^{2,3,5}Principal Scientist, ICAR-IARI, New Delhi ⁴Scientist, ICAR-IASRI, New Delhi, India

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

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ABSTRACT

The challenge faced by the incubators in India is finding good start-ups that solve the problems in the market or in value chain. A well-structured incubation program may lead the startup from idea generation stage to setting up the business and most crucial funding support. Analysis of effectiveness of training programme was done using primary as well as secondary data. Progress report of the institute and primary information from the trainees were matched to reach usefulness of the training programme. The primary data was collected during August, 2019 to January 2020 with partial structured pre-scheduled interview. For the ICAR-BPD trainees there was no substantial variation in age or land ownership, implying that the comparison on certain dimensions could be due to the training programme rather than underlying human attributes. The ICAR-BPD trainees were mainly attempting to obtain government employment and were often unaware of the training and other resources available to help them establish their own enterprise. Almost all of the trainees attributed their progress to the RUDSET Institute's EDP teaching.

INTRODUCTION

India is a vast nation with many diverse cultures, and India's traditional family size is huge. Farmers have suffered due to gradual land fragmentation, resulting in a significant reduction in land availability per capita. Due to this fragmented area, mechanised farming is not possible. Even if the number of such businesses has increased as a result of the creation of policies for medium small-scale entrepreneurs and other incentives by the Indian government, local concerns such as basic infrastructure remain a severe barrier. Although network of roads is developing but not connected to the places where agriculture is mainly practiced. Entrepreneurs play a critical role in society's economic growth. They are seen as precious assets and human resources with a great deal of potential that must be properly tapped in order to provide beneficial outcomes. Entrepreneurs share characteristics such as single-mindedness, drive, ambition, creativity, problem-solving, practicality, and goal-orientation. Personal characteristics of an agribusiness entrepreneur

have a big impact on the agribusiness (Gupta et al., 2019). Innovativeness, leadership ability, achievement motivation, decision making ability, risk orientation, management orientation, scientific orientation, competition orientation, critical thinking, resiliency, entrepreneurial self-efficacy, and locus of control were operationally defined as the cumulative outcome of twelve trait components (Bhaskar et al., 2019). Entrepreneurship should be fostered among youngsters in the farm and non-farm sectors to guarantee sustainable growth in the farm sectors and therefore a significant contribution to employment and economic growth (Kobba et al., 2020a). A step in the right direction is the RUDSETI model of entrepreneurship development training, which has been replicated across the country. Since the beginning of the training programmes, there have been frantic efforts to enhance the quality of the training programmes (Kobba et al., 2020b).

Business incubation is quickly becoming one of the most creative tools for assisting SME formation and development throughout the world. The process of a person or an organisation

assisting in the formation and growth of a startup is referred to as business incubation. In a nutshell, the objective of incubation is to improve the likelihood of a business's success. Agribusiness incubators not only help to commercialise technologies, but they also help to bridge the gap between farmers and development by providing necessary research and an avenue for feedback, which serves as the foundation for further innovation spread, as well as increasing the role of local government in farming. The incubators have a significant difficulty in securing funding to feed the nurturing process. This issue affected the longevity of the model and in absence of the basic support appropriate results could not be achieved (Tengeh & Choto, 2015). The non-acquaintance to the legal issues had a severe impact on his venture (Bagchi & Chatterjee 2017). A well-structured incubation program led the startup 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). There is a need for comprehensive research work to be undertaken about the effectiveness and impact of various business incubation strategies undertaken in agriculture. It is also important to study in detail about the roles of various stakeholders and the challenges associated with the agribusiness incubation, so as to suggest measures for enhancing their performance. In the current context, agribusiness, which was not seen in previous years, is gaining relevance and beginning to expand. Various institutes are now offering agricultural management degrees with specialisation, which is expanding the youth's participation in agribusiness. With all of these factors in mind, an evaluation of the agri-business incubators' performance was conducted.

METHODOLOGY

The current inspection uses *ex-post facto* research design and was carried out by covering purposively three selected agri-business incubators of ICAR namely IARI, New Delhi; CIPHET, Ludhiana and 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, Gurugram) was studied to aid in useful comparison between the business incubators. A partial structured pre-scheduled interview was prepared especially for the trainees, non-trainees and also for all four incubation centres. Elaborated discussion and per person observation ways were also applied in order to collect the data primarily. Amongst the chosen evolution centres, 40 incubates/trainees were chosen with the help of simple random sampling technique. 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 were consulted and questioned for the data collection process being involved in the research. For the data being quantitative, SPSS 24 was applied for the analysis. In order to compare average, t test, and Mann Whitney U test was done.

RESULTS AND DISCUSSION

Effectiveness was measured through index developed for this purpose, covering the broad indicators of incubates perceptions regarding; timeliness of service delivery, quality of information, utility of service, efficiency of service, satisfaction of incubates etc.

From the Table 1 it was found that the mean age of ICAR-BPD trainees was 32.33 which was somewhat more than that of RUDSETI trainees i.e. 30.57 but there exists no significant difference in the age of the trainees from both the institutes. The land holding of ICAR-BPD trainees was 1.44 ha that is slightly more than that of RUDSETI trainees i.e. 1.26 but there exists no significant difference between them. There exists a significant difference in the annual income of the trainees. The annual income of RUDSETI trainees was Rs. 2.60 lakhs that was found to be more than that of ICAR-BPD trainees i.e. Rs. 2.14 lac. Mann-Whitney 'U' test was applied to test the profile characteristics of RUDSETI trainees and ICAR-BPD trainees, it was found that for formal sources of information, ICT sources of information, social valuation, entrepreneurial intention, perceived supports and barriers, achievement motivation, leadership, locus of control and passion for work, there occurred a significant difference between trainees

Table 1. Comparison of socio-economics and personal characteristics of trainees and non-trainees

Profile characteristics	RUDSETI trainees Mean (SD)	ICAR-BPD trainees Mean (SD)	Level of Significance (2-tailed)
<i>t</i> - tests			
Age	30.57(7.26)	32.33(6.80)	0.441 ^{NS}
Land holding (ha)	1.26(1.21)	1.44(2.15)	0.551 ^{NS}
Annual income (lakh Rs.)	2.60(2.81)	2.14(1.65)	0.015*
<i>Mann-Whitney 'U' test</i>			
Education	3.83(1.21)	3.19(1.68)	0.676 ^{NS}
Informal sources of information	6.62(0.96)	6.57(0.99)	0.442 ^{NS}
Formal sources of information	8.02(2.76)	5.25(2.75)	0.035*
ICT sources of information	4.94(0.97)	3.09(1.28)	0.045*
Social valuation	11.43(2.67)	9.56(3.93)	0.049*
Entrepreneurial intention	41.01(6.26)	32.45(9.24)	0.018*
Entrepreneurial capacity	24.25(3.61)	16.92(6.22)	0.005**
Perceived supports and barriers	40.64(6.45)	34.18(9.29)	0.045*
Achievement motivation	13.48(9.43)	10.01(2.14)	0.013*
Leadership	12.79(2.02)	10.01(2.63)	0.014*
Locus of control	13.30(1.45)	10.03(2.90)	0.024*
Passion for work	13.10(1.65)	10.72(2.90)	0.008**

Table 2. Comparison of psychological characteristics of trainees and non-trainees

Profile characteristics	RUDSETI trainees Mean (SD)	ICAR-BPD trainees Mean (SD)	Level of Significance (2-tailed)
<i>Mann-whitney 'U' test</i>			
Self-efficacy	12.62(2.04)	9.17(2.95)	0.014*
Innovativeness	12.03(2.22)	9.21(3.34)	0.016*
Risk taking ability	11.86(2.29)	10.01(2.96)	0.046*
Pro-activeness	11.37(2.60)	9.04(3.13)	0.016*
Resource mobilization	10.99(2.35)	9.05(3.44)	0.046*
Need for achievement	23.13(1.90)	20.49(2.68)	0.031*
Need for power	21.13(1.94)	18.55(3.57)	0.019*
Need for affiliation	20.26(2.01)	21.48(2.62)	0.075 ^{NS}

of both the institutes. The profile characteristics of RUDSETI trainees was found to be better but for education and informal sources of information no significant difference was found between them.

Mann-Whitney 'U' test was applied to test the profile characteristics of RUDSETI trainees and ICAR-BPD trainees and the data presented in the Table 2 reveals that for Self-efficacy the mean value of RUDSETI trainees was more than the mean value of and ICAR-BPD trainees. Significant difference was found in the self-efficacy between the trainees of both the institutes. For innovativeness the mean value of ICAR-BPD trainees was 12.03 which was more as compared to RUDSETI trainees. There existed a significant difference in the innovativeness among both institutes. The mean value showed that the risk taking ability of RUDSETI trainees was higher and significant difference was found in the risk taking ability. The RUDSETI trainees were more pro-active as compared to ICAR-BPD trainees. The Resource mobilization of RUDSETI trainees was more and significant difference was found. Need for achievement and need for power for RUDSETI trainees was found to be higher. But no significant difference was found for need for affiliation between RUDSETI trainees and ICAR-BPD trainees.

Secondary data showed that farm EDP trainees had a higher settlement ratio (79.19%) than non EDP trainees (64.57%) when the average production of all RUDSET institutes is considered. The key explanation for the higher farm EDP settlement ratio was that the majority of them were either recommended by a lending organisation to become eligible for a loan or were interested in their own enterprise and want to gain the necessary skills to raise their profits. ICAR-BPD and RUDSETI trainees who engaged in their own farm company prior to and after attending the EDP training were considered resolved. Often trainees are unable to organise these skills and end up working for a living. Although government departments used to offer incentives to various agricultural enterprises in order to support a specific market opportunity but, the bulk of incubation trainees settled without the assistance of a bank. The key explanation for this may be that they often seek to acquire skills (both soft and hard) in order to excel in their company/enterprise. The large number of trainees in these institutes were in the process EDP category (beauty salon governance, computer tally, mobile repairing, etc.), which generally did not require a large investment and were capable of being organised. This form of behaviour was observed, as both RUDSETI and ICAR- BPD trainees had a higher potential for resource mobilisation.

According to research reports, approximately 60 per cent of agriculture trainees experienced a medium degree of realistic usefulness of the training and a medium level of satisfaction, which might also be attributed to factors such as less practical experience, obtaining a certification and a loan as the primary goal of training, a shortage of different scenarios for doing practical, and so on. They were given actual hands-on experience useful in day-to-day dealing of enterprise, as well as enough time for hands-on experience to master the requisite skills under the guidance of the teacher during extended hours of study. Also whose key motivation for completing the training programme was to acquire the necessary skills but instead to obtain the certificate.

CONCLUSION

The trainees were characterized by the fact that there was no substantial variation in age or land ownership but they were found significantly different in terms of annual income. Trainees differed substantially in terms of formal sources of knowledge, ICT sources of information, social valuation, entrepreneurial aim, perceived supports and obstacles, achievement inspiration, leadership, locus of influence, and passion for work. The training for RUDSETI has encouraged the trainees to mould their behaviour in a desired direction to take up their own entrepreneurial venture. The ICAR-BPD trainees were mainly attempting to obtain government employment because their parents wanted their youngsters to work for the government. They were often unaware of the training and other resources available to help them establish their own enterprise. Almost all of the trainees attribute their progress to the RUDSET institute's EDP teaching. It can be concluding that the large difference in income between RUDSETI and ICAR-BPDs trainees could be due to the impact of the EDP training programme.

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Impact of Migration on Women Empowerment: A Situational Analysis of North-Bihar

Kalpana Kumari^{1*}, K. M. Singh² and Nasim Ahmad³

¹Ph.D. Scholar, Agricultural Economics, Dr. RPCAU, Pusa, Samastipur, Bihar, India

²Professor & Dean, Post-Graduate College of Agriculture, Dr. RPCAU Pusa, Samastipur, Bihar, India

³Senior Technical Officer, Department of Agricultural Economics, Dr. RPCAU Pusa, Samastipur, Bihar, India

*Corresponding author email id: kalpanasingheco@gmail.com

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ABSTRACT

The study was conducted during 2018-2019 to explore the impact of male migration in north-Bihar in empowering women in different domain of household decisions. Five domains namely agricultural production, asset creation, health care, educational decision of children and leadership were considered and women empowerment indices were computed for each domain. The result revealed that migration of male member adequately empowered only 29.44 per cent of women. Larger proportion of women respondents (43.89%) were found under moderately empowered category and 29.67 per cent were observed still under low empowerment group. Women were adequately empowered in studied area to take decisions related to health care, education and agricultural production. The decision to purchase and sale of assets still was under the jurisdiction of male counterpart as the patriarchal system still dominated. The role of women in decision making in all the farm activities, from selection of crops to the sale of farm produce, showed comparatively more moderate empowerment indices. The paper concludes that the women are empowered to varying extent in situation of male migration from their native places.

INTRODUCTION

Migration has significant economic impact at both, the native and the destination places (Borjas et al., 1994; Dustmann et al., 2016) and it is imperative to assess the impact of migration and remittances on households 'left behind' at native places (Antman, 2013). Generally, the male member of the family migrates for better job opportunity. In the absence the male member(s), the onus of managing the household affairs lies with the female members. In the male migrated families, females have to participate in all socio-agro-politico-economic activities at native places. Therefore, women contribution in various spheres of social upliftment including their own being needs to be assessed, discussed and reorganized. Emphasizing the contribution of women in the development of society, Amartya Sen (1999) opined that 'Nothing, arguably, is as

important today in the political economy of development as an adequate recognition of political, economic, and social participation and leadership of women'. Global Gender Gap Index (GGGI) by World Economic Forum assess the gender parity on four premises *i.e.* health, education, economic participation and political empowerment. In GGGI, India ranked 140th among 156 nations (WEF Gender Gap Report, 2021). According to 2020-21 Sustainable Development Goal (SDG) Index of NITI Aayog, that measures the progress of Indian states based on 115 indicators including gender parity, wage equality among men and women and domestic violence against women, Bihar was adjudged the worst performer state (SDG India Index & Dashboard, 2020-21). Many researchers have studied women's empowerment using indicators like education (Haddad, 2000; Smith & Haddad, 2000; Berti et al., 2004), control over income (Berti et al., 2004; Leroy et al., 2008; Arimond et al., 2011)

and women decision making power and gender parity in society (Smith, 2003). Kabeer (1999) defines empowerment as expansion of people’s ability to make strategic life choices, particularly in contexts where this ability had been denied to them.

Migration of labourers from Bihar is well known on account of poor economic condition and underdeveloped infrastructure. In rural Bihar, migration of male members reduces the multi-faceted dimension women personality into single gender identities like ‘left-behind women’. Migration of male member makes women of the household more mobile in both private and public sectors and they don’t remain under direct and constant control of their male counterparts. It has been observed that women who became de-facto head of household have to take their own decision in their day-to-day activities spanning from education of children to health care to looking after in-laws through other household activities. Such condition of male migration seems to leverage women to break the age-old patriarchal system, empower them in various household businesses and enhances their stake in advancement of society. These positive impact of migration on left-behind women needs to be answered quantitatively and at the same time it has to be keenly evaluated whether this has any negative impact on them as well. Because, males are conventionally thought to better manage the agricultural activities, finances and various buying-procurement activities (Hughes, 2011; Singh et al., 2012; Kumar et al., 2014; Singh et al., 2015) and once, the male counterpart migrates, the roles and responsibilities of left behind women get intensified. In this context, the present study was carried out to assess the impact of migration on women left-behind and the extent of their empowerment.

METHODOLOGY

The present study is based on primary data collected from 180 migrant households selected randomly from twelve villages of Samastipur, Darbhanga and Madhubani districts of Bihar. The selection of districts was purposive as these districts recorded large scale migration according to 64th round NSSO report and Census of India, 2011. The survey was conducted with the help of pre-structured schedule in the year 2019 and detailed information on various socio-economic aspects were collected.

The Women Empowerment index was calculated on the basis of the model suggested by Alkire et al., (2013). Five Domains of Empowerment (agricultural production, asset creation, education,

and health related decisions and leadership quality) were taken to estimate WEI. The individual data on women was used to access the WEI from the respondent’s household of migrant labourers. To evaluate the degree of empowerment at the individual level, various indicators under each domain were identified and quantified to assess the level of women empowerment across the domains. Each domain was assigned equal weights and further indicators were given weights as per their observed importance such that sum of all the weights of the indicators under all five domains was equal to one. Indicators were binary, with 1 indicating empowerment and a 0 indicating lack of empowerment. Accordingly, the aggregate empowerment score lied between 0 and 1. The score of WEI was set at 0.75 as a benchmark for achieving adequate empowerment.

$$\text{Individual Empowerment Index} = \sum_{ij} W_{ij}$$

Where,

I_{ij} = jth indicators of ith domain, W_{ij} = jth weights for ith domain

After calculating individual empowerment scores, indicator wise domain empowerment was estimated by the using formula:

$$\text{Average} = \frac{\sum_{i=1}^n W_i I_i}{\sum W_i}$$

On the basis of indicator wise empowerment scores, group empowerment was computed using following equation:

$$\text{Women Empowerment Index} = W_e + W_n (D_a)$$

Where, W_e = Percentage of women with adequate empowerment, W_n = (1- W_e) = Percentage of women without adequate empowerment, D_a = Percentage of domains in which disempowered women have adequate empowerment

RESULTS AND DISCUSSION

For assessing women empowerment five important domains related to involvement of the left behind women in decision making for financial and social status upliftment of family were considered in the analysis. The indicators under each domain was carefully selected that were appropriate to reflect the decision making ability of women in day-to-day activities of household in absence of male member and quantifiable to assess individual empowerment index. The weight assigned to individual indicator, based on their importance, is presented in Table 1. The sum of weight of all the indicators is equal to unity. The empowerment and lack of empowerment of women were represented by binary value of 1

Table 1. Weights assigned to various domains and indicators of WEI

Domain (I_i)	Indicators (I_{ij})	Weights (W_{ij})
Agricultural Production (I_1)	Crop selection related decision (I_{11})	0.08
	Purchase of input decision (I_{12})	0.07
	Sale of output decision (I_{13})	0.05
Assets creation (I_2)	Ownership of assets (I_{21})	0.10
	Purchase, sale, or transfer of assets (I_{22})	0.10
Education (I_3)	Decision related to children education (I_{31})	0.10
	Expenditure on education (I_{32})	0.10
Health care (I_4)	Dietary decision for family (I_{41})	0.10
	Consultation with doctors in case of illness (I_{42})	0.05
	Sanitary measure of household (I_{43})	0.05
Leadership (I_5)	Member of social Group (I_{51})	0.10
	Speaking in public (I_{52})	0.10

Table 2. Frequency distribution of women under different ranges of Individual Empowerment Index (IEI)

Range	Percentage
Low (0.10-0.50)	26.67
Moderate (0.50-0.75)	43.89
Adequate (≥ 0.75)	29.44
Total	100

and 0, respectively. Thus the individual empowerment score would lie between 0 and 1 (Table 2).

The score for Individual Empowerment Index (IEI) was calculated and categorized in three groups on the basis of IEI *i.e.* (0.10-0.50) indicates low empowerment, (0.50-0.75) indicates moderate empowerment and equal and greater than 0.75 indicates adequate empowerment. The frequency of women under each range of IEI has been given in Table 3.

A perusal of the Table 2 showed that only 29.44 per cent of women were assessed to be adequately empowered. Larger proportion of women respondents (43.89%) were found under moderate empowered category, and this result is also supported by the findings of other researchers which revealed that majority of rural women had medium participation in decision making agricultural activities (Yadav et al., 2021) and 26.67 per cent were observed still under low empowerment group. The reason that could be attributed is the type of family the left-behind women has. In the nuclear family the left behind women are more empowered while the left behind women in joint/extended family are less empowered as most of the decisions are taken by elderly family members particularly in-laws. Extent of women empowerment was low in joint family however, such families are still much existent in Bihar due to its associated benefits like support in health problems and other household burden sharing (Antonucci et al., 2007). Women who live with in-laws have to take decisions in consultation with their in-laws. Dual decision-making authorities appear which often lead to a deterioration of relationship. Kulczycka (2015) described this type of arrangement as patriarchal control. Adequate empowerment may be because the left-behind women who live in nuclear family were not under control of other family members as in extended family and have autonomy to take their own decisions and are free to bear additional responsibilities in absence of their male counterparts. Similar findings have been reported by Desai and Banerji (2008) that women not living in extended families have

faced higher levels of responsibilities and greater autonomy, while women who live in extended households do not experience these demands or benefits.

Decision making of women in household plays an important role in the overall welfare of the family. A woman’s empowerment in household decision making increases the likelihood that her children’s schooling, proper medical care during illness and provision of nutritionally secure foods. Women have played important role in agriculture in most of the agrarian economies for their active participation in production, processing and marketing (Singh et al., 2020a; Singh et al., 2020b; Kumari et al., 2020). With migration of the male members of the family, there has been a role reversal and women were more actively involved in farm decision making in migrant families. Decision making powers of women in selection of crop, purchase of inputs and sale of output are studied in the area under investigation under the domain of agricultural production.

Domain-wise women empowerment indices (Table 3) revealed that the health care domain shows comparatively high empowerment indices and for all its three indicators followed by education and agricultural production domain. Low empowerment indices were observed in asset creation and leadership domain. The result indicated that women were adequately empowered to take decisions related to health care, education and agricultural production. Their autonomy in decision-making in these domains have contributed to overcome many constraints that hamper their empowerment (Shinogi et al., 2021).

The decision of purchase and sale of assets still comes under the jurisdiction of male counterpart as the patriarchal system still dominates in the study area. The health care has emerged as most important domain having adequate empowerment score in the area under investigation. The probable reason may be added responsibilities on women in absence of their spouse who are also the caretaker of the family. They have to take care of health related problems of children and elder family member. Similar findings was also reported by Roy and Nangia (2005); Datta & Mishra (2011). Apart from additional household responsibilities on part of women in male migrated families in search of job opportunities, information and communication technology (ICT) tools are also playing role in women empowerment (Sabharwal et al., 2020).

The educational empowerment may be due to the state government’s envisioned girls’ education policy which has invested heavily in state sponsored girls’ education programs such as *Mukhya*

Table 3. Domain wise women empowerment indices

S.No.	Domain (I _i)	Indicators (I _{ij})	Weighted average index	Percentage of women
1.	Agricultural Production (I ₁)	Crop selection related decision (I ₁₁)	0.83	10.1
		Purchase of input decision (I ₁₂)	0.79	9.62
		Sale of output decision (I ₁₃)	0.74	9.01
2.	Assets creation (I ₂)	Ownership of assets (I ₂₁)	0.38	4.62
		Purchase, sale, or transfer of assets (I ₂₂)	0.36	4.38
3.	Education (I ₃)	Decision related to children education (I ₃₁)	0.88	10.71
		Expenditure on education (I ₃₂)	0.75	9.13
4.	Health care (I ₄)	Dietary decision for family (I ₄₁)	0.86	10.47
		Consultation with doctors in case of illness (I ₄₂)	0.78	9.50
		Sanitary measure in their household (I ₄₃)	0.91	11.08
5.	Leadership (I ₅)	Member of social Group (I ₅₁)	0.48	5.84
		Speaking in public (I ₅₂)	0.45	5.48

Mantri Balika Cycle Yojana, Mukhya Mantri Akshar Aanchal Yojana and the *Mukhya Mantri Kanya Utthan Yojana* as a pathway for women's educational empowerment.

Study indicated that the role of women in decision making in all the farm activities like selection of crops to be grown, purchase of inputs and managing labour and selling of farm produce yielded comparatively more moderate empowerment indices (Table 3).

The empowerment indices were 0.83, 0.79 and 0.74 for the indicators; crop selection related decision, purchase of inputs and sale of produce related decisions. This is probably due to increased involvement of women of migrant households in various farming activities. Findings revealed that crop selection indicator in agriculture domain have showed the highest empowerment index which infers that women of the migrant households have highest autonomy in taking decision related to selection of crop. This finding is also supported by study of other researcher in which women have chosen cash crop to become socially, politically and economically more empowered (Rabha et al., 2021). Similar results were reported in another study which stated that due to male out-migration, the women left behind in the villages assume a major role in various farm activities resulting in the so-called 'feminisation of agriculture' (Singh et al., 2011); Singh et al., (2013); Jha & Varghese (2021) also observed similar results in their studies. Singh et al., (2017) advocated women committee in the form of cooperatives, strengthening the livestock extension service by recruiting sufficient number of women dairy extension personnel and liberal arrangement of credit facilities for empowerment whereas Slathia et al., (2015) advocated self-help groups for rural congregation on large scale for empowerment of women. National Skill Development Mission is being implemented to prepare young women to enter the work place and to increase women's work participation in Bihar. The government has made reservation of 35 per cent for women in government jobs and in local body elections it is hoped that women and girls in Bihar would be able to achieve their potential and fulfill their aspirations.

CONCLUSION

From the ongoing discussion it is evident that male migration has greatly impacted the role of women in household business. Male migration has bearing on upscaling the responsibility of women and making them self-reliant. Decision making by women in households plays an important role on the overall welfare of the family. Various governmental interventions like, National Skill Development Mission, *Mukhya Mantri Balika Cycle Yojana, Mukhya Mantri Akshar Aanchal Yojana* and the *Mukhya Mantri Kanya Utthan Yojana* have also been helpful in empowering women in domains like; health care, education & agricultural production. However the women empowerment in domains like, asset creation & leadership are still low, the reason for which, in part, are rooted in prevalence of patriarchal hegemony of rural society and therefore, more awareness and governmental initiatives are required in these sectors.

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Land Resource Cards: An Innovative Approach to Empower Farmers for Site-Specific Farm Resource Management

K. N. Ravi^{1*}, S. L. Patil², Hrittick Biswas³, M. N. Ramesha⁴, B. S. Naik⁵, P. R. Ojasvi⁶, Ravi Dupdal⁷, M. Prabhavathi⁸, Suresh Kumar⁹ and A. S. Morade¹⁰

^{1,4,7,8,10}Scientist, ⁵Senior Scientist, ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Ballari, Karnataka, India

²Principal Scientist, ICAR-Indian Institute of Pulse Research, Regional Station, Dharwad, Karnataka, India

³Principal Scientist, ICAR-National Bureau of Soil Survey and Land Use Planning, Nagpur, Maharashtra, India

⁶Principal Scientist & Head, ICAR-Indian Institute of Soil and Water Conservation, Dehradun, Uttarakhand, India

⁹Scientist, ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Koraput, Odisha, India

*Corresponding author email id: raviknswamy01@gmail.com

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ABSTRACT

The paper investigates an innovative extension approach of generation and distribution of Land Resource Cards, developed from Land Resource Inventory database, used for site-specific farm resource management in watersheds adopted under World Bank funded Sujala-III project. Extent of reach, satisfaction level and training status of Land Resource Cards in 12 model micro-watersheds located in different agro-climatic regions of Karnataka with a sample size of 720 farmers was assessed. The Land Resource Cards reached only 18 per cent of farmers while 22 per cent of farmers were trained for its utilization. However, 77 per cent were satisfied with the information provided and 23 per cent suggested for further improvement in cards for greater utility. The overall farmer's perception on capacity building on land resource cards revealed that they were very useful in farm-level resource management. Hence, need for replication of similar approach in all database driven watersheds to be implemented in the future with adoption of modifications is suggested.

INTRODUCTION

Land and water provides the principal basis for human livelihoods and well-being. Therefore, sustainable use of these natural resources is paramount importance for continuous food production and income generation to farming community. Improper and unscientific management of resources may cause further degradation and deterioration of natural resources. According to Intergovernmental Panel on Climate Change (IPCC) special report (2019) on land degradation highlights that soil erosion from agricultural fields is estimated to be currently 10 to 20 times to more than 100 times higher than the natural soil formation rate. Evidence to the same the soil loss rate in our country is about 1535 t km⁻² yr⁻¹ (Sharda & Ojasvi, 2016) and as a consequence of this the major rainfed crops suffer an annual production loss of 13.4

million tons due to water erosion alone with estimated loss of Rs. 205.32 billion (Sharda & Dogra, 2013) in monetary terms. Therefore, reducing and reversing land degradation at different spacial scales from individual farms to entire watershed will be cost effective and offer immediate and long-term benefits to the communities (IPCC, 2019). In this regard watershed is an ideal unit for management of natural resources for land use planning (Krishna, 1996; Lalitha et al., 2016). Over the years huge financial resources were invested in the watershed development programs, but most of conventional watersheds not given expected level of output in India (Lalitha et al., 2016; Hegde et al., 2018). The reasons attributes, lack of site-specific watershed planning and implementation (Lalitha et al., 2016), improper utilization of natural resources both at farm and watershed level (Hegde et al., 2018) and Inadequate management of conservation practices by the farmers due to poor knowledge

and awareness (Oraon et al., 2020; Dupdal et al., 2021; Kumar et al., 2021) are some of them to be noted from various studies. Meanwhile, many suggested need for detailed site-specific land resources database to identify the inherent potentials, constraints and suitability for various land use options that suit to local conditions (Bandyopadhyay et al., 2009; Nain et al., 2012; Kumar et al., 2014; Ramamurthy et al., 2016; Bandyopadhyay et al., 2018; Hegde et al., 2018; Sharma et al., 2018; Oraon et al., 2020) and such interventions must easily understandable and manageable by farming community for decision-making at local level (Doubling Farmers' Income, 2018). Therefore to overcome all the above mentioned problems, a site-specific and scientific approach of watershed planning and implementation through generation of both watershed and farm-level database was adopted in recently implemented Sujala-III watersheds in Karnataka state. Under the project emphasis was given for development of Land Resource Inventory (LRI) database at micro-watershed level. The project approach also involves a new extension approach of preparation of Land Resource Cards emanated from the Land Resource Inventory (LRI) database and dissemination of knowledge through capacity building on utility of cards for site-specific farm level management was carried out at village level. The paper elaborates a detailed framework of new extension model and its reach and utility among farmers.

METHODOLOGY

Firstly the efforts were made to elaborate the framework of new extension approach and its mechanism adopted under Sujala-III project for dissemination of farm level land resource information. Second, field survey conducted with semi-structured interview schedule to assess its extent of reach, satisfaction level and capacity building status with a sample of 720 farmers responses collected from 12 micro-watersheds, three each from Raipalli, Bedawatti, Lingapurahalla and Harve sub-watersheds in Bidar, Koppal, Tumakur and Chamarajanagar districts of Karnataka, respectively. A stratified random sampling technique was used for sampling purpose. The selection criterion picks one micro-watershed from upper, middle and lower reaches (strata) of the each sub-watershed. Within the micro-watershed, 60 respondents were drawn, 20 each from upper, middle and lower reaches.

RESULTS AND DISCUSSION

Land resource cards and its generation process

Land Resource Card (LRC) is an information guide generated for each land parcel at farm level developed from LRI database of micro-watersheds which provide site-specific and location specific crop choices, soil and water conservation measures, nutrition status of soil, soil limitations and their management information to guide farmers for sustainable management of resources. The cards are a result of an extensive investigation by consortia of partners involving 14 research institutions (LRI partners) under Sujala-III project. Initially the LRI partners mapped various characteristics to determine the profile of the soil, socio-economic and bio-physical properties of watersheds, rainfall situation of region, suitable economically potential crops of the locality and among others

through field survey. Further, consortia of partners developed a LRI database for preparing optimum land use plans for the micro-watersheds through generation of LRI Atlas maps, treatment plans and hydrology atlas using GIS, GPS and Remote sensing techniques. This database of each micro-watershed helps Project Implementing Agencies (PIAs) like State Agriculture line Departments for further site-specific scientific Detailed Project Report (DPR) preparation and implementation of watershed interventions as per plans at both micro-watershed and farm level. Later an innovative product, LRC was brought out for each land parcel within the micro-watershed using LRI database. Specifically cards contain micro-level LRI information which remains valid for 25 years, except soil nutrient status, which needs to be updated at every three years interval. Meanwhile all this database information was made available in an interactive web portal (<https://www.sujala3lri.karnataka.gov.in/>) for stakeholder's utility by Watershed Development Department, Government of Karnataka. The project generated Land Resource database for 2531 Micro-watersheds covers area of 12.66 lakh ha during 2013-19.

To disseminate the database information generated in the Sujala-III watersheds, the LRI partner Institutes were generated LRC for all the land parcels located in the micro-watershed. The generated information was transferred to LRI Extension Managers employed at each *Raitha Samparka Kendras (RSKs)*, called Farmer Contact Centers, located in respective micro-watershed. They laminated LRC for further distribution among farmers in micro-watersheds. Approximately each card preparation (after received database from LRI Partners) with color printing and lamination cost was Rs. 12. Once the cards were generated, the next step was card distribution to farmers at village level and they were trained on the scientific and site-specific land resource details and its proper utilization for sustainable management of soil and water resources at farm level.

The comprehensive database generated through the LRI covering all the land holdings in a watershed area will help in the preparation of individual farm level information through LRCs. It helps the farmers in identifying site-specific soil constraints affecting crop production, gives land-use option based on suitability of different crops and their management options, potentiality of soil for cultivation of cereals, pulses, major vegetable crops, horticulture plantation, forestry and other uses, soil nutrient status (Available pH, EC, OC, N, P₂O₅, K₂O, S, Zn, B, Fe, Mn and Cu) for judicious use of fertilizers and additional information like Kissan Call Centre number, Horticulture helpline, Varuna mitra helpline, and Agriculture marketing helpline numbers for enquiry on any agriculture related issues. Thus highlighted the cards to enrich the knowledge of farmers and empower to take best farm management decisions pertaining to his/her land. Further, the Land Resource Cards with detailed information provided in cards to overcome some of the knowledge constraints faced by farmers reported by Ghaswa (2019) & Kaur et al., (2020) in use of Soil Health Cards (SHC) in which latter provide only information on nutritional status of soil.

LRI card distribution status in Sujala-III micro-watersheds

The micro-watershed wise Land Resource Card distribution status was analysed and the results are presented in Figure 1.

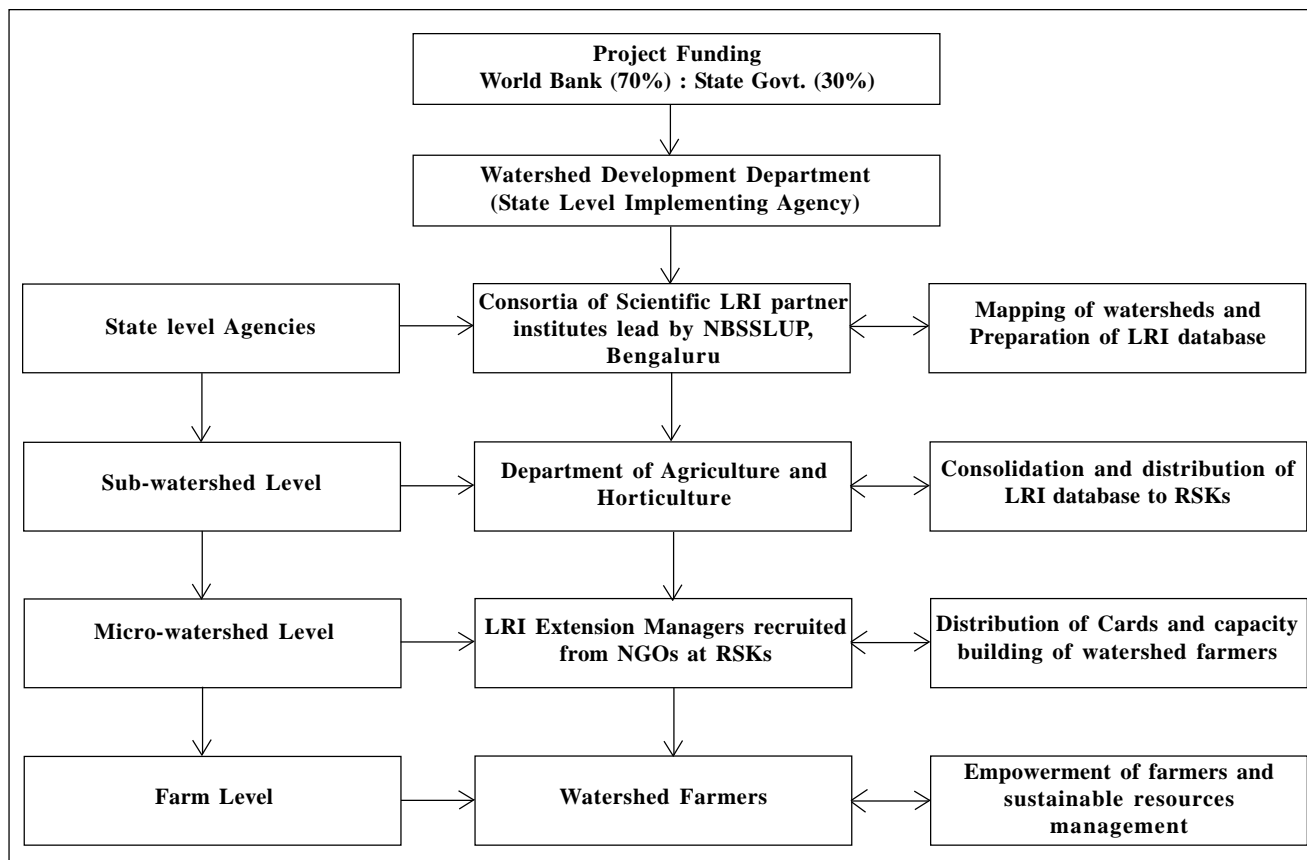


Figure 1. Innovative approach adopted for creation of awareness on utility of LRC for site-specific farm-level planning among farmers

Results indicate that about 60 per cent of the farmers of Chikkamageri-3 micro-watershed in Bedawatti sub-watershed received Land Resource Cards, which is the highest percentage among all 12 micro-watersheds studied. This followed by Ryavanaki-1 micro-watershed (52%). However, Bedawatti-6, Huliya-pura, Raipalli-2 and Kharanjikhurd micro-watersheds reported 10-20 per cent distribution. Further, in Kunchamanahalli-1, Sagade and Harve-1, Kalyanpura, Lingapurahalla and Babulgaon-2 micro-watersheds received less than 10 per cent Land Resource Cards (Figure 2). Meanwhile, the overall reach of the cards to the farmers was 18 per cent and it was lower when project was about to complete in December, 2019. The reason for lower card reach among watershed farmers is mainly due to distribution of cards at the middle of the project and also higher LRI Extension Manager to farmer's ratio.

Satisfaction of farmers on information provided in land resource cards

The satisfaction on the information provided in the cards as perceived by the farmers who received LRCs was documented in twelve micro-watersheds. The satisfaction level on information provided in cards ranged between 60 to 100 per cent (Table 1). The percentage of satisfied farmers was more than the unsatisfied farmers in all the micro-watersheds. The reason expressed by the satisfied farmers were documented in open ended questions, which revealed that cards helped farmers in identifying site-specific soil

constraints affecting crop production, also helped to understand constraints/limitations affect land productivity and gave crops suitable to their soil condition and other suitable conservation measures to be adopted at farm level to manage land for better income. Thus a LRC provided an adequate knowledge and awareness among farmers to overcome constraints faced by farmers due to inadequate knowledge about scientific conservation practices and land or soil limitations as reported by some studies (Kumar et al., 2021; Dupdal et al., 2021). The fraction of farmers who dissatisfied with the Land Resource Card information cite lack understanding due to illiteracy and prejudice in accepting new farming techniques and moving away from traditional practices, particularly older age farmers. Hiwarkar et al., (2014) also observed a positive correlation between illiteracy and old age on low awareness about knowledge on soil and water conservation practices even after capacity building. The reasons also depicted by Kumar et al., (2021) on personality traits like age and education are associated positively significant with constraints like knowledge and awareness on conservation practices.

Land resource card training status in Sujala-III micro-watersheds

The capacity building of famers through trainings on LRCs was crucial for the dissemination and influence for adoption of the LRI based scientific watershed management activities. Understanding the information provided and how to use to derive maximum benefit from the LRCs needed a timely training to the

Figure 2. Micro-watershed wise percentage of Land Resource Cards distribution among farmers

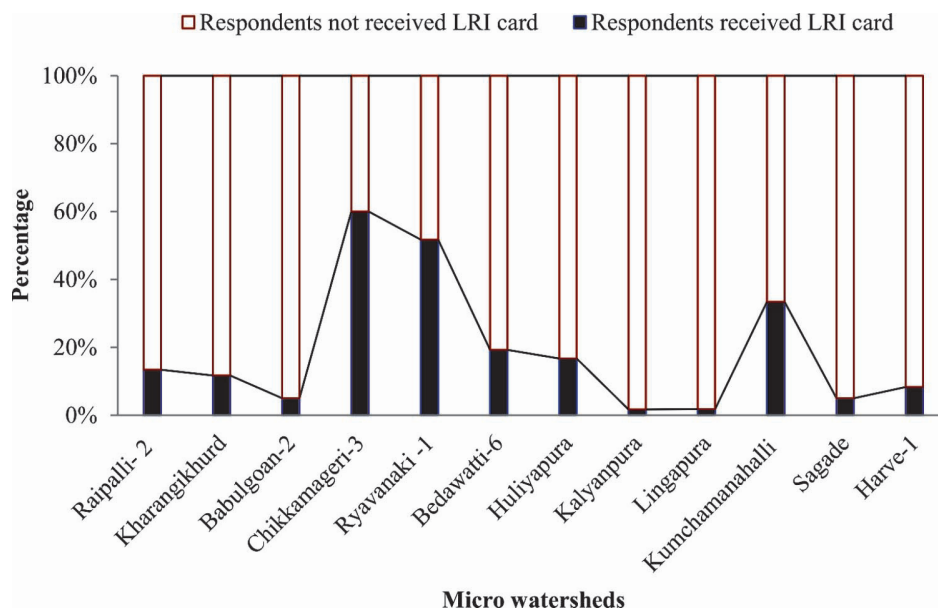


Table 1. Micro-watershed wise farmer’s satisfaction on information provided in land resource cards

Sub-watershed	Micro-watershed	Satisfied farmers (%)	Unsatisfied farmers (%)
Raipalli sub-watershed, Bidar	Raipalli 2	87.5	12.5
	Kharangikhurd	85.7	14.3
	Babulgoan-2	66.7	33.3
	Total/Average (n ₁ =18)	83.3	16.7
Bedawatti sub-watershed, Koppal	Chikkamageri-3	75.0	25.0
	Ryavanaki -1	74.2	25.8
	Bedawatti-6	60.0	40.0
	Total/Average (n ₂ =92)	70.7	29.3
Lingapurahalla sub-watershed, Tumkur	Huliypapura	90.0	10.0
	Kalyanapura	100.0	0.0
	Lingapura	100.0	0.0
	Total/Average (n ₃ =14)	92.9	7.1
Harve sub-watershed, Chamarajnagar	Kumchamanahalli	90.0	10.0
	Sagade	66.7	33.3
	Harve-1	80.0	20.0
	Total/Average (n ₄ =28)	85.7	14.3
	Overall (n=152)	83.15	16.85

Table 2.

Sub-watershed	Micro-watershed	Farmers received training (%)
Raipalli sub-watershed, Bidar	Raipalli 2	13.3
	Kharangikhurd	10.0
	Babulgoan-2	5.0
	Total/Average (n ₁ =180)	9.4
Bedawatti sub-watershed, Koppal	Chikkamageri-3	53.3
	Ryavanaki -1	51.7
	Bedawatti-6	40.0
	Total/Average (n ₂ =180)	48.3
Lingapurahalla sub-watershed, Tumkur	Huliypapura	26.7
	Kalyanapura	5.0
	Lingapura	8.3
	Total/Average (n ₃ =180)	13.3
Harve sub-watershed, Chamarajnagar	Kumchamanahalli	38.3
	Sagade	8.3
	Harve-1	11.7
	Total/Average (n ₄ =180)	19.4
	Overall (n=720)	22.6

farmers. The results revealed that the number of farmers received training in all three micro-watersheds of Bedawatti sub-watersheds was approximately 50 per cent of the total number of respondents surveyed (Table 2). In other micro watersheds of the Raipalli, Lingapurahalla and Harve sub-watersheds the percentage of farmers received LRI trainings was less than 20 per cent and the percentage of farmers not trained is higher i.e. >80 per cent. The lower distribution (reach) and training on Land Resource Cards is due to generation and distribution of cards to farmers was conceptualised in the middle of the project, which gives less time and scope for its distribution and training among farmers.

CONCLUSION

The study revealed that Land Resource Cards generated using LRI database will be useful for farmers for scientific farm-level planning using information provided in the cards. However, lower reach of cards among farmers was observed. The study recommends that LRC distribution and training to be conducted before

implementation of the project to create awareness and mobilize farmers to accept the LRI based recommendations at the early stage of the watershed projects. Further, this innovative generation and dissemination model of LRC generation need to be scaled up at state and national level and generated database to be linked to Nation Farmers Database for its greater utility and to realize self-reliance among farmers for sustainable rainfed agriculture. Further long-term impact study of Land Resource Cards and its site-specific database on knowledge, attitude and utility among in watershed farmers need to be taken up.

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Issues, Challenges and Opportunities of Agriculture in West Kameng District of Arunachal Pradesh

Ankit Tiwari^{1*}, Sunil K. Singh², Ajitabh Bora³, Baikuntha J. Gogoi⁴ and Sanjai K. Dwivedi⁵

¹Scientist B, ²Senior Technical Assistant B, ³Scientist D, ⁴Scientist E, ⁵Director, Defence Research Laboratory, (DRDO), Tezpur-784001, Assam

*Corresponding author email id: ankit.tiwari0126@gmail.com

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ABSTRACT

A survey was made during 'Kisan Jawan Vigyan Mela' at Defence Research Laboratory Research and Development Centre (DRL R&D Centre), Salari, West Kameng district of Arunachal Pradesh with an aim of getting insight of issues, challenges and opportunities of agriculture sector. The relevant data was collected during Mela from 67 farmers of 11 villages of the district using semi-structured interview (SSI) and a rank-based quotient (RBQ) was worked out to rank the farmers issues and challenges. Based on ranking of problems by the group of farmers, outbreak of insect-pest and diseases, paucity of quality seed material of field and vegetable crops and lack of technical knowhow were found to be the major issues and challenges of the region. The problem solution trees for three of the major problems were constructed and the opportunities in hill farming were suggested to the farmers as per the impact analysis and RBQ.

INTRODUCTION

West Kameng is one of the districts of the mountainous state of Arunachal Pradesh in North-East India with its headquarters in Bomdila and lies between 91° 30' to 92° 40' East longitude and 26° 54' to 28° 01' North latitude having an area of 2873 sq. km. Defense Research Laboratory (DRL, DRDO), Tezpur (Assam) has a Research and Development Centre (R&D Centre) at Salari village in West Kameng which is located in mid hills at an altitude of 1069 meters at a distance of 30 km from district headquarters. This village is the vegetable basket of West Kameng district as there is year-round production of tomato and cabbage. However, poor productivity and quality issues are major challenges.

The high and medium altitude area of Arunachal Pradesh are least explored with respect to status, challenges and opportunities in farming sector while agriculture is the mainstay of the inhabitants of the region. A very limited number of studies conducted so far necessitates the detailed survey of these areas to identify major issues and challenges and to suggest tangible solutions to farming community. A plethora of problems in production, marketing and

storage of crops are faced by the farmers particularly dwelling in forward areas of hilly region. The inadequate supply of inputs, unawareness about the good agricultural practices (GAPs), hovering freight charges, low seed replacement ratio, lack of timely availability of sufficient and good quality seed material, irrigation problem, non-availability of sufficient credit, non- remunerative market price for the farm produce, lack of sufficient storage space and facilities and malpractices exercised by middle man are to name a few (Arneja et al., 2009; Lal et al., 2011; Pandit et al, 2017; Katayani et al., 2017; Reema et al., 2020). Hence, the productivity of this region is sub optimal due to cumulative effect of aforementioned problems coupled with environmental and socio-economic factors. However, it can be significantly enhanced, provided there is proper information about the root causes of problem. Although, there are number of farmers' welfare scheme, which are being implemented by the Government to uplift their socio-economic standards, there is lacuna in outreaching the last beneficiary due to unavailability of the information about ground zero problems and feedback. It is reported in previous studies that there is a knowledge chain between information required by the

farmers and its source (Mwakaje, 2010). Furthermore, it is found that most of the farming communities of the country do not have access to information related to improved farming practices (Meitei & Devi, 2009). Keeping the above in view, a study was undertaken during DRDO 'Kisan Jawan Vigyan Mela' organized at the DRL R&D Centre in Salari during September 2018 to find out the major issues, challenges and opportunities of agriculture in West Kameng district of Arunachal Pradesh and to rank the problems for their tangible solutions.

METHODOLOGY

A brief survey was made during the DRDO 'Kisan Jawan Vigyan Mela' under the theme of "Technologies for doubling farmers' income". The interview schedule for gathering information was prepared in a bilingual format and were distributed among the farmers during the farmers registration process. The schedule was filled by interview method for the purpose. The major agriculture related problems identified in the 11 villages of district West Kameng listed and Rank Based Quotient (RBQ) of the problems was worked out based on the ranking done by 67 farmers of the villages. RBQ was calculated using following formula as devised by Sabarathnam (1988):

$$RBQ = \frac{\sum_i (n + 1 - i)}{N \times n} \times 100$$

Where, i = Concerned ranks, N = Numbers of farmers, n = Numbers of ranks, fi = Frequency of farmers for ith rank of the technological need

Based on the agriculture-related problems identified, a problem-solution tree was constructed to appropriate the possibilities to overcome the identified problems. A proper understanding on the agricultural practices such as variety of the crops grown in these areas is paramount for tasking the problems of insect-pests and diseases associated with these crops. The fair was conducted to suggest and recommend appropriate package of practices to the farmers for improvement in productivity of their crops. The farmers' feedback was recorded to estimate the possible impact of the suggested interventions. For this purpose, a farmers-scientists

interaction session was organized in the form of 'Kisan Gosthi' in which the farmers actively participated and discussed about their agriculture related problems. The problems were categorized for rank and suggestions of the experts were categorized for the impact analysis. The weightage was calculated in percent and it was depicted accordingly.

RESULTS AND DISCUSSION

Geo-demographical status

Major population of the district is dwelling in rural areas accounting for 82 per cent and economy of the *Monpa* tribes is primarily agrarian (Anonymous, 2011). Terrace farming is common in this region owing to undulated topography with sloppy terrain. Most of the farmers own land holding that falls under the category of small to medium (0.5 hectare to 1.0 hectare) as pointed out during the interaction with farmers. The traditional unit of land measurement in West Kameng is *kattha*, which is approximately 720 square feet. Soil of West Kameng district are mainly coarse in texture, acidic in soil reaction and rich in organic matter, potassium and magnesium but low to medium in sulphur and phosphorus (Sannigrahi and Pandey, 1998). The physical condition of the soil of the region is such that it can support a wide range of crops. The major staple food crop of the region is maize supplemented with local rice, millet, buckwheat, wheat and barley. Soybeans, French beans, chilies, potatoes, cabbage, cauliflower and apples are mainly cultivated for self-use and, to some extent, for the sale in local markets (Singh & Sureja, 2006).

These farmers also grow some miscellaneous crops as per their family requirement like wheat, soybean, vegetable mustard (*lai patta*), leek and some medicinal crops. Salari village and its adjacent region is known for tomato cultivation. It is mainly a vegetable growing belt, which is mainly comprised of tomato and cabbage cultivation. Farmers of locality mainly grow local varieties of crops or they purchase seeds from local seed vendors of Tezpur in Assam. State Horticulture Department, KVKs and DRL R&D Centre Salari are some of the outlets from where some progressive farmers collect quality seeds etc.

Table 1. General agricultural analysis of participant villages of West Kameng District

Particulars	Details
Major Crops	Field crops Maize (kharif), Kidney bean, Mandua (finger millet), buckwheat, wheat (rabi) etc. Vegetable crops Tomato, cabbage, beans, cucumber, chili, pumpkin, chow-chow, radish, capsicum, potato etc. Fruit crops orange, lemon, walnut, apple, pomegranate, mango, kiwi, persimmon, watermelon etc. Spices ginger, garlic, cardamom, turmeric etc.
Cropping pattern	<i>Jhum</i> cultivation, patches of permanent pastures and sedentary agriculture
Water resources	Kameng River (lifting) and diversion of water streams
Agro-technologies	Sun drying of wild fruits and cultivated vegetables for lean seasons, terrace farming, bamboo structure for staking of tomato plants, mixed farming of maize with cucurbits etc.
Problems	Undulated topography, sloppy terrain, heavy rainfall and soil erosion, Insect-pest and disease outbreak, Water unavailability during winters due to wastage of water by heavy runoff, Unavailability of quality seed material and manures/fertilizers.
Opportunities	Integrated insect-pest and disease management (IPM and IDM) Introduction of remunerative crops such as exotic vegetables, strawberry etc. and their soilless nursery under low cost protected structures, Popularization of vermicomposting and mushroom technology Value addition and Food processing (vertical diversification), Soil and water conservation (water harvesting) along with drip irrigation setup, especially for orchards, Capacity building through popularization of low cost protected cultivation technologies for off season and exotic vegetables (horizontal crop diversification)

The region experiences an annual rainfall in the range of 1600 mm to 2000 mm. The farming of the region largely depends on rainfall and hence characterized as rain fed. However, some of the progressive and large-scale farmers have lift irrigation systems. The most common source of irrigation is lifting of water either from the Kameng River or from diversion of small streams of water from hilltops. Most of the farmers are facing problems in irrigating their orchards, as there is huge loss of rainwater due to the hilly and sloppy terrain. The shortage of water specifically encountered by orchard growers during winters due to insufficient rainfall during the season and lack of water conservation measures.

Farmers' issues and challenges

Major issues and challenges faced by the farmers of the region were worked out as per the data collected during Mela as well as farmers-scientist interaction (Figure 1). It is evident that input supply and resource management (37.2%) were the major issues faced by the farmers followed by knowledge in terms of technical knowhow (21.6%) and demonstration (21.6%). Further, it was observed that market (12.3%) and consultations (9.1%) were secondary issues. The primary reason behind the less emphasis on market availability issue was low productivity of scattered and marginal land holdings due to which there is lack of marketable surplus as most of the farm produce could hardly suffices the needs of family.

Since, the West Kameng district is a mid-altitude hilly region, the major environmental challenges such as undulated topography, slopy terrain, heavy rainfall and run-off and uneven distribution of rainfall throughout the seasons were the factors caused huge soil loss due to erosion and landslide. Moreover, torrential rainfall during rainy season coupled with high solar intensity made congenial environment for insect-pests and diseases to flourish abundantly in the region.

It is evident from the rank-based quotient (RBQ) analysis that maximum number of the farmers complained about the crop failure due to insect-pests and diseases outbreak causing significant crop loss. Hence, it came out to be one of the major challenges of the vegetable farmers followed by lack of technical knowhow, lack of fertilizers and manures and their untimely availability and lack of irrigation facilities (Table 2). The insect-pest and disease outbreak might be due to congenial environment for their multiplication along with lack of knowledge to identify their threshold limits and their effective management. However, lack of good quality agricultural inputs like high yielding variety of seeds, seedlings fertilizers and irrigation facility were also found to be equally important challenges.

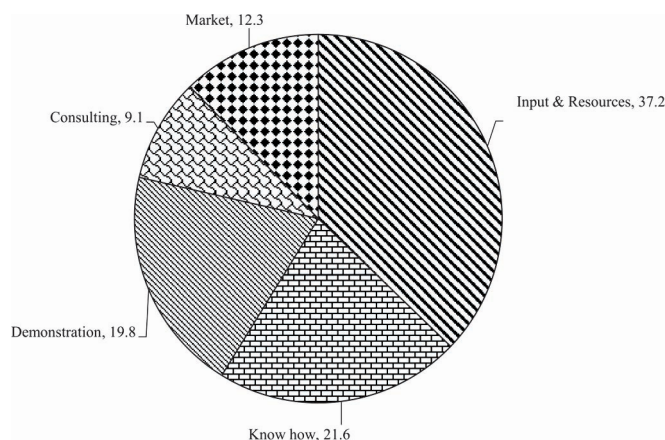


Figure 1. Farmers' issues and challenges

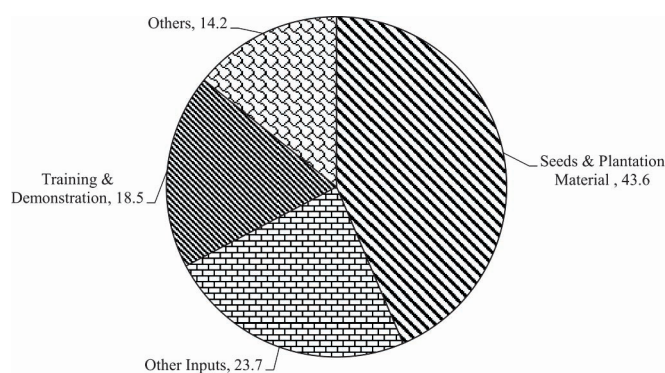


Figure 2. Impact of various interventions

Suggested solutions

The tangible solutions for three of the major problems were suggested in the form of problem solution trees (Figure 3). In addition, farmer-experts interaction came up with some suggestions for the issues, which the farmers might overlook, but equally important to mitigate the challenges of farming community are standardization of package of practices of major crops of the region including vegetable crops, field crops, medicinal and aromatic crops etc. to improve the agricultural productivity and their effective demonstration. However, encouragement of cooperative farming and establishment of custom hiring centers (CHCs) for agricultural inputs can significantly reduce the cost of cultivation and production and optimize the farm profits. Adoption of low cost protected cultivation technologies such as bamboo-based polyhouses, net

Table 2. Rank Based Quotient of the major challenges identified in the 11 villages of West Kameng district in Arunachal Pradesh

Agricultural problem	1	2	3	4	5	6	7	RBQ value	Rank
Paucity of quality seed material of field/vegetable crops	26	19	22	-	-	-	-	86.57	2
Lack of manures/fertilizer and their untimely availability	18	11	14	15	9	-	-	75.16	4
Lack of irrigation facilities	-	25	16	14	12	-	-	70.03	5
Crop Insect-pests and diseases outbreak	30	14	23	-	-	-	-	89.82	1
Unfamiliarity with the technical knowhow	25	12	20	10	-	-	-	86.00	3
Market availability	-	-	-	-	29	20	18	32.46	7
Weeds menace	-	-	-	21	12	15	19	38.20	6

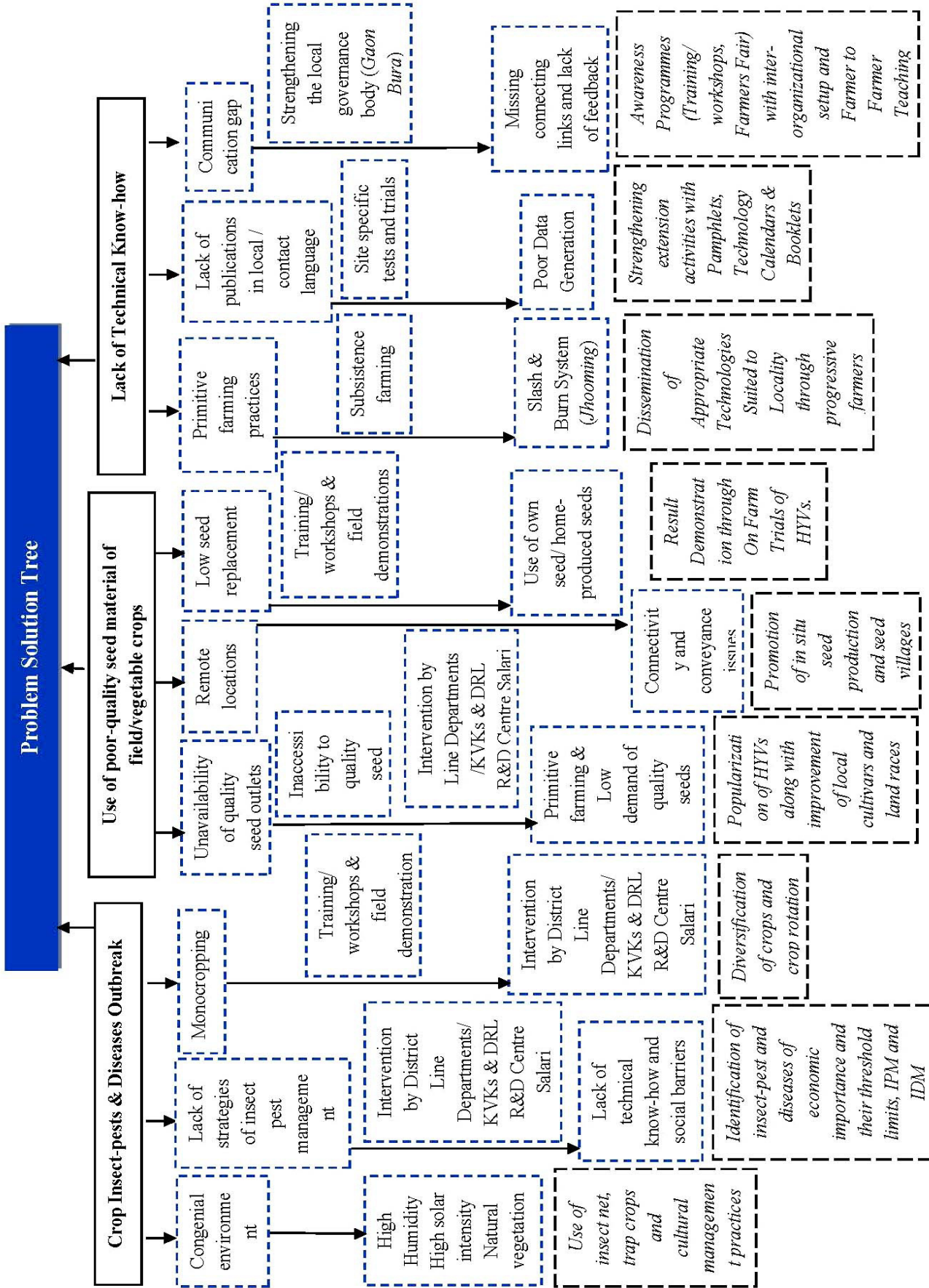


Figure 3. Problem Solution Tree for major agricultural problems of West Kameng District (Problem normal font; Solution(s) in italics)

houses, low tunnels, and bench terracing of the slopes ranging from 6.0 to 33 per cent etc. are some of modern agro techniques, which can be vital to agro-ecosystem sustainability and can aptly address the major challenges of farming community. Kalita et al., (2019) also found front line demonstration as an effective tool to increase productivity of rapeseed in Tirap district of Arunachal Pradesh.

Opportunities

West Kameng district being a part of Eastern Himalayan state Arunachal Pradesh is particularly rich and bestowed with a wide range of plant species and is considered a global hotspot of biodiversity (Myers et al., 2000). The soil of most of the region is fertile in terms of organic carbon and other essential nutrients for plants like potassium and magnesium. A wide range of crops ranging from field crops, fodder crops, spices and medicinal plants, fruits and vegetable to agro-forestry crops can be grown in West Kameng district. It is likely to fetch good prices and lead to economic improvement of the farmers of the region. Introduction of remunerative crops such as strawberry; improved cultivars of existing fruit crop and natural resource management has vast scope for improving agricultural productivity and for the advancement of existing agricultural practices through capacity building and technology demonstration (Table 1). This region is known for bumper production of quality oranges, persimmon, tomato, cabbage and ginger. Hence, there lies a good scope of post-harvest management including value addition and food processing of local produce for the prevention of spoilage and long-term storage. However, DRL R&D Centre (DRDO) at Salari has established a food processing cum skill development center. Training and demonstration of value addition techniques of locally available crop produce is conducted regularly at this center.

It was estimated that there is a huge gap of demand and supply of good quality seeds. It is evident that intervention in maintaining the supply chain of good quality seeds and plantation material (43.6%) followed by other agricultural inputs (23.7%) and organizing of training and demonstrations (18.5%) could make a significant difference in the current scenario of the farming sector of West Kameng district (Figure 2). Other interventions such as field days, farmers schools etc. may also have significant impact which need to be identified and implemented as per the suitability. Training of farmers and farm women has always been regarded as critical input for the rapid transfer of improved agricultural technologies (Kumar & Nain, 2013; Jaiswal et al., 2019). Bihari et al., (2017) also emphasizes priority training needs in soil and agronomical measures, viz. use and doses of plant protection chemicals, preparation of vermi-compost and commercial crop cultivation in high altitude areas of Uttarakhand.

CONCLUSION

The social scenario as evidenced in participant villages of West Kameng district of Arunachal Pradesh indicated a dire need of intervention to improve the basic infrastructure for the holistic improvement in agricultural enterprises and providing sustainable employment to the rural youth. The major issues such as outbreak of insect-pest and diseases; unavailability of high quality agro-inputs such as seeds and seedlings of high yielding varieties,

untimely or poor availability of manures and fertilizers etc. addressed with due priority through trainings, demonstrations, field trials and on farm trials of modern agro-techniques. Though, farmers pointed out insect-pest problem as major issue, the availability of good quality seed material resistant to insect-pest attack and disease infestation could play a major role in bridging the gaps. The primary health care facilities are hard to reach in these villages and people are not even aware about basic health care and hygiene. Hence, the development-oriented interventions need to be done especially in providing primary health care facilities, safe disposal of fecal matter, veterinary aids to name a few. The frequent conduct of awareness programs for the adoption of profitable and sustainable agriculture practices along with various health and hygiene care aspects by dovetailing it with supplementary and complementary schemes may lead to revolutionary impact in these remote areas.

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Determinants of Women's Entrepreneurial Performance in Kerala

Binoo P. Bonny^{1*}, Lokesh S.² and Smitha S.³

¹Professor and Project Coordinator, ³Assistant Professor, CGSAFED, College of Agriculture, Kerala Agricultural University, Kerala, India

²Senior Research Fellow, ICAR-NAHEP CAAST, Kerala Agricultural University, Kerala, India

*Corresponding author email id: binoo.pb@kau.in

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ABSTRACT

Women entrepreneurs have significant impact on the economic development in global as well as national context. Capacitating women with entrepreneurial qualities have remained key to social transformation especially in developing countries. The paper presents the results of a study conducted in Kerala during 2020-21 to analyse the determinants of women's entrepreneurial performance related to agricultural enterprises. Seventy women entrepreneurs involved in agricultural ventures randomly selected from the 14 districts of Kerala formed the study sample. Analysis of data collected based on a pretested structured interview schedule indicated mushroom and value addition enterprises as the most successful enterprises among women. It was estimated that these enterprises took three and six months respectively and production levels of 1872 kg and 1462 kg each in the order to reach break-even points. Mass media contact and stage of enterprise were the factors which were delineated as the factors that contributed significantly to the period taken to achieve the break-even point by the women led enterprises.

INTRODUCTION

Entrepreneurship is one of the most important inputs towards economic development of the country. An entrepreneur can be considered as a person who has creativity and is motivated to set up his own business or innovation and is always in the pursuit of great achievements. They are catalysts for social change and work for the common good. The term entrepreneurship implies a dynamic course of generating progressive asset (Shailesh et al., 2013). Entrepreneurship is a feasible approach for upward mobility, as a one per cent increase in entrepreneurial activities decreases the poverty rate by two per cent (Singh, 2014). As such, the quantity and competency of entrepreneurs affect the economic development of the country. The economic history of most of the developed countries confirms the dynamic role played by enterprises and the entrepreneurs.

Recent years have witnessed a surge of women entrepreneurs especially in agricultural sector of transforming economies such as India. This is reflected in the research findings that report a shift

in attitude of farm women towards entrepreneurship (Singh & Singh, 2018). Also, there are extensive evidence to prove that the performance of women-owned micro and small enterprises played pivotal roles in development (Shakeel et al., 2020) and contributed to the well-being of societies by creating jobs, wealth, and innovations (Mozumdar et al., 2020). Floriculture, seed production, net house cultivation, vermi compost/organic products, apiary, value addition, mushroom production and dairy enterprises excelled in preferences for enterprise establishment (Nain et al., 2015). These suggest the great significance entrepreneurship development especially among women hold to transform the socio-economic scenario of rural India. However, the 6th Economic census released by Ministry of Statistics and Programme Implementation (MoSPI) highlighted that the women constituted 48.9 per cent in the population, but represent only 14 per cent of the total entrepreneurs in India. This indicates the need for concerted efforts to improve the women entrepreneurial ecosystem in the country to reap the emerging demographic dividend.

In fact, entrepreneurship in agriculture could be defined as the formation of novel economic organization for the intention of growth under risk and uncertainty in agriculture (Dollinger, 2003). Less educated small farmers can also become an agri-entrepreneur, if they are clearly informed about the right type of technologies and knowledge about their use (Kharga et al., 2021). Among the many characteristics of entrepreneurship development, profit making ability of the enterprise plays a vital role in its sustainability and is dependent on the well-developed linkages among stakeholders (Singh et al., 2014). Therefore, an in-depth study was conducted among the selected agripreneurs of Kerala State to explore the net profit and its relationship with the socio-psychological, socio-personal and communication related determinants embedded with the enterprise and entrepreneurs.

METHODOLOGY

The study was conducted in Kerala during 2020-21 and ex-post-facto research design was followed in the present investigation. Purposive sampling technique were followed and five women entrepreneurs engaged in agriculture and allied sector were selected from each district of Kerala State and thus the total 70 women entrepreneurs were selected for the study. The required data were collected by personal interview through a well-structured and pre-tested interview schedule. The performance indicators like type of the product, entrepreneurial stage, were collected from the selected women entrepreneurs. Data of the enterprises viz., fixed cost, variable cost, price of the products were collected to assess the performance on selected enterprises. Break even analysis based on the assumption of constant input price, technology and selling price, were used in the assessment. Break-even point was calculated using the algebraic formula given in the equation (1).

$$BEP = F / P - V \dots(1)$$

BEP-Break-even point, F- Fixed cost of production, P-Price per unit of production, V-Variable cost per unit of product.

Multiple linear regression models are used to delineate the impact of independent variables on the dependent variable. In the present study it was used to identify the factors contributing to the time taken to reach break-even point based on the following equation (2).

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + u_i \dots(2)$$

Where, Y = Time taken to achieve the Break-even point by the different enterprises (in months)

X1 = Age of the farmers (in years)

X2 = Education (0- illiterate, 1- Primary, 2- higher primary, 3- secondary, 4- Higher Secondary and 5- Graduation & Above)

X3 = Technical education (1- yes, 0- No)

X4 = Entrepreneurial stage (1- First generation entrepreneur, 2- Ex-

employee, 3- Family entrepreneur, 4- First generation entrepreneur + Ex-employee, 5- First generation entrepreneur + Family entrepreneur)

X5 = Assets owned (1- Only Machinery and Equipment, 2- Equipment, machinery and own building, 3- Equipment, machinery, own building and land)

X6 = Mass media contact (1- Rare contact, 2- often, 3- regular)

X7 = Social media contact (1- Rare contact, 2- often, 3- regular)

RESULTS AND DISCUSSION

Personal attributes such as age, education, technical education, entrepreneurial stage, mass media contacts are known to play a crucial role in success of entrepreneurs and the results from the study. The composition of women entrepreneurs was dominated (48.57%) by middle aged entrepreneurs with mean age of 43 years. The findings corroborated the view of McElwee (2008) who reported that agricultural entrepreneurs are those who own the farm and are aged under 45 years. Another important variable studied was education, which encouraged and supported risk bearing capacity. There were no illiterates in the study and significant percent (71.44%) of respondents were having moderate education viz., secondary, higher secondary and graduate level of education. However, with respect to technical education related to the entrepreneurs only 37.14 per cent of the respondents possessed any technical education. The results on formal and technical education could be well explained in the light of the high literacy rate in the State, especially for women. Type of entrepreneur was an attribute that indicated how the respondent was attracted to the venture, whether by personal choice or by situational choice and revealed elements of family support in the development of the enterprise. The results from the table indicated that 47.14 per cent of entrepreneurs belonged to the category of first-generation entrepreneurs. This suggested that most of the respondents entered the entrepreneurial activities based on their personal interest and passion rather than any situational or family compulsions. However, majority of the women entrepreneurs in the study were having poor mass media contacts. Most of the women entrepreneurs (81.43%) had rare contact with the mass media, which indicated non-utilization of easy and possible way of improving social networks and reaching out to prospective customers. Therefore, concerted efforts to improve their mass media contacts including social media needs to be attempted as a component of entrepreneurship development programmes especially through development agencies such as Kudumbasree Mission, District Industries Centers and Krishi Vigyan Kendras.

Entrepreneurial activities in which women were engaged had great significance in their performance. Accordingly, the study attempted to categorize the respondents based on enterprises

Table 1. Women owned enterprises in percent

	Central Zone	North Zone	South Zone	Total
Farming	20.00	15.00	28.00	21.43
Livestock management (Dairy/Poultry)	24.00	20.00	28.00	24.29
Agribusiness Services	4.00	15.00	8.00	8.57
Value Addition	76.00	70.00	68.00	71.43
Others (Fisheries/ mushroom/ nursery etc.)	16.00	10.00	8.00	11.43

handled *viz.*, farming, livestock management, agribusiness services, value addition and other allied sector activities as presented in Table 2. The results from the table showed that the majority of women entrepreneurs were engaged in value addition (71.43%) activities followed by livestock management (24.29%) of dairy, poultry etc. and farming (21.43%). Moreover, the results also indicated that trend almost followed similar pattern across the state irrespective of the zone.

The major value addition activities in which the women entrepreneurs were engaged included making of chips, pickles, papad, snacks, jam etc. These results pointed that women entrepreneurs preferred activities that could often be performed in and around the homestead without affecting their daily household chores and responsibilities. The results reiterated the substantial contribution of women in farming, livestock management, post-harvest, processing, value addition and allied activities as reported by many recent studies (Sidhu, 2007; Nain & Kumar, 2010; Sidhu, 2011; Gupta et al., 2013; Singh et al., 2016; Panda et al., 2016).

An attempt was also made to understand the number of entrepreneurial activities in which a women entrepreneur was involved and the results are presented in Table 2. The results revealed that most of the respondents (68.57%) were engaged in single activity enterprise, whereas 25.71 per cent and 5.71 per cent were involved in two and three activities respectively per enterprise at a time. The engagement with more than one activity in an enterprise could be viewed as a strategy to improve their risk bearing abilities. However, all these results were indicative of how women empowered themselves to cope with the changing times by setting up and sustaining enterprises.

Break-even point of enterprises practiced by women

Respondents in the study have taken up various entrepreneurial activities *viz.*, fisheries, Dairy, egg production, bakery items, chicken (broiler), nursery, mushroom and value addition. The estimates on fixed costs, variable costs, price per unit, break-even points of each enterprise and time taken to achieve reach the break-even point is presented in Table 3. Among the enterprises

Table 2. Number of activities engaged by selected entrepreneur

	Central zone (%)	North zone (%)	South zone (%)	Total (%)
One	68.00	15.00	68.00	68.57
Two	24.00	30.00	24.00	25.71
Three	8.00	0.00	8.00	5.71
Grand Total	100.00	100.00	100.00	100.00

Table 3. Cost of investment and break even points of different women enterprises

S.No.	Enterprises	Fixed cost (Rs.)	Price/unit (Rs.)	Variable cost/unit (Rs.)	Break-even point (quantity) (kg)	Production/ month	Time (Months)
1	Bakery	346429	262	219.60	8170	328	25
2	Egg production	163000	6	4.68	123485	4100	30
3	Fisheries	236667	210	180	7889	118	67
4	Dairy	228077	68	55.25	17883	494	36
5	Mushroom	116750	390	310.13	1462	234	6
6	Chicken (Broiler)	96250	148	113.00	2750	150	18
7	Value Addition	142264	350	274.00	1872	574	3
8	Nursery	170833	100	72.00	6101	500	12

practiced, fixed cost was highest for bakery units (Rs. 3,46,429), followed by fisheries (Rs. 2,36,667), and dairy (Rs. 2,28,077). Break-even point column in the table indicated the quantity of each product needed to be produced to reach the profit zone. Among the different enterprises mushroom venture which reached the profit zone by producing 1462 kg of mushroom had the least lag time. Time required to achieve the said production level was six months with the average production of 234 kg/month. It was followed by value addition enterprises, they had to produce 1872 kg of value-added products to attain break-even point and enter the profit zone. Time taken by the value addition enterprises for reaching the break-even point was three months with average monthly production of 574 kgs. Fisheries and dairy sectors have attained the break-even point with production of 7,889 kg and 17,883 kg respectively and had taken the time of more than 3 years to attain the break-even point and earning the profit. Results have concluded that mushroom production, value addition sector and nursery are the best enterprises which fetched the profits at the earliest compared to other enterprises. The results of the Table 4 also proved that entrepreneurs have made the right choice by selecting value addition and allied enterprises (Table 3) as the most commonly practised entrepreneurial venture.

Factors affecting the time taken to achieve the break-even (BE) point

The results indicated that the time taken to achieve the break-even point mainly depended on factors *viz.*, input cost, technology used, and scale of production. Apart from these factors there were also other personal factors like age, education, technical education, entrepreneurial type, social media contacts and mass media contacts that influenced BE point. An attempt was also made to delineate the factors that influenced the time to reach breakeven point in women led enterprises through regression and the results are presented in Table 5. Results showed that entrepreneurial type (6.92) and mass media contact (2.44) of the entrepreneurs were significantly contributing in reducing the time taken to achieve the break-even point. Significance of the entrepreneurial type, confirmed that as the entrepreneur with family entrepreneurship and previous experience were more successful because of their in-depth knowledge and experience back up. On the other hand, significance of mass media contact confirmed its role in developing the successful entrepreneurship reiterating the results that the entrepreneurs with more mass media contact had better performance. However, the R^2 value of 0.25 confirmed that there were many more possible variables that contributed to the period to the break-even point

Table 4. Factors influencing the time taken to reach break-even point

S.No.	Particulars	Co-efficient	Std. error	t
1	Constant	-71.16	1.28	0.40
2	Age	0.50	15.49	-0.37
3	Education	-5.76	21.47	1.15
4	Technical education	24.75	3.71	1.87
5	Entrepreneurial stage	6.92***	14.29	-0.06
6	Facilities	-0.84	1.44	1.70
7	Mass media contact	2.44*	16.91	-0.18
8	Social Media contact	-3.11	1.51	0.41
R ²		25		

which need to be explored through future studies. Kobba et al., (2021) found four determinants of entrepreneurial success in farm entrepreneurs viz.; family size, land size, turnover and annual income whereas in the non-farm sectors five determinants of entrepreneurial success were long term involvement, initiative, number of employees, entrepreneurial experience and annual income.

CONCLUSION

The results of the study could conclusively prove the potential of entrepreneurship as one of the most important interventions towards inclusive development. It contributed towards reduction of socio-economic imbalances related to gender. It could also be inferred from the results that despite the educational advantage of women in the state, promotion of technical education among women could be effective in harnessing the entrepreneurial advantages. Also, special purpose programmes targeting women entrepreneurs could attract more young women into entrepreneurship. It was also observed that mushroom and value addition were the enterprises which were highly successful among women. The BE analysis showed that these enterprises entered profit zone at three and six months respectively vindicating the popularity. The study also concluded that entrepreneurial stage and mass media contact played the crucial role in determining the performance of the enterprises. This implied that women entrepreneurs should be given more access to technical guidance and networking opportunities with the help of agribusiness incubators and business accelerators dedicated for the purpose. Also, entrepreneurship development and capacity development programmes for women need to have components on mass media contacts which contribute to accelerate the achievement of break-even point.

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Attitude and Willingness of Practising Dairy Farmers sons to Work Permanently in Rural Area

Mahammad Shafi Rupanagudi Shaik^{1*} and N. B. Chauhan²

¹Ph.D. Scholar, ²Professor and Head (Retired), Department of Agricultural Extension and Communication, B. A. College of Agriculture, Anand Agricultural University, Anand-388110, Gujarat, India

*Corresponding author email id: shafiagri23@gmail.com

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ABSTRACT

The study on the attitude and willingness of sons of the practising dairy farmers towards permanently working in a rural area was carried on milk-producing districts of Anand and Kheda of Gujarat state with 200 sample size. The study reveals that the majority (96.50%) of the sons of practising dairy farmers had a favourable to highly favourable attitude towards permanently working in the rural area. It also concludes that the majority (80.50%) of the dairy farmers' sons had poor overall willingness to stay physically to work in the rural area. The relationship of the attitude of young dairy sons of dairy farmers towards permanently working in the rural area was positively and significantly correlated with their age, marital status, scientific orientation, economic motivation and attitude towards farming, while it was negatively significant with the level of their father's education. The willingness to work in the rural area was observed positively and significantly correlated with their level of father's education, while it was negatively significant with their achievement motivation, self-confidence, scientific orientation, economic motivation and attitude towards farming.

INTRODUCTION

The prosperity of India is directly dependent on farming and animal husbandry. There are so many business activities in India, which are greatly dependent on farming and animal husbandry occupations and productions. This shows that until and unless a new generation of human resources is equipped with a positive feeling to accept vocations and reside in the rural area, it is not easy for a rural and agrarian economy like India to make a considerable improvement to its highest capability. More or less in India, it is noticed that the young generation of practising farmers and animal husbandry practitioners is not prepared to work in rural areas. The youth who want to be a part of the animal husbandry occupation are expected to work in rural areas and should have enthusiasm, motivation, keenness and compliance to work and stay in a rural set up to carry out dairy farming. As the mainstream of inhabitants of India lives in rural areas and depends on agriculture

and animal husbandry, there is a need to encourage and develop these two activities or occupations to expand rural India.

The scarcity of practicable new generations to perform and carry out crop production activities and animal husbandry as livelihood professions is the most important worry in India, which in turn affects the effective delivery of agriculture and dairy farming. Our country, with the second-largest population of the world, is cited in the serious category of availability of able and workable human resources for animal husbandry and farming. Huge numbers of practicing farmers' sons disappear from the villages or rural areas in search of livelihood to urban locations or big cities. This situation has resulted in a depressing impact in developing irregularity in the availability of youth for rural India. The gap between the mass of the youth functioning in urban areas as compared to rural areas is broadening, which is causing risk in the functioning and protecting the Indian agriculture and dairy farming.

METHODOLOGY

With a view to conducting current study on the willingness of dairy farmer's sons to stay physically and work in rural area, the 'Ex-post facto' research design was used. The study was carried out in dairy farming governing Kheda and Anand districts of central Gujarat. Anand district is comprised of eight talukas and the Kheda district is comprised of ten Talukas. The five random talukas from each district were selected by proportionate random sampling method. From each selected Taluka two random villages thus, a total of twelve villages were selected for this study. Based on the availability of total numbers of practising dairy farmers having adult sons between the ages of 18 to 35 years, 6 to 12 dairy farmers' sons from each village were selected proportionately. Finally, a random sample of a total of 200 farmers' sons was selected for the study. The complete interview schedule was pretested in the field on a group of 20 non-sampled respondents in order to eliminate any unrelated items included in the interview schedule. Based on responses received and experience gained, the essential alterations were incorporated in the final draft of the interview schedule. The data were collected personally using a finalised interview schedule. Attitude towards permanently working in the rural areas was understood as an optimistic, unbiased or unenthusiastic feeling of the respondents towards staidly working in the rural areas. In this study, a scale developed by Khatri (2020) was used to measure attitude towards permanently working in rural areas. The willingness to work in the rural area for different animal husbandry was understood as the enthusiasm of the respondents to settle for a certain period of time to work various animal husbandry related activities. The responses of the respondents were obtained against each statement on a five-point continuum ranging from strongly agree, agree, undecided, disagree and strongly disagree and scores of 5, 4, 3, 2 and 1 were assigned for positive statements and for negative statements the reverse scoring technique was assigned. The final score was worked out by summing scores obtained by the respondent for all statements. Thereafter the score of each individual was calculated and the respondents were categorized into five categories using an arbitrary method of classification. The frequency, percentage and coefficient of correlation were used as a statistical tools to see the relationship between the independent and dependent variables.

RESULTS AND DISCUSSION

Willingness of dairy farmers' sons to stay physically and work in rural area

It was observed that half (51.50%) of the sons of practising dairy farmers had a highly favourable attitude towards permanently working in a rural area, followed by 45 per cent of them were with favourable attitude, while only 3.50 per cent of them were with the neutral attitude and none of them was with a highly negative or negative attitude towards permanently working in the rural area. Thus, it can be concluded that the vast majority (96.50%) of the sons of practising dairy farmers had a favourable to highly favourable attitude towards permanently working in the rural area. As the Charotar area of Gujarat covered by Anand and Kheda districts have been recognizing as a milk-producing area since

independence. The soils of this area are highly fertile and known for producing three seasons of the crop annually due to the availability of canal irrigation. This makes the young dairy farmers with a highly positive attitude towards farming as well as animal husbandry as occupations, so it is natural that these two occupations can be only managed effectively and profitably only by staying in rural areas. The findings are similar to the findings of Gupta et al., (2020); Onima et al., (2017)

Table 1. Willingness of dairy farmers' sons to stay physically and work in rural area

Willingness to stay physically & work in rural area	Percentage
Very poor (Up to 9 score)	05.50
Poor (above 9 to 18 score)	80.50
Medium (above 18 to 27 score)	11.50
High (above 27 to 36 score)	02.50
Very high (above 36 to 45 score)	00.00
Total	100.00

As seen in Table 1, the majority (80.50%) of the dairy farmers' sons had poor overall willingness to stay physically and work in the rural area, followed by 11.50 per cent of them were with medium, 5.50 per cent with very poor and only 2.50 per cent of them were with a high level of the willingness to stay physically and work in rural areas. The possession of small size of the average farming land might have restricted the dairy farmers' sons to stay physically and work in the rural areas for the lifetime as the dairy farmers' sons with small size of land holding might not have felt advisable to stay permanently to maintain personal, social, economic, educational and psychological requirements of the members of young and next generations of their family. The result of the current survey is moderately in conformity with the findings of Elvis (2020) and Elvis and Chauhan (2019).

Factors of attitude and willingness to stay physically and permanently working in the rural area

The association of personal, economic, social and communicational, and psychological factors of sons of the practising dairy farmers with their attitudinal and willingness to stay physically and permanently working in the rural area with help of coefficient of correlation and the emerged results about existence or non-existence of relationship between dependent variables and the selected factors under the study is presented in Table 2. It can be observed that within the personal factors, the relationship of the personal factors of the sons of practising dairy farmers like age was positively and highly significantly correlated with 1 per cent level of significance, while marital status was 5 per cent level of positive significantly correlated and fathers education was negatively at 1 per cent level of significantly correlated with their attitude towards permanently working in the rural area. The other factors like education and distance from district place of the sons of practising dairy farmers were non-significantly correlated with their attitude towards permanently working in the rural area. It is obvious that married individuals with slight matured and elder age have to bear more liability of themselves and family members to fulfil their personal, financial, social, psychological and educational needs than those of bachelor or unmarried individuals. It is observed

Table 2. Factors responsible to form the attitude of sons of the practising dairy farmers to stay physically and permanently working in rural area

Factors	Attitude r value	Willingness r value
<i>Personal Factors</i>		
Age	0.231**	0.003
Education	-0.072	-0.017
Marital Status	0.156*	0.054
Father's education	-0.261**	0.162*
Distance from district place	0.048	-0.055
<i>Economic Factors</i>		
Landholding	-0.001	0.000
Herd size	0.127	-0.064
Annual income	0.087	-0.019
Occupation	-0.073	0.073
<i>Social and Communicational Factors</i>		
Type of family	0.061	0.112
Social participation	-0.073	-0.051
Farm media exposure	0.061	0.057
Extension contact	-0.017	0.065
<i>Psychological Factors</i>		
Achievement motivation	-0.129	-0.286**
Self confidence	0.044	-0.239**
Scientific orientation	0.531**	-0.351**
Economic motivation	0.583**	-0.233**
Attitude towards farming	0.388**	-0.279**

** Significant at 0.01 level of probability; * Significant at 0.05 level of probability

that the families with animal husbandry and farming as major sources of income managed by the low educated fathers have the tendency to influence and motivate occupational workability to their daughters and sons of the new generation from the beginning of their childhood. In this way, they learn animal husbandry and farming practices linked sources of income by willing to settle in rural areas permanently. The findings were similar to the findings of Kumar et al., (2017). It can be seen that amongst the personal factors, father's education was positively and significantly correlated with the willingness of dairy farmer's sons to stay physically to work in a rural area, while age, education, marital status, distance from district place were non-significantly correlated with their willingness to stay physically to work in the rural area for different activities. The result indicates that though the level of education of the respondents' fathers was observed significant with the willingness of their sons to stay physically and work in a rural area, only one-tenth of their fathers had above the higher secondary level of education and most of them were educated from primary to higher secondary level. Thus the sons of dairy farmers, whose fathers had a secondary to a higher secondary or even slightly higher level of education might have the wish to settle their sons in the rural area for different farming and allied activities because majority of their sons education was also up to secondary to higher secondary level. None of the economic factors like landholding, herd size, annual income and occupation were significantly correlated with the attitude of the sons of practising dairy farmers towards permanently working in the rural area. However, it was noticed that within the irrespective size of landholding, herd size, level of annual family income and association of family in one or more occupations amongst the sons of practising dairy farmers, attitude

towards permanently working in the rural area was identical and positive. It shows that with irrespective levels of economic condition oriented sons of dairy farmers realised the parallel significance of adopting dairy farming staying in the rural area. The findings were similar to the findings of Kumar et al., (2020); Maurya et al., (2021); Kumar & Meena (2021). It can be seen that amongst the economic factors, all the variables viz. landholding, herd size, annual income and occupation were non-significantly correlated with the willingness of dairy farmer's sons to stay physically and work in the rural area. This shows that landholding, herd size, annual income and occupation did not play an important role in motivating dairy farmers' sons' willingness to stay physically and work in rural areas for different farming and allied activities. In other words, it can be said that sons of dairy farmers with irrespective sizes of their family landholding, herd size, annual income and occupation, the willingness of the practising dairy farmer's sons to stay physically and work in a rural area was identically very poor to poor. The findings were similar to the findings of Malla et al., (2019).

Among social and communicational factors, type of family, social participation, farm media exposure and extension contact of the sons of practising dairy farmers were demonstrated non-significant relationship and did not play any key role in forming the positive attitude of young sons of dairy farmers towards permanently working in the rural area. On the other hand, it can also be said that with irrespective types of family, levels of social participation, farm media exposure and extension contacts of the sons of dairy farmers were equally highly positive towards eternally working in the rural area considering the similar significance of adopting dairy farming staying in the rural area. The findings were similar to the findings of Chauhan & Patel (2020); Gulkari & Chauhan (2019). It can be noticed that type of family, social participation, farm media exposure and extension contact of dairy farmer's sons as social and communicational factors were non-significantly correlated with their willingness to stay physically and work in the rural area. This indicates that none of the social and communicational factors played a significant and motivating role in developing the willingness amongst the dairy farmer's sons to stay physically and work in the rural area. This might be due to identically poor to medium degree of willingness amongst the majority of the sons of dairy farmers to work in a rural area with irrespective types of their family, activeness in various social organizations, association with farm media and levels of connectivity with extension agents. The findings are similar to the findings of Yadav et al., (2017); Khatri & Chauhan (2020).

Amongst the psychological factors, scientific orientation, economic motivation and attitude towards farming were positive and significantly correlated with the attitude of the sons of dairy farmers towards permanently working in the rural area at 1 per cent level of significance, while achievement motivation and self-confidence were non-significant with their attitude. It confirms that whoever young sons of dairy farmers was highly oriented towards scientific ways of handling occupation, highly motivated to be financially rich and emotionally encouraging in accepting farming as an occupation had a positive attitude towards working in the rural area. The result is in conformity with the findings of Khatri

& Chauhan (2020). It can be observed in Table 2 that achievement motivation, self-confidence, scientific orientation, economic motivation and attitude towards farming of dairy farmer's sons as psychological variables were negatively highly significant with their degree of willingness to stay physically and work in the rural area with 1 per cent level of significance. This shows that the dairy farmers sons with a low degree of inspiration to achieve good status in life, low confidence in their own ability to handle activities of life and occupation, low tendency to follow scientific ways of living life, less enthusiasm to achieve high economic status and unenthusiastic mind set towards adopting farming as a livelihood occupation had a high degree of approval to be a part of rural life. It is obvious that dairy farmer's sons with secondary to the higher secondary level of education have comparatively low belief in their own abilities to achieve higher goals in career, low wish to settle in urbanized areas, low orientation towards science, poor capacity to achieve economic status would always have wish to settle in the rural areas.

CONCLUSION

The study reveals that the majority of the sons of practising dairy farmers had a favourable to highly favourable attitude towards permanently working in the rural area. It also reveals that the majority of the dairy farmers' sons had poor overall willingness to stay physically to work in the rural area, It also concludes that the relationship of the attitude of young dairy sons of dairy farmers towards permanently working in the rural area was positively and significantly correlated with their age, marital status, scientific orientation, economic motivation and attitude towards farming, while it was negatively significant with the level of their father's education. The willingness of dairy farmer's sons to work in the rural area was observed positively and significantly correlated with their level of father's education, while it was negatively significant with their achievement motivation, self-confidence, scientific orientation, economic motivation and attitude towards farming.

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Understanding Farm Diversity through Typology for Technological Interventions in Western Plain Zone of Uttar Pradesh, India

K. J. Raghavendra^{1*}, L. R. Meena², A. L. Meena¹, Debashis Dutta², Nirmal¹, Devendra Kumar² and A. S. Panwar³

¹Scientist, ²Principal Scientist, ³Director, ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut-250110, Uttar Pradesh, India

*Corresponding author email id: raghavakj@gmail.com

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ABSTRACT

The farming systems having diverse characteristics need to be understood for tailored technological interventions. Farm typology designates the heterogeneous farmers' characteristics into homogenous groups to understand the factual situation in the region. The multivariate analysis viz. PCA and Cluster analysis performed to minimize data and group them into homogenous characteristics by various farm variables. A cross section survey of 120 farmers in WPZ of Uttar Pradesh was carried out and identified 9 significant variables and generated 4 PCs from PCA. Hierarchical clustering of PCs leads to grouping farms into homogenous class. The predominant farm types based are type-1 (22.5%) livestock based intensive farms, type-2 (23.3%) are resource endowed large farms, type-3 (10.8%) are crop based marginal farms and type-4 (43.3%) are small farmers with high profit margin. Large farms are integrated with crop and animal components earning higher income. The results show that the diversified farms with both livestock and crop sectors are reaping better income and technology adoption capacities.

INTRODUCTION

The farming community in India characterised with scarce resource endowment, technology use and market access. Dependence of these farmers on monsoon makes it to jiggle with lot of risks and uncertainties. Uncertain climatic situations like cloud burst, drought, flood, cyclone etc., lead to huge economic losses to farmers in the form of yield curtailment. These risks can be minimised through mitigation strategies by technology development and dissemination at farm level. Therefore, existing complex system must be understood to develop technologies to minimise the risk and uncertainty. To identification and characterization of existing heterogeneous farm systems is of utmost importance for transfer of technology. To plan the resource endowment for economic benefit, farm families develop different livelihood strategies driven by the opportunities and constraints derived from such diversity. The technology development need slump-sum amount of investment in research and development (R&D) by both public and

private sectors to accelerate the economic growth. All the technologies developed in the lab conditions may not perform well at field sometimes, it need to be diagnosed with involvement of respective stakeholders in development of technology through participatory approach to identify the potential technologies. There are technologies with great potential, but are not adopted because of the complexity and heterogeneity of the farm households is not addressed properly by these technologies. As "one size fits all" policy doesn't work in agriculture, particular farmers may need specific technologies as solutions.

The farm typologies are an attempt to capture farming systems heterogeneity and are considered as a useful tool for identifying need-based technology transfer for improving farm performance and rural livelihoods. Moreover, typology studies are of paramount importance for understanding the factors explains the adoption and/or rejection of new technologies. Classification based on structural and functional characters are on the basis of the factors to which the diversity is attributed. The structural typology focuses on

production side parameters such as land, livestock or labour; whereas the functional typology is based on livelihood orientations and decisions of farmers. In farm or farmer typology studies, classification is based on multiple variables, with the selection of the variables based on the objective and locale of the study (Shukla et al., 2019). However, economic factors have been in limited use, especially in small-scale studies, for farm classification (Briggeman et al., 2007). Different approaches can be used for developing farm typologies, from participatory workshops to statistical multivariate analysis of data for typologies construction (Alvarez et al., 2018; Chatterjee et al., 2015).

Based on the insights gained from farm typology we used a conceptual framework of Alvarez et al., (2014) for capturing drivers of farming in the Western Plain Zone (WPZ) of Uttar Pradesh.

METHODOLOGY

The study was undertaken in six villages viz., Tisang, Maphoda, Meerapurdalpat, Rasulpur Jatan, Chandpur and Dinkarpur of Muzaffarnagar district popularly known as sugar bowl of India, where villages were selected randomly in two blocks.

A multistage random sampling method was followed for selecting 120 farmers in the district. In each village 20 farmers were selected randomly totaling 120. A survey was done with a focus on socio-economic and ecological information particularly with farm income from different crops and animal husbandry (Landais, 1998).

The structure of the typology construction framework was adopted from Alvarez et al., (2014) which comprises six steps to go from a heterogeneous population of farms to the grouping into similar farm types. The variables represent factors of farming systems which influence the farmers' decision making in the matter of inputs and outputs (Alary et al., 2002). The key variables used in multivariate statistics should have variability in the data. Keeping this concern in mind we checked the correlation among the variables and dropped the variables which are highly correlated with each other and also having near zero or zero variance. Analysis was carried out using R studio software. The multivariate analysis was done to estimate the classification and grouping of farmers into homogenous groups, at first Principal Component Analysis (PCA) was evaluated using the identified variables. After generating respective PCs the variables are grouped using Cluster analysis with Ward's method of clustering.

RESULTS AND DISCUSSION

The basic characteristics of the farmers are presented in the Table 1. 50 per cent of the farmers were small land holding category remaining 35 per cent were marginal and rest 15 per cent large farmers. The mean age of farmer was 52 years, family size was in proportional to land holding (Singh, 1985), having 8 members per family in large holding and 5-6 members in small and marginal categories. Average land holding with marginal, small and large farmers were 0.71 ha, 1.46 ha and 3.24 ha, respectively. The cost and returns of the farm categories for both crop and livestock is presented in Table 2. The small farmers are more efficient than remaining farmers (Agarwal, 2018) with B:C ratio of 2.95. Small farmer's crop component was earned higher income as compared to marginal farmers whom livestock was more income contributing component.

Table 1. Characteristics of samples across the farm categories

Farmer category	Marginal	Small	Large	Over all
Number	42(35.0)	60(50.0)	18(15.0)	120(100.0)
Age (years)	50.04	52.85	58.27	52.68
Family size (no.)	5.64	6.46	8.16	6.44
Mean area (ha)	0.71	1.46	3.24	1.8

*Figures in parenthesis indicates percent share

Table 2. Average cost and returns of crop and livestock systems

Category of farmer	Income from livestock (Rs)	Total crop income (Rs)	Total cost of production (farming system) (Rs)	B:C ratio of cropping system
Marginal farmer	53745	194542	93517	2.08
Small farmer	56785	350132	118718	2.95
Large farmer	96085	399838	179827	2.22
Over all	61616	303131	119064	2.55

Initially there were 21 variables considered for the classification before reducing it to meaningful normally distributed variables (Table 3). The mean family members were 6 which provided opportunity for depend more on family labours for farm operations. Small farmers were producing efficient milk yield than the rest with 1875 litre/year/animal leaving behind marginal and large farmers. The per hectare basis labour requirement was lower in large farmers but higher in marginal farmers. Marginal farmers employed 84 labours/ha which was much higher than other categories of farmers. Net profit from crop component of small farmers was more than that of large farmers with Rs. 231414 and Rs. 220011. Profit margin of small farmers was 60 per cent when compared with marginal and large i.e. 41 per cent and 46 per cent, respectively. Marginal farmers were having more cropping intensity (158%) than small and large farmers, whereas large farmers have only 97 per cent cropping intensity. Area under cultivation was higher for cash crop i.e. sugarcane (69%) followed by wheat (30%). Meagre area under paddy and fodder crops cultivation, as the enough water resource available farmers choose sugarcane-ratoon-wheat cultivation. Mechanization for land preparation and harvesting used in the region was 9.5 hr/year, where large farmers (17.5 hr/year) machine use was twice as that of small farmers (9 hr/year).

Histogram of all the variables are verified for normal distribution and correlation among the variables were estimated to selected variables which are devoid of multicollinearity. The correlation matrix shows that the most of the variables considered for the study are not linearly correlated to each other except some. Those correlated variables were dropped along with variables not normally distributed, finally considered only 9 variables for the study purpose out of 21 variables.

After finalizing the variables, PCA was executed to identify the principal components (PCs) and their rotated component matrix. The KMO test shows the significance resulting in the data adequacy. The results are provided in the Figure 1 shows the 4 PCs with eigen value >1 generated with variance explaining 74 per cent of the data using varimax rotation. The first PC constitutes of factors related to crop cultivation, second PC can be classified as labours category, and third component shows the variables related to animal husbandry.

Table 3. Variables considered under different farm categories

	All farmers		Marginal		Small		Large	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total area (ha)	1.8	0.9	0.7	0.2	1.5	0.3	3.2	1.1
Family member (no.)	6.4	3.0	5.6	2.4	6.5	3.1	8.2	3.4
TLU	2.7	1.8	2.0	1.6	2.3	1.4	2.7	1.8
Milk total (liters)	1804.4	672.8	1693	805.0	1875.7	539.3	1825.6	699.7
Labour total off farm (no.)	76.5	44.3	50.3	34.2	84.1	39.3	123.1	42.1
Labour (no/ha)	64.5	48.1	84.7	69.8	58.2	25.6	38.6	10.7
Labour (no./HH)	78.6	44.8	51.7	34.1	84.1	39.8	123	42.09
Crop revenue (Rs.)	303131.5	151117.4	194542.1	93514.2	406917.4	143068.0	399838.3	149643.8
Crop profit (Rs.)	184067.5	138541.4	101024.9	79721.9	231414.0	129227.5	220011.8	180575.3
Profit (Rs/ha)	134127.6	117620.8	125791.2	158931.9	159605.0	83483.5	68654.6	58722.5
Profit margin (%)	51.0	44.1	41.6	56.9	59.0	28.7	46.0	46.7
Revenue by crop (%)	81.7	14.7	77.8	17.9	84.6	11.3	81.3	13.9
Crops cultivated (no)	4.4	1.1	4.0	1.1	4.4	0.9	5.3	0.8
Cropping intensity (%)	136.1	61.0	158.7	98.7	120.7	37.5	97.6	35.2
Age of HH head (years)	52.7	11.3	50.0	11.4	52.9	10.4	58.3	12.1
Cost of production (%)	49.0	44.1	58.4	56.9	41.0	28.7	54.0	46.7
Mechanization (%)	9.5	6.1	6.5	3.7	9.2	3.9	17.3	9.1
Milch animals (%)	80.1	72.9	60.1	52.1	88.5	72.1	100.0	99.5
Total cows (no.)	2.2	1.6	2.0	1.6	2.3	1.4	2.7	1.8
Improve breed cow (%)	59.5	78.1	43.3	41.5	61.1	40.5	52.3	36.8
Revenue by milk (%)	18.3	14.7	22.2	17.9	15.4	11.3	18.7	13.9

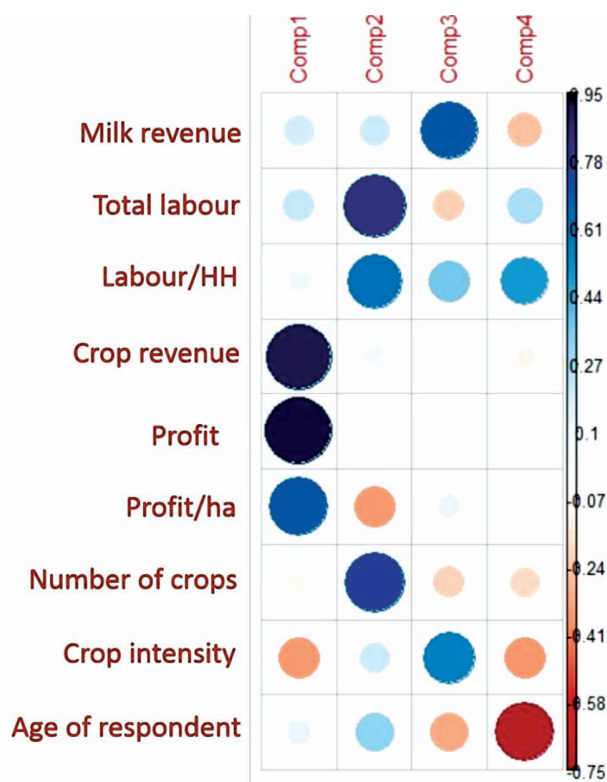


Figure 1. Rotated component matrix of principle components

After generating PCs, we forwarded to make clustering the farmers in to homogeneous groups using Hierarchical clustering. The cluster dendrogram in Figure 2 classifies the observations in to 4 homogeneous clusters. After the detailed study of cluster, the following four types of farms have been classified indicating the scope for identifying technologies suitable for each farm type to adoption against risk. Clustering of farms shows that large number

of small farmers was in type-4 (47) and type-1 (20) group. Type-3 having only small farmers with meagre farm income at subsistence level. Medium and large farmers were in type-2 group with enough resource endowment for livelihood.

Each farm type with different parameters given in the Table 4 is discussed below in detail.

Type-1: (Highly intensive livestock-based farms) (22.5%): These farms are having higher cropping intensity (188%) with highest milk production. Study showed that the Farmers with small land holding earns lower profit per hectare as their profit margin was significantly lower (7.22%). This makes them vulnerable to investment for technology adoption due to financial constraints.

Type -2 (Resource endowed large farms) (23.3%): These farms were characterized with large land holding along with high use of labour and mechanization. These farms were financially stable with huge profit/ha and major revenue was from crop sector, indicating the potential to adopt the high cost technologies for more intensification at farm level evidence in line with Patra et al., (2018) Choudhary et al., (2017). **Type-3** (Crop based marginal farms) (10.8%): These farms have land holding <1 ha with major revenue from crop sector and vary less income from livestock. The efficient labour use resulting in more profit/ha and moderately intensive farms. Farms are less mechanised due to lower financial resources (Sarkar, 2020).

Type-4 (Profitized small farms) (43.3%): Farms with small land holding are earning revenue both from livestock and crop sectors supported by Priscilla et al., (2021). The profit/ha was higher compared to other farms as they utilized very less labours among all. These profit earnings show the potential to adopt cost intensive technologies and can have efficient operations.

CONCLUSION

The result from multivariate analysis shows that there exist four groups of farms in the selected study area, elucidation of characteristics by considering several variables which influence the

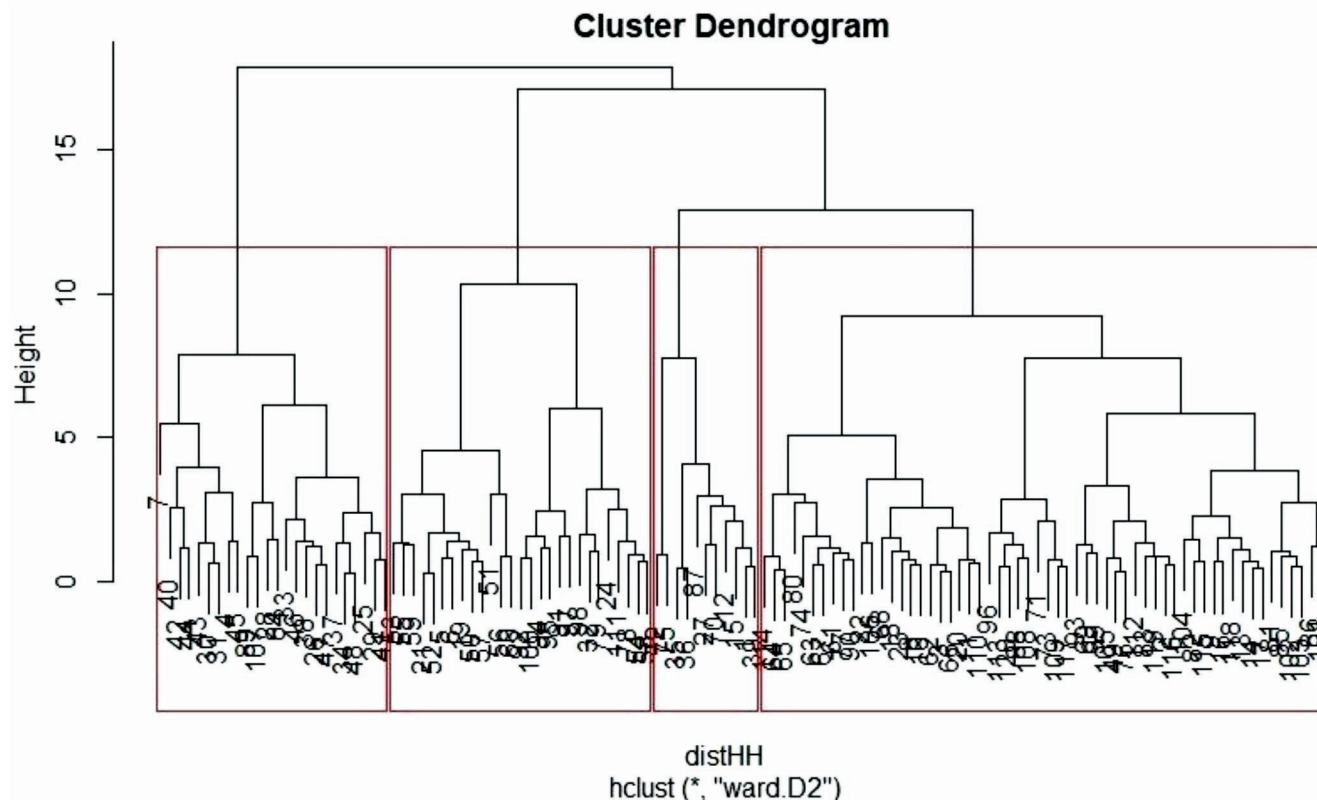


Figure 2. Hierarchical clustering of the observations

Table 4. Characteristics of identified farm types and p-value of Kruskal–Wallis test

Variables	Type-1 (N=27)	Type-2 (N=28)	Type-3 (N=13)	Type-4 (N=52)	p value
Total area (ha)	1.27	2.23	1.01	1.28	0.00
Family member (no.)	6.41	6.36	5.15	6.42	0.29
TLU	2.89	2.14	1.54	2.87	0.00
Total milk (liters)	2078	1772	751.5	1943	0.00
Total off farm labour (no.)	85.37	117.7	60.38	53.83	0.00
Labour/ha (no.)	93.92	63.00	60.76	50.87	0.00
Labour/HH (no.)	58.13	57.46	41.56	30.83	0.00
Crop revenue (Rs)	189926	408710	169213	338541	0.00
Crop profit (Rs)	50500	287978	83372	222641	0.00
Profit/ha (Rs)	30966	162913	94725	182042	0.00
Profit margin (%)	7.22	69.29	46.71	64.92	0.00
Revenue by crop (%)	69.37	88.32	88.69	82.85	0.00
Crop intensity (%)	188.1	113.5	113.7	126.8	0.00
Cost of production (%)	92.78	30.71	53.29	35.08	0.00
Mechanization (hrs)	9.22	13.39	7.38	8.00	0.03

farming. Around 65 per cent of sampled farmers classified under two farm categories i.e. profit oriented small farms and resource endowed large farms. Type-1 are highly intensive livestock-based farms, they are more dependent on livestock for their revenue as enough green fodder availability in the region makes them more oriented to livestock. Very small number of farmers classified under crop based marginal farms, mainly depends on crop sector with less profit and less mechanization, having lower potential for cost intensive technology adoption. The results clarify that the diversified farms with both livestock and crop sectors were reaping better income and technology adoption capacities. This classification asks for differentiated farm planning and extension intervention to outreach technologies on need based. With vast extension system

involving ICAR, KVKs, SAU and line departments of state can construct typology at its regional level and can identify the specific farm types and can arrange for need based technological intervention at farm levels.

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Behavioural Determinants of Functionality of Farmer Producer Organisations in Punjab

Manjinder Singh¹, Devinder Tiwari², Sarang Monga¹ and Rajesh K. Rana^{1*}

¹ICAR-Agricultural Technology Application Research Institute, Ludhiana-141004, Punjab, India

²KVK Ludhiana at Samrala-141114, Punjab, India

*Corresponding author email id: rajesh.rana@icar.gov.in

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ABSTRACT

Small and marginal farming communities of Indian agriculture account for more than 85% of the total farming households. They face the challenges of land fragmentation, high cost of inputs and inability to market their produce efficiently. To tackle these challenges, policy makers came up with the model of farmers' mutual cooperation through Farmer Producer Organisations (FPOs). This study conducted in Punjab analyses the behavioural factors responsible for functionality of FPOs. A random selection of 150 members from 5 functional and 5 non-functional FPOs (*i.e.*, 15 respondents from each selected FPO) was made and the respondents were interviewed personally. The findings revealed that the members (including management) of the functional FPOs had higher risk bearing capacity, greater economic motivation and more innovativeness as compared to the respondents from non-functional FPOs. Similarly, respondents from functional FPOs were socially, economically and managerially more empowered than the non-functional FPOs. Business skills of the members, including the managerial members, of functional FPOs were also better as compared to those from the non-functional FPOs. Regression estimates revealed that the functionality, better academic qualification, bigger land holding and joint family system were responsible for the higher net annual income of the respondents.

INTRODUCTION

More than half (58%) of the rural population in India is dependent on farming as the primary source of their livelihood. Very large proportion of the farmers in the country is small/ marginal (>85%) while about 66 per cent of them have less than one hectare of land holdings (Census, 2011; Singh, 2012). About 15 to 20 lakh small and marginal farmers are being added every year due to fragmentation of land holdings (NAC 2012-13). Due to uneconomical scale of operations small holder farmers are financially losing in the process of input as well as output markets (Sawairam, 2015). Further, poor handling of pre and post-harvest farm produce, lack of processing, logistics and export infrastructure constitutes other constraints for such farmers (Kumar et al., 2019; Deka et al., 2020; Sahu et al., 2021).

Past experiences of farmers' cooperatives in the state vis-à-vis benefits of farmers' collectives, the government of India came up with the idea of Farmer Producer Companies (FPCs) with the amendment in Section IX A of the Indian Companies Act 1956. These FPCs are solely run and owned by the farmers and financially supported by the government and managed by the professionals. Policy makers have also ensured that these FPCs sustain the uniqueness of cooperatives while their regulatory structure is similar to that of the private limited companies (Mukherjee et al., 2020; Mwambi et al., 2020; Sawairam, 2015). FPC is a group of primary producers/ farmers that come together as a Farmer Producer Organisation (FPO) and register themselves under the Indian Companies Act 1956 as a producer company. FPO can be registered in initial stages as a society, co-operative society, trust and section-8 company according to their business activities and can convert

from one form to another accordingly. The village level farmers' clubs/ groups can also come together and form an FPO and start under taking their collective activities in order to have adequate bargaining power. An FPO can address the challenges of small holder farmers by aggregating their produce in order to fetch better prices. The economies of scales in purchase of inputs, transport facilities, primary and secondary processing etc. results in reduction of cost of production/ marketing (Partiban et al., 2015; Mukherjee et al., 2019; 2020; Vinayak et al., 2019). Moreover, many government initiatives help the FPOs to develop their agri-infrastructure like siloes, processing plants, cool-chain logistics etc.

The concept of FPOs appears very appealing and attractive to ensure economic empowerment of small holder farmers through innovative and entrepreneurial initiatives. Entrepreneurial initiatives and farmers' innovations to fulfil this aim has been studied and documents by various authors (Shirur et al., 2016; Nain et al., 2018; Shirur et al., 2018; Nain et al., 2019; Shirur et al., 2019; Kobba et al., 2020; Nain et al., 2021). However, all the established FPOs are not in a position to operate efficiently and sustainably (Deka et al., 2020). It was imperative to study the determinants of sustainability of the operations of various FPOs as tremendous amount of public energy and resources have been deployed in this movement. Hence, this study attempts to analyse the determinants of the sustainability/ success of FPOs so that the policy makers can formulate better plans in the future.

METHODOLOGY

The study was conducted in the state of Punjab. List of registered FPOs in Punjab was obtained from the Small Farmers Agribusiness Consortium (SFAC) and the National Bank for Agriculture and Rural Development (NABARD). At the time of data collection (June 2019) 74 FPOs were registered under SFAC and NABARD. All FPOs' representatives were personally contacted in order to check the exact status of FPOs' functioning. The FPOs were classified under the categories of functional and non-functional FPOs. From this final list 5 functional and 5 non-functional FPOs were selected randomly, thus a total of 10 FPOs were selected for the present study. From each selected FPO, 15 members were randomly selected regardless of their designation/ positions in the FPO. Overall, a total of 150 respondent farmers constituted the sample of the study. An interview schedule incorporating all the variables pertaining to the purpose of the study was developed and data collected through personal interviews from the selected respondents. The entrepreneurial behaviour of the respondents was studied in terms of risk bearing capacities, economic motivation and innovativeness of the members of the FPOs. The risk bearing capacity of the respondents was taken as the degree to which the respondent was oriented towards risk and uncertainty and had courage to deal with the unforeseen problems emerging while working in the FPO. The economic motivation was taken as the degree to which an individual desires to increase income and maximize his profit while working in FPO. These variables were measured by modifying the scales developed by Supe (1969). The innovativeness of the respondents was studied as the degree to which an individual was relatively quick in adopting an innovation compared to the other persons of their social system.

It was measured by modifying a scale developed by Singh (1972). The responses to the statements of scales were recorded on a five-point continuum *viz.* strongly agree, agree, neutral, disagree and strongly disagree. On the basis of total score obtained the respondents were categorized into three categories *viz.* low, medium and high. A total of 5 statements were used to assess risk bearing ability of the respondents while 6 and 4 statements were used to study economic motivation and innovativeness, respectively (Annexure-1).

The impact of FPOs on empowerment of the respondents, in relation to their social, economic and managerial empowerment, was measured on three-point continuum *i.e.*, improved, remained same and can't say using frequency and percentage. Similarly, to study the business skills of the respondents the statements were analysed in order to measure the empowerment of the respondents, several statements were used. However, taking into considerations the adequacy of responses two most prominent statements for each of the three attributes of empowerment (social, economic and managerial) were selected (Table 2). Members of the FPOs also include management as the management positions are elected/ selected by the members from themselves only. Hence, whenever, findings of the study are discussed in terms of members the management is included among them unless it is imperative to specify.

For studying the effect of various socio-economic variables on the level of net annual family income of respondents, simple regression analysis was carried out. Chi square test was used to study the independence of responses, largely between the functional and non-functional FPOs. In order to study interdependence of various variables on each other Karl Pearson's Correlation coefficient (r) were also estimated.

RESULTS AND DISCUSSION

Entrepreneurial characteristics

The entrepreneurial characteristics in this study have been studied and discussed under three heads *viz.*, risk bearing capacity, economic motivation and innovativeness of the respondents.

A perusal of the data presented in Table 1 indicates that in case of respondents of functional FPOs, more than half of the respondents (53%) had high risk bearing capacity followed by 38.67 per cent with medium and only 8 per cent having low risk bearing capacity. However, in case of non-functional FPOs, large proportion (47%) of respondents had medium risk bearing capacity followed by 36 per cent with high and 17 per cent with low level risk bearing capacity. From these observations, it can be concluded that risk bearing capacity is an important factor behind sustainability/ continuity of the FPOs in the long run. Supe (1969) viewed economic motivation as profit maximization and the relative value placed by the farmers on financial goals. Six statements were taken to study the economic motivation (Annexure-I). The results presented in Table 1 show that 56 per cent respondents of the functional FPOs and 42.67 per cent respondents of the non-functional FPOs had higher economic motivation. It is worth mentioning here that in spite of higher economic motivation of nearly 43 per cent respondents under non-functional FPOs the desired results could not be achieved due to non-availability of the

Table 1. Distribution of respondents according to their entrepreneurial characteristics

Entrepreneurial characteristics	Functional FPOs (n ₁ =75)		Non-functional FPOs (n ₂ = 75)	
	f	%	f	%
<i>Risk bearing capacity*</i>				
Low (< 2.26)	6	8.00	13	17.33
Medium (2.26-3.74)	29	38.67	35	46.67
High (> 3.74)	40	53.33	27	36.00
<i>Economic motivation</i>				
Low (< 2.50)	4	5.33	10	13.33
Medium (2.50-3.50)	29	38.67	33	44.00
High (> 3.50)	42	56.00	32	42.67
<i>Innovativeness*</i>				
Low (< 2.19)	19	25.33	26	34.67
Medium (2.19-3.81)	17	22.67	24	32.00
High (> 3.81)	39	52.00	25	33.33

Note: Chi square test indicates that the entrepreneurial behaviour of the members of functional vis-à-vis non-functional FPOs were independent at * (10% level of significance)

needed platform to them in the form of a functional FPO. About 39 per cent of the respondents under functional FPOs and 44 per cent under non-functional FPOs were having medium level of economic motivation. Overall, it can be concluded that the respondents of functional FPOs were having higher level of economic motivation to remain active in the FPOs as compared to the members of the non-functional FPOs. The innovative behaviour of the respondents was measured by getting the responses on different statements given in Annexure-I. The findings given in the Table 1 reveal that majority of the respondents of the functional FPOs (52%) and non-functional FPOs (33%) were having high innovativeness followed by 23 per cent respondents of functional FPOs and 32 per cent respondents of the non-functional FPOs having medium level of innovativeness. Nearly 30% respondents of functional FPOs and 35 per cent respondents of the non-functional FPOs had low level of innovativeness. Overall, it can be concluded that the respondents from functional FPOs were having higher level of innovativeness compared to the respondents from the non-functional FPOs.

Impact of FPOs on empowerment of respondents/ members

The impact of the FPOs on social, economic and managerial empowerment of the respondents was estimated and results are

presented in Table 2. The finding reveals that the respondents from functional FPOs improved their links with the key persons responsible for managing different activities of running an FPO by 92 per cent. Similarly, the bargaining power and marketing skills of the respondents from functional FPOs improved by 51 per cent. However, the performance of respondents from non-functional FPOs was much lower. On the front of economic empowerment about 57 per cent of the respondents from functional FPOs experienced enhancement in their purchasing power. The respondents from functional FPOs also got higher debt repayment capability/ higher saving ability (61% respondents). However by and large, there was a little change in the economic empowerment of the respondents from non-functional FPOs. In case of managerial empowerment, it was observed that 37% respondents from functional FPOs and 36 per cent respondents from non-functional FPOs improved their decision-making abilities. However, majority of respondents from functional and non-functional FPOs (*i.e.*, 40% and 48% respectively) this ability remained same. The proportion of respondents with participation in FPO activities remained same for 55 per cent in functional and 83 per cent in non-functional FPOs. Interestingly 28 per cent respondents from functional FPOs improved their participation in FPO activities against nil in non-functional FPOs. Overall, it can be concluded that social, economic and managerial empowerments of respondents from functional FPOs was higher than those from the non-functional FPOs.

Business skills

Business skills constitute an important entrepreneurial characteristic of the persons. It is usually assumed that the innovators and early adopters have better business skills. Since business skills have a strong influence on the behaviour of an entrepreneur, it was considered important to analyse the selected respondents on this aspect too. It was studied on the basis of the responses of the respondents to the statements given in Table 3. It was found that the business skills of the respondents from the functional FPOs were better than the business skills of the respondents from the non-functional FPOs which ultimately affect the performance of the organisation.

Correlation analysis of the key studied variables was carried out in order to understand the interdependence between them for the respondents of this study. A strong negative correlation was

Table 2. Distribution of the respondents according to the impact of functional and non-functional FPOs on their empowerment

Parameters	Functional FPOs (n ₁ =75)			Non-functional FPOs (n ₂ =75)		
	Improved f(%)	Remained same f(%)	Can't say f(%)	Improved f(%)	Remained same f(%)	Can't say f(%)
<i>Social empowerment</i>						
Links with key person(s)***	69(92.00)	3(4.00)	3(4.00)	17(22.67)	49(65.33)	9(12.00)
Empowerment in bargaining power/marketing skills***	38(50.67)	12(16.00)	25(33.33)	12(16.00)	57(76.00)	6(8.00)
<i>Economic empowerment</i>						
Enhancement in purchasing power***	43(57.33)	18(24.00)	14(18.67)	-(0.00)	72(96.00)	3(4.00)
Debt repayment capability/Higher savings ability***	46(61.33)	13(17.33)	16(21.33)	-(0.00)	73(97.33)	2(2.67)
<i>Managerial empowerment</i>						
Decision making ability	28(37.33)	30(40.00)	17(22.67)	27(36.00)	36(48.00)	12(16.00)
Participation in FPO activities***	21(28.00)	41(54.67)	13(17.33)	-(0.00)	62(82.67)	13(17.33)

Note: Chi square test indicates that the studied statements were independent in case of functional vis-à-vis non-functional FPOs at *** (1% level of significance)

Table 3. Distribution of the respondents according to the business skills among farmers

Skills	Functional FPOs (n ₁ =75)		Non-functional FPOs (n ₂ =75)	
	Frequency	Percentage	Frequency	Percentage
<i>Do you package your produce attractively?</i>				
Always	43	57.33	39	52.00
Sometimes	19	25.33	21	28.00
Never	13	17.33	15	20.00
<i>Do you seek information regarding produce prices from other markets? ***</i>				
Always	19	25.33	12	16.00
Sometimes	39	52.00	27	36.00
Never	17	22.67	36	48.00
<i>Do you with hold supply of your produce till you get remunerative prices? ***</i>				
Always	17	22.67	7	9.33
Sometimes	36	48.00	29	38.67
Never	22	29.33	39	52.00
<i>Do you adopt proper records of production/ marketing of your produce? ***</i>				
Always	59	78.67	37	49.33
Sometimes	9	12.00	32	42.67
Never	7	9.33	6	8.00
<i>Do you go for collective sale of produce to generate bargaining power? **</i>				
Always	45	60.00	30	40.00
Sometimes	15	20.00	18	24.00
Never	15	20.00	27	36.00
<i>Do you opt to sell your produce in more than one market? **</i>				
Always	13	17.33	7	9.33
Sometimes	47	62.67	37	49.33
Never	15	20.00	31	41.33
<i>Do you estimate demand before sowing of the crops? ***</i>				
Always	11	14.67	7	9.33
Sometimes	23	30.67	9	12.00
Never	41	54.67	59	78.67
<i>Do you plan and invest in agri-enterprises with higher future profitability? ***</i>				
Always	17	22.67	8	10.67
Sometimes	43	57.33	35	46.67
Never	15	20.00	32	42.67

Note: Chi Square test indicates that the studied statements were independent in case of functional FPOs vis-à-vis the non-functional FPOs at *** (1% level of significance) and ** (5% level of significance)

Table 4. Karl Pearson Correlation coefficients (r) of various attributes

	Age	Family size	Academic qualification	Land holding	Participatory decision making	Functional sustainability	Family type
Age	1						
Family size	-0.070	1					
Academic qualification	-0.795***	0.104	1				
Land holding	-0.046	0.586*	0.104	1			
Participatory decision making	-0.061	0.034	0.146	0.076	1		
Functional sustainability	-0.050	0.014	0.131	0.052	0.974***	1	
Family type	-0.053	0.866***	0.106	0.670**	0.050	0.027	1

Note: Correlation coefficients (r) indicate that interdependence between the selected variables studied in this table were statistically significant at *** (1% level of significance) and ** (5% level of significance) and * (10% level of significance)

observed between the age and academic qualification of the respondents indicating that the young members had higher academic qualification compared to the aged ones. Similarly, the bigger family size of the respondents had higher land holding size too. Participatory decision making was found to be very strong factor for functional sustainability of the FPOs in the studied area. The obvious findings such as bigger land holding size and family size of the joint families was also confirmed in this analysis (Table 4).

On an average the male members of the FPOs were earning income Rs. 35000 higher than the female members. However, the

estimate was statistically non-significant. The effect of age on income of the members of the FPO was insignificant. With every acre increase in the land holding the annual net income of the respondents increase by Rs. 63000. With each schooling year enhancement in academic qualification of the respondents the annual income increased by Rs. 80000. The average annual income of the respondents under functional FPOs was Rs. 88000 higher than the respondents under non-functional FPOs. The average annual income of the respondents living in joint families was Rs. 12000 higher than the respondents living in the nuclear family type (Table 5).

Table 5. Estimates of regression analysis of dependence of income of the FPO members on various attributes

Particulars	Coefficients	Standard error	t Stat	P-value
Intercept	0.704	1.290	0.546	0.586
Age	-0.011	0.019	-0.591	0.556
Family size	0.373	0.296	1.260	0.210
Academic qualification	0.805	0.041	19.790	0.000
Land holding	0.639	0.514	0.218	0.000
Participatory decision making	-0.002	0.069	-0.033	0.974
Gender	0.357	0.044	0.498	0.619
Functionality	0.881	0.395	-1.833	0.009
Family type	0.124	0.363	3.834	0.000

The coefficient of academic qualifications, land holding, functionality and family type variables were statistically significant at 99% level of tolerability.

CONCLUSION

FPOs have been proposed and supported in a big way as an important solution to the marketing problems of small and marginal farmers in India. In the state of Punjab 74 FPOs had been established by June 2019, however, a considerable number out of them had turned non-functional by that time. This study has analysed behavioural factors responsible for ensuring functionality of the established FPOs. Entrepreneurial characteristics/behaviour was the most important factor responsible for ensuring continuity of the FPOs in the study area. Further, functionality/continuity of the FPOs have also been responsible for improving socio-economic empowerment of the members of the FPOs. It was noticed that the managerial skills of the members have also been improved over the time in the functional FPOs. The study has clearly revealed the pattern of functional continuity of established FPOs. The results of the regression analysis showed that functionality (continuity), landholding size, academic qualification and type of family (joint families) had significantly positive effect on the overall net annual income of the respondents.

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Annexure-I

S.No. Statements	SA	A	N	DA	SDA
<i>Risk bearing capacity</i>					
1. A farmer should enrol with FPOs to avoid risk involved in marketing the produce individually.					
2. A farmer who is willing to take greater risks than the average farmer usually does better financially.					
3. It is good for a farmer to take risks when he knows his chance of success is fairly high.					
4. It is better for a farmer not to try new practice unless most other farmers have used them with success.					
5. Trying an entirely new practice in farming by a farmer involves risk but it is worth trying.					
<i>Economic motivation</i>					
1. The most successful farmer is one who makes the most profit.					
2. A farmer should try new idea like enroll with FPOs which may earn him more money.					
3. A farmer should enroll with FPOs to increase monetary profit in comparison to work individually.					
4. It is difficult for the farmers to enroll with FPOs unless he provides with some economic assistance like monetary help.					
5. The sacrifices needed to get ahead financially not only help the farmer to reach that goal, but also help in building good character.					
6. In deciding about making changes in his farm, a farmer's first consideration is the profitability in it.					
<i>Innovativeness</i>					
1. Whenever I come to know about new practice, I try it.					
2. Although much is being said about the farmers' organizing like FPOs these days but who knows if they are better than old ones.					
3. On outset of new strategies, I may or may not succeed; but I surely like to try it.					
4. I see, I follow others before trying a new venture.					

Note: SA=Strongly Agree; A=Agree; N=Neutral; DA=Disagree and SDA=Strongly disagree



Need Based Information Media for Farmers in Hill Regions of Uttarakhand: Implications for Extension

Kushagra Joshi

Scientist, ICAR-VPKAS, Almora-263601, Uttarakhand, India
Email id: kushagra.me@gmail.com

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ABSTRACT

Farmers use different information sources and channels for seeking reliable, timely and relevant information on improved agricultural practices. Developing appropriate farmer educational and marketing strategies will depend on how farmer groups differ in their information search behavior. Understanding what information farmers need, how they search for their information, which sources they depend on for accessing information can help in designing effective extension programs. The study examined farmer's communication characteristics with an intent to assess farmer's accessibility and use of extension media and information sources for fulfilling their information needs pertaining to agricultural and allied activities in three hill districts of Uttarakhand state. A sample of 1318 farmers was selected through a stratified random sampling technique. Interpersonal communication sources were used more by farmers as these were more easily available and accessible to obtain information related to agriculture. *Majority of farmers were categorised as low searchers.* Gender, primary occupation, land size and education significantly affected search behaviour of farmers. Implications for policy and extension have been given for improving information dissemination among farmers of hill regions. Emphasis on extension system providing a context for the flow of authentic knowledge through authentic media among farming communities on an equal basis is emphasized.

INTRODUCTION

Agricultural information is one of the very crucial inputs for rural development. The agriculture sector is progressively becoming knowledge intensive and the researchers are continuously coming up with new pool of information to enhance agricultural production and productivity. There is an extensive accumulation of knowledge and information at regional, national and international level. What remains important is the timely dissemination of the generated information to the stakeholders for its effective use in practical conditions. This calls for making relevant and useful information available to farmers timely and easily through available channels. Making information accessible to the farmers can play a vital role in enhancing farm productivity and sustainable growth of agricultural

activities. Timely and appropriate information helps the farmers to decide upon various aspects like crop varieties, selection of crops, insect pest management, choice of market, weather trends, etc.

Information needs of rural farmers are changing over time (Elly et al., 2013). In the era of rapid climate change, farmers need to make decisions regarding change in crop production practices, rainfall predictions, soil nutrient management, varietal selection, crop diseases and pest information based on available scientific information generated and validated by crop experts. Farmers seek scientific information for remedial every season as with the incidence of new insect-pest infestations and diseases. An efficient and effective, readily accessible information system may help farmers to open up and avail opportunities to improve their livelihoods (Ballantyne, 2005). Thus, response to the changing information

needs of farmers is indispensable to improve farmer's understanding, decision making, and management of farming activities. Mudukuti & Miller (2002) suggested that in this information age, dissemination of need based information and applying this information in the process of agricultural production will play a significant role in the development of agriculture-based livelihoods.

Screening the specific information needs of farmers paves the way for designing strategies to address information needs of farmers (Musi et al., 2004; Nain et al., 2019a; Nain et al., 2019b). Location-specific information promotes adoption of technologies. Not only for programme developers, it is also giving necessary inputs to policymakers, researchers, and technologists to design need-based policies, programmes and innovations. Through need assessment exercises, farmers also understand what they actually need and eventually decide the information product that is best to fulfil their information needs. Any programme that considers farmers needs has a great chance of success and adaptation (Islam & Gronlund, 2010). It also applies on extension programmes which have more chances of failure in absence of feedback from farmers and reach to farmers, thereby reducing the relevance of the content of the programmes. The present study is a part of project on developing information dissemination system(s) for farming community of hill regions of Uttarakhand state. The assumption was that the knowledge of information needs of farmers in the surveyed areas will provide baseline information for future planning and establishment of effective agricultural information dissemination system in rural hill farm communities. Based on the information needs and the accessibility of media by farmers of the selected districts, an information media was developed to cater their information needs.

METHODOLOGY

Uttarakhand is the 27th state of Republic of India. There are 13 districts in Uttarakhand which are grouped into two divisions, Kumaon and Garhwal. The study on "Information dissemination system(s) for empowering farming community of Uttarakhand" was conducted by ICAR-VPKAS, Almora in three hill districts namely Almora, Bageswar and Uttarkashi. This paper explains the findings of four village clusters namely Shama, Nakuri, Patiya, and Himrol. The village clusters (each cluster comprises of 3 villages) were selected based on the discussion with the Expert team comprising the KVK expert, NGO representative, Government representative, progressive farmer and agriprenuer of the respected districts. Survey method was used to conduct the study and questionnaire was used as a data collection tool for fulfilling the objectives of the study. Sample size of the cluster was determined using sample size calculator at confidence level of 95 per cent. The number of respondents from each village of the cluster was determined using probability proportionate sampling method.

The information seeking behaviour of farmers was taken as the dependent variable. These variables were taken only for finding out any difference in information search behaviour of farmers across their socio-personal domains. Farmer information search behaviour was identified using a cluster analysis based on the number of sources of information used, frequency of use of the information source (352=daily, 52=weekly, 12=monthly, 4=quarterly, 2=half

yearly, 1=yearly, 0=none these points were calculated on per year basis) and the number of sources from which information was tried. Further farmer's importance of source for information was gauged on using a six-point Likert scale (0= not important, 1= less important, 2= neutral, 4= somewhat important, 5= very important and 6=highly important). Further frequency of use of information sources and farmer's importance of source for Information marks were multiplied together to obtain a Utility score. Further correlation between age, education, landholding, gender, risk orientation, economic motivation and value orientation to Communication sources were analysed.

RESULTS AND DISCUSSION

Information search behaviour of farmers

Information search behaviour of farmers was calculated based on number of information sources used for accessing farm related information. For this, cluster analysis was performed to identify homogenous subgroups of farmers with similar information source usage. To identify the subgroups, information source index was calculated & hierchieral clustering technique was employed (Fig. 1). The information search behaviour of farmers is shown in Figure 2.

Most of the farmers fell into low searcher category (43.93%) followed by high searchers (36.79%) while only a few (19.27%) fell into moderate searchers category. It can be inferred that majority of farmers were not making use of multiple information sources. Farmer's ability to search for information depends on the sources that are accessible to farmers. Information sources were categorised under three-point scale often, sometimes and never for which 3, 2 and 1 marks were assigned, respectively and average weighted mean was calculated from theses assigned marks. Table 1 depicts the average weighted mean for different information sources.

Table 1 shows that the majority of the respondents contacted with contact farmers, friends/ neighbours and shopkeepers, which might be due to the easy availability, timeliness, need based and understandable content of message delivered by these sources. Some of the respondents contacted with rural leaders and least of the

Table 1. Frequency of contact with information sources

Frequency of contact with interpersonal sources	Average weighted mean
Friends/neighbours	2.76
Rural leaders	2.02
Village Development Officer	1.46
Block Development Officer	1.10
Other farmers	2.79
Shopkeepers	2.11
Scientists	1.45
Frequency of contact with mass media sources	1.27
Radio	2.35
Television	2.44
Telephone/mobile	1.08
Tape recorder	1.47
Video	1.73
Newspaper	1.20
Magazine	1.55
Pamphlet	1.74
Hoardings/boards	1.34
Plays	1.64

Figure 1. Dendrogram of information search behaviour of farmers

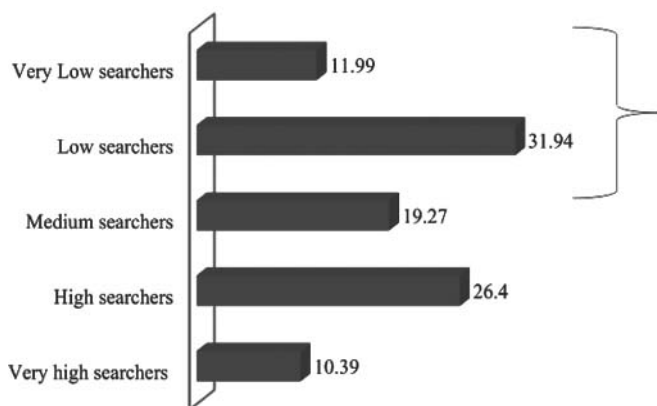
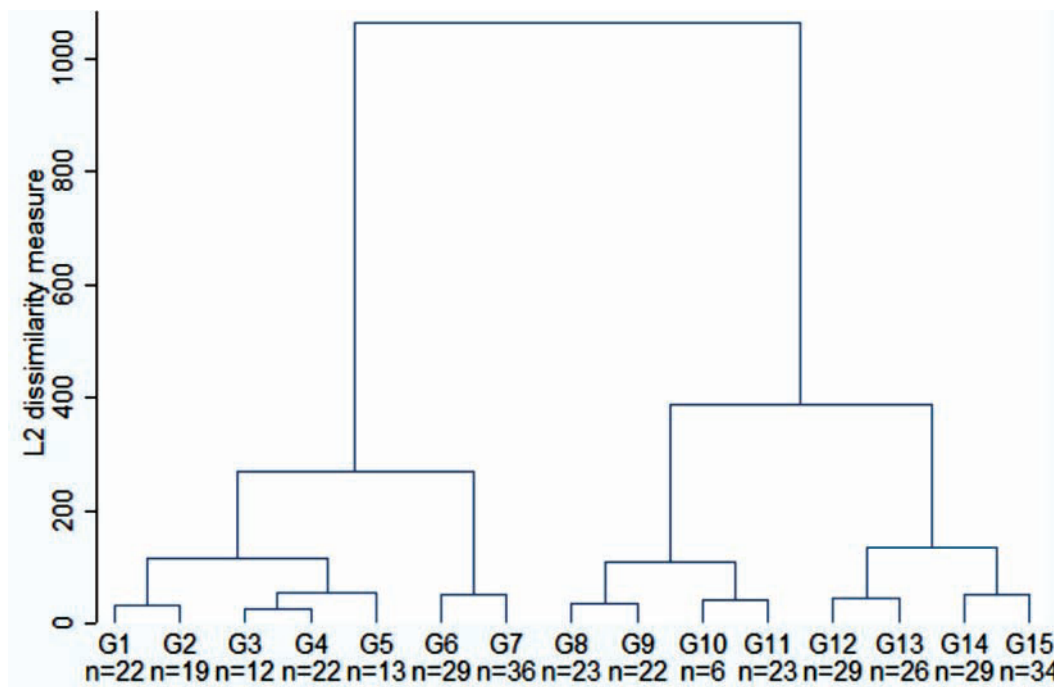


Figure 2. Information search behaviour of farmers

respondents contacted with Block Development Officer, Scientist and Village Development Officer for agricultural related information which may be due to lack of reach of farmers or unavailability of these sources in near proximity. Similar results are reported by Bhagat et al., (2004); Nain et al., (2015); Sharma et al., (2020) who also reported use of contact farmers as the most accessible source, followed by the state department of extension staff, and while Television and radio were used least. It is inferred that panchayat

meetings, telephone/ mobile and television were the most contacted mass media sources by the respondents whilst some of the respondents rely on demonstration, fair/ exhibition, announcement, etc. for information.

Analysis of variance showed variation in information search behaviour of farmers across socio-economic characteristics. Information search behaviour varied across gender, farming as primary or secondary source of livelihood, caste, education and land holding (Table 2). It is also inferred by studies (Deichmann et al., 2016; World Bank, 2016) that the widespread uptake of advisory or information is sometimes been limited by differences in the degree of access to mobile phones, related to factors such as gender or wealth status.

Major information needs of the farming community

On the basis of data received from different items related to sixteen sub-heads mentioned in interview schedule and the data collected through village survey and field visits was triangulated to identify the specific information needs of farming community in selected village clusters (Table 3). Respondents were asked to categorize each mentioned item into ‘Not Needed’, ‘Needed’ and ‘Most Needed’ which were scored as 1, 2 and 3, respectively. Based on their responses, the weighted mean score for each mentioned

Table 2. Search behavior clusters by sociodemographic characteristics

Information search behaviour	Very high	High	Medium	Low	Very low	ANOVA
Age	47.31	48.83	49.31	48.71	50.01	F=1.14, P>F=0.3365
Gender	0.788	0.724	0.709	0.682	0.652	F=2.12, P>F=0.0764
Main source of livelihood	0.321	0.422	0.331	0.116	0.038	F=40.74, P>F=0
Alternate source	0.029	0.060	0.059	0.086	0.089	F=1.74, P>F=0.1379
Caste	0.350	0.250	0.327	0.366	0.411	F=4.14, P>F=0.0015
Education	1.759	1.833	1.680	1.540	1.180	F=19.02, P>F=0
Land holding	1.189	1.169	1.141	1.081	1.044	F=6.75, P>F=0
Family Type	0.562	0.514	0.492	0.496	0.551	F=0.78, P>F=0.54

Table 3. Information needs for the different clusters

Information need	Weighted mean score
<i>Crop related</i>	
Cereals	2.71
Pulses	2.20
HYVs/ Resistant/ Early varieties	2.33
<i>Land and soil related</i>	
Land preparation	1.55
Moisture conservation	1.56
Soil testing	2.94
<i>Seed/planting material related</i>	
Seed treatment	2.06
Good quality seed	2.04
<i>Sowing related</i>	
Time/ Method/ Depth of sowing	2.94
Plant population	1.97
Seed rate	2.93
Intercultural operations	1.78
<i>Fruit/vegetable/flower cultivation related</i>	
HYVs	2.43
Intercultural/ Post-cultivation operations	1.98
Nursery raising	2.85
Post-harvest management	1.76
<i>Storage related</i>	
Management of pests	1.99
Storage techniques	2.19
Cold stores	1.59
<i>Fertilizer-related</i>	
Need of nutrients	2.28
Optimum dosage	2.03
Application techniques	2.09
Organic fertilizers	2.19
<i>Plant-protection related</i>	
Insect/pest identification	2.33
Organic pesticides	1.70
Dosages/ Precautions using insecticides	1.89
Biological plant protection	2.97
<i>Weed management related</i>	
Prominent weeds	2.21
Use/Precautions of herbicides	2.20
<i>Irrigation management</i>	
Irrigation techniques	1.78
Time/ optimum water for irrigation	2.18
Crop stages of irrigation	2.23
Policies offered by government	2.41
<i>Farm implements related</i>	
Requirement of implements	1.77
low-cost farm implements	1.97
Women friendly implements	2.16
<i>Animal (cattle/poultry/goat/sheep) rearing related</i>	
Suitable breed	1.71
Vaccination/disease management	1.89
Nutrition/Fodder management	2.10
Marketing of product	2.17
Government policies	2.46
<i>Loan and marketing related</i>	
Sectors for loan available	2.14
Procedure to obtain	2.29
<i>Energy conservation related</i>	
Energy conserving structures	1.98
Solar energy	1.89
Smokeless Chulha	1.83
<i>Miscellaneous</i>	
Weather predictions	1.67
New innovations	1.89
Agricultural updates	1.99
Mushroom cultivation	2.82
Bee keeping	1.50
Sericulture	1.32
Development programs	1.89
Prevention to wild animals	2.81

item was calculated ranging from 1 to 3. Information needs were further categorized as 'Not important', 'Important' and 'Most Important' based on calculated "Mean (2.02) ± Standard deviation (0.49)". The study findings (Table 3) show that there were some overlapping and some different types of information needs.

The information needs of farming community varied from cluster to cluster as the climatic conditions and crop profile of the clusters was quite different from each other.

Developing tailor-made information and media packages

To cater the information needs of the farmers, a package was developed through participatory mechanism. The content was selected, messages were treated for ease of understanding in local language. We observed farmers interactions with these prototypes and recorded their usage behavior, including misunderstandings and redundancies. Users' perceptions of the various media- text, video, audio and took decisions on the eventual design were discussed. Based on the decisions taken with farmers, the characteristics of the package were determined. The treated and accepted messages with ease of understanding in local language were eventually uploaded in form of a mobile app. According to the altitude from the mean sea level, regions were categorised as per altitudes of hill regions. The information was further organised under three media-audio, video and text.

In selected village clusters demonstration for the mobile application (e-Sanchar) were successfully organized, the application was installed in mobile of 39 farmers from mid hills (Patiya in Almora district) and higher hills (Shamaof Bageshwar district) and perception and attitude towards e-Sanchar mobile application was examined. Majority (74.36%) of respondents had medium perception, followed by high (20.51%) and only 5.13% have low perception about the e- Sanchar mobile application. Most (71.79%) of the respondents have medium attitude, 15.38 per cent have high and 12.82 per cent low attitude towards the e-sanchar mobile application. Majority (71.79%) respondents have medium impact, followed by low 20.51 per cent and 7.69 per cent have high impact of mobile application after 6 months of usage. Most of the farmers were of the opinion that they have much access to information at their fingertips now and the mobile app also solved the constraint of mobility. However, in high hills, in one of the clusters, the network connectivity was a problem, but they were assured that the connectivity was soon to be availed in the area by the local government's efforts. For such print media was provided on their information needs.

In order to develop a successful and feasible information dissemination mechanism for farmers, what farmer's need, in which form, when and through which media-is an important aspect to consider. The communication profile and information search behaviour of the target farmers must be examined before developing any information dissemination mechanism. It is found that in hills usually the farmers depend upon the informal sources of information pertaining to agriculture, which could be due to their constraints in mobility from one place to another because of lack of facilities and proper infrastructure. Singh et al., (2020) also reported similar results for usage of informal sources of information by Maniupri farmers. Sharma et al., (2008) also reported that personal localite

sources like neighbours, friends, progressive farmers and opinion leaders were playing important role in transfer of technologies to the fellow farmers. The farmer's need for agricultural information varied across clusters and altitude. It can be supported with the finding of Kaniki (2003) who suggested that the level of information needs may differ between individuals or groups depending on a variety of factors such as demographic factors, economic characteristics, or information source characteristics such as availability and ease of use. Study by Babu et al., (2012) reported that the major information needs of rural smallholder farmers were related to pest and disease management. Singh et al. (2003) interviewed farmers in Haryana and found that progressive farmers were the most frequently accessed information source. Small farmers cited market prices, weather information, information on diseases and plant protection, and seed information as their top needs (Mittal et al., 2010; Panda et al., 2019).

There remains a heterogeneity among the hill farmers with more credibility to formal sources of information while more access to the informal sources, which is due to gap in our extension mechanism. The study found difference in information needs of farmers from mid and high hills regions, highlighting the need of context specific, demand driven information disseminating mechanisms. Such mechanism, well supported with an enabling environment may help in bridging the information gap between the new emerging advances in agriculture and farmer. Similar procedures were followed by Berta Ortiz-Crespo et al., (2020) while designing a user centred advisory service. It also provides a feedback mechanism to the researchers or technologists to put their concern on decentralized, demand driven technology development. As agriculture is seasonal, the incidence of new problems, challenges also remains dynamic and needs time bound, assured, authentic solutions to the problems. Any information dissemination plan when planned and developed in a participatory manner will be well received and adopted by the farmers.

CONCLUSION

An understanding of farmer's need, in which form, how they access information, and the factors which affect the information search behaviour of farmers will also provide the guideline to the programme developers to design demand driven context specific media/packages which will succeed in fulfilling the aim of designing such programmes. Our study shows that, a mobile advisory service, created through a participatory manner, can help to address the communication and challenges of information dissemination in hill agriculture. During the pilot, a high segment of farmers actively used the package, demonstrating its prospective effectiveness to improve farmers' access to agricultural information. In hill regions, where lack of infrastructure and tough terrains for frequent mobility is a constrain, extension system providing a context for the flow of authentic knowledge through authentic media among farming communities on an equal basis is appreciated by farming community.

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Assessment of Technological Interventions in Farm Women Empowerment

A. Shamna*, S. K. Jha, N. M. Alam, R. K. Naik and G. Kar

ICAR CRIJAF, Barrackpore, Kolkata, West Bengal, India

*Corresponding author email id: shamnababun@gmail.com

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ABSTRACT

Women play an important role in agriculture. There is a need to empower these farm women to improve their overall wellbeing. An attempt was made to assess the impact of technological interventions in terms of participation of farm women in farming activities, change in drudgery involved, involvement in decision making and other attributes related to empowerment in North 24 Parganas district of West Bengal involving 110 farm families. The results reveal that there is significant increase in participation in all the selected farming activities in post intervention period. Majority of the farm women participated in decision making always in activities like drying (95%), weeding (70%) and storing (70%) in the post intervention period. The mean drudgery score had also decreased for all the activities, the higher decrease was observed in case of retting (1.525) followed by sowing (1.225). Among the personal attributes studied, the highest difference level in mean was attained in case of self-confidence (2.45) followed by decision making ability (2.15). The present study clearly indicate that special emphasis on women friendly technologies can make a huge change in their existing status in agriculture by improving their participation in farming activities, decision making ability and self-confidence.

INTRODUCTION

Women play a significant and crucial role in agricultural development and allied fields including the main crop production, livestock production, horticulture, postharvest operations, agro/social forestry, fisheries, etc. The nature and extent of women involvement in agriculture varies greatly from region to region. Women's status is often described in terms of their level of income, employment, education, health and fertility as well as their roles within the family, the community and society (Awais et al., 2009). Despite doing the back breaking works, women are not socially and economically empowered. Women face many problems in carrying out the income generating activities. These problems are to be addressed first for their socio-economic upliftment. Women agriculturalists are associated with traditional subsistence and low-yield food crops, poverty, lack of influence and the inability to adopt crop and husbandry innovations (Youssef, 1995). It is very important to solve this issue by empowering them socially and

economically as the livelihood of these farm women depend entirely on farming and related activities. Empowerment is a multi-faceted, multi-dimensional and multi layered concept. With regards to women, empowerment is a process in which women gain greater share of control over resources- material, human and intellectual like knowledge, information, and ideas and financial like money- and control over decision making in the home and community (Awasti et al., 2020). Women's empowerment has a direct impact on agricultural productivity and household food security (Sraboni et al., 2014; Harper et al., 2013). There is also a need to enhance women participation in the decision-making regarding agricultural and livestock activities and the educational facility should be provided to females to enhance their capabilities in the rural areas (Nain & Kumar, 2010; Yadav et al., 2021).

Under Tribal Sub Plan (TSP) various activities for enhancing the livelihood security was initiated by ICAR-Central Research Institute for Jute and allied Fibres since 2015 in Makaltala and

Farmania villages of Habra block, North 24 Parganas. A special emphasis was given on tribal farm women of the village since majority of the agricultural activities were undertaken by the women folk of the village. The major interventions were improved jute varieties, line sowing, jute intercrop with green gram, nail weeder, retting with CRIJAF Sona, improved rice cultivation practices, vegetable cultivation in rice crop, Improved package and practices of mustard, coriander, fisheries, poultry and entrepreneurship development through value addition of jute fibre and fabrics. Technologic empowerment of farm women was focused since the participation of women in agriculture activities need to be improved and drudgery to be reduced simultaneously. The present study was taken up to assess the impact of technological interventions in terms of participation of farm women in farming activities, drudgery, involvement in decision making and other personal attributes of farm women related to empowerment.

METHODOLOGY

The study was conducted at Makaltala village of North 24 Parganas, West Bengal where jute based farming system is followed by majority of the farmers. After analysing the existing farming situation and level of farm women's participation in farming activities through baseline study, a cafeteria of technologies was introduced slowly in the villages from year 2015 to 2019 in order to technologically empower the farm women by providing skill on improved jute production technologies, providing drudgery reducing tools and implements and also training them on value addition which is a part and parcel of sustainable agriculture system. A total of forty farm women out of 110 farm families was considered for collecting data for analysing the impact of technological interventions on farm women empowerment. As the population was homogenous simple random sampling procedure was used. Based on the objectives, a semi structured interview schedule was prepared. The investigation was applied in nature and survey in design. Self-anchoring technique was used wherein the respondents were asked to rate themselves on the scale on the range given against the selected activity or dimensions before and after the introduction of interventions. Three levels were mentioned against each farm activity for measuring the participation- always, sometimes and never with a score of 2,1 and 0 respectively. Descriptive statistics such as frequency and mean were used wherever necessary.

Participation of women in farming activities in two dimensions like physical participation and participation in decision making was considered for the study. The term Physical participation is operationalized as the extent of participation of farm women in different farming activities physically, right from land preparation to marketing of farm products. Similarly, the participation of farm women in decision making of farming activities in the present study is operationalized as the extent of involvement of farm women in decision making of various farm activities right from land preparation to marketing of products and by-products.

RESULTS AND DISCUSSION

The impact of introduction of farm interventions in terms of participation of farm women in farming activities, the level of drudgery and the overall perceived impact of the interventions were assessed and the results are presented below.

Physical participation of farm women in different farming activities of jute cultivation in terms of field preparation, sowing, weeding, irrigation, plant protection, harvesting, retting, drying, storing etc. was studied. The results (Table 1) reveal that there is significant increase in participation in all the selected farming activities in post intervention period. The highest participation, after the introduction of technological interventions on crop production aspects in jute was shown in drying and storing as per the score recorded (69), followed by record keeping (66) and weeding (63) whereas in pre intervention period farm women participating in various farming activities regularly were very less, the highest being in weeding operation (44). In other farming activities the farm women who participated in farming activities regularly were very less or nil. In the pre intervention period no respondent reported regular participation in sowing, irrigation, plant protection and selling of bi-products, the total score in the level of participation being 8,2,1 and 4 respectively. But the post intervention period score shows that the participation level has increased to 20, 17, 10 and 38 respectively. The farm activity that showed least change in the participation level of farm women was plant protection, the reason for which was the higher drudgery involved in operating the sprayer in jute field. Mittal & Kaur (2021) also reported that the participation of farm women in plant protection measures are very less. The results indicate that women friendly technologies in agriculture can improve their level of participation in farming activities.

Table 1. Level of participation of women in farming activities

Activities	Level of physical participation of farm women		Participation of farm women in decision making	
	Pre-interventions	Post-interventions	Pre-interventions	Post-interventions
Field preparation	17	42	21	56
Sowing	8	20	18	43
Weeding	44	63	43	68
Irrigation	2	17	8	43
Plant protection	1	10	4	30
Harvesting	39	48	38	60
Retting	3	25	8	46
Drying	44	69	45	78
Storing	38	69	36	68
Selling products	30	52	18	42
Selling biproducts	4	38	10	45
Record keeping	26	66	24	65

Participation of farm women in decision making also increased in all the farming activities studied. It can be observed from the pre intervention and post intervention scores that increase in participation in decision making was more in activities like drying (78), weeding (68), storing (68), record keeping (65) and harvesting (60). The difference in the total score obtained under each farming activities revealed that a greater change happened in case of participation in decision making regarding record keeping followed by retting, field preparation, irrigation and selling bi-products. The studies by Kaur (2008); Jamali (2009); Devendra & Chittedi (2010); Pal & Haldar (2016) also support that in order to increase the role of farm woman in decision making for agricultural production, dairy and other allied activities of technical nature, it is necessary to equip them with latest information so that they can play a vital role in decision making in the family. Baliyan (2014) reported that higher work has a favourable impact on the status of women in the family and their role in decision-making.

Level of drudgery

In the present study, the level of reduction in drudgery in jute farming activities due to introduction of interventions were studied by collecting the data of pre and post intervention period (Table 2). In the post intervention period, the mean drudgery score had decreased for all the activities, the higher decrease was observed in case of retting (1.525) followed by sowing (1.225) and weeding (1.05). The technology CRIJAF Sona, a microbial formulation that helps in faster and quality retting helped the farm women to reduce drudgery as the fibre extraction from the bark became easier, less difficulty in separating the fibre from the bark as there was more or less uniform retting and the root content was almost nil. Another drudgery reducing tool used by farm women in jute cultivation was four row jute seed drill. Since there was uniform seed distribution in rows, there was no need for the farm women to go for thinning operation. Further, the line sowing of jute also made the other intercultural operations easy for them. The drudgery in weeding

operation was reduced due to the introduction of CRIJAF nail weeder. The Wilcoxon test also showed that there is a significant reduction in the drudgery level (at $p < 0.01$) of all the farming activities except in case of drying. None of the technology having direct or indirect impact on drudgery reduction in drying of fibre was introduced in the study area.

The results are in line with the studies of Singh et al., (2014) who reported higher working efficiency while harvesting with serrated sickle. Similarly, Sharma et al 2018 in their study on awareness about various innovative agriculture techniques, farm tools and implements and drudgery experience of respondents found that, for majority of women with the help of modified technology, the work output was more than traditional techniques. Barakha et al., (2018) reported increased efficiency, work output and reduced drudgery of farm women resulted from adoption of improved technology using hanging grain cleaner. Surabhi et al., (2016) reported similar findings in the study comparing energy expenditure of farm women during performing agricultural activities in traditional practices and by using drudgery reducing tools.

Impact of the technological interventions on individual ability of farm women

The impact of the interventions on farm women in terms of their individual abilities was analysed and the result reveal that among the personal attributes studied (Table 3), the highest difference level in mean was attained in case of self-confidence (2.45) followed by decision making ability (2.15), economic freedom level (2.08), leadership ability (1.73), freedom of expression (1.63), individual identity and managerial skills (0.60). The regular trainings on improved crop production technologies, skill development programmes of SHG members on various income generating activities such as backyard poultry, duckery, vegetable cultivation, value addition of jute through jute bag preparation etc. helped the women farmers to gain knowledge and skill on new technologies which in turn resulted in increase in self-confidence and decision

Table 2. Impact of interventions on perceived level of drudgery of farm women

Activities	Mean score before	Mean score after	Difference	Wilcoxon test(z value)
Field preparation	2.925	2.050	0.875	5.51 (p<0.01)
Sowing	2.925	1.70	1.225	5.37 (p<0.01)
weeding	2.700	1.650	1.050	4.69 (p<0.01)
irrigation	2.775	2.275	0.500	3.26 (p<0.01)
plant protection	2.675	2.100	0.575	4.01 (p<0.01)
harvesting	2.200	1.950	0.250	2.75 (p=0.01)
retting	2.925	1.40	1.525	5.37 (p<0.01)
drying	2.100	1.975	0.125	1.33 (p=0.18)

Table 3. Impact of interventions on individual ability of farm women

Attributes	Mean before interventions	Mean after interventions	Difference	Wilcoxon test (z value)
Leadership ability	0.75	2.48	1.73	4.97 (p<0.01)
Individual identity	0.73	1.78	1.05	4.11 (p<0.01)
Freedom of expression	0.88	2.50	1.63	5.03 (p<0.01)
Economic freedom level	0.53	2.60	2.08	5.44 (p<0.01)
Decision making ability	0.43	2.58	2.15	5.37 (p<0.01)
Managerial skills	1.20	1.80	0.60	3.41 (p<0.01)
Self Confidence	0.38	2.82	2.45	5.29 (p<0.01)

making ability of the farm women. Access to technology and improvement of farming and production systems can have positive benefits not only from an economic perspective but also in helping to enhance the status of women. Research by Sanginga et al., (2006) & Bhuyan et al., (2019) support this finding. The income level of the farm women increased because of the technologic empowerment. This had led to their increased economic freedom level which in turn helped them to influence the expenditure pattern of their family.

This may be the reason for indicating the increase in economic freedom level by the farm women. Women gained knowledge and became active in their Self Help Groups, guiding others in the village because of the technological interventions. This might have contributed to their higher mean score towards leadership ability, freedom of expression, individual identity and managerial skills. It can be concluded from the table that the interventions had left an indelible improvement in the personal, social and economic conditions of farm women.

CONCLUSION

Training or skill enhancement on improved technologies play a major role in improving and sustaining the participation of farm women in agriculture. Special emphasis on women friendly technologies can make a huge change in their existing status in agriculture in terms of their participation in farming activities physically as well as participation in decision making regarding the farming activities, reduction in drudgery and improving the overall personal attributes. If these women farmers can be provided with equal access to other resources like land, credit and other services, a tremendous sustainable impact on their overall livelihood can be made. The researchers and policy makers should therefore be more gender sensitive in designing research agenda and programmes that may encourage more farm women to adopt new suitable women friendly technologies.

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Participatory Evaluation of Effectiveness of Farmer-Led Adaptation Strategies to Climate Change in Eastern Uttar Pradesh

Preeti Yadav^{1*}, Sanjit Maiti², S. K. Jha³, H. R. Meena⁴, Mukesh Bhakat⁵ and A. K. Dixit⁶

¹PhD Student, Agricultural Extension, ICAR-IARI, New Delhi, India

²Senior Scientist, ⁴Principal Scientist, Dairy Extension, ICAR-NDRI, Karnal, Haryana, India

³Principal Scientist, Agricultural Extension, ICAR-IISWC, Research Station, Chandigarh, India

⁵Senior Scientist, LPM, ICAR-NDRI, Karnal, Haryana, India

⁶Principal Scientist, Dairy Economics, Statistics and Management, ICAR-NDRI, Karnal, Haryana, India

*Correspondent address email id: yadavpreeti1704@gmail.com

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ABSTRACT

India has shown high vulnerability towards the impact of climate change due to the dependency of 58 per cent of India's population on agriculture. The study was carried on 180 respondents in three districts selected randomly of eastern Uttar Pradesh to evaluate farmer-led adaptation strategies to the impact of climate change, activities that are predominantly led by farmers to make them more adaptable to long-term changes in weather patterns. All the respondents had experienced extreme climatic events in the last 5-10 years, making the region climate-prone. Nine farmers'-led adaptation strategies to climate change followed in crop farming were documented and quantified by using Climate Change Adaptation Index. Adaptation strategies were evaluated using the Quantification of Indigenous Knowledge method (QuIK) method; by involving the key informants followed by peer farmers. Crop diversification, use of high yielding varieties of crops and preparations of bunds to control water flow were the most preferred adaptation strategies to climate change. The irregular rainfall increased the incidence of floods in eastern Uttar Pradesh; thus, the preparation of bunds to regulate water flow in crop fields was the most efficient adaptation strategy.

INTRODUCTION

Climate change is affecting the vulnerable section of society i.e. the farming community. It is not only about rising temperatures, shifting precipitation patterns, and extreme weather events. It is much more. It is about changing the way farmers are practicing farming and adapting to change caused by the extreme long-term weather conditions. India is the seventh most climate-affected country in 2019 (Global Climate Risk Index, 2021) with agriculture as the primary source of livelihood of the Indian population with 86.2% of farmers with less than 2 hectares of land, making them more vulnerable to the impact of climate change (Agriculture Census of India, 2019). It was predicted that a 1-2.5 degrees Celsius

temperature rise by 2030 is likely to show serious effects on crop yields (Ahluwalia and Malhotra, 2006). An economic survey in 2017-18 cautioned that "climate change might be reducing annual agriculture income from 15 per cent to 18 per cent and up to 20 per cent to 25 per cent for unirrigated areas". Guiteras (2009) indicated that without any adaptation by the farmers the yields for crops decreased by 4.5 per cent to 9 per cent in the short-run (2010-2039) and by 25 per cent in the long run (2070-2099). The challenge of adapting to the impact of climate change is growing and hence research is important in the field of adaptation strategies (Raghuvanshi & Ansari, 2020). Farmers know and understand the environment in which they farm, answers to agronomic questions can be found in the collective experience of the farming community

(Scoones & Thompson, 1994). QuIK method focuses on farmers' participation in reviewing their practices and, based on their reviews, an intervention that combines farmers' knowledge and scientific rationale could be offered as a solution.

Uttar Pradesh has a strong agriculture base with the most fertile landmasses and a well-connected river network but the climate sensitivity of agriculture is very high with high-level poverty, rapid urbanization coupled with a flood, heat waves and cold waves. The state is divided into four regions: western, central, eastern, and Bundelkhand. Eastern regions have a larger impact on climate change due to low per capita income, low educational status, and high population density, the dominance of the small and marginal resource-poor farmers compared to other regions of Uttar Pradesh. Almost 77 per cent of the area affected by floods in the state is constituted by eastern U P (Uttar Pradesh State Action Plan on Climate Change, 2017). The adaptive capacity was found to be very low in districts located in vinyan, eastern Plain, north-eastern Plain, and Bundelkhand (Tripathi & Mishra, 2017). Rao et al., (2013) study reflected that majority of the districts of eastern Uttar Pradesh were moderate to highly vulnerable to climate change and is expected to show very high and high vulnerability in the mid-century 2021-2050. Sehgal et al., (2013) concluded that 21 out of the 28 districts in eastern Uttar Pradesh are highly vulnerable to climate change. Hence, the livelihoods of farmers in Uttar Pradesh's eastern region are under threat from climate change.

METHODOLOGY

Eastern Uttar Pradesh was selected purposively and out of 28 districts in eastern Uttar Pradesh, 3 districts were randomly selected viz., Azamgarh, Varanasi and Ghazipur. From each district, 4 villages were randomly selected. A farmer who was growing crops was considered as a respondent for this study. From each village 15 farmers were randomly selected, making the sample size of 180 respondents. Adaptation strategies were operationalized as the measures adopted by the farming community to cope up with the adverse impact of climate change on crop farming for sustainable agricultural production. A set of probable adaptation strategies was prepared using the snowball technique during the pilot study and a total of nine adaptation strategies were documented. 'Climate Change Adaptation Index (CCAI)' was developed at two-level *i.e.* adaptation strategies wise and respondent wise using the following formula:

$$\text{Climate Change Adaptation Index} = \frac{\text{Obtained Score}}{\text{Maximum Obtainable Score}}$$

Ranking of these adaptation strategies was done according to their higher index value. Adaptation strategies with higher index values indicated that these adaptation strategies had comparatively

more coping capacity than the adaptation strategies with the lower index value (Table 4). In the study, the effectiveness of the adaptation strategies was operationalized as the ability of farmer-led adaptation strategies to cope up with the adverse effect of the changing climatic scenario. The study adopted the principle De Villiers (1996) where the performance of the farmers' practices was assessed without field trial. The tool of Participatory Rural Appraisal (PRA) like matrix ranking was combined with semi-structured interviews to elicit numerical data from experienced farmers. Key informants were selected based on the snowball technique and by interviewing the farmers from each village. Accordingly, three key informants were selected from each village of the sampled districts. Therefore a total of 36 key informants were used to study the effectiveness of the adaptation strategies. They were asked to weigh practices in comparison among the identified strategies according to the following four criteria of effectiveness: (1) Effect on yield performance (2) Associated cost (3) Reducing climate sensitivity (4) Easy in availability and application. In each block of the matrix, key informants were asked to position the necessary number of pieces of stone out of five to each adaptation strategy for every criterion. Collected data were subjected to one-way analysis of variance followed by Duncan's Multiple Range Test (DMRT) as modified by Kramer (1957) was used to identify the most effective adaptation strategies.

RESULTS AND DISCUSSION

Table 1 clearly shows that all the sampled farmers had experienced extreme climatic events like drought, flood, heavy rainfall, cold wave, heatwave, and hailstorm over the last 10 years. This shows that the locale of the study was a climate-disaster prone region. Ranks were allocated to adaptation strategies followed by the farmers based on CCAI scores. The five most preferred strategies of each three districts were selected for performing QuIK. Climate change has a global effect, but it also has a highly region-specific impact (Chunera & Amardeep, 2018) therefore the adaption measures that people prefer vary from district to district (Table 2).

Effectiveness of adaptation strategies related to crop-farming in Azamgarh district

Table 3 shows that 'search for the alternate sources of income' (mean score = 3.81) was considered the most effective adaptation strategy. Due to the ease in availability of jobs in the farm and non-farm activities in Azamgarh district such as working as agricultural laborers, working in nearby cities as marginal workers (*mistri*). Therefore, farmers preferred this particular strategy as an adaptation to climate change. The farmers have agreed that getting income apart from farm activities could be beneficial in providing sustainability to their livelihood and the additional income earned from alternate

Table 1. Distribution of respondents according to extreme climatic events experienced

Study Area	Azamgarh (n=60) (Percentage)	Varanasi (n=60) (Percentage)	Ghazipur (n=60) (Percentage)	Overall (n=180) (Percentage)
Experienced Climatic Events	100.00	100.00	100.00	100.00
Types of Extreme Events	Cold wave, Heat wave, Flood, Drought and Frost	Drought, flood, Hailstorm, heatwave, cold wave frost and sea-water intrusion	Drought, flood, Hailstorm, heatwave, cold wave and frost	Flood, Drought, Frost, Hailstorm, heatwave, cold wave

Table 2. Index score and ranking of adaptation strategies in crop farming followed by the farmers of eastern Uttar Pradesh

Adaptation strategies	Azamgarh (n=38)	Varanasi (n=53)	Ghazipur (n=52)	Overall (n=143)
Crop diversification	0.87 (I)	1.00 (I)	1.00 (I)	0.97 (I)
Use of tolerant varieties of seeds	0.22 (VI)	0.64 (IV)	0.21 (IX)	0.37 (IX)
Use of high yielding varieties and/or hybrid varieties of seeds	0.55 (III)	0.64 (IV)	0.69 (III)	0.64 (II)
Preparation of bunds to control water-flow	0.66 (II)	0.66 (III)	0.62 (V)	0.64 (II)
Search for alternate sources of income	0.39 (IV)	0.40 (IX)	0.44 (VIII)	0.41 (VI)
Use of neem in the field/stored grains	0.37 (V)	0.47 (VII)	0.77 (II)	0.55 (IV)
Vegetable farming	NA	0.42 (VIII)	0.63 (IV)	0.38 (VII)
Value addition /Use of by-products of crops	NA	0.55 (VI)	0.50 (VII)	0.38 (VII)
In-situ mulching in a rice field by <i>Dhaincha</i>	NA	0.81 (II)	0.58 (VI)	0.51 (V)

(Values in parenthesis indicate column-wise rank); NA: Not Adopted

Table 3. Effectiveness of adaptation strategies related to crop-farming in Azamgarh (n=12)

Adaptation strategies	Effect on yield performance	Associated cost	Reducing climate sensitivity	Easy in availability and application	Overall effect
Crop Diversification	1.33 ^b ±0.14	1.83 ^c ±0.21	1.25 ^d ±0.13	1.75 ^d ±0.22	1.54 ^d ±0.10
Use high yielding varieties and hybrid varieties of seeds	1.75 ^b ±0.18	3.50 ^{ab} ±0.19	2.67 ^c ±0.22	3.83 ^b ±0.27	2.94 ^c ±0.09
Preparation of bunds to control water flow	3.92 ^a ±0.29	2.91 ^b ±0.36	3.67 ^b ±0.19	2.92 ^c ±0.19	3.35 ^b ±0.11
Search for alternate source of income	3.92 ^a ±0.19	4.00 ^a ±0.39	2.67 ^c ±0.36	4.67 ^a ±0.14	3.81 ^a ±0.18
Use of neem in the field and stored grains	4.25 ^a ±0.28	2.00 ^c ±0.35	4.75 ^a ±0.25	1.58 ^d ±0.23	3.14 ^{bc} ±0.15

Mean with different superscripts in a column differ significantly at a 5 percent level of significance. Multiple comparisons were based on DMRT.

occupations enabled farmers to practice more innovation in their agricultural practices. Hence, it was also considered as the most cost-effective (mean score = 4.00) adaptation strategy.

Off-farm work involvement is one of the key climate change adaptation approaches used by small-scale rice farmers (Kyeremeh & Bannor, 2018). In case of reducing the climate sensitivity, the use of neem (leaves, fruits etc.) in the crop-field and stored grains was most effective by preventing attack of pests and insects, though the availability and application pose a problem to farmers as the standard formulation of neem solution was not clear to them and the seasonality of neem fruit production has also been cited as constraints to the usage of neem as pesticides.

Effectiveness of adaptation strategies related to crop-farming in Varanasi district

Table 4 depicts that the preparation of bunds to control water flow (mean score = 4.08) was considered the most effective adaptation strategy in Varanasi district. The incidence of floods has shown an increasing trend in Varanasi district leading to huge damage to standing crops therefore, making soil bunds to control the water and channelize the water for other uses in the future irrigation purposes was proved to be beneficial and reducing climatic

sensitivity. Chouksey et al., (2021) study indicated that water-saving irrigation methods and water harvesting and recycling for supplement irrigation had good adaptation scores. Due to the increased frequency of localized and short-term rainfall events, flooding events have increased in Eastern Uttar Pradesh in recent years and are expected to increase in the future (Guhathakurta et al., 2008) which impose the need for water management practices. The adverse effect of climate sensitivity on rice, wheat, sorghum, *Arhar*, *Bajra* productivity can be alleviated by irrigation (Kar & Kar, 2008; Ranuzzi & Srivastava, 2012; Singh, 2012; Zou et al., 2012). The practice was considered even effective in stabilizing the crop yield (mean score = 4.33), easy in availability and preparation (mean score = 4.50) and cost-effective (mean score = 4.00) too. As already some incentives and support were provided by local government to assist farmers in preparation of bunds; hence leading this particular practice scored more value in terms of easy availability and application and associated cost. The use of high yielding varieties was also considered effective in reducing climate sensitivity (mean score = 3.92) in Varanasi district.

Farmers were introducing improved varieties such as early maturing; flood-tolerant and short-duration varieties to maintain profitability and protect crops during flood-like conditions.

Table 4. Effectiveness of adaptation strategies related to crop-farming in Varanasi (n=12)

Adaptation strategies	Effect on yield performance	Associated cost	Reducing climate sensitivity	Easy in availability and application	Overall effect
Crop Diversification	1.33 ^d ±0.14	2.42 ^a ±0.36	1.33 ^c ±0.19	1.83 ^c ±0.34	1.73 ^c ±0.13
Tolerant Varieties	3.58 ^{ab} ±0.31	3.33 ^a ±0.38	2.33 ^b ±0.28	2.67 ^{cb} ±0.40	2.98 ^b ±0.13
Use of high yielding varieties/hybrid varieties	2.42 ^c ±0.31	2.58 ^a ±0.38	3.92 ^a ±0.26	2.75 ^{cb} ±0.25	2.92 ^b ±0.15
Preparation of bunds to control water flow'	4.33 ^a ±0.22	3.58 ^a ±0.34	3.92 ^a ±0.29	4.50 ^a ±0.19	4.08 ^a ±0.14
In-situ mulching of paddy field with <i>Dhaincha</i>	3.33 ^b ±0.40	3.17 ^a ±0.47	3.42 ^a ±0.42	3.08 ^b ±0.40	3.25 ^b ±0.20

Mean with different superscripts in a column differ significantly at a 5 percent level of significance. Multiple comparisons were based on DMRT.

Table 5. Effectiveness of adaptation strategies related to crop-farming in Ghazipur (n=12)

Adaptation strategies	Effect on yield performance	Associated cost	Reducing climate sensitivity	Easy in availability and application	Overall effect
Crop diversification	1.67 ^c ±0.19	3.33 ^{ab} ±0.37	1.75 ^c ±0.22	2.08 ^c ±0.29	1.77 ^c ±0.92
Use of high yielding varieties/hybrid varieties	2.67 ^b ±0.14	3.67 ^a ±0.41	3.25 ^{bc} ±0.30	2.83 ^{bc} ±0.27	2.48 ^b ±0.14
Preparation of bunds to control water flow	4.17 ^a ±0.21	3.25 ^{ab} ±0.33	4.00 ^a ±0.28	4.33 ^a ±0.14	3.15 ^a ±0.74
Use of neem in the crop field and stored grains	4.58 ^a ±0.15	2.50 ^{ab} ±0.41	3.92 ^{ab} ±0.34	3.50 ^{ab} ±0.48	2.90 ^a ±0.21
Vegetable farming (Olericulture)	1.50 ^c ±0.19	2.00 ^c ±0.35	2.08 ^c ±0.44	2.2 ^c ±0.43	1.57 ^c ±0.16

Mean with different superscripts in a column differ significantly at a 5 percent level of significance. Multiple comparisons were based on DMRT.

Effectiveness of adaptation strategies related to crop-farming in Ghazipur district

Table 5 shows that preparation of bunds to control water flow (mean score = 3.15) was considered most effective in improving yield performance (mean score = 4.17), helped reduce climatic sensitivity (mean score = 4.00) and was easy to avail and prepare (mean score = 4.33). Therefore, the preparation of bunds was considered the most effective adaptation strategy. However, the use of high yielding varieties was considered by the farmers in Ghazipur district to be the most cost-effective adaptation strategy. Farmers observed improved yields due to the use of high yielding varieties which were short-duration varieties of paddy and wheat, allowing them to go for more vegetables in the cropping system and enabling crop diversification which ultimately helps in improving overall crops yield. The study by Harikrishna et al., (2019) mentioned that adoption of climate-resilient practice increased the availability of irrigation water, usage of improved varieties and input use efficiency which will increase the quantity of produce.

CONCLUSION

Farmers by integrating their expertise, local and extension contact opted for practices like the use of high yielding varieties and better water conservation techniques. The public authorities can provide more information on adaptation strategies to climate change along with routine improved practices of crop farming. The preference for adaptation strategies for each district was different. Hence, region-specific contingency plans and documentation of farmer-led practices should be planned by bringing farmers, key informants of a particular region, extension agents, scientists and policymakers on the same platform. Scientists can learn most from farmers about factors in the farmers' lives that are important and easy to observe and accordingly can develop technologies that will increase the extent of adoption of practices suggested by extension functionaries. QuIK facilitates rapid transfer knowledge and can unpack the practice of successful farmers/enterprises so that it reaches a wider group of a farmer.

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Knowledge and Adoption of Drip Irrigation in Citrus Crops among Farmers of Western Haryana

Vinod Kumari^{1*}, Subhash Chander² and Sushil Sharma³

¹Professor & Head, ²Assistant Professor, Department of Sociology, ³Assistant Scientist, Department of Horticulture, CCS Haryana Agricultural University, Hisar-125004, Haryana, India

**Corresponding author email id: vinodkumari2000@yahoo.com

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ABSTRACT

Water is becoming increasing scarce which limits agricultural development not only in India but also in many parts of the world. Drip irrigation is an incredibly efficient watering method that slowly delivers water directly to plant root system. The present study was undertaken to assess the knowledge and adoption level of drip irrigation in citrus crops among farmers of Haryana state. Majority of respondents belonged to middle age group (51.67%), general castes (96.67%), joint families (68.33%) and having land between 4-10 hectares (45.00%). It was found that majority of sampled farmers (61.67%) had high level of knowledge while 31.67 per cent had moderate level of knowledge of drip irrigation. More number of farmers had high level of adoption (40.00%) whereas 35.00 per cent had medium and 25.00 per cent had low level of adoption of drip irrigation. Socio-economic factors like income, landholding, mass media exposure, education and socio-economic status of farmers were found significantly associated with the level of knowledge and adoption of drip irrigation. It is concluded that more efforts are required to increase the knowledge of farmers about drip irrigation for wider adoption of micro-irrigation technologies.

INTRODUCTION

In India, water use is increasing and its demand for agriculture, industry, and personal usage is expected to rise in the future decades. Water scarcity is becoming more prevalent, limiting agricultural development not only in India but throughout the world. Water use efficiency is critical for the survival of a growing population as well as the nation's vertical development. Drip irrigation is an effective way to deliver water directly to the root zone of the soil. The value of drip irrigation can be demonstrated by the fact that it reduces water wastage and is considered a feasible alternative for crops that require a lot of water. The drip irrigation technology is particularly well suited to saline and alkaline soils, with a water consumption efficiency of 80 to 90 per cent. (Verma & Sharma, 2017). In India, the area under drip irrigation has increased dramatically during the previous 15 years. Rajasthan (1.68 mh), Maharashtra (1.27 mh), Andhra Pradesh (1.16 mh), Gujarat

(0.83 mh), and Haryana (0.57mh) are the states that use micro irrigation the most. Although there have been many technological developments in the Drip Irrigation System in the country, the system is not fully employed by farmers in water-scarce areas. It is becoming increasingly necessary for us to consider the different elements that influence farmers who use drip irrigation. Micro-irrigation technology adoption knowledge has significant physical, biological and social repercussions. In order of quantitative importance, socio-economic variables such as age, caste group, poverty index, and percentage of income from off-farm and non-farm activities had a substantial impact on decisions to adopt micro-irrigation technology (Neil & Lee, 2001; Ragassa et al., 2005).

Research has been done on various elements of micro irrigation in different crops (Barse et al., 2010; Kumar & Pallanisami, 2010; Shantaram, 2014; Hakkin et al., 2016; Moinand Kamil, 2018), but there has been no critical assessment of knowledge and adoption of drip irrigation in citrus crops. Furthermore, studies from one

region cannot be extrapolated to another to determine the reasons behind a technique's limited acceptance. According to Ragassa et al., (2005), there is a significant disparity in the timing of micro-irrigation technology adoption in Maharashtra and Gujarat. With these facts in mind, the current study was conducted to determine the level of knowledge and adoption of drip irrigation in citrus crops among farmers in Haryana.

METHODOLOGY

The study was conducted in Haryana state in two districts namely Sirsa and Fatehabad which are the major citrus growing districts. From each district, thirty respondents were selected randomly from different villages. In Fatehabad district villages selected randomly were Khara Kheri, Kumharia, Bigher, Jhallania, Mehuwala, Sulikhera, Haroli, Lehrian, Tibbi, Jandlikalan, DhaniChanan and GillanKhera villages. Similarly from Sirsadi district villages namely Jamal, Rampura Dhilon, Darbi, Jorian, Jhiri, Santor Mandori, Teja Khera, Chhatria, Jodhpuria, Dariawala, Kheowli, Munnawali, Nuhianwali, AbubSahar and Burkwala were surveyed.

For assessing the knowledge and adoption of drip irrigation in citrus crops, data were collected by personal interview with the respondents at their home/farm. The interview of every individual was taken separately so that the others did not influence the answer. In order to measure the knowledge level of farmers and adoption of drip irrigation they were asked a set of questions on drip irrigation in citrus crops. To assess the knowledge about DIS a total 19 questions were asked like increase in yield than conventional method, water saving, knowledge of subsidy, water requirement, use of chemical fertilizers, checking of flinters, minimum wastage of water and use of saline water, application of liquid fertilizer, decrease the problem of weed, run by computer, improvement in soil health, etc. The options of reply were full knowledge, partial knowledge and no knowledge. Three points were given to full knowledge, 2 points to partial knowledge and 1 point to no knowledge. In this way total score for each respondent was calculated by summing up total points and knowledge about drip irrigation was categorised as low, moderate and high. To measure the level of adoption of drip irrigation of the farmers, an index was developed by taking into account following parameters (i) maximum number of years of adoption of drip irrigation (ii) Crop intensity (iii) area under drip irrigation adopted by farmers (iv) high income (v) high yield (vi) less weed (vii) less labour, etc. Scores were assigned and categorised as low, moderate and high level of adoption. The information so collected through the responses of the respondents, was suitably coded, tabulated and analysed to draw meaningful inferences by using statistical tools such as frequency distribution, percentages, chi-square and coefficient of contingency analysis.

RESULTS AND DISCUSSION

Contextual matrix of the respondents with respect to age, caste, education, marital status, family type and size, landholding, income, mass media exposure, social participation and SES was analysed. Personal profile of respondents revealed that majority of farmers belonged to middle age group (51.67%) and upper middle group (28.33%). Regarding the caste, overwhelming majority hailed from

general castes (96.67%) and only 3.33 per cent from backward castes. More than two fifth of respondents (43.33%) were educated up to senior secondary level followed by 31.67 per cent educated as graduate and above. Overwhelming majority (98.33%) were married and having no membership of social organization (95.00%). Majority of respondents were having land between 4-10 hectares (45.00%), belonging to joint families (68.33%), having high income (46.67%) and having medium family size (40.00%). Half of the respondents were having medium level of mass media exposure and 60.00 per cent were having medium socio-economic status whereas 40.00% were having high SES. A total of 57 respondents were cultivating Kinnow whereas only 3 respondents were growing lemon crop.

Knowledge level of farmers about drip irrigation and socio-economic factors

Knowledge level of farmers about drip irrigation system was assessed. To judge the different aspects of knowledge about DIS, questions were framed with the help of literature and Collaborator from Horticulture department. Majority of sampled farmers had high (61.67%) and moderate (31.67%) level of knowledge of drip irrigation (Table 1). Only 6.67 per cent had it low. Swetha et al., (2019) found medium to low level of knowledge which led to medium extent of use and maintenance of drip irrigation system. Mohan et al., (2012) elucidated that benefits of drip irrigation must be extended through proper extension services so that farmers can get higher crop productivity. The present findings are in conformation with the findings of Jitarwal (2007); Modi et al., (2008); Ghanshas et al., (2015). Kaarthikeyan & Suresh (2019) reported that all the farmers who adopted DIS were aware about most of the benefits of drip irrigation.

Knowledge level was found associated with age, education, land holding, income mass media exposure, type and size of family and SES of farmers as indicated by Chi-square results (Table 2). It was found that respondents belonging to upper middle age group (94.11%), high mass media exposure (90.90%), high SES (87.50%), high income (87.72%), education up to senior secondary (84.63%), large family (84.22%), medium land holding (70.37%), belonging to joint family (63.43%) and general caste (62.07%) were having high level of knowledge about drip irrigation. Kaarthikeyan & Suresh (2019) reported that awareness was not at all a problem for non-adoption of this technology. Government need to support farmers in terms of providing subsidy and encouragement to farmers which will finally reduce the wastage of water. Swetha et al., (2019) also reported that education, age, innovativeness, aspirations, social participation and extension contacts have impact on knowledge level of farmers. Sharma et al., (2018); Mishra & Kaur (2019) reported that age, education and owned area were found associated with awareness parameters.

Table 1. Knowledge level of respondents about drip irrigation

Level of Knowledge	
Low (30-38)	04 (06.67)
Moderate (39-47)	19 (31.67)
High (48-57)	37 (61.67)

Table 2. Association of socio-economic variables with knowledge level about drip irrigation.

Age (years)	Low	Moderate	High	Total
Young	03(25.00)	02(16.67)	07(58.33)	12(20.00)
Middle	01(03.23)	16(51.61)	14(45.16)	31(51.67)
Upper middle	00(00.00)	01(05.89)	16(94.11)	17(28.33)
Total	04(06.67)	19(31.66)	37(61.67)	60(100)
				$\chi^2=14.29^{**}$; C=0.43
<i>Caste</i>				
General	04(06.90)	18(31.03)	36(62.07)	58(96.67)
Backward	00(00.00)	01(50.00)	01(50.00)	02(03.33)
				$\chi^2=0.058$; C=0.03
<i>Size of land holding (hae)</i>				
1 to 2.00	01(50.00)	00(00)	01(50.00)	02(03.34)
2.01 to 4	00(00)	07(87.50)	01(12.50)	08(13.33)
4.1 to 10.00	02(07.41)	06(22.22)	19(70.37)	27(45.00)
Above 10	01(04.35)	06(26.09)	16(69.57)	23(38.33)
				$\chi^2=12.81^{*}$; C =0.42
<i>Type of family</i>				
Nuclear	04(21.05)	04(21.05)	11(57.90)	19(31.67)
Joint	00(00.00)	15(36.57)	26(63.43)	41(68.33)
				$\chi^2=09.68^{**}$; C =0.37
<i>Size of family (members)</i>				
Small (upto 4)	02(11.77)	03(17.64)	12(70.59)	17(28.33)
Medium (5-8)	01(04.17)	14(58.33)	09(37.50)	24(40.00)
Large (above 8)	01(05.26)	02(10.52)	16(84.22)	19(31.67)
				$\chi^2=14.12^{**}$; C=0.43
<i>Education level of the respondents</i>				
Primary	01(50.00)	01(50.00)	00(00.00)	02(03.33)
Middle	02(15.38)	09(69.24)	02(15.38)	13(21.67)
Senior secondary	01(03.84)	03(11.53)	22(84.63)	26(43.33)
Graduation and above	00(00.00)	06(31.58)	13(68.42)	19(31.67)
				$\chi^2=18.80^{**}$; C=0.48
<i>Income of the family (Rs.)</i>				
Low	02(20.00)	00(00.00)	08(80.00)	10(16.67)
Medium	01(04.55)	16(73.73)	05(22.72)	22(36.67)
High	01(03.57)	03(10.71)	24(85.72)	28(46.67)
				$\chi^2= 27.89^{**}$; C=0.56
<i>Social participation</i>				
Nil (0)	04(07.02)	17(29.82)	36(63.16)	57(95.00)
Low (1)	00(00.00)	02(66.67)	01(33.33)	03(05.00)
				$\chi^2=0.48$; C= 0.08
<i>Mass media exposure</i>				
Low (upto 9)	01(12.50)	04(50.00)	03(37.50)	08(13.33)
Medium (10-17)	03(10.00)	13(43.33)	14(46.67)	30(50.00)
High (above 17)	00(00.00)	02(09.10)	20(90.90)	22(36.67)
				$\chi^2=12.54^{**}$; C =0.41
<i>Socio economic status</i>				
Medium	03(08.33)	17(47.22)	16(44.45)	36(60.00)
High	01(04.17)	02(08.33)	21(87.50)	24(40.00)
				$\chi^2=11.51^{**}$; C= 0.40

Adoption level of drip irrigation and socio-economic factors

Regarding the level of adoption of drip irrigation more number of farmers had high level of adoption (40.00%) while 35.00 per cent and 25.00 per cent had medium and low level of adoption of drip irrigation, respectively (Table 3). Shaik and Mistry (2018) found that before adoption of drip irrigation system, majority of drip owners spent money more than Rs. 10001 for purchasing fertilisers. But after adoption of drip irrigation system, most of

drip owners spent money between Rs. 1001 to 5000 in purchasing fertilisers. It was revealed that before adoption of drip irrigation system, majority of drip owners spent money for labours between Rs. 5001 to 10000 but after adoption of drip irrigation system, most of drip owners spent money for labourers in between Rs. 1001 to 5000. Prajapati et al., (2016) reported that the knowledge about drip irrigation system was found to be moderate to high (60.83%) and majority of respondents (58.33%) were having moderate to high level of adoption of management practices of drip irrigation system. Swadia (2017); Gupta & Rao (2019) found that more than 60 per cent respondents had medium and high adoption level of drip irrigation system, respectively. Yadav et al., (2019) also found that 48.96 per cent farmers had medium extent of adoption of drip irrigation system.

Table 3. Adoption level of respondents about drip irrigation

Level of adoption	
Low (12-14)	21(35.00)
Moderate (15-17)	15(25.00)
High (18-21)	24(40.00)

Table 4. Association of socio-economic variables with adoption level of drip irrigation

Age (years)	Low	Moderate	High	Total
Young	09(75.00)	02(16.67)	01(08.33)	12(20.00)
Middle	06(19.35)	12(38.71)	13(41.94)	31(51.67)
Upper middle	06(35.29)	01(05.88)	10(58.82)	17(28.33)
Total	21(35.00)	15(25.00)	24(40.00)	60(100)
				$\chi^2=17.34^{**}$; C=0.47
<i>Caste</i>				
General	21(36.21)	13(22.41)	24(41.38)	58(96.67)
Backward	00(00)	02(100)	00(00)	02(03.33)
				$\chi^2=0.20$; C=0.05
<i>Size of land holding (ha)</i>				
1 to 2.00	02(100)	00(00)	00(00)	02(03.34)
2.01 to 4	01(12.50)	07(87.50)	00(00)	08(13.33)
4.1 to 10.00	12(44.44)	07(25.93)	08(29.63)	27(45.00)
Above 10	06(26.09)	08(34.78)	09(39.13)	23(38.33)
				$\chi^2=12.01^*$; C =0.41
<i>Type of family</i>				
Nuclear	10(52.63)	01(05.26)	08(42.11)	19(31.67)
Joint	11(26.83)	14(34.15)	16(39.02)	41(68.33)
				$\chi^2=06.83^*$; C=0.32
<i>Size of family (members)</i>				
Small (upto 4)	11(64.71)	01(05.88)	05(29.41)	17(28.33)
Medium (5-8)	09(34.50)	10(41.67)	15(62.50)	24(40.00)
Large (above 8)	01(05.26)	04(21.05)	14(73.68)	19(31.67)
				$\chi^2=22.47^{**}$; C=0.52
<i>Level of education of the respondents</i>				
Primary	02(100)	00(00)	00(00)	02(03.33)
Middle	02(15.38)	10(76.92)	01(07.69)	13(21.67)
Senior secondary	05(19.23)	03(11.54)	18(69.23)	26(43.33)
Graduation and above	12(63.16)	02(10.53)	05(26.32)	19(31.67)
				$\chi^2=34.91^{**}$; C=0.60
<i>Income of the family (Rs.)</i>				
Low	06(60.00)	01(10.00)	03(30.00)	10(16.67)
Medium	07(31.82)	10(45.45)	05(22.73)	22(36.67)
High	08(28.57)	04(14.29)	16(57.14)	28(46.67)
				$\chi^2=11.99^{**}$; C=0.40
<i>Social participation</i>				
Nil (0)	20(35.09)	14(24.56)	23(40.35)	57(95.00)
Low (1)	01(33.33)	01(33.33)	01(33.33)	03(05.00)
				$\chi^2=0.04$; C= 0.02
<i>Mass media exposure</i>				
Low (upto 9)	04(50.00)	02(25.00)	02(25.00)	08(13.33)
Medium (10-17)	10(33.33)	12(40.00)	08(26.67)	30(50.00)
High (above 17)	07(31.82)	01(04.55)	14(63.64)	22(36.67)
				$\chi^2=12.32^{**}$; C =0.41
<i>Socio economic status</i>				
Medium	13(36.11)	13(36.11)	10(27.78)	36(60.00)
High	08(33.33)	02(08.33)	14(58.33)	24(40.00)
				$\chi^2=07.83^{**}$; C= 0.34

Level of adoption of drip irrigation on citrus crops was found affected by multiple socio-economic factors (Table 4). Age of the farmers was found significantly associated with level of adoption. Majority of farmers from upper middle age group (58.82%) and middle age group (41.94%) had high level of adoption of drip irrigation. However, caste of the respondents and level of adoption of drip irrigation was found non-significantly associated. Adoption level of drip irrigation was relatively high among general castes (41.38%) than other backward caste groups.

Size of the landholdings was found highly significantly associated with the adoption level of drip irrigation of the farmers. Two fifth majorities of large farmers (39.13%) had high level of adoption of drip irrigation on citrus crops. Likewise 29.63 per cent medium land holders had high level of adoption. In contrast, 87.50

per cent small farmers had moderate level of adoption. On the whole, as the size of landholding of the farmers increased, level of adoption of drip irrigation also increased simultaneously. So size of landholding also facilitated the adoption level of drip irrigation of the farmers.

Size of family also affected the level of adoption of drip irrigation. It was found highly significantly associated with level of drip irrigation. The respondents from large family size were having high level of adoption (73.68%). Level of mass media exposure of the farmers also influenced the level of adoption of drip irrigation of the farmers, as both were found highly significantly associated. Majority of farmers (63.64%) had relatively high level of adoption of drip irrigation that had high level of mass media exposure. Those having low mass media exposure were having low

level of adoption of drip irrigation (50.00%). Kaarthikeyan & Suresh (2019) reported that cost, land size and water source were the major factors for adoption of drip irrigation technology.

Socio-economic status of the farmers affected the adoption of drip irrigation on citrus crops. Analysis clearly revealed that farmers who had high level of adoption of drip irrigation were from high socio-economic status (58.83%) and vice-versa. Significant association was also found between these two variables. Mohan et al., (2012) reported that farmers' income, size of land holding, education and kisan credit card were having statistically significant and positive impact on drip irrigation and improved their socioeconomic conditions. Jumanne (2016) reported that technology adoption was influenced by farmer's age, education and other socio-economic factors. It is recommended that policy makers and private sector should consider socio-economic factors when mainstreaming small holding farmers in horticulture industry production and productivity. Verma & Sharma (2017) also reported that variables like knowledge, education, social participation, annual income, economic motivation and mass media exposure were found positively and significantly associated with the adoption of drip irrigation by the farmers. While, size of land holding, experience in farming and irrigation potentiality were found non-significantly associated with the adoption of drip irrigation by the farmers. Yadav et al., (2019a) found that subsidy, motivation, demonstration and training were the main prioritized strategies.

On the whole, it can be concluded that factors like age, general caste status, senior secondary level of education, large size of landholdings, mass-media exposure and socio-economic status played an important role in the adoption of drip irrigation in citrus crops. Therefore, there is a need to improve, mass-media exposure, extension contacts and trainings and education, etc. in rural areas to improve the adoption level of drip irrigation among farmers. Mohan et al., (2012) also concluded that water saving technology must be expended to other regions to elucidate the benefit of drip irrigation through proper extension service so that farmers can get higher crop productivity using limited resources of water and also benefit economically. Low level of adoption was mainly due to low level of education, small size of landholdings, low mass-media exposure and socio-economic status and lack of knowledge.

CONCLUSION

It was concluded that the knowledge level of majority of farmers in western Haryana about the drip irrigation system was high (61.67%) followed by moderate (31.67%) level of knowledge. The results further revealed that 40.00% respondents were having high level of adoption of drip irrigation followed by low (35.00%) and moderate level of adoption (25.00%). Various socio-economic factors like income, landholding, mass media exposure, education and socio-economic status were found significantly associated with the level of knowledge and adoption of drip irrigation. There is a need to improve these indicators in rural areas to improve the adoption level of drip irrigation among farmers.

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Attitude of Farmers towards Groundnut Cultivation in Bikaner District of Rajasthan

Amit Kumar^{1*}, L. S. Bareth², R. Ghaswa³ and J. P. Yadav⁴

¹Faculty of Agricultural Sciences, SGT, University, Gurugram, Haryana, India

²Swami Keshwanand Rajasthan Agricultural University Bikaner, Rajasthan, India

³Krishi Vigyan Kendra, Ratlam, Madhya Pradesh, India

⁴Sri Karan Narendra Agriculture University, Jobner, Jaipur, Rajasthan, India

*Corresponding author email id: amitexted2010@gmail.com

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ABSTRACT

The National Mission on Oilseed and Oil Palm (NMOOP) in India aims to increase oil seed and oil palm production and productivity by converting fallow lands to oilseed crops and diversifying regions away from low-yielding cereals. It plans to improve vegetable oil availability and reduce edible oil imports by increasing oilseed production and productivity from 29.79 million tons and 1122 kg/ha in the 12th plan period to 36.10 million tons and 1290 kg/ha by the end of 2019-20. The study, aimed to explore respondents' opinions towards groundnut cultivation was conducted on 80 beneficiary farmers of NMOOP and 80 non-beneficiaries. Groundnut growers, accounting for 11.24 percent, had a less favorable attitude toward groundnut cultivation whereas, 69.38 per cent of respondents fell into the moderately favorable category. It was noted that the both category of respondents had favorable attitude towards the interventions of groundnut cultivation.

INTRODUCTION

Agricultural extension aims to disseminate knowledge from the global knowledge base and from local research to farmers. Conceptually attitude is 'the degree of positive or negative affect associated with some psychological object' (Thurstone 1928). Attitude is important component of behavior as it plays significant role in forming the overt and covert behavior of a person which determines the success or failure of any endeavor. The world's most significant oilseed and supplementary food crop is groundnut (*Arachis hypogaea* L.). There is 18.9 million hectares of land and 17.8 million tons of production in the world. After China, India is the world's second-largest producer of groundnuts, accounting for around 16 per cent of global production. Groundnut is India's most important oilseed crop, and it contributes significantly to the country's vegetable oil shortfall. Oilseeds are the country's principal source of vegetable oils, which are mostly farmed under rainfed conditions over 26.4 million hectares with a total yield of 37.1 million MT. Increased seed replacement ratio with a focus on

varietal replacement; increased irrigation coverage under oilseeds from 26 to 36 per cent; diversification of area from low yielding cereals crops to oilseeds crops; intercropping of oilseeds with cereals/pulses/ sugarcane; and use of fallow land after paddy/potato cultivation are all part of the mission's strategy. The programme is being conducted in a mission mode, with all stakeholders actively participating. In light of this, the current study was done to investigate farmer attitudes regarding groundnut farming.

METHODOLOGY

The Likert type summated rating (Likert, 1932) approach was used to design the attitude scale since it is widely used for evaluating attitudes and is the most effective and efficient method for producing highly reliable scales. The study was carried out in the Bikaner district of Rajasthan chosen as it has the highest production of oilseeds (47.2 tons) among all districts in the state. The district of Bikaner is divided into six panchayat samities: Bikaner, Sri Dungargarh, Lunkaransar, Nokha, Khajuwala, and Kolayat. Two panchayat samities (Bikaner and Sri Dungargarh) were chosen based

on their larger area and production of oilseed crops, and the NMOOP scheme was also implemented in these panchayat samities. In the Bikaner district, NMOOP initiatives focused mostly on two crops: mustard and groundnut. In the 2014-15 fiscal years, NMOOP activities were carried out in 4 villages in the selected two panchayat samities for groundnut crop. Two villages from each selected panchayat samiti were chosen at random for the study and four villages from two panchayat samities collaborated in the groundnut crop were chosen. For selection of beneficiary respondents, a comprehensive list of groundnut growers benefited under the National Mission on Oilseed and Oil Palm in 2014-15, was prepared separately with the help of the office of the Deputy Director of Agriculture (Extension) for the selected villages. From each village, 20 beneficiaries and an equal number of non-beneficiary farmers were selected randomly for groundnut crops making a total of 160 groundnut growers. For the groundnut crop, an attitude scale was created using Edwards' (1969) method of summated ratings. All feasible factors that differentiated between the farmers' positive and negative views regarding groundnut cultivation were gathered and included in the scale. The final scale featured a total of 14 items. Farmers' attitude was analyzed using mean score of the entire number of respondents for each item. With the use of mean and standard deviation calculations, respondents were divided into five categories: strongly agree, agree undecided, disagree, and strongly disagree.

RESULTS AND DISCUSSION

Table 1 reveals that 68.75 per cent of beneficiary and 70.00 per cent of non-beneficiary respondents had a moderately favorable attitude towards groundnut cultivation, whereas, 8.75 per cent of

beneficiaries and 13.75 per cent of non-beneficiary respondents had a less favorable attitude towards groundnut cultivation. Likewise, 22.50 per cent and 16.25 per cent of beneficiary and non-beneficiary respondents expressed highly favorable attitudes towards groundnut cultivation respectively. Furthermore, 69.38 per cent from all respondents had a moderately favourable view toward groundnut cultivation. The study's findings are consistent with that of Kumar et al., (2018), who indicated that 61.77 per cent of respondents had a favorable opinion toward soybean cultivation, with 11.57 per cent expressing the most favorable attitude and 26.66 per cent possessing the least favorable attitude.

A mean percent score (MPS) was generated for each item and then sorted according to the MPS. Table 2 summarizes that the majority of beneficiary respondents strongly agreed with Groundnut recommendations properly give better yield," which scored highest with 86.25 MPS, followed by "Groundnut cultivation grown in a large area is profitable", "Groundnuts fetch good value for the produce", "Hybrid varieties of groundnut are superior in production", "Recommended production technique gives higher yield than traditional practices method", "A farmer can get a good price by grading his produce", "Groundnut cultivation is suitable for small and marginal farmers" and "Recommended practices need high skill" with 83.25, 82.75, 82.00, 79.50, 78.25, 74.75 and 74.00 MPS. This may be due to the fact that respondents possessed complete knowledge about the groundnut cultivation. Furthermore, the beneficiary respondents agreed with the attitude item "Groundnut gets markets relatively easier than others." The mean percent scores for all assertions varied from 52.50 to 86.25, indicating that respondents had a moderately favorable to extremely favorable attitude toward various claims about groundnut cultivation

Table 1. Attitude towards groundnut cultivation

S.No.	Category	Beneficiary (n=80) %	Non-beneficiary (n=80) %	Total (n=160) %
1.	Less favorable (<47 score)	8.75	13.75	11.24
2.	Moderately favorable (47 to 59 score)	68.75	70.00	69.38
3.	Highly favorable (>59 score)	22.50	16.25	19.38

F = Frequency; % = percent; Mean=53.03; SD=6.14

Table 2. Attitude of beneficiary and non-beneficiary respondents towards groundnut cultivation

S.No.	Items	Beneficiary (n=80) MPS	Non-beneficiary (n=80) MPS	Overall (n=160) MPS
1.	Groundnut recommendations properly give better yield.	86.25	74.25	80.25
2.	Recommended groundnut practices are difficult to adopt. (-ve)	62.50	69.50	66.00
3.	Recommended practices needs high skill.	74.00	75.50	74.75
4.	Recommended production technique gives higher yield than traditional practices method.	79.50	72.50	76.00
5.	Illiterate farmers cannot adopt recommended practices. (-ve)	72.00	75.00	73.50
6.	Utilizing recommended production technique is a waste of money. (-ve)	57.25	50.00	53.63
7.	Recommended based production technique is a labour intensive job. (-ve)	64.25	67.50	65.88
8.	Groundnuts fetch good value for the produce.	82.75	80.00	81.38
9.	Groundnut gets markets relatively easier than other.	67.00	52.00	59.50
10.	Hybrid varieties of groundnut are more superior in production.	82.00	78.75	80.38
11.	Nutrient management in groundnut is unpredictable. (-ve)	68.25	69.75	69.00
12.	Groundnut cultivation is suitable for small and marginal farmer.	74.75	63.00	68.88
13.	Groundnut cultivation grown in a large area is profitable.	83.25	76.25	79.75
14.	A farmer can get good price by grading his produce.	78.25	75.25	76.75
	Overall	73.71	69.95	71.83

MPS =mean percent score

Table 3. Comparison of level of attitude between beneficiary and non-beneficiary respondents towards groundnut cultivation

S.No.	Statements	Beneficiary (n=80)		Non-beneficiary (n=80)		'Z' value
		Mean \pm	S.D.	Mean \pm	S.D.	
1.	Groundnut recommendations properly give better yield.	4.31	0.88	3.71	1.42	3.60**
2.	Recommended groundnut practices are difficult to adopt. (-ve)	3.13	1.52	3.48	1.24	1.78 ^{NS}
3.	Recommended practices needs high skill.	3.70	1.34	3.78	1.32	0.40 ^{NS}
4.	Recommended production technique gives higher yield than traditional practices method.	3.98	1.06	3.63	1.35	2.04*
5.	Illiterate farmers cannot adopt recommended practices. (-ve)	3.60	1.11	3.75	1.08	0.97 ^{NS}
6.	Utilizing recommended production technique is a waste of money.(-ve)	2.86	1.75	2.50	1.41	1.61 ^{NS}
7.	Recommended based production technique is a labour intensive job. (-ve)	3.21	1.32	3.38	1.48	0.82 ^{NS}
8.	Groundnuts fetch good value for the produce.	4.14	0.90	4.00	1.10	0.97 ^{NS}
9.	Groundnut gets markets relatively easier than other.	3.35	1.55	2.60	1.45	3.53**
10.	Hybrid varieties of groundnut are more superior in production.	4.10	1.06	3.94	1.08	1.07 ^{NS}
11.	Nutrient management in groundnut is unpredictable. (-ve)	3.41	1.38	3.49	1.30	0.40 ^{NS}
12.	Groundnut cultivation is suitable for small and marginal farmer.	3.74	1.33	3.15	1.53	2.90**
13.	Groundnut cultivation grown in a large area is profitable.	4.16	1.02	3.81	1.19	2.23**
14.	A farmer can get good price by grading his produce.	3.91	1.02	3.76	1.03	1.03 ^{NS}
	Overall	3.69	1.23	3.50	1.29	1.06 ^{NS}

practices. The majority of non-beneficiary respondents strongly agreed with the attitude statement "Groundnuts fetch good value for the produce," followed by "Hybrid varieties of groundnut are more superior in production", "Groundnut cultivation grown in a large area is profitable", "Recommended practices needs high skill", and "A farmer can get a good price by grading his produce" with 78.75, 76.25, 75.50, and 75.25 MPS, respectively. These assertions were strongly agreed upon, which might be attributed to respondents' extensive understanding of groundnut cultivation. According to the data, the non-beneficiary respondents agreed with the attitude statement "Groundnut cultivation is suitable for small and marginal farmers" with 63.00 MPS. It was also discovered that the majority of non-beneficiary respondents, to the extent of 52.00 MPS, strongly disagreed with the negative statement "Groundnut gets markets relatively easier than others." The overall level of attitude toward groundnut cultivation among beneficiary respondents was 73.71 MPS, whereas the level of attitude among non-beneficiary respondents was 69.95 MPS. There was difference in magnitude of Mean Percent Score of beneficiary and non-beneficiary respondents. The study's findings are consistent with those of Kumar et al., (2018). Thus, it can be concluded that respondents had a favorable attitude toward groundnut cultivation, but they still require some encouragement from the government or an organization to prepare favorable and supportive policies, as well as to strengthen and revitalize the existing extension system, responsible for technical know-how and other relevant details to farmers regarding interventions of groundnut cultivation in their respective area. It means that farmers are always thinking about how they can maximize their return from their fields, and NMOOP is the best alternative in front of the farming community, particularly in Rajasthan, where the majority of oilseed growers were interested in adopting interventions provided by NMOOP in order to earn more profit.

The data in Table 3 show that the calculated 'z' value was higher than the tabulated value at the 1 & 5 per cent level of significance in five groundnut cultivation items, namely "Groundnut recommendations properly give better yield", "Groundnut gets

markets relatively easier than other", "Groundnut cultivation is suitable for small and marginal farmers", "Groundnut cultivation grown in a large area is profitable" and "Recommended production technique gives higher yield than traditional practices method". This revealed that beneficiary and non-beneficiary respondents had very different attitudes on five statements about groundnut cultivation. It indicates that beneficiary respondents had a more favorable attitude toward groundnut cultivation than non-beneficiary respondents in the five statements listed above. The value of the 'z' test was determined to be non-significant in the remaining nine assertions concerning groundnut cultivation. This indicates that there is no difference in the attitudes of both groups of groundnut growers.

The overall computed 'z' value for groundnut crops was (0.78 and 1.06) lower than the tabulated value, indicating a similarity in attitude between beneficiary and non-beneficiary farmers about groundnut cultivation practices. Further examination of the table reveals that the mean score of groundnut beneficiary farmers was (3.56 and 3.69) higher than that of non-beneficiary farmers (3.42 and 3.50), indicating that beneficiary farmers had a more favorable attitude toward groundnut cultivation than non-beneficiary farmers. This non-significant difference between beneficiary and non-beneficiary respondents suggests that the oilseed mission performed a non-significant but favorable impact in changing attitudes about various groundnut crop production technologies in the research area.

CONCLUSION

It was discovered that both (beneficiary as well as non-beneficiary) categories of respondents were favorable to groundnut cultivation interventions. Farmers were continuously trying to optimize their yield from their groundnut field. The Mission on Oilseed and Oil Palm proved to be the best alternative in front of the oilseed farming community, especially in Rajasthan, with a lot of big farmers, and the farmers were interested in adopting the interventions provided by the Mission on Oilseed and Oil Palm to earn more profit. It suggested that the oilseed mission under consideration was having a positive influence.

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Prevalence of Food Consumption and Diversification Among People having Lifestyle Diseases

Anjali Yadav¹ and Usha Singh²

¹M.Sc. Research Scholar, ²Professor cum Chief Scientist, Department of Food and Nutrition, College of Community Science, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

*Corresponding author email id: anjali.ay.7790@gmail.com

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ABSTRACT

Lifestyle diseases are the serious threat among adults. Most of the people in India are suffering from more than one form of diseases mainly type II diabetes mellitus, hypertension, obesity, constipation etc. To combat this, one of the foremost ways is to take proper food at apparent time in adequate amount. For the study, 40 subjects (21 male and 19 female) above 45 years were selected from Pusa block or university campus on the basis of occurrence of lifestyle diseases. Proper schedule was prepared consisting questionnaire related to their general information, food habits, anthropometric details, physiological and biochemical parameters. Information collected through personal interview. Dietary intake of both the subjects was recorded by using 24 h dietary recall method for 2 consecutive days. However, observed value of dietary nutrient (energy, protein, total fat, carbohydrates and sodium) intake were more than the recommended because of overconsumption. Therefore, only good nutrition and healthy lifestyle that is proper balanced diet, physical exercise, adequate sleep, reduced stress, well-adjusted biological clock, avoidance of fast and processed foods etc. will be followed by people regularly which helps to defeat the lifestyle consequences.

INTRODUCTION

Lifestyle diseases are the conditions that takes away people from various physical activity and force towards a sedentary routine pattern which can cause numerous health hazards, ultimately leads to chronic non-communicable diseases and closely life-threatening viable consequences (Tabish et al., 2017). Most important possible factor that leads to non-communicable diseases are unhealthy diet, smoking, alcoholism, disrupted biological clock, lack of physical inactivity, unhealthy choices, poorly physical fitness etc. According to World Health Organization (WHO) the most prevalent lifestyle diseases are obesity, diabetes mellitus (type II diabetes), colon cancer, cardiovascular diseases (Atherosclerosis or Hypertension), mortality, depression, stroke, etc.

According to IDF Atlas (2019), an estimated 463 million adults of aged 20 to 79 years which represent 9.3 per cent of total world's

population are suffering from diabetes. Furthermore, 578 million people will reach till 2030 and are projected to reach 700 million next 2045. India is moving to be the second largest number of sufferers in the world (Sanjeevaiah et al., 2019). The population based cross-sectional research study assumed that the incidence of diabetes in Bihar ranges between 4.30 per cent to 10.0 per cent respectively.

Globally, cardiovascular diseases are the foremost cause of death. Moreover, in India also it is becoming a leading cause of mortality. The death rate of cardiovascular diseases (CVD) among western population was around 23 per cent and Indian throughout 52 per cent below 70 years of age (Prabhakaran et al., 2016). The elevated body mass index and excessive waist hip ratio were the causative factor of hypertension in the young adults although it was higher among hypertensive population (Patil et al., 2017). Gupta et al., (2012) study reported that increased prevalence of

cardiovascular diseases and its health related risk factors were seen in middle class families due to an increased body mass index (BMI), elevated systolic blood pressure and lower intake of HDL (High Density Lipoprotein) cholesterol level. The occurrence of hypertension and its related risk components among urban residents are due to threats accompanied viz. smoking, alcohol consumption, tobacco chewing, high BMI, psychological disturbances respectively.

Another most prevalent lifestyle disease is obesity due to excessive accumulation of fat at that proportion which might have negative consequences on health. Females are more susceptible than males (Ahirwar et al., 2019). Higher incidence of hypertension and diabetes were founded in obese population than overweight (Mandal et al., 2016). However, incidence of abdominal obesity was higher amongst the post-menopausal women than pre-menopausal (Khokhar et al., 2010). Spirituality and psychological well-being were higher in elderly with controllable health problems as compared to serious health problems moreover; it brings to organize programs directly centered to their overall health status (Singh et al., 2021). Better nutrition is always important because it plays a crucial role in various metabolic reactions and another physiological or pathophysiological process which occurs in the body. Keeping in this view, the present investigation was conducted in Pusa block, Bihar state to know the food consumption pattern and food diversity among people suffering from lifestyle diseases.

METHODOLOGY

The research study was carried out in Samastipur district of Bihar during 2020-2021 in Pusa block or university campus, Dr. RPCAU. One of the aspects of study was to know the food consumption pattern among people suffering from lifestyle diseases. For this purpose, total 40 subjects (21 male and 19 female) above 45 years were selected by simple random sampling method through community survey on the basis of lifestyle diseases such as diabetes mellitus, cardiovascular diseases, obesity etc. To fulfill the desired objectives of present study, schedule for the assessment of nutritional and health status of people was developed. The questions were placed in the schedule regarding information with reference to personal, biochemical, medication, food habitat, blood pressure, anthropometric details (height, weight, BMI) and food consumption pattern. The data of people were collected through personal interview and biochemical information was collected after measured by prescribed instruments.

The information regarding age of selected samples was noted in terms of years. All the respondents were categorized into three age groups i.e. 45 to 50 years, 51 to 55 years and above 55 years. As per the given information by subjects, occupation had been categorized into four forms viz. government, private, retired and unemployed. The eating habits, food frequency, dietary intake etc. of subjects was considered under present investigation. Eating habit varies from person to person moreover; it depends on whether they consumed animal foods or plant foods (non-vegetarian and vegetarian). The frequency of food items among different food groups, consumed by individuals at a definite period of time is an important aspect. Dietary intake of both the subjects was recorded by using 24 h dietary recall method for 2 consecutive days (24 h

dietary recall method and 48 h dietary recall method). The daily food intake among subjects was compared with ICMR-RDA (Recommended Dietary Allowances) 2020 of adult men and women. The data analysis was done by using Microsoft excel 2010 version and various statistical tools were applied such as mean, standard deviation and percentage.

RESULTS AND DISCUSSION

General information of selected individuals and their socio-economic condition

General information collected from subjects suffering from lifestyle diseases includes name, age, sex, food habits and occupation. Majority of subjects (40%) belongs to the age group of 45 to 50 years followed by 50 to 55 years (22.50%) and above 55 years (37.50%) old. Out of 40 subjects, 21 (52.50%) were male and 19 (47.50%) female respectively. Regarding food habits, majority of them were vegetarian (55%) than non-vegetarian (45%). It was evident that most (45%) of the people suffering from life style diseases were government employee including private (7.50%), unemployed (32.50%) and retired (15%). Li et al., (2017) revealed that diabetes mellitus is related with various occupational health consequences, together with work loss productivity, injury associated with work.

Routine activity performed by subjects

The information given below is related to regular activity performed by selected subjects. The data finding suggested that majority (60%) of subjects have good health status followed by fair (32.50%) and poor (7.50%). Majority (85%) of subjects were physically active always and remaining were not (15%) by the reason of fatigue, occupational cause (workload), aging and increased body weight. Whereas majority of them (75%) were followed specialized diet i.e. low carbohydrate, low fat, low sodium, high dietary fibre and high protein whereas remaining (25%) were not on account of less severe condition. Preparation of nutrition garden is one of the simplest ways of securing access to a healthy diet that holds adequate amount of macro and micronutrients (Kumari et al., 2019). While 19 (47.50%) subjects were not participating in any kind of physical activity since last year followed by 18 (45%) participated 3 to 4 times per week, some (5%) were engaged in 1 to 2 times per week and remaining (2.50%) were participated hardly 1 to 2 times per month. About 75 per cent subjects does not have any difficulty to fall asleep in bed however, rest 25 per cent had complications to fall sleep because of stress and strain, fatigue, etc. One of the cause of lifestyle diseases is genetic but half (50%) of the selected subjects in the study doesn't have history of diseases furthermore, majority (30%) of subjects have a history of diabetes mellitus in their immediate family (mother, father, brother and sister) members and others (20%) had history of overweight or obesity. Majority (95%) of subjects drink sweetened beverages once a month or less and remaining (5%) were like to drink 1 to 2 times a week.

However, all the selected subjects (100%) were stay away from cigarette and tobacco related products. Lower consumption of cigarette smoking is correlated with the possibility of lung cancer,

although consumption of one cigarette per day increases the 40 to 50 per cent chances of cardiovascular diseases (Bras et al., 2018). Though, majority (65%) of subjects were not consuming fast foods, some (25%) consume once a week and remaining (10%) were more than two times per week. More than half of the subjects (60%) considered as overweight or obese due to their bad eating habits, and remaining (40%) were fit and fine. Mostly lifestyle diseases affect person's efficiency of work on account of weakness, overtime working, mentally pressurized, rescheduled sleeping etc. Approximately 47.50 per cent subjects had sometimes felt that due to their ill health condition efficiency of doing their work is being affected subsequently some never felt (22.50%), some felt always (17.50%), often (7.50%) and frequently (5%) thought that lifestyle diseases were related to their working efficiency.

About 37.50 per cent of subjects were not avoiding travelling outside like business tour, holiday tour, and general outings due to their necessities followed by very little (35%), little (12.50%), highly (10%) and remaining (5%) avoids a lot. Although some (47.50%) subjects had sometimes felt tiredness or fatigue in past three months because of weakness, improper diet, stress and strain followed by often (17.50%), never (15%), always (12.50%) and felt frequently (7.50%) in past three months. Therefore, more than half (65%) of the subjects were taking drugs or medication other than caffeine, nicotine such as pain-killers, sleeping tablets, anti-depressants, anti-anxiety drugs (e.g. valium), hallucinogens and barbiturates everyday prescribed by doctor including once or twice (20%) a week and remaining (15%) never take medication because they ever thought it necessary.

Food consumption pattern

Table 1 showed the food consumption pattern among people. Cereals are used as a staple food in most of the population diet in the form of chapatti, poori, paratha, rice, poha, upma etc. Wheat, rice and maize are the three major crops grown by farmers in Bihar. Moreover, out of 40 subjects; majority (82.50%) of were consuming cereals and their related products thrice a day followed by once or twice a day (12.50%) and alternatively (5%). Pulses are the good sources of protein; they provide 20-25 per cent protein and double in amount compared to cereals but pulses are expensive and people with low-economic group cannot afford it. As well, red gram and lentil pulse were mostly consumed by subjects whereas, black or

green gram rarely. However, most of them (72.50%) were consumed once or twice a day followed by alternatively (15%), thrice (7.50%) and once a week (5%). Mishra et al., (2019) reported that consumption of millets based recipes in regular diets of peoples declines the blood sugar level or improves bowel movement but also increase the food value chain of millets.

Milk and milk products are consumed by subjects in the form of buttermilk, tea, paneer, coffee, curd, cheese, whey etc. It was recorded that 55 per cent of subjects was like to consume once or twice a day followed by alternatively (27.50%) and (17.50%) weekly. Roots and tubers provide more calorie content in the diet. Onion and garlic were consumed daily and potatoes rarely. From the data it was observed that 37.50 per cent subjects consumed weekly in addition with once or twice a day (32.50%), alternatively (20%) and thrice (10%).

Green leafy vegetables known for its protective function though it consists of all yellow, green and orange colored vegetables. Seasonal vegetables were mostly preferred by respondents due to easy availability and accessibility. Majority (67.50%) of subjects consumed vegetables thrice a day in the form of salad, mixed vegetable raita etc. including once or twice a day (27.50%) and (5%) alternatively. Other vegetables includes brinjal, pumpkin, ladies finger, pointed gourd, etc. were less consumed by subjects because of its high cost and availability issues. From Table 2 it was observed that some subjects were consumed alternatively (52.50%) and weekly (47.50%).

Fruits include all categories of orange and yellow colored fruits. Apple, papaya, and kiwi were mostly consumed by respondents. Out of 40 subjects half of the (50%) subjects consumed fruits at least once or twice a day while most of them like to eat at morning and evening time also but some were like to eat after dinner. Around 32.50 per cent subjects eat alternatively and weekly (17.50%) because of high cost and limited availability. Non-communicable diseases can be prevented by eating 400 g or 5 portions of fruits and vegetables daily (WHO, 2020).

Sugar and jaggery were consumed seldomly by subjects, incorporated in tea, coffee, halwa, sweets etc. Most of the respondents like to eat jaggery after dinner because of better digestion. About 65 per cent subjects consumed alternatively followed by weekly (25%) and once or twice a day (10%). Regarding fats and oils, mustard oil was mostly preferred and refined oil rarely for

Table 1. Percentage distribution of food consumption pattern among subjects suffering from lifestyle diseases

Food Groups	Daily		Alternate	Weekly	Total
	Once/Twice	Thrice			
Cereals and Millets (g)	12.50	82.50	5.00	-	40
Pulses and legumes (g)	72.50	7.50	15.00	5.00	40
Milk & milk products (ml)	55.00	-	27.50	17.50	40
Roots and tubers (g)	32.50	10.00	20.00	37.50	40
Green leafy Vegetables (g)	27.50	67.50	25.00	-	40
Other vegetables (g)	-	-	52.50	47.50	40
Fruits (g)	50.00	-	32.50	17.50	40
Sugars and Jaggery (g)	10.00	-	65.00	25.00	40
Fats and oils (g)	62.50	-	12.50	25.00	40
Meat, fish, poultry and their products (g)	-	-	17.50	27.50	18

Figures in parenthesis indicates percentage

Table 2. Mean daily nutrient intake by the selected subjects

Nutrient	Male (n=21)		% Intake*	Female (n=19)		% Intake*
	RDA	Observed value		RDA	Observed value	
Energy (Kcal)	2110	2459.31±720.15	116.55	1660	1719±508.37	103.55
Protein (g)	54.0	79.06±19.64	137.14	45.70	56.92±15.81	124.55
Carbohydrate	130	312.30±92.34	240.23	130	218.25 ±38.70	167.88
Total fat (g)	25	50.69±16.73	202.76	20	43.86±18.87	219.30
Sodium (mg)	2000	2590.09±133.88	129.50	2000	2394.79±139.2	119.70

There is no RDA for energy. The EAR (Estimated Average Requirement) is equivalent to the (EER) Estimated Energy Requirement
Values are (Mean±SD)

*Percent intake has been taken with reference to RDA of sedentary workers (ICMR 2020)

cooking Majority (62.50%) of subjects consumed fat and oils once or twice a day in addition to weekly (25%) and alternatively (12.50%).

In case of meat, fish and poultry, it was observed that fish was mostly consumed by subjects as compared to other flesh foods. Second preference goes to egg after fish but CVDs (cardiovascular diseases) subjects eat only white part of egg because yolk contains higher amount of cholesterol. Therefore, majority (27.50%) of subjects was consuming fish, poultry, and chicken weekly followed by alternatively (17.50%).

Mean daily dietary nutrient intake

The mean daily dietary nutrient intake of respondents has been presented in Table 2 which was calculated by using Indian Food Composition Table, 2017 after collecting data from respondents (24 hour dietary recall method for 2 consecutive days). The observed energy intake of both the subjects was comparatively higher than recommended i.e. 2459.31 and 1719 kcal. From Table 2 the per cent intake of energy in male and female was 16.55 and 3.55 per cent. However, observed value of protein intake by male (79.06 g) and female (56.92 g) was also higher than recommended; per cent intake of both i.e. 37.14 male and 24.55 per cent female found higher than recommended. The observed value of carbohydrates among male (312.30 g) and female (218.25 g) subjects were just double in amount as compared to RDA because of higher intake of cereals and their related products whereas per cent intake of male (140.23%) and female (67.88%) was also more.

The average daily intake of total fat by both male and female was 50.69 g and 43.86 g furthermore, per cent intake of male (102.76%) and female (119.30%) that means they were taken more amount of fat. Consumption of fat ought to be less than 30 per cent of total energy intake which aid to prevent gain in body weight (WHO, 2020). The observed sodium intake was higher than recommended in both the category of subjects i.e. 2590.09 mg and 2394.79 mg respectively. In terms of per cent intake, the value of both male and female was more i.e. 29.50 per cent and 19.70 per cent. Salt can be consumed greater than 5 g per day (WHO, 2020).

CONCLUSION

Based on the findings, it was concluded that prevalence of lifestyle diseases were common among people those who are employed due to their bad eating habits and sedentary routine pattern. Most of the respondents selected for investigation were employed and sedentary workers. The nutrient intakes were higher than recommended due to overconsumption of food intake by the

subjects because of easy accessibility, availability and unawareness that lead to toxicity of nutrients. While Better nutrition is always important because it plays a crucial role in various metabolic reactions and another physiological or pathophysiological process which occurs in the body. Therefore, it was recommended to eat balanced diet which contains all the required nutrients for healthy life.

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Impact of Cluster Front Line Demonstrations on Green Gram (MH-421) in Sirsa District of Haryana State

Devender Singh Jakhar¹ and Sunil Kumar^{2*}

¹Senior Co-ordinator, ²Young Professional-II, Krishi Vigyan Kendra, Sirsa, CCSHAU, Hisar-125004, Haryana, India

*Corresponding author email id: maliksunil25@hau.ac.in

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ABSTRACT

Pulses are one of the important food crops globally due to higher protein content. In India, they are also responsible for yielding large financial gains by amounting for a large part of the exports. Cluster frontline demonstrations on moong bean crop covering 110 ha area under variety MH-421 were conducted by Krishi Vigyan Kendra at 110 locations in Sirsa district of Haryana state during four consecutive years *viz.* 2016 to 2019. The technological gaps were identified in existing crop production technology through farmers meetings and group discussions. The findings showed significant increase in the average yield of demonstrated plot (23.1%) over the farmer's plot of moong bean crop. Average yield of demonstration plots was recorded higher by 26.90 per cent, 20.50 per cent, 20.00 per cent and 25.00 per cent in years 2016, 2017, 2018 and 2019, respectively. The extension gap was 2.02 q/ha, 1.50 q/ha, 1.50 q/ha and 2.00 q/ha while technology gap was 2.48 q/ha, 3.20 q/ha, 3.00 q/ha and 2.00 q/ha in 2016, 2017, 2018 and 2019 respectively. During these four years yield increase in demonstrations plots expressed as additional income over check plots accounted for Rs. 11300/ha, Rs. 900/ha, Rs. 6200/ha and Rs.14400/ha during various years.

INTRODUCTION

Pulses are one of the important food crops globally due to higher protein content. In India, they are also responsible for yielding large financial gains by amounting for a large part of the exports. India is the largest producer as well as consumer of pulses (also referred to as grain legumes, peas & beans) in the world. India has lion share in area (42.6%) and production (28.34%) of pulses globally (Chury, 2019). The quantum increase from 14.76 m t (2007-08) to 25.43 m t (2017-18) in pulses production and productivity from 625 kg/ha (2007-08) to 864 kg/ha (2017-18) can certainly be termed as "Pulses Revolution" in India (Chaturvedi et al., 2018).

Over a period of time, a number of improved pulses varieties and production technologies have been developed, but full potential of these varieties as well as technologies could not be exploited due to low rate of adoption and low yields (Reddy, 2009). Green

gram (*Vigna radiata*) also known as moong bean is short duration legume crop grown mostly as fallow crop and in spring season with vegetables. In India, area under green gram during 2020-21 was 33.91 lakh ha as against 29.03 lakh ha during the same period in 2019-20 (Greengram Outlook, 2021). India contributes more than 70 per cent of world's green gram production (Greengram Outlook, 2020).

Cluster Frontline Demonstrations scheme was initiated by Ministry of Agriculture and Farmers Welfares, GOI, New Delhi to implement on pulses during 2015-16 through National Food Security Mission. The aim of these practices in general is to raise production through transfer of farm technology. The efforts were taken with planning, execution and follow up action of the pulses production technology through front line demonstrations, to access the impact of demonstrations on green gram production, yield and ultimately fulfilling objective of providing nutritive diet and increase availability of green gram per capita.

METHODOLOGY

Cluster Front Line Demonstrations on pulses had been organized every year since 2014-15 in different villages of the district. The villages were selected in different blocks on the basis of less sown area of moong bean. The main aim of these demonstrations was to showcase advanced technologies so that adoption gaps should be minimized. Before demonstrations, surveys in adopted villages were conducted and technology gaps, extension gap & technology index were identified by standard methods.

After identifying the gaps, in all 110 numbers of demonstrations were organized during various years *viz.* 2016, 2017, 2018 and 2019 at different locations of Sirsa district. During all the years, demonstrations were conducted after harvest of potato so that crop could be harvested before occurrence of rainfall. The recommended amount of fertilizer was applied and crops were sown in lines. Before sowing, 1 litre of pendimethalin per hectare was applied (pre-emergence) to control weeds. Clusters were monitored from time to time during entire cropping season. At the end of cropping season yield and economics was calculated. A control *viz.* farmer practice was run simultaneously to have an idea of impact of these techniques in increasing yield and improving income of farmers which was calculated in terms of economics.

RESULTS AND DISCUSSION

The economic analysis of demonstrations has been presented in Table 1. The expenditure incurred on cultivation practices *viz.* land preparation, seed cost, herbicide, fertilizers and miscellaneous costs was slightly higher in demonstration. The average gross return of Rs. 47600/ha, Rs. 43200/ha, Rs. 41400/ha and Rs. 48000/ha was calculated in the year 2016, 2017, 2018 and 2019 respectively. The average net return for respective years to the tune of Rs. 30800/ha, Rs. 28600/ha, Rs. 22200/ha and Rs. 28400/ha during the study period was recorded. Further, it was also found that additional return ranged from Rs. 6200/ha to Rs. 14400/ha. This may be attributed to the use of improved technologies in demonstration

plots. Benefit-cost ratio (BCR) was at par in all the years. FLD participating farmers got approximately Rs. 9000/ha additional income as compared to farmers practice. Similar findings were stated by Singh et al., (2017) in moong bean, Kumar and Boparai (2020) whereas the B: C ratio ranged 1.92 to 2.44 during their study period. The variety (SML818) showed very high B:C ratios as 3.20 to 6.56 during investigation period of Kumar et al., (2019).

The results indicated in Table 2 shows that there was 100 per cent gap in seed treatment, bio-fertilizer and bio-fertilizer application performed by farmers. In adoption of improved variety and proper seed rate, the gap was 60 and 90 per cent respectively. While in case of weed management a key concern to be addressed only 60 per cent farmers' used recommended practice. So there was an urgent need to minimize the gap by creating awareness among the farmers which could ultimately lead to increase in yield and returns. The results were corroborated with the earlier findings of Biyan et al., (2012); Sangwan et al., (2021); Dhillion (2016); Lathwal (2010).

Analysis of gap

An extension gap of 2.02 q/ha, 1.50 q/ha, 1.50 q/ha, and 2.00 q/ha during 2016, 2017, 2018 and 2019 was found respectively (Table 3). The reason for existence of gap may be attributed to consideration of moong bean as subsidiary crop as compared to other main crop. Kumar et al., (2019) concluded that field extension functionaries of Poonch district, Jammu and Kashmir focused on dissemination of improved moong bean production technologies to enhance its productivity over existing level. Kumar and Boparai (2020) observed average extension gap of 1.80 q/ha and emphasized need to educate farmers for adoption of improved moong bean cultivation practices. The findings are also line with Singh et al., (2019); Kumar & Kispotta (2017).

The existed technology gap was 2.48 q/ha, 3.20 q/ha, 3.00 q/ha and 2.00 q/ha in years 2016, 2017, 2018 and 2019, respectively. This gap may be attributed to prevailing micro farming situation

Table 1. Economic analysis of CFLDs and farmers' practice of moong bean

Year	Average cost of cultivation (Rs./ha)		Average gross return (Rs./ha)		Average net return (Rs./ha)		Additional return (Rs/ha)	B:C Ratio	
	FLD	FP (Check)	FLD	FP (Check)	FLD	FP (Check)		FLD	FP (Check)
2016	16800	16000	47600	37500	30800	19500	11300	2.83	2.34
2017	17600	16500	43200	35000	28600	20700	7900	2.45	2.12
2018	19200	18750	41400	33750	22200	16000	6200	2.10	1.80
2019	19600	19600	48000	33600	28400	14000	14400	2.45	1.71

Table 2. Technological gap in CFLDs and farmers' practice of moong bean

Technology	Recommended Practice	Farmers' practice	% Gap
Variety	MH-421	SML-668	60
Seed Rate	25-30 kg/ha	15-20 kg/ha	90
Seed Treatment	Thiram (4 g/ kg seed)	No seed treatment	100
Bio-fertilizer	Rhizoctonia (125 ml/ha seed); PSB (125 ml/ha seed)	No seed treatment	100
<i>Fertilizers (kg/ha)</i>			
N	20	No application	100
P	40	40kg/ha	90-95
K	20	No application	100
Weed Management	Pre-emergence application of pendimethalin @ 2.5 ltr/ha	60 per cent farmers use recommended practice	40

Table 3. Yield, extension and technology gap analysis of CFLDs and farmers practice of moong bean

Year	Yield (q/ha)			Increase over farmers practice (%)	Extension gap (q/ha)	Technological gap (q/ha)	Technology index (%)
	Potential	FLD	Farmers' practice				
2016	12	9.52	7.5	26.90	2.02	2.48	20.66
2017	12	8.80	7.3	20.50	1.50	3.20	26.66
2018	12	9.00	7.5	20.00	1.50	3.00	25.00
2019	12	10.00	8.0	25.00	2.00	2.00	16.66

i.e. variation in soil fertility, weather conditions at maturity of moong bean crop, crop management practices etc. Therefore, there is an urgent need to recommend location specific crop management practices to pass over the potential demonstration yield. The similar findings were observed by Biyan et al., (2012); Kalita et al., (2019); Dhillon (2016).

Technology index varied from 20.66, 26.66, 25.00 and 16.66 per cent during 2016, 2017, 2018 and 2019, respectively. It indicates that there exists a gap between the generated technology in moong bean cultivation at the research institution and its dissemination to the farmers. Kumar et al., (2019) reported as high as 55.00-70.85 per cent technology index in his study.

CONCLUSION

There was a gap in potential yield, demonstration yield and farmers' practice due to existing technological extension gap and CFLDs had positive effect towards increase in yield of moong bean. The dual advantage of this technology *i.e.* enhancing farmers' income and improving soil health may help in its rapid spread. A gap also existed between improved recommended cultivation practice of moong bean and their adoption by the farmers in the District. Therefore, Cluster Front Line Demonstration (CFLD) being an educational activity was effective in updating knowledge, skills and attitude of farmers and enhancing production and productivity of moong bean in the district. As the gaps still exists, the CFLDs should be continued in coming years so that gaps may be minimized as more and more area is covered under moong bean.

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Constraints in Adapting the Climate Change in Konkan Region of Maharashtra

Rohit Shelar^{1*}, A. K. Singh² and Saikat Maji³

¹Research Scholar, ²Professor, ³Assistant Professor, Department of Extension Education, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, Uttar Pradesh, India

*Corresponding author email id: rohit.shelar10@bhu.ac.in

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ABSTRACT

Changing climate is a serious environmental issue affecting agricultural production all over the world. India is also facing the problem of increased mean temperature and irregularity of rainfall, and the Konkan region of Maharashtra is also not escaped from this issue. The study was designed and conducted in the northern part of the Konkan region to understand the constraints experienced by the farmers while adapting the climate change. The study was carried in four villages of Palghar district with 245 respondents selected by proportionate random sampling method. Major constraints were expressed by the farmers while adapting the changing climate were, lack of credence on current weather forecasting system, poor accurate weather forecast information, irregular & low voltage capacity power supply and seven others.

INTRODUCTION

Agriculture and climate are strongly co-dependent on each other. Changing pattern of the climate is adversely affecting the rate of farm production. Climatic factors like precipitation and temperature plays deciding role in crop yields. Even though changed temperature and precipitation will have slight number of advantages for some regions, agricultural experts agrees that average change in the climatic pattern will result in overall reduction in agricultural production on global level (Kucharik & Serbin, 2008; CCSP, 2008). Most of the Indian farming population still belongs to non-urban part of the country and most of them are possessing small and marginal land holding. Also large number of the working population depends on agriculture for their livelihood support. The agriculture sector particularly, in rainfed area depend on monsoon are likely to observe the adverse impacts of climate change. While, major impacts of climate change will be on rainfed crops, which is cultivated in nearly 60 per cent of area in India. (Dupdal et al., 2021). In past years it has been predicted that, with the rise in temperature by 2.5°C to 4.9°C the yield of rice and wheat will drop by 32 to 40 per cent and 41 to 52 per cent, respectively (Chouksey et al., 2021). Maharashtra is the third largest State in India and the most vulnerable to climate change

and faces extreme climatic events and stressors such as floods, cyclones, droughts, changing rainfall patterns and extreme temperatures (Adhav et al., 2021). The narrow coastal belt along the western margin of the state is known as Konkan (Sanskrit word “Kona” = corner and “Kana” = piece) and is located between the Sahyadri ranges in the east, and Arabian Sea in the west. Konkan region has much variation in rainfall as well as in temperature and faces many climatic as well as geographical challenges.

Adaptation strategies are important to cope with extreme weather. It is the process of adjustments or moderation in natural or human systems in response to actual or expected climate change as well as taking advantage of beneficial opportunities (IPCC, 2001). Constraints hampers the potential to find out, to approach and to handle the risk that decreases the adverse effect related to climatic event and also affects the development and application of adaptation into use. Farmers are facing number of constraints while adapting to the changing climate. With the help of proper planning, suitable strategies and efficient utilization of available resources it is possible to overcome the constraints. Therefore, to understand the constraints experienced by the farmers while adapting the change in the climate, become important that too for the adversely affected regions.

METHODOLOGY

The study was conducted in the Palghar district which is the northern part of the Konkan region of Maharashtra state. The study was conducted in two randomly selected Taluka. For the selection of the respondents, proportionate random sampling method was employed through which a total of 245 respondents from four villages (two from each selected Taluka) was finalized. Primary data was conducted using structured interview schedule. With the help of Henry Garrett’s Ranking Technique, rankings given by respondents was evaluated. Respondents were asked to assign the rank to the listed constraints and the outcomes of such ranking have been converted into score value with the help of the following formula:

$$\text{Percent position} = \frac{100 (R_{ij} - 0.5)}{N_j}$$

Where, R_{ij} = Rank given for the i th variable by j th respondents, N_j = Number of variable ranked by j th respondents

With the help of Garrett’s Table, the percent position estimated was converted into scores. Then for each constraint factor, the scores of each individual were added and then total value of scores and mean values of score was calculated. The constraint factor having highest mean value was considered to be the most important factor.

RESULTS AND DISCUSSION

Table 1 portrayed that while adapting the changing climate 72.25 per cent of the respondents were having lack of trust on current weather forecasting system as the existing forecast system provides poor information about weather forecast said by 71.30 per cent of the respondents. Current weather forecasting systems were deficient in specific level which do not support farmers in adaptation. Despite the fact that weather forecasting systems keep changing their forecast rapidly, the agriculturists are still depending on them, yet recasting in advisories finds challenging to adapt such changes for agriculturists.

Availability of the practical information and support about changing climate plays vital role in adaptation of climate change (Semenza et al., 2011; Pandve et al., 2011). It was noticed that, 68.70 percent of the respondents reported lack of support from government agencies with respect to climate change and 56.43 % of the respondents confirmed limited access to agricultural extension services. Figures indicate that the role played by the government extension agencies was insufficient to support the farmers with

regards to adaptation of changing climate. The efficient and timeous execution of farm inputs like; use of quality seeds, planting material, suitable varieties, integrated pest management practices, healthy soil and water management practices are important for the sustainable crop production which also contributes to adaptation of climate change (FAO, 2013). It was found that, 55.95 per cent of the respondents experienced unavailability of the inputs on time as their major constraint while adapting the changing climate which shows there is a need to address these challenges to strengthen the farmers’ capability. For the appropriate adaptation having the updated knowledge is seen as important factor among the farmer (Castilla et al., 2013; Liang et al., 2014; Ghanghas et al., 2015; Ravikumar et al., 2015). Akpan et al., (2012) in their study on analysis of the influence of the Nigerian mass media on public understanding of climate change, argued that ‘public action towards climate change will not begin until the public understands climate change and their place in the fight against it, especially in the area of forcing the authorities to make and execute meaningful policy about it.’ It was noticed that 48.34 per cent of the respondents pointed out that farmers were having inadequate knowledge about appropriate climate change coping strategies. Further 39.73 per cent of the respondents expressed that they were experiencing unsteady communication facilities at their place which becomes the hurdle to access different communication as well as media sources. Study further revealed that, 30.57 per cent of the respondents said that they were lacking with savings which would help them in emergency while adapting the sudden change in the climate and aftermost 28.75 per cent of the respondents reported irregular and low voltage supply of the electricity as their major constraint which act as obstacle in accessing different electricity dependent farm operations.

CONCLUSION

The farmers faced multiple constraints and challenges to adapt to changing climatic pattern as they are at vulnerable situation. Farmers needed more reliable weather forecast system upon which they can trust to carry out their farming operations timely. Extreme climatic events affecting the agriculture sector requires that the farmers be provided with updated information on climate change as this will help farmers in improving their awareness and adaptive capability with respect to climate change. There is need to improve extension connectivity and to provide assistance with respect to climate change among the farmers. In addition to that farmers also needed timely supply of inputs and stable communication facilities. It is essential to promote awareness and importance of saving habits among the farmers.

Table 1. Constraints experienced by the respondents

S.No.	Constraints	Average	Rank
1	Lack of credence on current weather forecasting system	72.25	I
2	Inadequate knowledge about appropriate climate change coping strategies	48.34	VI
3	Poor accurate weather forecast information	71.30	II
4	Lack of support from government agencies with respect to climate change	68.70	III
5	Unavailability of inputs on time	55.95	V
6	Limited access to agricultural extension services	56.43	IV
7	Irregular & low voltage capacity power supply	28.75	IX
8	Unsteady communication facilities	39.73	VII
9	Short of savings	30.57	VIII

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Information Source Utilization by Livestock and Poultry Farmers of Uttar Pradesh

Pratikshya Panda¹, Rupasi Tiwari^{2*}, Sushant Handage¹ and Triveni Dutt³

¹PhD Scholar, Division of Extension Education, ICAR-Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India

²Principal Scientist, Division of Extension Education & In-charge, Agricultural Technology Information Centre, ICAR-Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India

³Director (Acting), ICAR-Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh, India

*Corresponding author email id: rtiwarirupasi@gmail.com

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ABSTRACT

The study was conducted during 2020-2021 to assess the information sources utilization pattern of livestock and poultry farmers of Uttar Pradesh. A total of 120 farmers, 40 from each group i.e., dairy, piggery and poultry were selected randomly. Semi-structured personal interview and online survey through google forms were considered together for collection of data keeping in view the COVID-19 second wave. Information source utilization by majority of the respondents was medium. ICT utilization among the respondents was maximum with mean score of 0.63 followed by mass media with mean score of 0.51 and extension agency contact with mean score of 0.498. Education, land holding and experience in farming business were found to be significant contributors in information source utilization. Except age, all the variables such as education, annual income, land holding, experience in farming business and number of trainings undergone were positively correlated with information source utilization of the respondents.

INTRODUCTION

Livestock is an integral part of the Indian agriculture production system and plays a key role in the progress of country's economy. Due to conducive climate, topography, and religious beliefs, animal husbandry sector has played prominent socio-economic role in India. As per the current scenario, India harbours 535.8 million of livestock population and 851.8 million of poultry (20th Livestock Census, DAHD&F, 2019) which depicts that there is 4.64 per cent increase in livestock and 16.8 per cent increase in the population of poultry compared to the last census (2012). The livestock sector contributes 25.6 percent of total agricultural GDP and 4.11 percent of total national GDP (vikaspedia.in). Additionally, around 20.5 million population is directly or indirectly dependent on livestock for their livelihood generation. Though livestock sector is a major contributor of Nation's GDP, its growth is restrained due to multiple factors. Up-to-date and quality information on livestock rearing is essential for the effective

management of the livestock which is currently the biggest challenge for the farmers. Farmers access information from multiple sources (Rees et al., 2000). Some of these sources use ICT tools whereas the others are various non-ICT sources. But as per the previous reports, farmers' access to information is found to be extremely poor, delayed and less credible (Bhagat et al., 2004; Kumar & Roy, 2014; Nain et al., 2015). Hence, certain effective media could enable the service to rapidly reach to a wider audience at relatively low cost. Keeping these facts under consideration, the present study was conducted to assess the information source utilization of commercial dairy, pig and poultry farmers of Uttar Pradesh.

METHODOLOGY

The study was conducted in 2020-2021 in the purposively selected state of Uttar Pradesh considering its 1st rank in milk and meat production (20th Livestock Census). The sample of the study were commercial livestock and poultry (broiler) farmers of the area selected. Commercial livestock/ poultry farmer was operationally

defined as a farmer who practices dairy/pig/ poultry farming as a business venture with minimum holding of 10 Livestock Unit (LSU) and earns a substantial part of his overall income through these enterprises. The conversion factor for LSU comprises of bovine (calf=0.4, heifer=0.8, dairy cow=1.0, buffalo= 1.26), Pig (breeding sow=0.5, other pigs=0.3) and poultry (boiler=0.007) (<https://ec.europa.eu/eurostat>). A total of 120 respondents, 40 from each group i.e., dairy, piggery and poultry (broiler) farmers were randomly selected for the investigation. Keeping in view the COVID-19 crisis, both semi-structured interview and online survey through google forms were considered for data collection. Some of the responses were collected through personal interview.

Information source utilization by the respondents was assessed under various sub heads such as mass media, ICT tools and extension agency contacts. The respondents were enquired about their pattern of access of various information sources and responses were taken under 3-point continuum viz., Often accessed (3), occasionally accessed (2) and never accessed (1). Mean Rank Score for overall information source utilization was calculated by using the following formula:

$$MRS = \frac{\sum_{i=1}^n \text{Total Score}_i}{k}$$

Where, k= total number of respondents, MRS: Mean Rank Score

Mean Rank Score (MRS) and Mean Score (MS) were estimated to examine the utilization of different categories of information sources. MRS was calculated by adding the scores obtained by individual farmers and dividing them by number of

farmers. MS was calculated by adding the scores obtained by individual farmers and then dividing them with the total obtainable score. Mean Percent Score (MPS) was calculated by dividing the MS with total mean score of the category of farmers and multiplying by 100. The Mean Rank Scores of information source utilization among three groups of farmers were compared using Kruskal-Wallis H Test in SPSS software version 26.

RESULTS AND DISCUSSION

Table 1 reveals that majority of the respondents (78.30%) had medium level of mass media utilization with MRS of 9.33. among the different groups, poultry farmers showed higher MRS (9.55) followed by dairy and pig farmers, respectively. Mean score for mass media utilization by the total population was found to be 0.51. In case of ICT utilization, majority (65%) had a medium level of utilization. Same trend was seen among various groups of farmers. Pattern of contact with various extension agencies depicts that about 84.20 per cent of the respondents had medium extension agency contact. From the different groups, dairy farmers showed higher extension agency contact with MRS of 10.63 and MS of 0.50 followed by pig farmers (MRS=10.45 & MS=0.49) and poultry farmers (MRS=10.33 & MS=0.49). In overall majority of the farmers (82.50 %) had medium level of information sources utilization with MRS of 27.44 and MS of 0.53. Kruskal-Wallis H test among the three groups of farmers revealed no significant difference in case of information source utilization.

ICT utilization among the respondents was maximum with MS of 0.63 and MPS of 38.65 followed by mass media exposure with MS of 0.51 and MPS of 31.28 and extension agency contact with

Table 1. Levels of information sources utilization

Level	Dairy Farmers (n=40)	Pig Farmers (n=40)	Poultry Farmers (n=40)	Pooled (N=120)	MS _{Pooled}	MPS _{Pooled}
<i>Mass Media Sources</i>					0.51	31.28
Low (1-6)	5 (12.50)	10 (25.00)	0 (0.00)	15 (12.50)		
Medium (7-12)	26 (65.00)	28 (70.00)	40 (100.0)	94 (78.30)		
High (13-18)	9 (22.50)	2 (5.00)	0 (0.00)	11 (9.20)		
MRS ± SE	9.28±0.42	9.15±0.38	9.55±0.29	9.33±0.21		
Mean Score	0.515	0.463	0.53	0.51		
<i>ICT</i>					0.63	38.65
Low (1-4)	6 (15.00)	0 (0.00)	0 (0.00)	6 (5.00)		
Medium (5-8)	29 (72.50)	24 (60.00)	25 (62.50)	78 (65.00)		
High (9-12)	5 (12.50)	16 (40.00)	15 (37.50)	36 (30.00)		
MRS ± SE	6.65±0.26	8.05±0.28	8.43±0.19	7.65±0.16		
Mean Score	0.554	0.565	0.70	0.63		
<i>Extension agency contact</i>					0.498	30.55
Low (1-7)	6 (15.00)	6 (15.00)	2 (5.00)	14 (11.70)		
Medium (8-14)	32 (80.00)	31 (77.50)	38 (95.00)	101 (84.20)		
High (15-21)	2 (5.00)	3 (7.50)	0 (0.00)	5 (4.19)		
MRS ± SE	10.63±0.36	10.45±0.42	10.33±0.24	10.47±0.20		
Mean Score	0.506	0.497	0.491	0.498		
<i>Overall Information Source Utilization</i>					1.63	100
Low (1-17)	5 (12.50)	1 (2.50)	4 (10.00)	10 (8.33)		
Medium (18-34)	30 (75.00)	35 (87.50)	34 (85.00)	99 (82.50)		
High (35-51)	5 (12.50)	4 (10.00)	2 (5.00)	11 (9.16)		
MRS ± SE	26.38±0.88	27.65±0.87	28.30±0.48	27.44±0.45		
Mean Score	0.51	0.54	0.55	0.53		
Kruskal Wallis H Test= 4.32 ^{NS}						

(Figures in parentheses indicate percentage; MRS: Mean rank Score; SE: Standard Error, MS: Mean Score; MPS: Mean Percent Score)

Table 2. Relationship of information source utilization with independent variables

Independent variables	Dependent variable: - Information source utilization			
	r	r ²	B	Sig.
Age	-0.110	0.012	-.068	.074
Education	0.242**	0.058	1.258	.049*
Annual income (Rupees)	0.051	0.002	.008	.958
Land holding (in acre)	0.296**	0.087	.235	.005**
Experience in farming business (Years)	0.185*	0.034	.166	.050*
Total number of trainings	0.046	0.002	-0.13	.973

(r: Correlation coefficient; r²: Coefficient of Determination; B: Regression Coefficient)

MS of 0.498 and MPS of 30.55. While considering the individual groups, similar results were seen in case of dairy and poultry showing maximum utilization of ICT followed by mass media exposure while in case of pig farmers, ICT utilization was maximum followed by extension agency contacts with MS of 0.565 and 0.497, respectively.

It is evident from Table 2 that education, annual income, land holding, experience in farming business and total number of trainings undergone were positively associated with information source utilization whereas age was negatively associated. This signifies that as age increases, information source utilization decreases, thus making younger age group utilising more information sources. Regression analysis showed that three variables i.e., level of education, land holding and experience in farming business were significant contributors towards information source utilization.

The outcomes of the study are in line with Sachan et al., (2018) who reported that mass media utilization of majority of the dairy farmers was medium. As far as ICT utilization is concerned, the results are in support of the reports of Ndag et al., (2008) who reported that the ICT utilization among majority of respondents from North-central Nigeria was moderate to high. It is also in agreement with the results of Kailash et al., (2017) in which the ICT utilization level of farmers was found to be high. This paves the path towards better adoption of new technologies as suggested by Monikha et al., (2021) that Expert system helped farmers to take decisions to adopt different management practices. As far as extension agency contact is concerned, the results are in agreement with the previous findings of Roy et al., (2015) and Sachan et al., (2018) whereas it was reported that majority of the respondents were having medium level of personal cosmopolite channel usage. The results are also in partial agreement with the study of Shah et al., (2021) who reported that majority of the respondents from two districts (Shopian and Baramulla) had medium level extension agency contact whereas the respondents of Budgam had low level of extension agency contact. In the current study the socio-personal and socio-economic variables were found to be affecting the overall use of information sources. These are consistent with previous research findings which showed the effect of age, education and farm characteristics on ICT adoption (Warren et al., 2000; Ali, 2012; Kusumaningtyas & Suwanto, 2015; Cattaneo et al., 2016; Patra et al., 2020).

CONCLUSION

The study showed that majority of the respondents had medium level information source utilization. ICT utilization was

seen to be high among the respondents. The negative association of age with information source utilization of the farmers depicts that young generations were having more information source utilization than the older generation. The positive association of education, experience in farming business and number of trainings undergone explains that those who were have higher education, higher experience in farming and undergone more number if training were seen to be having higher information source utilization. The popularity of ICTs among the farmers and its utilization was higher among the three categories of information sources. Hence, several ICT platforms can be developed to impart quality information and knowledge to livestock and poultry farmers regarding various management practices for effective adoption of those practices. The farmers should be educated and trained to use the ICT tools effectively.

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Marketing of Mango: Perceived Constraints During Normality and due to Lockdown in West Bengal

Rakesh Roy^{1*}, Suddhasuchi Das², Victor Sarkar², Bhabani Das², Adwaita Mondal², B. C. Rudra³, Paramita Bhowmik² and Debjyoti Majumder²

¹Senior Scientist and Head, ²Subject Matter Specialist, ³Farm Manager, Malda Krishi Vigyan Kendra, Uttar Banga Krishi Vigyan Kendra, Ratua, Malda-732205, West Bengal, India

*Corresponding author email id: rakeshvetext@gmail.com

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ABSTRACT

The study was undertaken to assess the perceived constraints in marketing of mango during normality and due to lockdown in West Bengal. In all, 90 respondents were randomly considered for the study with equal proportionate of small, medium and large farmers. The perceived constraints faced and suggestions in improving the marketing of mangoes were analyzed through Garrett ranking techniques. The study shows that the major perceived constraints in marketing of mangoes during normality were high fluctuation in market price during season followed by inadequate marketing channel and exploitation by middlemen. But during the lockdown, the major perceived constraints were no market to sell their mangoes followed by exploitation by middlemen and small opening hours of market. The suggestive measures recommended by the mango growers to improve marketing opportunities were stable market rate according to grade of mangoes followed by proper marketing channel and elimination of middlemen. The mangoes growers had not felt need for cooperative marketing network or formation of Farmer Producer Company for its marketing.

INTRODUCTION

India is only next to China in production of fruits and vegetables in the world and has a share of about 16 per cent of vegetables and 10 per cent of world's fruits production. India produces 65 per cent of world's mango and 11 per cent of world's banana ranking first in the production of both the crops (Shankar et al., 2017). Due to the perishable nature of horticultural product, delayed post-harvest marketing causes huge losses. Saraswat et al., (2018) studied the distribution process of the mango and have reported that it passes through more than one hand excluding from the fact when it is directly sold to the consumer by the producer which is a rare phenomenon. Various agencies like grower, pre-harvest contractors, commission agents, wholesaler, retailers, etc., are engaged in this chain. With all this existing marketing channels,

the average income from mango orchard was around 30,000/- per acre (Majumder et al., 2016). But, with the outbreak Coronavirus disease of 2019 (COVID-19), lockdown was one of the common options suggested to curb the pandemic (WHO, 2020). Complete lockdown was declared all over India from 25th March for 21 days to curb the pandemic (Dev, 2020) which further enhanced with some sort of relaxation in agriculture sector. Horticultural crops were adversely affected during the lockdown even though there was no restriction on sale of vegetables and fruits in the market, excluding the ban on operations of rural haats and restriction in transportation. Further, the impact of COVID-19 in prices of horticultural commodities was irregular. Though in some states in India there were reports on increase in the prices of horticultural commodities, majority of the states have reported a decline in prices of horticultural commodities in India with a falling of 7.6 per cent in

prices of horticulture products (NABARD, 2020). Keeping these in mind, a study was undertaken to assess the perceived constraints in marketing of mangoes during normality and due to lockdown in West Bengal.

METHODOLOGY

The study was purposively conducted in Malda district due its highest land area under mango orchard and highest producing district in the state. Commercial mango cultivation in Malda started at the end of the 19th century and beginning of the 20th century (Saadat, 2017). Leasing of mango orchard was a common practice in the region, but the farmers considered for the study didn't prefer leasing out their mango orchard and carry out all the management and marketing by themselves. In all, 90 respondents were randomly selected categorically into small (up to 1 ha.), medium (1-2 ha.) and large farmers (more than 2 ha) with 30 respondents from each category from six blocks of Malda district. The perceived constraints and suggestions in marketing issues were analyzed through Garrett ranking techniques (Garrett, 1981). The respondents were asked to rank the given factors. The orders of merit assigned by the respondents were converted into ranks by using the following formula.

$$\text{Percent Position of each rank} = 100 (R_{ij} - 0.5) / N_j$$

R = Rank given for ith factor by jth individual; N = Number of factors ranked by jth individual.

The percentage position of each rank obtained was converted into scores as per the table given by Henry Garrett. The scores of individual respondents were added together for each factor and divided by the total number of the respondents. The mean scores for all the factors were arranged in order of merit and inference drawn.

RESULTS AND DISCUSSION

Constraints in marketing of mangoes

The study shows that perceived constraints in marketing of mangoes during normal year (i.e., no lockdown issues) were high fluctuation in market price during season with highest mean score (72.79) followed by inadequate marketing channels and exploitation

by middlemen. Small and medium mango growers have perceived exploitation by middlemen as 3rd major constraint but the large farmers perceived distant market for mangoes and high cost of transportation as 3rd major constraint (Table 1). Earlier studies among mango growers have shown that lack of storage facilities, high cost of transportation and price fluctuation were some problems associated with marketing (Vijay et al., 2019; Datarkar et al., 2014) whereas, price fluctuation and distant market were major constraints faced by vegetable grower (Chandran & Podikunju, 2021; Singh & Hansra, 2021). Non-availability of storage, high transport cost and price fluctuation were the three major problems in Nadia district (Sarkar et al., 2018) and the existence of middlemen and lack of proper market were major marketing constraints as perceived by orange growers (Roy et al., 2018).

The perceived constraints in marketing of mangoes due to COVID-19 and lockdown issues were no market to sell their mangoes with highest mean score (71.21) followed by exploitation by middlemen and small opening hours of market. Further, it can also be stated that all the types of mango growers had ranked no market to sell their mangoes as 1st ranked perceived constraint but only small and large farmers had perceived small opening hours of market (2nd) and exploitation by middlemen (3rd) as major constraints whereas medium farmers have perceived exploitation by middlemen (2nd) and inadequate marketing channels (3rd) as major constraints in marketing of mangoes due to lockdown issues.

Suggestions to improve marketing of mangoes

The suggestive measures recommended by mango growers to improve marketing opportunities were stable market rate according to grade of mangoes with highest ranked mean score (67.54) followed by proper marketing channel and elimination of middlemen. All the mango growers irrespective of its types had given similar ranks to improve the marketing opportunities of mangoes. One of the interesting facts that came from the study was that the mangoes growers had not felt for cooperative marketing network or formation of Farmer Producer Company for mangoes and therefore ranked as last suggestion of improving the marketing opportunities of the region. As per the study of Sarkar et al., (2018) the farmers had suggested that provision for appropriate storage facilities, reduction

Table 1. Constraints in marketing of mangoes

Perceived constraints	Small	Medium	Large	Total	
	Mean	Mean	Mean	Mean	Rank
<i>During normality</i>					
High fluctuation in market price	70.90	73.17	74.30	72.79	I
Inadequate marketing channels	62.60	62.07	59.60	61.42	II
Lack of export promotional strategies	42.40	45.50	42.40	43.43	VI
High cost of packing material	46.50	45.00	46.50	46.00	V
Exploitation by middlemen	54.60	51.27	47.27	51.04	III
Lack of cooperative marketing networks	29.10	32.83	30.43	30.79	VII
Distant market for mango and high cost of transportation	46.90	43.17	52.50	47.52	IV
<i>During COVID-19 and lockdown</i>					
No market for sell	72.63	69.23	71.77	71.21	I
Low selling price	47.17	48.57	46.57	47.43	V
Exploitation by middlemen	49.47	54.87	50.23	51.52	II
Small opening hours	50.10	48.57	51.30	49.99	III
Inadequate marketing channel	49.13	49.13	47.90	48.72	IV
High fluctuation in the market price	33.5	31.63	34.23	33.12	VI

Table 2. Suggestions to improve marketing of mangoes

Suggestions	Small		Medium		Large		Total	
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Stable market rate according to grade of mangoes	65.70	I	67.17	I	69.77	I	67.54	I
Proper marketing channels	61.57	II	62.07	II	60.97	II	61.53	II
Processing industry	44.87	VI	47.60	IV	41.97	VII	44.81	V
Cold storage facility	46.30	V	45.00	V	46.50	IV	45.93	IV
Elimination of middlemen	54.87	III	50.47	III	48.07	III	51.13	III
Cooperative marketing network or Farmer Producer Company	30.57	VII	38.87	VII	43.50	V	37.64	VII
Export promotion strategy	49.13	IV	41.83	VI	42.23	VI	44.40	VI

in cost of fertilizer and pesticide and supply of good quality mango saplings were the major areas for improvement of mangoes in Nadia district. Kharga et al., (2021) in their study have concluded if right environment is created and farmers are provided adequate infrastructure support many farmers can enhance their income and quality of life. Ferrier et al., (2012) reported that Indian mangoes are likely to be confined to a quality niche for United States of American consumers, including South Asians living in the United States who have taste preferences for the Indian varieties. This shows that Indian mangoes are having good demand in foreign countries and therefore the strategy for export promotion needs to be undertaken to promote marketing strategy. Das et al., (2014); Das et al., (2015) also expressed similar concerns.

CONCLUSION

The existing marketing system of mangoes in Malda district has not proved to be adequate and efficient. Farmers were not able to sell their surplus produce remuneratively and there are widespread distress sales. Further, the sudden lockdown has created a huge problem in selling of mangoes even no market for mangoes. The mango growers have faced huge loss due to non availability of market in the year 2020 and similarly poor market and low rate of mangoes in the year 2021. The large farmers have faced comparatively more problems in marketing than medium and small farmers. To save the mangoes of the region there is a need of good marketing channels and cold storage facilities for delayed marketing. The policy makers need to improve the marketing channels and the basic infrastructure such as cold storage to improve marketing opportunities. Strategy also needs to be taken to develop for export promotion. Further, formation of Farmer Producer Company is still an unfelt need among the farmers. Extension organisations and agencies working in this region should create awareness about Farmer Producer Company and provide assistance for its formation.

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Impact of Farmer FIRST Project on Livelihood of Farmers

Himansu Kumar De, Sivaraman Iyemperumal, Manoj Kumar Das*, Prabhati Kumari Sahoo, Pratap Chandra Das, Subhas Sarkar, Jackson Debbarma and Durga Prasad Rath

ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha, India

*Corresponding author email id: manojkumar.das288@gmail.com

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ABSTRACT

Under the farmer FIRST project about 400 beneficiary farmers were provided access to improved agricultural technologies in Khordha district. Skill training and demonstration of modules on improved technologies on Crop, Horticulture, Livestock and Fishery were conducted. Following the DFID framework (1999) the impact on livelihoods of farmers was measured through finding a comparative position of physical, social, financial, human and natural assets of the farmers before and after the adoption of the interventions. A structured interview schedule was developed and data was collected from 87 randomly selected beneficiaries by personal interview method twice (before i.e., in 2016-17 and after the intervention i.e., in 2019-20). The mean value of overall standard of living of adopted farmers derived through the addition of the index values of five assets was worked out to be 2.84 in the post-adoption period against 2.41 in the pre-adoption period. Paired sample t-test indicates the positive and significant impact of the project on the livelihood of the beneficiaries.

INTRODUCTION

The Farmer FIRST approach considers putting the farmer in the driver's seat in matters of problem identification, prioritization, conduct of experiment and its management. This approach focuses on enriching knowledge and integrating technologies in the farmers' conditions and enhancing the farmer-scientist interface. This project is unique in its approach which creates a platform for all the scientists irrespective of their disciplines, to get an opportunity to regularly interact with the rural farm environment and thus, collect valuable feedback on problems, priorities, opportunities and status of agriculture and agricultural technology at the ground level and develop suitable technology modules for different farm situations. The emphasis of the project was on farmers' farm, innovations, resources, science and technology. Smallholders, landless and farm women are especially being addressed through technology integration modules.

Farmer FIRST project implemented by ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar has covered 4 villages in

Khordha district i.e., Kantia Talasahi, Kantia uparajahi (Block-Jatani), Jagannathpur (Block-Balianta) and Dorbanga (Block-Balipatna). In total, the project has involved more than 400 beneficiaries from 2016-17. Modules on improved technologies on Crop, Horticulture, Livestock and Fishery are being demonstrated. Skill training and technical backup were provided to the beneficiaries. Aiming at sustainable agriculture along with profit maximization, 4 fish-based integrated farming systems were developed where different enterprises like fishery, horticulture, poultry and vermicomposting were integrated. Integrated farming that includes aquaculture can be broadly defined as the concurrent or sequential linkages between two or more farming activities, of which at least one is aquaculture (Edwards, 1993). Integrated aquaculture-agriculture is reported to have improved the livelihoods of small-scale farmers in Bangladesh. Given the inherent local adaptability of the IAA approach, this concept offers a promising alternative – and thus should be considered and tested – in other developing countries (Murshed-E-Jahan et al., 2011). Improved technological modules like integrated nutrient management in paddy,

green gram in rice fallow (TARM 1), scientific carp culture, backyard poultry strain (Kaveri/Vanaraja), introduction of photo insensitive variety of cauliflower var. Fujiyama and introduction of bush-type French bean var. Falguni were demonstrated and performance was recorded.

A livelihood is a means of deriving a just and dignified living by the society, family and individuals (Ellis, 2000). A livelihood can be urban or rural depending upon the context in which families derive their living (Scoones, 1998). The majority of the people in the study area were small and marginal farmers and are involved in farming as a primary means of earning a living. Agriculture, fish farming, animal husbandry and non-farm activities are some of the common livelihoods. The livelihoods of these people are at times challenged due to frequent visits of natural calamities. Rural livelihood is complex and wide-ranging (Ashley et al., 2003). The farmer first project emphasized - providing access to advanced agricultural technologies, building capacities, enhanced farmer-scientist interface and institutional innovations. These interventions assume significance for attaining sustainable rural livelihoods. Through this study, an attempt was made to assess the impact of improved agricultural practices on the livelihood of adopted farmers.

METHODOLOGY

The impact assessment of this project on farming situation and livelihood of farmers was carried out covering a randomly selected sample of 87 farmers in the adopted villages of Farmer FIRST project in the Khordha district of Odisha during 2016-17. A structured interview schedule based on the DFID framework was developed and data was collected by personal interview method. The same interview schedule was introduced before i.e., in 2016-17 and after the intervention i.e., in 2019-20. The impact on livelihoods was measured through finding comparative positions of physical, social, financial, human and natural assets of the farmers before and after the adoption of the interventions.

The physical assets included type of housing, sanitation, conveyance, availability of electricity, cooking and communication facilities. The social assets mainly referred to the recognition, social and political participation, active involvement in developmental works, common services used and group membership pattern. The financial assets were measured based on parameters like sources of income, kinds of savings and investments, lending and borrowing. The human assets involved language competencies, literacy level, management skills and mobility. The natural assets were the possession of natural resources of farm family, viz. farm size, irrigated land, livestock holding, poultry and fishpond. Overall, the standard of living of farmers was assessed based on their assets held before and after the adoption of the technology. Thus, the value of the overall standard of living ranged from 5 to 25. Standard of living of beneficiary farmer is expressed as

$$Li = \sum (Pi + Si + Fi + Hi + Ni)$$

i = 1, 2, 3..... 87

$$P_i = \frac{\sum_{i=1}^{87} \sum_{j=1}^7 PA_{ij}}{\sum_{i=1}^{87} \sum_{j=1}^7 S_{max}}$$

Where, Pi- Physical Asset index, PA- Physical asset, Smax- Highest score, j- Indicates the parameters measuring physical assets, viz. no. of rooms in house, type of roof of the house, sanitary/latrline condition, type of vehicles-owned, electric power usage, cooking facilities and telephone connectivity. In the similar fashion other variables like social (Si), financial (Fi), human (Hi) and natural (Ni) assets were evaluated. Appropriate statistical tools like mean, standard deviation and paired sample 't' test are used.

RESULTS AND DISCUSSION

It is evident from Table 1 that there was an improvement in all the five types of assets measuring the changes in the livelihood of farm families during post-adoption period. The gain was found maximum in the financial assets (25%), followed by natural assets (21%), human assets (19%), physical assets (15%) and social asset (14%). All assets of farm families increased considerably. The high improvements in financial and natural assets indicate the betterment of living as well as economic conditions. The overall gain in livelihood is worked out to be 18 per cent. Livelihood improvement is not just about the positive change towards a better quality of life and human wellbeing, but it takes into account the local and global change which determines the livelihood (Pandey, 1996).

Table 1. Livelihood index (including physical, social, financial, human and natural) of the farmers before and after of the intervention of the project

Indices of Assets	After	Before	Difference	% Gain
Physical (Pi)	0.71	0.62	0.09	15
Social (Si)	0.72	0.63	0.09	14
Financial (Fi)	0.50	0.40	0.10	25
Human (Hi)	0.56	0.47	0.09	19
Natural (Ni)	0.35	0.29	0.06	21
Livelihood index	2.84	2.41	0.43	18

The mean value of overall standard of living of the respondents derived through addition of the index values of five assets indicated it to be 2.41 during pre-adoption and it increased to 2.84 during post-adoption period. Being a dynamic process, livelihood diversification depends on many factors having spatial and temporal variations. This process of change varies from farmer to farmer and over space and time (Ghosh *et al.*, 2011). Therefore, integration of improved technology through Farmer FIRST project is not exclusive, but one of the factors influencing the changes in livelihood of farmers. (Mehta, 2009) too emphasized that adoption of appropriate agricultural technology holds the key for development of the rural economy.

After implementation of the project i.e. after providing critical inputs, interface with scientists along with technical back up of advanced technologies, the livelihood of the beneficiary farmers has improved leading to enhancement of standard of living of the farmers. It is evident from Table 2 that all the five indices of livelihood namely physical asset (Pi), social asset (Si), financial asset (Fi), human asset (Hi) and natural asset (Ni) have increased significantly (p<0.01). Thus the project indicates a positive and highly significant impact on the livelihood of the beneficiaries. Dey et al., (2010) found that adoption of integrated agriculture aquaculture resulted in increased diversification and higher cropping

Table 2. Paired sample t test

	Paired differences				t	df	Sig. (2-tailed)	
	Mean	Std. deviation	Std. error mean	99% confidence interval of the difference				
				Lower				Upper
AFTER_PA - BEFORE_PA	3.023	3.389	.363	2.066	3.980	8.319	86	.000
AFTER_SA - BEFORE_SA	1.851	2.385	.256	1.177	2.524	7.238	86	.000
AFTER_FA - BEFORE_FA	2.184	2.683	.288	1.426	2.942	7.592	86	.000
AFTER_HA - BEFORE_HA	1.839	2.658	.285	1.088	2.590	6.453	86	.000
AFTER_NA - BEFORE_NA	1.517	2.057	.220	.936	2.098	6.881	86	.000

intensity. Wang (2018) also suggested that increased household livelihoods play an important role in improving land space utilization efficiency, resource conservation and use, and the ecological environment. Kaur & Kumar (2020) reported that introduction of summer moong in paddy-wheat cropping system in Sangrur has led to higher net return for the adopted farmers. Letha Devi et al., (2021) worked out livelihood vulnerability index for crop farming systems, livestock farming system and integrated farming systems in Karnataka. They observed that crop farming system with mono cropping is the most vulnerable while integrated farming system is the least vulnerable. Kumari et al., (2020) reported positive impact of self-help groups on livelihood of women members. It has contributed to their empowerment and increased decision making abilities.

CONCLUSION

The Farmer FIRST project implemented by ICAR-Central Institute of Freshwater Aquaculture has brought in significant improvement in livelihood of the beneficiary farmers. Access to improved agriculture and allied sector technologies coupled with technical backup and institutional innovations have contributed towards this. As per the premise of the Farmer FIRST project, this arrangement needs to be institutionalized and its four elements-Scientists farmers interface, technology assemblage, institutional development and content mobilization should continue even after the closure of the project. This suggests that this approach of direct interface with farmers for developing and applying appropriate technology modules for different agro-ecosystem must receive due attention.

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Production and Marketing Problems Faced by Dry Grape Producers of Karnataka

Shivananda P. Yarazari^{1*}, Arun Kumar Singh² and Saikat Maji³

¹Ph.D Scholar, ²Professor, ³Assistant Professor, Department of Extension Education, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India

*Corresponding author email id: shivananda7063@gmail.com

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ABSTRACT

The study was an “*ex post-facto*” research carried out in Vijayapura district of Karnataka State during the year 2020-21. Two taluks were purposively selected based on the highest production of dry grapes to make a sample size of 200. The collected problems were analyzed using Garret’s ranking methodology to develop a quantitative position of each problem. The findings showed that dry grape producers faced production and marketing problems more severely. Among the production problems, heavy investment on inputs, no standard package of practices available from agriculture or horticulture universities and high rate of interest were prominent. Similarly, in the case of marketing problems, no local market and lack of processing and storage units were ranked at top. There is an immediate need to improve various marketing practices by developing a strategy in order to overcome these impediments which will enhance the entrepreneurial access of the dry grape producers.

INTRODUCTION

The need for diversification to horticulture sector was acknowledged by the Government of India in mid-eighties by focusing its attention on investment in this sector. Presently horticulture has moved from rural confines to commercial venture and established its credibility in improving income through increased productivity, generating employment and in enhancing exports. The Department of Agriculture, Co-operation and Farmers Welfare (DAC&FW) of the Ministry of Agriculture & Farmers Welfare is the nodal department for implementation of different programmes through Departments of Horticulture/Agriculture in all the States and provides the leadership to coordinate activities for the promotion of horticulture. However, efficient implementation of programme and policies call for robust information in time.

Raisin is prepared from dried grapes of the varieties conforming to the characteristics of *Vitis vinifera* L. The grapes are processed in an appropriate manner into a form of marketable raisin with or without coating with suitable optional ingredients. Raisin provides the energy of 299 kcal, carbohydrates of 79.18 g and a good source of protein which provides 3.07 g (per 100 g) and it is

rich source of vitamins such as vitamin C, K and B. It is rich source of minerals like potassium, phosphorus, manganese, iron and contains no cholesterol (National Health and Nutrition Examination Survey, 2001–2012). In India, raisins are mostly produced in Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Punjab, Rajasthan, Madhya Pradesh, and Western Uttar Pradesh. Raisin production in India was 1,95,900 MT in 2017-18 in which 22,471 MT was exported. Maharashtra ranks first in production with 82.56 per cent of total grape production along with highest productivity (APEDA, 2017-18). However, the major produce is derived from the states of Maharashtra and Karnataka. In India, total grape production was 29,20,000 Tons whereas Karnataka produced 5,24,000 Tons in 2017-2018 and stands second among Indian states (*Source*: Horticultural Statistics at a Glance, 2018).

In Karnataka, Vijayapura district has highest area under grapes with 12,253 ha followed by Belagavi and Bagalakot districts. In production aspect the Vijayapura district stands first by producing 1,98,000 M. Tonnes followed by Bagalakot and Belagavi districts. In Vijayapura district, the Vijayapura taluk produces highest (1,60,185 M. Tons) grapes followed by Indi taluk (18,273 M. Tons) (Horticultural Statistics at a Glance, 2018). Considering raisin

industry, the packaging and labeling has also to be improved so that our product complies with the international quality standards in this regard. Different packing materials of food grade quality should be tested for their suitability with regards to easy availability, convenience, environmental profile and overall economics. There is urgent need to develop technology for storage of the raisins under ambient condition to save the huge expenditure incurred towards electricity in cold storage. Further, this storage technology should protect the raisins from browning or discoloration while on storage (Sharma, 2007). Thus there is a big potential of raisin industry in India in terms of the marketing of this product in domestic and international market for import substitution and better utilization. Besides, there is possibility of diversification of raisin industry by promoting the production of flavoured and coloured raisins and promoting raisins as nutraceuticals in public health care.

METHODOLOGY

The Vijayapura district comprises of five taluks among these Vijayapura and Indi taluks were purposely selected based on highest production of dry grapes (12,000 Tonnes and 3000 Tonnes, respectively. APEDA, 2017-18). From each taluk ten villages were selected. From each village ten respondents were selected randomly. Hence, the study covered 20 villages from 2 taluks of Vijayapura district to form a sample of 200 respondents. Through the use of the literature review, expert opinion, different forms of problems were collected. Data were obtained using a structured interview schedule. Garrett’s score was used to determine the most important problems among the two groups as perceived by dry grape producers. The formula for percent position suggested by Garret (1981) is

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

Where, R_{ij} = Rank given for the i^{th} variable by j^{th} respondents,

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

RESULTS AND DISCUSSION

The level of problems encountered by dry grape producers and their ranking of different level (both group-wise and overall ranking) as perceived by dry grape producers in relation to production and marketing aspects are presented in Table 1 and Figure 1. In case of production problems, heavy investment on inputs (53.16) was assigned an overall third rank and group ranked

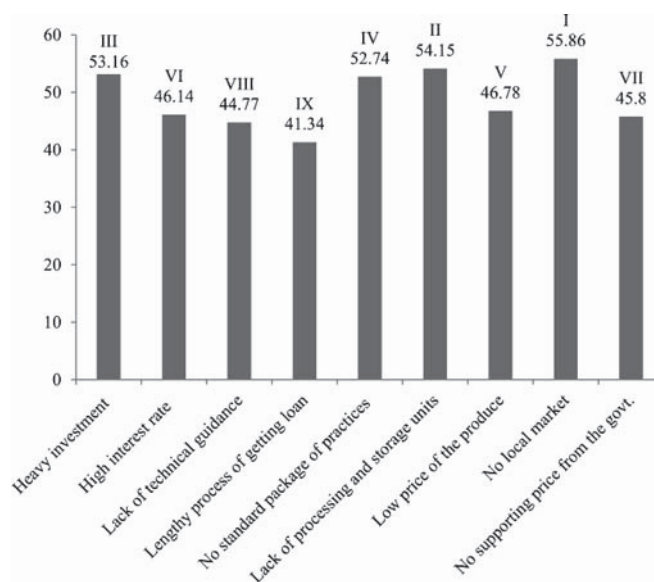


Figure 1. Problems faced by dry grape producers

first, no standard package of practices available from Agriculture or Horticulture Universities (52.74) has overall ranked fourth and group ranked second, high rate of interest (46.14) has overall ranked sixth and group ranked three. The problems such as lack of adequate extension support/ technical guidance (44.77) and lengthy process of getting loan (41.34) were expressed in fourth and fifth place in group wise ranking. Das et al., (2014) also observed similar type of constraints.

The reasons might be that, grape growers are following improved production practices to attain international standards and explore better opportunities for export. Operations like pruning, vineyard management, irrigation, fertilization, crop protection, appropriate stage and method of harvesting, packaging, storing and transporting are important. These practices involve high initial investment which is difficult for small and marginal farmers to afford this huge cost. To fulfill his farm requirements, farmer rely on banking institutions but due to high interest rate and lengthy process of obtaining loan, the farmer is not able to attain his financial requirement on-time. There is no standard package of practice is available from Agricultural or Horticultural universities with respect to dry grape production. Farm literature and technical guidance is

Table 1. Problems faced by dry grape producers

Problems	Sum of the Garret's score	Mean	Overall ranks	Group ranks
<i>Production problems</i>				
Heavy investment on inputs	10633	53.16	III	I
High rate of interest	9228	46.14	VI	III
Lack of adequate extension support/ technical guidance	8954	44.77	VIII	IV
Lengthy process of getting loan	8268	41.34	IX	V
No standard package of practices available from Agriculture or Horticulture University	10548	52.74	IV	II
<i>Marketing problems</i>				
Lack of processing and storage units	10830	54.15	II	II
Low price of the produce	9357	46.78	V	III
No local market	11172	55.86	I	I
No supporting price from the government	9160	45.80	VII	IV

required for the needy dry grape producers because these materials helpful to improve the production and quality of dry grape which fetches high price in the markets. The results similar with the findings of Prabhugouda (2011) indicated that high cost of plant protection chemicals, lack of adequate extension support, low rate of subsidy and non-availability of labour were the problems faced by farmers. Shindedesai (2011) expressed heavy investment, shortage of capital, high rate of interest on loan and lengthy procedure for getting loan as major constraints. Wadekar (2016) indicated that high investment followed high rate of interest and lack of technical guidance were the major constraints expressed by farmers. Rajasree et al., (2017) concluded that large investment on application of machines in heavy soil was ranked first followed by lack of technical support ranked second. Lack of credit facility, lack of technical knowledge and skill ranked third and fourth respectively. Gupta et al., (2013) also observed lack of technical guidance as the major constraint, similarly, Rajina (2017) observed that majority of the respondents faced high cost of chemical fertilizers, high interest rate and high labour cost were the major problems. Kumari & Malik (2020) revealed that lengthy loan sanctioning procedure was the main problem among farmers.

In case of marketing problems, no local market (55.86) was assigned first rank in both overall and group wise ranking. Lack of processing and storage units (54.15) has second rank in overall and group. Low price of the produce (46.78) has overall ranked fifth and group ranked three. No supporting price from the government (45.80) was expressed in seventh place in overall and fourth place in group wise ranking. The reason be might be that, there is no local market for raisin and farmers need to take the produce to neighboring state to sell the raisin and there is no regulation policy by the government on price of raisin so it is often that farmers face the problem of price fluctuation, low price for the produce. Further there is no provision for announcing the supporting price for the processed products. Inclusion of processed products under Minimum Support Price would help the dry grape producers from low price which affect the farmers' income stability. The results are in line with Singh et al., (2011) found that majority of the farmers have expressed lack of marketing facility and lack of processing and storage units as major constraints. Lwelamira et al., (2015) revealed that no local market was the most important constraint followed by low price for the product. Patra et al., (2019) found that marketing of produce was the most important problem. Kumari & Malik (2020) observed that lack of storage facilities nearby was the main problem among farmers.

CONCLUSION

No local market, lack of processing and storage units, heavy investment on inputs, no standard package of practices available from agriculture or horticulture university, low price of the produce, high rate of interest, no supporting price from the government, lack of adequate extension support/ technical guidance and lengthy process of getting loan were the major problems faced by the dry

grape producers in relation production and marketing aspects. These problems could be solved by the government by implementing the policies in the favour of farmers. Entrepreneurship development programs for the dry grape producers need to be conducted so as to make them capable of realizing the full potential of dry grape production.

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Entrepreneurial Behavior of Piggery Trainees of Pashu-Vigyan Incubator

Akriti Anna¹, B. P. Singh^{2*}, Mahesh Chander³, M. P. Sagar⁴, R. S. Suman² and S. S. Pawale¹

¹Research Scholar, ²Principal Scientist, ³Head & Principal Scientist, Division of Extension Education ICAR-Indian Veterinary Research Institute, Izatnagar-243122, Bareilly, Uttar Pradesh, India

⁴Principal Scientist, Technology Transfer Division, ICAR-Central Avian Research Institute, Izatnagar-2431122, Bareilly, Uttar Pradesh, India

*Corresponding author email id: bpsinghexivri@gmail.com

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ABSTRACT

Entrepreneurship as a dynamic and innovative process of a country's development has become a prerequisite for supporting the government of India's ambitious flagship program of 'Atm-nirbhar Bharat'. The study is an ex-post facto research to ascertain the entrepreneurial behavior of the trainees who attended the entrepreneurship development programme on piggery at agri-business incubator ICAR-IVRI (*Pashu-Vigyan Incubator*). A purposive sampling technique was used to select 80 trainees starting their piggery enterprises. The data were collected through mailed e-questionnaire and telephonic follow-up. The entrepreneurial behavior was determined on nine dimensions and majority of the trainees showed a high level of 'cosmopolitaness', 'achievement motivation', 'risk orientation' and coordinating ability but possessed medium level 'information seeking behavior', 'self-confidence', 'innovativeness', 'planning ability'. The entrepreneurial behavior showed positive and significant correlation with their experience in piggery, attitude towards scientific piggery farming, social participation, education and income. Overall high mean entrepreneurial behavior index was observed indicating a positive effect of the Entrepreneurship Development Program.

INTRODUCTION

India has a predominantly young population with 19 per cent of it being youth (231.9 million) in between 15-24 years of age (censusindia.gov.in) with unemployment rate being 7 per cent, (CMIE report, 2020). However, this rich human resource is the costliest wealth of nature which if channelized to remodel the socio economic setup can lead to a paradigm shift in the country's economy. Amidst unemployment and economic slowdown India requires its youth to be self-reliant, skilled and competent enough to manage their livelihood in uncertain times. Thereby, manifest the dream of the flagship ambitious program of Government of India viz. "Atma-Nirbhar Bharat", which has huge possibilities coming from livestock oriented start-ups in India. There is tremendous demand for livestock products like milk, meat and value-added meat products in the current market. Pig farming holds a key to great

self-sustained and profitable business if backed by scientific know-how especially when food habits have globalized.

The pig population of India is 9.06 million which comprises about 1.7 per cent of the livestock population and India ranks 2nd in the pig population in the world (Department of Animal Husbandry and Dairying, DAHD, 2019). Pig farming is an untapped way towards independence and self-employment for youth and farmers with low investment capacity. Therefore, under Rashtriya Krishi Vikas Yojana-Remunerative Approaches for Agriculture and Allied sectors Rejuvenation(RKVY-RAFTAAR) scheme of the *Ministry of Agriculture and Farmers Welfare*, Government of India, the Agribusiness Incubation Centre (ABIC)of ICAR-Indian Veterinary Research Institute(IVRI), also known as Pashu-Vigyan Incubator is creating an ecosystem for 'Entrepreneurship Development' and start-ups in diverse areas of livestock and animal science. It's "Entrepreneurship Development

Programme" (EDP) on Piggery provides research knowledge on the technical front along with mentorship at the business level to the farmers and youth who are the budding entrepreneurs in pig farming. Providing agri-businesses motivation in pig farming as a profession through entrepreneurship development and innovation, the paper attempts to throw light on the thrust in the piggery entrepreneurship brought about by the EDP of Pashu vigyan incubator.

METHODOLOGY

The study was conducted in the 'Division of Extension Education' ICAR-Indian Veterinary Research Institute, Izatnagar. The *ex-post facto* design was used because the trainings considered in the present study had already occurred. A purposive sampling method was applied on the list of trainees who have attended the Piggery Entrepreneurship Development Programme (EDP) organized by Agribusiness Incubator ICAR-IVRI during 2018-19, 2019-20 and 2020-21. A final sample size of 80 trainees (who had positively started their piggery enterprises and had returned the e-questionnaire duly filled) were selected. The data were collected via e-questionnaire which was developed for the purpose and individually followed-up telephonically. The measurement of entrepreneurial behavior was done with the help of Chaudhary (2007) with slight modification and nine components were included in it. The data collected were scored, tabulated and analyzed using suitable descriptive statistical tools such as frequency, percentage, Mean, SD and correlation.

RESULTS AND DISCUSSION

The study revealed medium to high level of innovativeness was prevalent among the pig entrepreneurs due to the fact that majority of them were from middle age group (62.50%), had high level of formal education of graduation and above along with medium level of experience in pig farming. This is in conformity with Patel et al., (2014); Khode et al., (2018); Kulkarni & Jahagirdar (2019) who found majority of respondents in medium category of innovativeness, while it differs from that of Seth et al., (2012) who found majority of the respondents having high innovativeness.

About 70 per cent of the trainees had a high level of achievement motivation. This result differs with findings of Patel et al., (2014); Khode et al., (2018) who claimed that the majority of respondents, had medium level of achievement motivation. This predominant high achievement motivation can be adequately linked to their mass media exposure and the training at IVRI which inculcated the ability of task accomplishment, social status, family support, sustainability, technical employment generation and social welfare motivation among them. A medium level of decision making ability was seen among majority of the trainees, which is in line with finding of Lawrence & Debasis (2012); Patel et al., (2014); Khode et al., (2018). The knowledge and awareness generated among the trainees about scientific pig management from they attended at IVRI had some positive effect on their confidence in taking decisions about their piggery enterprises thereby reflecting as medium level of decision making ability. A high level of risk bearing capacity of the trainees was seen which can be due to the personal, psychological and socioeconomic characteristics like majority of the trainees had medium level of experience in pig farming. A significant level of

knowledge, awareness and self confidence among the trainees due to exposure to the training programme on entrepreneurship development at IVRI along with their high education level might have contributed positively towards high level risk orientation. This is in contrast with finding of Lawrence & Debasis (2012); Patel et al., (2014); Bhise (2015); Khode et al., (2018) who found that the majority had medium level of risk orientation and Seth et al., (2012) who found that majority had low level of risk orientation. Further, majority of the trainees possessed high level of coordinating ability which is in contradiction with that of Patel (2014), while similar finding was reported by Lawrence (2015), who reported more than one-half having high level of coordinating ability. Coordinating ability results from high formal education and better understanding of the requirements of the enterprises. The possible reason for the same might be that the major proportion of the piggery trainees were having higher educational background (58.75%) and high knowledge level (38.25%) enough to have high level of coordinating ability. The trainees' educational and technical abilities supported by the entrepreneurship training at IVRI played an important role in their participation and hence positivity towards piggery farming. Also, 46.25 percent of the respondents had medium level of planning ability which is similar with finding of Lawrence (2012); Patel et al., (2014); Khode et al., (2018); Kobba et al., (2020) who found that majority had medium level of planning ability.

The study also deduced that a majority (75%) of the respondents had medium level of information seeking behavior since majority of trainees had low level of extension agency contact (57.50%) and medium level utilization pattern of sources of information (62.50%) which might form the basis of the predominant medium level of information seeking behaviour seen among the trainees. A highly predominant cosmopolitanism was seen among the piggery trainees which was not in conformity with finding of Lawrence & Debasis (2012); Patel et al., (2014); Khode et al., (2018), who reported that majority of the respondents had medium level of Cosmopolitanism. Development in communication facilities and its outreach extended towards the trainee during their training at IVRI might be the reason for the high cosmopolitanism. A high self confidence level was majorly seen among the trainees which tallies with finding of Lawrence (2012), who claimed that majority of the respondents had high level of self-confidence. This high level of self-confidence can be attributed to knowledge imparted during the training at IVRI, their high level of education, and medium level of experience in pig farming reported in the trainees.

Among the nine components of the entrepreneurial behavior considered for the present study 'cosmopolitanism', 'self-confidence' and 'achievement motivation' were the major dimensions of entrepreneurial behaviour observed among the respondents with mean percent score of 89, 81.12 and 77.62 respectively. Least observed dimensions of entrepreneurial behaviour among trainees were 'information seeking behavior' and 'decision making ability' with 46.84 and 49.66 per cent respectively. These results are in line with the findings of Gupta et al., (2013); Khode et al., (2018); Chandraker et al., (2021). In overview for all of the dimensions of entrepreneurial behaviour most of the respondents showed a medium to high level of distribution. This can positively be attributed to the entrepreneurial development program of ICAR-IVRI which inculcated such entrepreneurial qualities among the trainees and boosted their startups.

Table 1. Ranking of different dimensions of entrepreneurial behaviour

Dimensions	Trainees	
	MPS	Rank
Cosmopolitaness	89.00	I
Self-Confidence	81.12	II
Achievement Motivation	77.62	III
Coordinating Ability	76.25	IV
Risk Orientation	66.93	V
Innovativeness	64.37	VI
Planning Ability	59.75	VII
Decision Making Ability	49.66	VIII
Information Seeking Behaviour	46.84	IX

Table 2. Correlation between socio-economic characters and entrepreneurial behaviour of the piggery trainees (N=80)

Independent variable	'r' value
Education level	0.253*
Social Participation	0.389**
Experience in pig farming	0.340**
Income	0.305**
Attitude towards scientific piggery	0.489**
Adoption of scientific pig farming practices	0.520**

**Significant at 0.01 level; *Significant at 0.05 level

Relationship between socio-economic characters and entrepreneurial behaviour of the trainees

The study of Table 2 reveals that entrepreneurial behaviour of the piggery trainees was positively and significantly associated with adoption ($r=0.520^*$) and attitude ($r=0.489^{**}$) towards the scientific pig rearing practices. It elicits that the pig entrepreneurs with more entrepreneurial aptitude were having favourable attitude towards scientific piggery practices and were adopting them in their enterprises. It also shows positive and significant relationship with the social participation of the trainees. The pig farming experience of the trainees also significantly and highly correlated to their entrepreneurial behaviour ($r=0.340^{**}$). The income generation from piggery enterprises was highly correlated with entrepreneurial behaviour of the respondents ($r=0.305^{**}$) as well. Thus, it is elucidated that respondents possessing high level of entrepreneurial behavior also possessed high education level as well as good social participation and sound income.

CONCLUSION

The results indicated that about one third of the trainees had high entrepreneurial behaviour and 60 percent had medium level of entrepreneurial behavior and cosmopolitaness, self-confidence and achievement motivation formed the major components that contributed towards their entrepreneurial aptitude. Also, the entrepreneurial behaviour was correlated to the trainees' education level, social participation, experience in pig farming, income attitude and adoption of scientific piggery farming. This signifies a pivotal role played by the *Pashu-Vigyan* incubator in inculcating a high sense of business aptitude and entrepreneurship among them. However, there is some scope of improvement, as the trainees comparatively showed low level in few dimensions of entrepreneurial behaviour like information seeking behaviour and decision making ability. Effective and meaningful EDPs by Agribusiness incubators under ICAR in collaboration with various government financial institutions

and stakeholders should be focused primarily. Efforts needs to be intensified for target based & effective impact at the grassroots level.

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Entrepreneurial Behavior of Skilled Youths of Banda District of Bundelkhand Region, Uttar Pradesh

Saurabh Singh¹, B. K. Gupta², B. P. Mishra³, Gaurav Shukla⁴, Saurabh S. Raghubanshi⁵, Abhishek Kalia⁶ and Alok Kumar⁷

^{1,5}P.G. Student, ^{2&6}Assistant Professor, ³Professor, Department of Agricultural Extension, ⁴Assistant Professor, Department of Statistics, Banda University of Agriculture & Technology, Banda -210001, Uttar Pradesh, India

⁷Principal Scientist, ICAR-National Academy of Agricultural Research Management, Hyderabad-500030, Telangana, India

*Corresponding author email id: bkguptabuat75@gmail.com

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ABSTRACT

India being predominantly agriculture and agripreneurs play vital and important role in the agricultural value chain. In today's changing scenario, skills in entrepreneurship development have become important and Skill Development of Rural Youth is a flagship scheme of the Government of India. The study was conducted in Banda district of Bundelkhand region of Uttar Pradesh to study the entrepreneurial behaviour of youths and its impact on socio-economic status of youths. Total 90 respondents were selected through proportionate random sampling from three youth training centers of Banda district. The data were collected with the help of pre-structured schedule and entrepreneurial behaviour of youths was assessed by seven components of entrepreneurial behaviour. It was found that the majority (66.67%) of respondents had medium level of entrepreneurial behaviour. Further, the socio-economic profile attributes like education, land holding, material possession, occupation, annual income and sources of information utilization were positively and significantly correlated with entrepreneurial behaviour of youths.

INTRODUCTION

The agripreneurs play a significant role in development of nation as they contribute to agricultural GDP through the value addition of agricultural products. There are opportunities in many areas and sub-areas in agriculture as enormous number of commodities are available which can be adopted on need based, agro-climatic conditions and available resources. On other hand, there are uncounted jobless agricultural graduates looking for jobs. There is a way to reducing unemployment through development of entrepreneurial skill in youth. India is expected to have 34.33 per cent share of youth in total population (Social Statistics Division, Ministry of Statistics and Programme Implementation, 2017). Therefore, it becomes essential to develop entrepreneurial skill in

youth by various training and also provide them financial support to develop their own venture and business in agriculture and allied sectors.

Entrepreneurship is the central force of economic activity and prime mover of development and most needed component for the development. Entrepreneurship is the propensity of mind to take calculated risk with confidence to achieve a predetermined business or industrial objective. In substance, it is the risk taking ability of the individual broadly coupled with correct decision making. The entrepreneurial behaviour is doing things in different way. Entrepreneurial behaviour is the result of an interaction of individual, situational, psychological social and experimental factors. Many entrepreneurial opportunities are emerging in various fields such as food technology, agriculture, medicine, fashion designing, electronics,

computers etc. The present study was conducted in Banda district to know the entrepreneurial behavior of youths in this region and the problems faced by them.

METHODOLOGY

The study was conducted in Banda district of Bundelkhand region of Uttar Pradesh in Year 2020. The Ex-post-facto research design was followed in the present study. The Bundelkhand region of Uttar Pradesh is consist of seven districts namely Chitrakoot, Banda, Jhansi, Jalaun, Hamirpur, Mahoba and Lalitpur. Out of these seven districts Banda district was selected purposively for this study. For the present study, three training centers namely KVK Banda, State Fruit Preservation Centre, Banda and Banda University of Agriculture and Technology, Banda were purposively selected. These three centers were the leading skill training centers of Banda district engaged in providing specialized skill trainings in agriculture & allied sectors. Further, the lists of trainees were collected from all these three training centers following the criteria of attaining not less than 15 days skill training during 2018-19. A proportionate sample of 90 respondents was selected from all training centers. The data were collected through personal interview schedule and analyzed by using different appropriate statistical tools. The entrepreneurial behaviour was measured in terms of cumulative outcome of seven components viz., innovativeness, achievement motivation, risk orientation, decision-making ability, leadership ability, self-confidence and management orientation.

RESULTS AND DISCUSSION

It could be observed from Table 1 that majority (66.67%) of respondents had medium level of entrepreneurial behaviour followed by 17.78 per cent and 15.55per cent of respondents had high level and low level of entrepreneurial behaviour respectively. The possible reason might be that the components of entrepreneurial behaviour viz., innovativeness, achievement motivation, risk orientation, self-confidence, decision-making ability, leadership ability and management orientation of the respondents are medium level. Further, the socio-economic profile of the respondents like education, social participation, annual income and utilization of sources was also effect the entrepreneurial behaviour of respondents. The finding is in accordance with the findings of Gamit et al., (2015); Chaurasiya et al., (2016); Dutta et al., (2017).

Relationship between socio-economic profile of youths and their entrepreneurial behaviour

It could be revealed from Table 2 that out of ten variables of socio-economic profile the six variables namely education, land holding, material possession, occupation, annual income and sources of information utilization were positively and significantly

Table 1. Distribution of respondents according to their entrepreneurial behaviour (n= 90)

Category	Frequency	Percentage
Low	14	15.55
Medium	60	66.67
High	16	17.78

Mean: 134.86; SD:15.37

Table 2. Correlation between selected independent variables and entrepreneurial behaviour

Variables	Correlation co-efficient 'r' value	t value	Sig.
Age	-0.0017	1.811	0.074
Education	0.692**	2.211	0.030*
Family type	0.184	-0.684	0.496
Family size	0.161	0.703	0.484
Land holding	0.857**	3.502	0.001**
Material possession	0.822**	0.336	0.738
Social participation	0.108	0.882	0.380
Occupation	0.824**	4.208	0.000**
Annual income	0.850**	2.321	0.023*
Source of information utilization	0.706**	2.783	0.007*

**Significant correlation at 0.01 or 1% level; * Significant correlation at 0.05 or 5% level, R²= 0.876 F = 55.835

correlated with entrepreneurial behaviour and the family type, family size and social participation had found positive but non-significant relationship, whereas age was negatively and non-significantly correlated with entrepreneurial behaviour of youths. The age was negatively and non-significantly correlated with entrepreneurial behaviour of youths. The result is similar with finding of Bhosale et al., (2014). The education had positive and significant relationship with entrepreneurial behaviour of youths, might be the education can bring desirable change in human behaviour and contribute to creative thinking for generation of business idea. Further it enhances the decision-making ability of youths. This finding is in accordance with the findings of Paisur et al., (2014); Kulkarni and Jahagirdar (2015); Manjunath (2015); Raina et al., (2016). The family type and family size was found positively and non-significantly related with entrepreneurial behaviour of respondents. The majority of the respondents belonged to joint family and youth needed to have support from their parents about their decisions, it could more possible in joint family system. The large land holding provides more opportunities to people to take risk and adopt new practices to established and running their ventures as compare to marginal and small land holding. The similar findings reported by Gamit et al., (2015); Shreekant & Jahagirdar (2017); Raina et al., (2016). The material possession was also found positive and highly significant relationship with entrepreneurial behaviour of respondents. The probable reason might be that the persons who had good material possession they had more opportunities to try new practices and they had more risk taking ability. The finding of study is similar with findings of Lawerene and Ganguli (2012); Patel et al., (2014).

Social participation and entrepreneurial behaviour

It could be revealed from Table 2 that social participation was found a positive and non-significant relationship with entrepreneurial behaviour of respondents. It indicates that social participation did not have any impact on entrepreneurial behaviour of respondents. The occupation had a positive and significant relationship with entrepreneurial behaviour of youths. The possible reason might be that the respondents were engaged in agriculture along with several subsidiary occupations like service, business and

labour etc. which provides them more income and helpful in taking more risk in generating income from diverse sources. The similar finding was reported by Gupta et al., (2013); Paisur et al., (2014), Kobba et al., (2020). The annual income was positively and highly significantly correlated with entrepreneurial behaviour of youths. The reason might be that the person who had good annual income they had more investment ability than others and also they have more risk taking ability. Therefore, they were more innovative and risk taker in nature. The finding of study is in accordance with the findings of Pisure et al., (2014); Nikam and Singh (2016); Shreekant & Jahagirdar (2017). The sources of information was positively and highly significantly correlated with entrepreneurial behaviour of youths. The good sources of information improve the decision making ability. The excess to extension agencies and use of mass media may also helpful in good and right decision making. The result is similar with finding of Chauhan (2015).

To measure the combined effect of selected variables on entrepreneurial behaviour of respondents multiple linear regression analysis was carried out. It could be observed from Table 2 that all ten selected socio-economic variables viz., age, education, family type, family size, landholding, material possession, social participation, occupation, annual income and sources of information utilization together contributed nearly 87 percent variation in entrepreneurial behaviour of youths as indicated by 'R²' value. The similar finding was reported by Gupta et al., (2014). Further it was clear from Table 2 that education, land holding, occupation, annual income and source of information utilization were found to be positively significant, as evident from their significant 't' value. It reflects that the education, land holding, occupation, annual income and sources of information utilization had positive and significant contribution to the most of variation in the entrepreneurial behaviour of youths.

CONCLUSION

It is concluded that majority of the respondents had medium level of entrepreneurial behaviour followed by high and low level of entrepreneurial behavior. It is revealed from the study the socio-economic status and various components of entrepreneurial behaviour it shows the clear indication of their progressiveness of youths. The attributes viz. education, land holding, material possession, occupation, annual income and sources of information were significantly affected the entrepreneurial behaviour of skilled youth. Hence, special preference need to be given to develop entrepreneurial abilities in youth to setup new venture. The inceptive approach should be required to encourage the youth towards a better future but a steady focus on need based training on entrepreneurial skills could also be included when one considers the fact that business environments are highly unstable.

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Impact of Front Line Demonstrations on Mustard Crop in Sirsa District of Haryana

Sunil Kumar^{1*} and Devender Singh Jakhar²

¹Young Professional-II, ²Senior Co-ordinator, Krishi Vigyan Kendra, Sirsa, CCS HAU, Hisar-125004, Haryana, India

*Corresponding author email id: maliksunil25@hau.ac.in

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ABSTRACT

Krishi Vigyan Kendra conducts cluster demonstrations every year as per target assigned by ICAR. The study evaluates impact of 300 demonstrations on mustard crop in 120 hectare area conducted by KVK Sirsa since 2015-16 to 2017-18 in different villages of the district. The extension gaps in technologies were identified through farmers meetings and group discussions with the farmers. The findings indicated significant increase in the average yield of demonstrated plot (15.13%) over the farmer's practice plot of mustard crop. Average yield of demonstration plots was recorded higher by 18.18 per cent, 14.09 per cent and 13.13 per cent in years 2015-16, 2016-17 and 2017-18, respectively. The extension gap was 4.0 q/ha, 3.10 q/ha and 2.89 q/ha while technology gap was 2.0 q/ha, 2.90 q/ha and 2.11 q/ha during consecutive years respectively. During these three years, yield increase in demonstration plots expressed as additional income over check plots accounted for Rs. 7670/ha, Rs. 12350/ha and Rs. 11590/ha respectively during various years.

INTRODUCTION

Agriculture is an important sector of Indian economy as it contributes about 17 per cent to the total GDP and provides employment to over 60 per cent of the population (www.ccsniam.gov.in). The country is among the largest producers of oilseeds in the world which accounts for an estimated production of 32.10 MT with 26.21 thousand hectare of area in 2016-17 (Anon, 2017). Rapeseed and Mustard comes under the category of oilseeds. There oil is consumed as food oil and meal cake left after the extraction was utilized as cattle feed. The yield of these crops were lower in India (1121 kg/ha) as compared to other developed countries such as Germany (3811 kg/ha), France (3240 kg/ha), China (1834 kg/ha) and Canada (1769 kg/ha) as well as the world average (1849 kg/ha) (Kaur, 2020). Among the major oilseed producing states in the country, Haryana has the highest yield (1533 kg/ha) followed by Rajasthan (1170 kg/ha) while West Bengal (911 kg/ha) has the lowest yield.

Indian mustard is an important oilseed crop of Indian subcontinent contributing more than 80 per cent of the total rapeseed-mustard production in India (Meena et al., 2014; Meena

et al., 2015). This group of oil seed crops offers higher return with low cost of production and low water requirement, so it has greater potential to increase the availability of edible oil from the domestic production. In Brassica, breeding programme is one of the most important objectives for improvement of seed quality. High yielding new varieties are also imperative to meet potential edible oil requirement of the country which is still increasing due to increase in population, increase in per capita consumption and slow increase in local production of oilseed crops (Shengwu et al., 2003). Productivity of crops per unit area could be increased by adopting improved practices in a systematic manner along with high yielding varieties (Ranawat et al., 2011; Rai et al., 2016).

Krishi Vigyan Kendra are grass root level organization meant for application of technology through assessment, refinements and dissemination of proven technologies under different micro farming situation in the district (Das, 2007). Cluster front line demonstrations were conducted on mustard during 2015-16, 2016-17 and 2017-18. The aim of these practices in general is to raise production through transfer of farm technology. The efforts were taken with planning, execution and follow up action of the oilseed production technology through front line demonstrations, the

present investigation was therefore undertaken to access the impact of these demonstrations on mustard production technology in order to increase the yield and fulfilling objective of providing higher returns and nutritious feed to the farmers.

METHODOLOGY

Sirsa is situated at an elevation of 202 meters above mean sea level in the subtropical zone with average rainfall of 350-400 mm. The temperature raises around 48° C with dry desiccating winds and frequent dust storms during summers. Cluster Front Line Demonstrations on mustard (RH-749) have been organized every year since 2015-16 in different villages of the district. The villages were selected in different blocks on the basis of less sown area of mustard. The main aim of these demonstrations is to showcase advanced technologies so that adoption gaps should be minimized.

Before demonstrations, surveys in adopted villages were conducted and technology gaps were identified by following methods:

Extension gap = Demonstrated yield – Farmer's practice yield

Technology gap = Potential yield – Demonstration yield

Additional return = Demonstration return – farmer's practice return

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

$$\% \text{ increase yield} = \frac{\text{Demonstration yield} - \text{Farmers yield}}{\text{Farmers yield}} \times 100$$

After identifying the gaps, group meetings were organized to make farmers aware about advanced technologies. In all 300 numbers of demonstrations were organized during various years viz. 2015-16, 2016-17 and 2017-18 at different locations of Sirsa district with a coverage of 120 ha. The recommended amount of fertilizers was applied and crops were sown in lines. Before sowing, pendimethalin @ 1L per hectare was applied (pre-emergence) to control the weeds. All the Clusters were monitored from time to time during entire cropping season and farmers were guided accordingly. At the end of cropping season yield and economics was calculated. A control viz., farmer practice was run simultaneously to have an idea of impact of these techniques in increasing yield and improving income of farmers which was calculated in terms of economics.

RESULTS AND DISCUSSION

The results presented in Table 1 describes about the economic analysis of the demonstrations conducted during various years. The expenditure incurred on cultivation practices viz. land preparation, seed cost, herbicide, fertilizers and miscellaneous costs was slightly higher in demonstration. The average gross return of Rs. 79200/ha, Rs. 87850/ha and Rs. 93490/ha was obtained in the year 2016, 2017 and 2018 respectively. The average net return for respective years to the tune of Rs. 54770/ha, Rs. 55850/ha and Rs. 61490/ha during the study period. Further, it was also found that additional return of demonstration farmers ranged from Rs. 7670/ha to Rs. 12350/ha. This may be attributed to the use of improved technologies in demonstration plots. Benefit-cost ratio (BCR) was at par in all the years. While, the farmers participated in FLD got approximately Rs. 10536/ha additional income as compared to farmers practice. Similar findings were stated by Singh et al., (2019) in oilseeds, Sangwan et al., (2021) revealed that the B: C ratio was in range of 2.73 to 3.06 during their study period. These results corroborate with the earlier findings of Verma et al., (2012).

Analysis of gap

An extension gap of 4.0 q/ha, 3.10 q/ha and 2.89 q/ha during 2015-16, 2016-17 and 2017-18 was found respectively (Table 3). The average extension gap (the target was to reduce) was to be reduced with the help of different extension activities like training programmes on latest/improved production and protection technologies with high yielding varieties, awareness programmes, kisan gossthis on integrated pest and nutrient management etc. These programmes have the potential to help the farmers to adopt new and improved practices for crop production which lead to reduction in extension gap. The findings are also line with Singh et al., (2019), Kumar & Kispotta (2017) in moong bean. The existed technology gap was 2.00 q/ha, 2.90 q/ha and 2.11 q/ha in years 2015-16, 2016-17 and 2017-18, respectively. This gap may be attributed to prevailing micro farming situation i.e. variation in soil fertility, weather conditions at maturity of mustard crop, crop management practices etc. Therefore, there is an urgent need to recommend location specific crop management practices to pass over the potential demonstration yield. The similar findings were observed by Kalita et al., (2019) in moong bean and Chaudhary et al., (2018)

Table 1. Economic analysis of CFLDs and farmers' practice of mustard

Year	Average cost of cultivation (Rs./ha)		Average gross return (Rs./ha)		Average net return (Rs./ha)		Additional return (Rs/ha)	B:C Ratio	
	FLD	FP (Check)	FLD	FP (Check)	FLD	FP (Check)		FLD	FP (Check)
2015	24430	22700	79200	69800	54770	47100	7670	3.24	3.07
2016	32000	30000	87850	73500	55850	43500	12350	2.74	2.45
2017	32000	30600	93490	80500	61490	49900	11590	2.92	2.63

Table 2. Yield, extension and technology gap analysis of CFLDs and farmers practice of mustard

Year	Yield (q/ha)			Increase over farmers practice (%)	Extension gap (q/ha)	Technological gap (q/ha)	Technology index (%)
	Potential	FLD	Farmers' practice				
2016	28.00	26.00	22.00	18.18	4.00	2.00	07.14
2017	28.00	25.10	22.00	14.09	3.10	2.90	10.35
2018	28.00	25.89	23.00	13.13	2.89	2.11	10.32

Table 3. Technological gap in CFLDs and farmers' practice of moong bean

Technology	Recommended Practice	Farmers' practice	% Gap
Variety	RH-749	Pvt Hybrid	60
Seed Rate	5 kg/ha	7.5 kg/ha	90
Seed Treatment	Carbendazim @ 2g/kg seed	No treatment	100
<i>Fertilizers (kg/ha)</i>			
N	80	No application	100
P	30	20 kg/ha	90-95
K	20	No application	100
Zn	10	No application	100
Weed Management	Pre-emergence application of pendimethalin @ 2.5 ltr/ha	60 per cent farmers use recommended practice	40
Disease Management	600g mancozeb in 200-300 l water	60 per cent farmers use recommended practice	40

in mustard. Technology index varied from 7.14, 10.35 and 10.32 per cent during 2015-16, 2016-17 and 2017-18, respectively. It indicates that there exists a gap between the generated technology in mustard cultivation at the research institution and its dissemination to the farmers. Similar findings were reported by Mitra & Samajdar (2010); Dhaka et al., (2010). Technology index can be reduced with proper adoption of demonstrated technical interventions to increase the yield performance of mustard crop.

The results indicated in Table 3 showed that there was 100 per cent gap in seed treatment by farmers. In adoption of improved variety and proper seed rate, the gap was 60 and 90 per cent respectively. While in case of weed and disease management a key concern to be addressed only 60 per cent farmers' used recommended practice. So there was an urgent need to minimize the gap by creating awareness among the farmers which could ultimately lead to increase in yield and returns. The results were corroborated with the earlier findings of Biyan et al., (2012); Sangwan et al., (2021); Dhillion (2016); Lathwal (2010).

CONCLUSION

The crop productivity and economic returns of mustard crop can be increased with the use of scientific production and protection technologies. The enhanced benefit cost ratio, explained the economic viability of the demonstrations and was convincing for the farmers to adopt the intervention imparted. This study observed that CFLD programmes were very effective in motivating and changing the attitude of other farmers to adopt improved cultivation practices and crop management. Moreover, extension agencies in the district need to provide proper technical support to the farmers through different educational and extension methods to reduce the extension gap for better oilseed production in the District.

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Assessment of Hanging Type Grain Cleaner Drudgery Reducing Tool by Farm Women

S. P. Tripathi¹, G. S. Chundawat², Shashi Gour³, S. P. S. Somvanshi^{4*} and Kinjulck C. Singh⁵

^{1,2}RVSKVV-Krishi Vigyan Kendra, Mandsaur, Madhya Pradesh, India; ³JNKVV- Krishi Vigyan Kendra, Narsingpur, Madhya Pradesh, India

⁴BUAT- Krishi Vigyan Kendra Hamirpur, Uttar Pradesh, India; ⁵JNKVV- Krishi Vigyan Kendra, Rewa, Madhya Pradesh, India

*Corresponding author email id: surya.somvanshi@gmail.com

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ABSTRACT

The study was undertaken to assess ergonomically efficiency of hanging type wheat grain cleaner, carried out in adopted villages under On Farm Testing (OFT) and Front Line Demonstration (FLD) program conducted by KVK, Mandsaur (M.P.). Total Fifteen farm women were selected to assess the physiological workload to compare the impact of improved technology over conventional practice for hanging type grain cleaner. Physiological parameters i.e. HR, energy expenditure, cardiac cost reduction and physiological cost reduction etc., were measured during operations. The results revealed that hanging type grain cleaner has proved proficient on time and output parameters. The average cardiac cost of work was decreased by 82.29 per cent while using hanging type grain cleaner for wheat. Drudgery reduction was found 83.96 per cent and it saved time by 89.10 per cent when compared to traditional practice. The physiological cost of work and energy expenditure in terms of heart rate were observed to be lower while performing activities with hanging type grain cleaner as compared to the traditional practice.

INTRODUCTION

Agriculture is a primarily unorganized sector in which farm women perform the majority of drudgery prone works. The women farmers do the agricultural task with the age old traditional tools which are unsafe, hazardous, unhealthy and long hours of work which often accelerate health related problems among them. Women work force engaged in agriculture and allied activities is estimated around 92 million which constitute about 40 percent of the total rural workers in the country (Singh et al., 2007). The involvement of village women for agricultural work is well known. Farm women thus lead a very hard life. (Hasalkar et al., 2005). It was observed that more than 75 per cent women are involved in activities like winnowing, weeding, grading, threshing and cleaning of field farm operations (Singh & Vinay, 2013). Generally heart rate is used as an ergonomic measure to evaluate the physiological or functional demands of work on the individual workers (Hasalkar et al., 2004). The physiological point of view, the job demand or work load refers to the demands placed on the cardio-respiratory system and is

determined by the energy cost and cardiac cost of work (Chauhan, 1999). Keeping the above mentioned fact in mind, this study was planned to assess the physiological workload and working efficiency of farm women through hanging type grain cleaner for wheat.

METHODOLOGY

The present study was carried out on farm women in adopted villages Sejpuriya and Kolwa under On Farm Testing (OFT) and Front line Demonstration (FLD) program conducted by KVK, Mandsaur (M.P.). To assess physiological workload compare with improved technology over conventional practice for hanging type cleaner. Fifteen farm women subjects in the age group of 24-45 years without having any physical deformity, were selected because they usually attain their highest strength level between 20-45 years (Mc Ardle et al., 2001) Study was carried out with improved hanging type grain cleaner technology. It consists of main frame, grading screen, draper rod, rubber grip over handle, shutter etc. Four ropes are tied on the hooks provided on main frame of cleaner and hanged on any elevated point or hooks attached to the ceiling. It is

taken out in a bag that is hanged on a sack holder by opening shutter of cleaner, capacity of 225 kg/h made by CIAE, Bhopal whereas traditional manual sieves (Chhanna) were used cleaning the wheat in farmers practice. Well prepared interview questionnaire was carried out for collecting the data. The anthropometry and weighing balance were used to measure the physical characteristics like height and weight. The grading of health status of women was done on the basis of Body Mass Index. The BMI scores were interpreted as per the classification given by Garrow (1987). During the experiment various parameters viz., time profile, cleaning efficiency were recorded by using Stop watch for recording the time determined for the farm women. The physiological stress parameters were studied by using the heart rate monitor sphygmomanometer (Digital), based on the heart rate records, the following parameters were calculated. For calculation of Energy Expenditure Rate for heart rate, Singh et al., (2008) The cardiac cost of work is the total number of heart beats spent about the resting level in order to perform the work. The cardiac cost of recovery is the total number of heart beats above the resting level occurring at the end of work and return to the pre activity state (Saha, 1976). The results were statistically analyzed using method proposed by Snedecor & Cochran (1989).

1. Average heart rate during rest and work. Measured by (Digital) sphygmomanometer.
2. The energy expenditure per minute was estimated from the heart rate with the help of formula Energy expenditure (kJ/min) = (0.014 x WHR – 0.68) 20.93
3. ΔHR (beats/min) = Average working heart rate – Average heart rate during rest
4. Output (kg/h) = Cleaning yield of wheat grain kg / average time
5. Physiological cost reduction (%) = $T^1 (\Delta\text{HR}/\text{Output}) - T^2 (\Delta\text{HR}/\text{Output}) \times 100/T^1$
6. Cardiac cost reduction (%) = $(\text{CCWT}^1 - \text{CCWT}^2) \times 100/\text{CCWT}^1$

RESULTS AND DISCUSSION

It is depicted from Table 1 Physical characteristics of the respondent's basic anthropometric data of ergonomic point of view, average age was found 37.73 ± 6.18 years, height 157.40 ± 4.50 cm and weight 53.46 ± 4.34 kg respectively. The mean Body Mass Index (BMI) was calculated using standard formula weight in Kilograms / (Height in Meters)² it was 21.57 ± 1.33 which meant that they were in the normal category. Physiological stress for cleaner hanging type sieve for wheat was determined on the basis of various parameters like average heart rate during work and rest, energy expenditure and physiological cost of work while performing the cleaning activity. It is clear from Table 2. Output work recorded for cleaning saved time of farm women with the work capacity of 191.33 ± 13.29 kg hour⁻¹ against 20.73 ± 2.28 kg hour⁻¹ in local practices. The average working heart rate observed in traditional sieve and hanging type grain cleaner was 93.27 ± 5.54 beats/min and 107.40 ± 4.60 beats/min, respectively. Average ΔHR was 36.40 ± 2.69 beats/ min. while by cleaner hanging type sieve it was recorded as compare to traditional sieve 22.27 ± 4.43 beats/ min. Our results also confirm to (Badigar et al., 2006; Vishwakarma et al., 2015; Bajpai et al., 2016; Ohja & Singh, 2019). The cardiac

Table 1. Physical characteristics of selected respondent

Physical characteristics	Mean±S.D. (N=15)
Age (yrs)	37.73±6.18
Weight (kg)	53.46±4.34
Height (cm)	157.40±4.50
BMI	21.57±1.33

Table 2. Ergonomic evaluation data of different parameters hanging type sieve for wheat

Particulars	Mean±S.D. (N=15)	
	(Traditional Sieve)	(Cleaner hanging type Sieve)
No of Workers required	01	02
Output (kg/h)	20.73±2.28	191.33±13.29
Energy expenditure (kJ/min)	13.10±1.62	17.24±1.35
WHR (beat/min)	93.27±5.54	107.40±4.60
ΔHR (beats/min)	22.27±4.43	36.40±2.69
CCW (beats/kg)	64.91±13.68	11.49±1.39
Labour required (Man/h/qt.)	4.88±0.52	0.53±0.04
Cardiac cost reduction (%)	NA	82.29
Increase in work efficiency (%)	NA	416.93
Time Saving (%)	NA	89.10
Physiological cost reduction (%)	NA	83.96

cost of worker was 64.91 ± 13.68 beats/kg while using traditional sieve (Chhanna) where as 11.49 ± 1.39 beats/kg in cleaner hanging type Sieve. It saves 82.29 per cent cardiac cost of reduction per unit of output work. The average heart rate difference between working (ΔHR) was found more variant by using Cleaner hanging type Sieve. It is accountable for energy expenditure during cleaning by cleaner hanging type sieve and calculated energy expenditure 13.10 ± 1.62 kJ/min. traditional practices, while by improved practice it was recorded as 17.24 ± 1.35 kJ/ min. with increase in work efficiency 416.93 per cent respectively. Physiological cost reduction was calculated 83.96 per cent as compared to traditional practice. It also saves time by 89.10 per cent as compared to traditional practice. Manpower Labour engaged for cleaning also minimized 0.53 ± 0.040 (Man/h/qt.) in improved method. Whereas in traditional method 4.88 ± 0.52 (Man/h/qt.) respectively. Raina et al., (2021) reported increased labour work output per unit time by reducing efforts, drudgery and improved quality of farm operations. The physiological difference was also observed by many research workers (Singh et al., 2010; Singh, 2013; Bajpai et al., 2016; Sharma et al., 2018) during various agricultural operations. Tripathi et al., (2020) also reported user Eco-friendly tools can increase the working efficiency and reduce the working load health hazards during agricultural activities on farm (Kumari et al., 2019) reported that promotion of technology in gender perspective towards the challenges of farm women would help in reducing drudgery and occupational health hazards of women workers in agriculture.

CONCLUSION

From this investigation it has been concluded that in hanging type cleaner used by farm women decreases the cardiac cost and increases the efficiency of output work as compared to traditional practice for wheat cleaning. It saves time and minimizes the labour engagement tool is Eco-friendly, which helps to reduce the

environmental and occupational health hazards during farm activity. Hence, the agricultural workers involved in cleaning wheat suggested working with improved hanging type cleaner to lessen work related to physiological workload.

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Editorial Report on

Indian Society of Extension Education National Seminar 2021 on “*Transforming Indian Agriculture through Pluralistic & Innovative Extension Approaches for Self-reliant India*” held at Banaras Hindu University, Varanasi, Uttar Pradesh, India during 4-6 October, 2021

Agricultural Extension over the past several years has been an essential tool to bring a positive change in farm and home life of Indian Farmers. The contributions of agricultural extension in agriculture, animal husbandry, forestry, horticultural sciences and in health sciences have high significance and relevance to India as well as to the world. The core principle of extension are to make the farmers think, discover and work to fulfil their needs by using appropriate technology with the help of extension support to become successful and self-reliant. During COVID19 crisis the call for *Atmanirbhar Bharat* to make India self-reliant in economy, infrastructure and systems to manage demography and demand in different sectors of the country clamored the theme for ISEE National Seminar 2021 organised by Indian Society of Extension Education, New Delhi held from 4-6 October 2021 at Institute of Agricultural Sciences, BHU, Varanasi. The Banaras Hindu University, Varanasi, Banda University of Agriculture & technology, Banda, UP, Global Communication Research Association, Paraguay joined the Indian Society of Extension Education, New Delhi as Co organizers.

The ISEE, New Delhi extends sincere thanks to both the Organising Secretaries; Professor Basabaprabhu Jirli, Head, Department of Extension Education, IAS, BHU, Varanasi and his team and Dr. Rashmi Singh, Principal Scientist, ICAR-IARI, New Delhi and her team in the leadership of President ISEE, New Delhi for meticulously planning the Seminar and implementing it in highly professional manner. The Indian Society of Extension Education acknowledges three young researchers namely *Pranoy Ray, Priyanka Ginwal and Simantini Shasani* who not only participated in the Seminar but also published their experiences of the National Seminar 2021 held at BHU, Varanasi. The seminar brought together more than 450 scientists and delegates along with 50 farmers for three-day deliberations spread over 15 sessions – pertaining to seven seminar themes where 15 lead papers were presented by delegates from 25 states, 63 universities, and 17 ICAR research institutes. 667 abstracts were submitted by extension professionals, published in the form of Compendium of Abstracts containing 604 pages. The theme wise recommendations aroused from presentations and discussions are as follows:

Empowerment

1. The successful Farmers Organisation empowerment models tested and documented need to be pilot tested first on

commodity and geographical basis on micro agro-ecologies and replicated later.

2. Extensions services be immediately geared up for promoting famers empowerment models PPPs, entrepreneurs, market linkages and intensive use of ICT platforms.
3. Promotion of farmers’ collective, leveraging digital technologies, financial prudence, good agricultural practices, continued farmer’s education, re-skilling etc. are the key issues for risk management and diversified agriculture.

Outreach

1. The measures to be taken up to enhance outreach of extensions services include sectoral convergence, reaching disadvantaged areas and groups proactively, promoting entrepreneurial secondary agricultural opportunities for rural youth and improving access of rural women to credit – market services etc. through FPOs.
2. Structural support systems, incentives and policies, technological backstopping, financial flexibilities, market support system and information networking etc. need to converge for maximizing the farm profits by linking *Atma Nirbhar Bharat* and ODOP programme.
3. Various extension approaches tried scientifically validated at smaller samples by the extension professionals need to be appreciated by the stakeholders engaged in transfer of technology. Hence, professionalism in extension services and extension academics need to encouraged and strengthened.

Integrating Private services

1. FPOs need to be systematically promoted by appropriate handholding, may be linked with marketing and export systems and handholding, making farmers self-reliant. Extension services (both public and private) need to be reoriented accordingly.
2. Pluralistic extension approaches; public private partnerships, focused ICT usage, entrepreneurship development, promoting startups and farmers empowerment through FPOs are the key issues in advanced extension strategies.
3. One District one Export product strategy be promoted on cluster basis. APEDA, MANAGE, NABARD and ISEE may immediately workout suitable export centric extension strategy and promote the same through Public Private Extension systems.

Research Extension Linkages

1. Need for establishing and maintaining a meta database of agricultural information and developing a means for facilitating it to act as a platform for exchange of information and experiences in strengthening extension services.
2. The extension services need to emphasize on participatory technology validation, inference and institutionalization of delivery methodologies for greater socio economic impact. As such the social scientist must be involved from planning of an intervention to impact assessment and it's up scaling.
3. Extension priority setting, R-E linkages, feedback management and convergence mechanisms may be suitably strengthened at various levels. Convergence modalities be spelt out in block / cluster level extension plans, delineating resources and responsibilities.
4. In-Tensions of Ex-Tension should be internalized by both Extension Service Providers and Extension Educators

Training and Capacity Building

1. International experiences on good extension practices be collected, documented, prioritized and integrated in ongoing extension models suitably.
2. For promoting entrepreneurs and start ups the psychological and motivational dimensions need to be stressed upon and adequate focus be provided for HRD activates
3. It is necessary to undertake a longitudinal analysis of extension institutions and extension professionals to assess their potential for developing competent human resources to address upcoming extension challenges.

ICT and Media

1. Intensive use of social media be promoted through formal-informal extension arrangements, giving due emphasis on content validation and its timely and appropriate use.
2. ICT based social networking have resulted in the construction of knowledge base and promotion of social as well as technological interventions. As such, the institutionalization of social media platforms, content creation for social media and its evaluation need to be included in extension organizations and operations.

Extension Research

1. Simple communication techniques emphasizing local specifications and participation of stakeholders are critical for sustainable development. Hence, methodological research and innovative extension approaches need to be stressed upon in extension delivery.
2. Documenting farmers' knowledge and innovations in different subject matter areas need to be stressed upon strengthening farmer to farmer extension and its replication.
3. Extension research need to be strengthened in terms of research methodologies, with focus on technologies, system interplay, convergence of extension efforts and socio-economic dimensions.

Follow-up

ISEE in collaboration with SAUs and ICAR system may take up a few crucial recommendations for pilot testing and replication laterally with concerned agencies. It may include: convergence modalities, in a block or cluster, App based ICT application, entrepreneurship development, working out system interplays, farmer empowerment, HRD/Capacity building interventions etc.

The ISEE Awards

The Indian Society of Extension Education has instituted various awards, which were conferred on high-caliber extension educationists in recognition of their meritorious works & services to the disciplines of Extension Education. The contesting applicants who received awards were informed about it well in advance to make their presence in the event. The list of recipients for various awards is as follows:

- 1) **Life Time Achievement Award (1)**
Dr. Ashok Kumar Singh, DDG (Agricultural Extension), ICAR, New Delhi
- 2) **Dr. D. K. Mishra Memorial Award (1)**
Dr. Nagendra P. Singh
- 3) **Dr. K. N. Singh Memorial Award (2)**
Dr. Debbrata Basu
Dr. Joginder Singh Malik
- 4) **Dr. O. P. Dahma Memorial Award (1)**
Dr. Manjeet Singh Nain
- 5) **Dr. G. S. Vidyarthi Memorial Award (1)**
Dr. Milind Ahire
- 6) **Dr. Y. P. Singh Memorial Award (1)**
Dr. B. Krishnamurthy
- 7) **ISEE Fellow Award (11)**

Dr. Mahesh Chander	Dr. Lavleesh Garg
Dr. Kalyan Ghadei	Dr. Rajiv Bairathi
Dr. P. P Pal	Dr. Shakir Ali
Dr. Vijayabhinandana	Dr. M. L. Meena
Dr. S. S. Dolla	Dr. Seema Naberia
Dr. D. P. Rai	
- 8) **Young Scientist Award (7)**

Dr. K. Venkatesan	Dr. Pankaj Kumar Sinha
Dr. Sandeep Patil	Dr. Savita Kumari
Dr. Hemlata Saini	Dr. Sarvesh Kumar
Dr. Aparna Roy	
- 9) **Best KVK Scientist (15)**

Dr. Banarasi Lal	Dr. Arvind Kumar Singh
Dr. Dinesh Tiwari	Dr. S. D. Macarty
Dr. Jyoti Udgate	Dr. Uday Kumar Singh
Dr. Ajay Kumar	Dr. Vivek Kashyap
Dr. Raghu Raja	Dr. Narendra Singh
Dr. Mukesh Chand	Dr. Md. Mustafa
Dr. L. R. Tambade	Dr. Neeraj Hada
Dr. A. K. Dixit	

General impressions

The seminar was organised at a national level with core focus on the pluralistic and innovative extension approaches for a self-

reliant India. It was interesting to have a confluence of various stakeholders responsible for pluralistic and innovative extension approaches. It allowed us to build networks, deliberate on key ideas and bring to light insights on the challenges faced by extension personnel and researchers from private and public sectors. A pluralistic extension system wherein all the stakeholders from public, private, international and voluntary organizations came together planned and collaborated for providing demand-driven and holistic services to farmers emerged as the best and sustainable extension mechanism. The presence of NABARD, APEDA, IRRI, CIMMYT, CSISA, AIASA, MSEE, OSEE and UP College made the event not only multi stakeholder oriented but increased the reach. The Annual General Body Meeting was held on 4.10.2021 evening in highly professional manner took important decisions regarding the ISEE functioning as well as advancement. The presence of Hon'ble Sh. Lakhan Singh Rajput, State Minister for Agriculture, Agricultural Education and Agricultural Research UP Government

and Hon'ble Vice Chancellor, BHU Prof. V. K. Shukla during inaugural ceremony and Hon'ble Sh. Ravindra Jaiswal, State Minister for the Department of Stamp, Court fee and Registration (Independent Charge) along with Dr. A.K. Singh, DDG (Ag. Extension) during valedictory helped to situate the contribution of Indian Society of Extension Education and extension scientists in agricultural development in the eyes of policy makers. Well known scientists, academicians, educationists, researchers and science communicators spoke in various sessions of the seminar to provide a lead for future endeavors. The target audiences of this seminar was students, researchers, academicians, scientists, extension professionals, NGOs, financial institutions, research organisations and policy makers, etc. In general the annual event was an enriching academic exercise for extension professional all over the country.

Courtesy: Editorial Board, Indian Journal of Extension Education, ISEE, New Delhi

Guidelines to the Authors

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Submission of manuscript: Paper for publication should be submitted online on <http://epubs.icar.org.in/ejournal/index.php/ijee> or at official website <http://www.iseeindia.org.in/>. The official email of the chief editor of the society is chiefeditorisee@gmail.com. Before submission of paper, it is strongly advised that it may be checked and edited by your coauthor(s), professional colleagues for its technical contents including grammatical and spelling correctness. The length of the manuscript should not exceed 12 typed pages (double space).

Submission of final manuscript: The submitted paper will be evaluated by the editorial members and referees for their suitability. The paper will be sent back to the author to carry out the changes or modifications as suggested by the referees and editorial member. Final manuscript has to be uploaded only through electronic form (as an attachment) through <http://epubs.icar.org.in/ejournal/index.php/ijee> with an email to the following e-mail address: chiefeditorisee@gmail.com.

The manuscript should be arranged as follows: Title, running title, abstract, keyword, introduction, methodology, results and discussion, conclusion and references. Kindly check the recent issues at <http://www.iseeindia.org.in/>

Title Page: The names, current affiliation, complete address (place where work was conducted) including e-mail address of author(s), Present address(es) of author(s) if applicable; Complete correspondence address including email address to which the proofs should be sent (these should be given as footnote on first page). Do not use abbreviation or acronyms for designation of job, position and institution name. The title must be centered (16 point bold). The first letter of the every word of the title should be in upper case (Capital letter). All other letter should be in lower case (small letters). Example: Socio economic Impact of Self Help Groups.

Abstract: An abstract of about 150 to 200 words written in complete sentences. It should contain a very brief account of the materials, methods, results, discussion and conclusion, so that the reader need not refer to the whole article except for details. It should not have references to literature, illustrations and tables. The abstract should summarize pertinent results in a brief but understandable form. The abstract should start with a clear statement of the objectives of the experiment and must conclude with one or two sentences that highlight important conclusions.

Keywords: Provide a list of 5 to 8 keywords (indexing terms) that best describe the nature of the research after the abstract. The first letter of each keyword should be in upper case or capital letter. As major words in the title are not used in the subject index, appropriate words from the title (or synonyms) should be listed as key words.

The **'INTRODUCTION'** part should be brief and limited to the statement of the importance of the study, problem or the aim of the experiment. It should briefly justify the research and specify the hypotheses to be tested. The review of literature should be pertinent to the problem. Objective of the study should be discussed in view of latest references. No trade name should be used and Industrial products should be referred to by their chemical names (give ingredients in parentheses) at first mention. In the absence of a common name, use the full name or a defined abbreviation, in preference to a trade name. Introduction should be between 450 to 500 words.

The **'METHODOLOGY'** should contain relevant details including experimental design and the techniques employed. Where the methods are well known, the citation of a standard work is sufficient. All modifications of procedures must be explained. Experimental materials and statistical models should be described clearly and fully. Calculations and the validity of deductions made from them should be checked and validated. Units of measurement, symbols and standard abbreviations should conform to international standards. Metric measurements are preferred, and dosages should be expressed entirely in metric units (SI units). Give the meaning of all symbols immediately after the equation in which they are first used. **METHODOLOGY** should be between 300 to 450 words. There must not be table and figures in methodology and subheadings be avoided as far as possible.

The **RESULTS AND DISCUSSION** should preferably be combined to avoid repetition. Results should be presented in tabular form and graphs when feasible but not both. The colour figures and plates are printed when information would be lost if reproduced in black and white. Mean result with the relevant standard errors should be presented rather than detailed data. The data should be so arranged that the tables would fit in the normal layout of the page. Self-explanatory tables should be typed on separate sheets and carry appropriate titles. The tabular matter should not exceed 20% of the text. Any abbreviation used in a table must be defined in that table. All tables should be cited in the text. If an explanation is necessary, use an abbreviation in the body of the table (e.g. ND) and explain clearly in footnotes what the abbreviation means. References to footnotes in a table are specified by superscript numbers, independently for each table. Superscript letters are used to designate

statistical significance. Use a lower case p to indicate probability values (i.e. $p < 0.05$). In general, use numerals, when two numbers appear adjacent to each other, spell out the first (i.e. three plants were selected rather than 3 plants were selected). In a series using some numbers less than 10 and some more than 10 use numerals for all (i.e. 2 splits, 6 plants were selected). Do not begin a sentence with a numeral. Spell it out or rearrange the sentence. Abbreviate the terms hour (h), minute (min) and second (sec) when used with a number in the text but spell them out when they are used alone. Do not use a hyphen to indicate inclusiveness (e.g. use 12 to 14 yr or wk 3 and 4 not 12-14 mg or wk 3-4). Use Arabic numerals with abbreviated units of measure: 2 g, 5 d, \$4.00, 3% and numerical designations in the text: exp 1, group 3, etc. Figures (histogram/pie chart/ other type of charts) should be given in editable rich text material with the backup data file. The image of the figure or jpg/jpeg is not allowed.

The paper should always be written in third person form (Avoid I /We / Research Team / Project Team etc.). There is always a different style for paper writing and thesis writing, try to be precise enough without compromising the quality. Avoid too many paragraphs; one concept must be dealt at one place and time in one paragraph. Avoid presenting the same data in text, table, and figures in verbatim. Avoid making too many tables just for the number sake, also avoid giving socio personal profile till it is utmost necessary and has some bearing on the other part of the research (most times it is not so). The **DISCUSSION** should relate to the limitations or advantage of the author's experiments in comparison with the work of others.

The '**CONCLUSION**' section should not be of more than one paragraph after the discussion and explain in general terms the implications of findings of this research. Abbreviations, acronyms, or citations should not be used here.

REFERENCES lists should be typed in alphabetical order. The reference list should be first sorted alphabetically by author(s) and secondly chronologically. A recent issue of the journal should be consulted for the methods of citation of REFERENCES in the text as well as at the end of the article.

Reference Section

Indian Journal of Extension Education (IJEE) follows common APA Style references and citation in text. For more information on references and reference examples, see Chapters 8, 9 and 10 of the *Publication Manual* as well as the *Concise Guide to APA Style* (7th ed.). Also see the Reference Examples pages on the APA Style website. Few examples are of reference section as well as text citation are given below.

Including minimum of three references from previous issues of IJEE is desirable. There must be at least 15 references from the related researches. It is appreciable if the references are from Social Science/ Extension Education/ Communication/ Entrepreneurship/ Management/ Education related journals. The reference, in general, should not be older than 15 years and should be from published sources only. Avoid unpublished thesis (older than five years) references. Wherever possible provide the URL of the reference. Unauthenticated references will lead to rejection of article.

Indian Journal of Extension Education (IJEE) follows common APA Style references and citation in text. Journal name should never be abbreviated. For more information on references and reference examples, see Chapters 8, 9 and 10 of the *Publication Manual* as well as the *Concise Guide to APA Style* (7th ed.). Also see the Reference Examples pages on the APA Style website. Few examples are of reference section as well as text citation are given below:

a) Journal Article

Lachner, A., Backfisch, I., Hoogerheide, V., van Gog, T., & Renkl, A. (2020). Timing matters! Explaining between study phases enhances students' learning. *Journal of Educational Psychology*, 112(4), 841–853. <https://doi.org/10.1037/edu0000396>

b) Online Magazine Article

Gander, K. (2020, April 29). COVID-19 vaccine being developed in Australia raises antibodies to neutralize virus in pre-clinical tests. *Newsweek*. <https://www.newsweek.com/australia-covid-19-vaccine-neutralize-virus-1500849>

c) Print Magazine Article

Nicholl, K. (2020, May). A royal spark. *Vanity Fair*, 62(5), 56–65, 100.

d) Online Newspaper Article

Roberts, S. (2020, April 9). Early string ties us to Neanderthals. *The New York Times*. <https://www.nytimes.com/2020/04/09/science/neanderthals-fiber-string-math.html>

e) Print Newspaper Article

Reynolds, G. (2019, April 9). Different strokes for athletic hearts. *The New York Times*, D4.

f) Blog Post

Rutledge, P. (2019, March 11). The upside of social media. *The Media Psychology Blog*. <https://www.pamelarutledge.com/2019/03/11/the-upside-of-social-media/>

g) Authored Book

Kaufman, K. A., Glass, C. R., & Pineau, T. R. (2018). *Mindful sport performance enhancement: Mental training for athletes and coaches*. American Psychological Association. <https://doi.org/10.1037/0000048-000>

h) Edited Book Chapter

Zeleke, W. A., Hughes, T. L., & Drozda, N. (2020). Home–school collaboration to promote mind–body health. In C. Maykel & M.A. Bray (Eds.), *Promoting mind–body health in schools: Interventions for mental health professionals* (pp. 11–26). American Psychological Association. <https://doi.org/10.1037/0000157-002>

i) Online Dictionary Entry

American Psychological Association. (n.d.). Internet addiction. In *APA dictionary of psychology*. Retrieved April 24, 2020, from <https://dictionary.apa.org/internet-addiction>

j) Report by a Group Author

World Health Organization. (2014). *Comprehensive implementation plan on maternal, infant and young child nutrition*. https://apps.who.int/iris/bitstream/handle/10665/113048/WHO_NMH_NHD_14.1_eng.pdf?ua=1

k) Report by Individual Authors

Winthrop, R., Ziegler, L., Handa, R., & Fakoya, F. (2019). *How playful learning can help leapfrog progress in education*. Center for Universal Education at Brookings. https://www.brookings.edu/wp-content/uploads/2019/04/how_playful_learning_can_help_leapfrog_progress_in_education.pdf

l) Press Release

American Psychological Association. (2020, March 2). *APA reaffirms psychologists' role in combating climate change* [Press release]. <https://www.apa.org/news/press/releases/2020/03/combating-climate-change>

m) Conference Session

Davidson, R. J. (2019, August 8–11). *Well-being is a skill* [Conference session]. APA 2019 Convention, Chicago, IL, United States. https://irp-cdn.multiscreensite.com/a5ea5d51/files/uploaded/APA2019_Program_190708.pdf

n) Dissertation from a Database (Section 10.6)

Horvath-Plyman, M. (2018). *Social media and the college student journey: An examination of how social media use impacts social capital and affects college choice, access, and transition* (Publication No. 10937367) [Doctoral dissertation, New York University]. ProQuest Dissertations and Theses Global.

o) Preprint Article

Latimier, A., Peyre, H., & Ramus, F. (2020). *A meta-analytic review of the benefit of spacing out retrieval practice episodes on retention*. PsyArXiv. <https://psyarxiv.com/kzy7u/>

p) Data Set

O'Donohue, W. (2017). *Content analysis of undergraduate psychology textbooks* (ICPSR 21600; Version V1) [Data set]. Inter-university Consortium for Political and Social Research. <https://doi.org/10.3886/ICPSR36966.v1>

q) Film or Video

Doctor, P., & Del Carmen, R. (Directors). (2015). *Inside out* [Film]. Walt Disney Pictures; Pixar Animation Studios.

r) TV Series Episode

Dippold, K. (Writer), & Trim, M. (Director). (2011, April 14). Fancy party (Season 3, Episode 9) [TV series episode]. In G. Daniels, H. Klein, D. Miner, & M. Schur (Executive Producers), *Parks and recreation*. Deedle-Dee Productions; Fremulon; 3 Arts Entertainment; Universal Media Studios.

s) Webinar

Kamin, H. S., Lee, C. L., & McAdoo, T. L. (2020). *Creating references using seventh edition APA Style* [Webinar]. American Psychological Association. <https://apastyle.apa.org/instructional-aids/tutorials-webinars>

t) YouTube Video

Above The Noise. (2017, October 18). *Can procrastination be a good thing?* [Video]. YouTube. <https://www.youtube.com/watch?v=FQMwmbNNOQ>

u) Song or Track

Nirvana. (1991). Smells like teen spirit [Song]. On *Nevermind*. DGC.

v) Radio Broadcast

Hersher, R. (2020, March 19). *Spring starts today all over America, which is weird* [Radio broadcast]. NPR. <https://www.npr.org/2020/03/19/817237429/spring-starts-today-all-over-america-which-is-weird3>

Podcast Episode (Section 10.13)

Santos, L. (Host). (n.d.). Psychopaths and superheroes (No. 1) [Audio podcast episode]. In *The happiness lab with Dr. Laurie Santos*. Pushkin Industries. <https://www.happinesslab.fm/season-2-episodes/episode-1>

Infographic (Section 10.14)

American Psychological Association. (n.d.). *Data sharing* [Infographic]. <https://www.apa.org/pubs/journals/data-sharing-infographic.pdf>

PowerPoint From a Classroom Website (Section 10.14)

Mack, R., & Spake, G. (2018). *Citing open source images and formatting references for presentations* [PowerPoint slides]. Canvas@FNU. <https://fnu.onelogin.com/login>

Tweet

Obama, B. [@BarackObama]. (2020, April 7). *It's World Health Day, and we owe a profound debt of gratitude to all our medical professionals. They're still giving* [Tweet]. Twitter. <https://twitter.com/BarackObama/status/1247555328365023238>

Open Educational Resource

Fagan, J. (2019, March 25). *Nursing clinical brain*. OER Commons. Retrieved January 7, 2020, from <https://www.oercommons.org/authoring/53029-nursing-clinical-brain/view>

Webpage

Chandler, N. (2020, April 9). *What's the difference between Sasquatch and Bigfoot?* howstuffworks. <https://science.howstuffworks.com/science-vs-myth/strange-creatures/sasquatch-bigfoot-difference.html>

Webpage on a News Website

Machado, J., & Turner, K. (2020, March 7). *The future of feminism*. Vox. <https://www.vox.com/identities/2020/3/7/21163193/international-womens-day-2020>

Webpage with a Retrieval Date

Center for Systems Science and Engineering. (2020, May 6). *COVID-19 dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)*. Johns Hopkins University & Medicine, Coronavirus Resource Center. Retrieved May 6, 2020, from <https://coronavirus.jhu.edu/map.html>

Citations in Text

Groups of references cited in a sentence in the text must be listed in chronological order.

In-text, citations have two formats: parenthetical and narrative.

In **parenthetical citations**, the author name and publication date appear in parentheses. Both the author and the date, separated by a comma, appear in parentheses for a parenthetical citation. A parenthetical citation can appear within or at the end of a sentence. For example

Falsely balanced news coverage can distort the public's perception of expert consensus on an issue (Koehler, 2016).

In **narrative citations**, the author name is incorporated into the text as part of the sentence and the year follows in parentheses. The author's surname appears in running text, and the date appears in parentheses immediately after the author's name for a narrative citation. For example:

Koehler (2016) noted the dangers of falsely balanced news coverage.

In rare cases, the author and date might both appear in the narrative. In this case, do not use parentheses. For example

In 2016, Koehler noted the dangers of falsely balanced news coverage.

Each work cited must appear in the reference list, and each work in the reference list must be cited in the text (or in a table, figure, footnote, or appendix).

Both paraphrases and quotations require citations.

A paraphrase restates another's idea (or your own previously published idea) in your own words. Paraphrasing allows you to summarize and synthesize information from one or more sources, focus on significant information, and compare and contrast relevant details.

Authors paraphrase their sources most of the time, rather than directly quoting the sources; When you paraphrase, cite the original work using either the narrative or parenthetical citation format. Although it is not required to provide a page or paragraph number in the citation, you may include one (in addition to the author and year) when it would help interested readers locate the relevant passage within a long or complex work (e.g., a book).

Webster-Stratton (2016) described a case example of a 4-year-old girl who showed an insecure attachment to her mother; in working with the family dyad, the therapist focused on increasing the mother's empathy for her child (pp. 152–153).

A **direct quotation** reproduces words verbatim from another work or from your own previously published work. It is best to paraphrase sources rather than directly quoting them because paraphrasing allows you to fit material to the context of your paper and writing style. Use direct quotations rather than paraphrasing in case reproducing an exact definition, an author has said something memorably or succinctly, or when you want to respond to exact wording (e.g., something someone said).

For quotations of fewer than 40 words, add quotation marks around the words and incorporate the quote into your own text—there is no additional formatting needed. Do not insert an ellipsis at the beginning and/or end of a quotation unless the original source includes an ellipsis.

Effective teams can be difficult to describe because “high performance along one domain does not translate to high performance along another” (Ervin et al., 2018, p. 470).

For a direct quotation, always include a full citation (parenthetical or narrative) in the same sentence as the quotation, including the page number (or other location information, e.g., paragraph number). Place a parenthetical citation either immediately after the quotation or at the end of the sentence. For a narrative citation, include the author and year in the sentence and then place the page number or other location information in parentheses after the quotation.

If the quotation precedes the narrative citation, put the page number or location information after the year and a comma. If the citation appears at the end of a sentence, put the end punctuation after the closing parenthesis for the citation.

Place periods and commas within closing single or double quotation marks. Place other punctuation marks inside quotation marks only when they are part of the quoted material.

Format quotations of 40 words or more as block quotations:

- Do not use quotation marks to enclose a block quotation. Start a block quotation on a new line and indent the whole block 0.5 in. from the left margin. Double-space the entire block quotation. Do not add extra space before or after it. If there are additional paragraphs within the quotation, indent the first line of each subsequent paragraph an additional 0.5 in.
- Either cite the source in parentheses after the quotation's final punctuation or cite the author and year in the narrative before the quotation and place only the page number in parentheses after the quotation's final punctuation.
- Do not add a period after the closing parenthesis in either case.

Block quotation with parenthetical citation:

Researchers have studied how people talk to themselves:

Inner speech is a paradoxical phenomenon. It is an experience that is central to many people's everyday lives, and yet it presents considerable challenges to any effort to study it scientifically. Nevertheless, a wide range of methodologies and approaches have combined to shed light on the subjective experience of inner speech and its cognitive and neural underpinnings. (Alderson-Day & Fernyhough, 2015, p. 957)

Block quotation with narrative citation:

Flores et al. (2018) described how they addressed potential researcher bias when working with an intersectional community of transgender people of color:

Everyone on the research team belonged to a stigmatized group but also held privileged identities. Throughout the research process, we attended to the ways in which our privileged and oppressed identities may have influenced the research process, findings, and presentation of results. (p. 311)

The following are general guidelines to follow when writing in-text citations:

- Ensure that the spelling of author names and the publication dates in reference list entries match those in the corresponding in-text citations.
- Cite only works that you have read and ideas that you have incorporated into your writing. The works you cite may provide key background information, support or dispute your thesis, or offer critical definitions and data.
- Readers may find a long string of citations difficult to understand, especially if they are using assistive technology such as a screen reader; therefore, include only those citations needed to support your immediate point.
- Cite primary sources when possible, and cite secondary sources sparingly.
- Cite sources to document all facts and figures that you mention that are not common knowledge.
- To cite a specific part of a source, provide an author–date citation for the work plus information about the specific part.
- Even when sources cannot be retrieved (e.g., because they are personal communications), still credit them in the text (however, avoid using online sources that are no longer recoverable).

Layout Formats

General: Use Times New Roman font of size 12 point. The paragraph must be justified and separated from one another with a single space. Line spacing must be 'Double'.

Page layout: Format your article so that it can be printed on A4 size paper with a provision of left right and top margin of 2.5 cm. The bottom margin must be 4 cm.

Major heading: All major heading (ABSTRACT, KEYWORDS, INTRODUCTION, METHODOLOGY, RESULTS AND DISCUSSION, CONCLUSION AND REFERENCES) should be in upper case or capital letters (14 point bold) 'centre aligned'.

Sub-headings: Use font size of 12 point bold. To be typed on a separate line and 'left aligned' first letter of the first word to be in upper case (capital letter) and all other letters in lower case (small letter) e.g. Socio-economic and psychological characteristics.

Sub-sub headings: Use font size of 10 point bold, in italics and 'left aligned'. To be typed in a separate line with use with left margin. The first letter of first word to be in upper case (capital letter) and all other letters in lower case (small letters)

Table formats: Tables have to be placed in the appropriate place in the text. They should be prepared using the Table facility of Microsoft Word. Tables must have a Table caption on the top of the Table. The first letter of the first word of the caption should be in upper case (capital letters) and all other letters in lower case (small letters). A research paper should not have more than seven Tables.

Graphic formats: Only computer generated charts of figures (as a part of Microsoft word or GIF of JPEG files) or photographs relevant to the contents of the paper will be accepted.

Acronyms: You have to spell out the acronym for its first occurrence followed by the acronym within parenthesis. Example: Integrated Rural Development Programme (IRDP) or Training and visit (T & V).

Plagiarism: Authors must obtain permission to reproduce any copyright material, and include an acknowledgement of the source in their article. They should be aware that the unreferenced use of the published and unpublished ideas, writing or illustrations of others, or submission of a complete paper under a new authorship in a different or the same language, is plagiarism.

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