ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Indian Journal of Extension Education

Volume 58, No. 2
April-June 2022

THE INDIAN SOCIETY OF EXTENSION EDUCATION
Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute
New Delhi 110 012, Website : www.iseeindia.org.in

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EDITORIAL

From fuel to fertilizer and crude oil to vegetable oil the recent Russia-Ukraine conflict is roiling markets. India experienced a shortage of DAP right before *rabi* 2021-22 sowing season, and the recent sanctions may result in rising input costs and farmers may get lesser DAP for their fields. At least 80% of crude oil, 60% of the cooking oil and 35% fertilizers is met through imports and the crisis region have lion's share. Although, it is an opportune time for India to export its agricultural surplus and cut down the huge inventories it is carrying but the farmers and consumers need be prepared to weather the storm. Also the agricultural extension system needs far deeper commitment and more active engagement for contingent times.

It's my privilege to present the current issue (April- June, 2022) containing 46 manuscripts from cross sectional authors and content ranging from basic research in the form of measuring tool development; Climate Smart framework; Innovation decision process analysis; forecasting the price; studies on producer federations; knowledge and attitude analysis of various technologies and innovations; food consumption pattern; promising avenues like DSR; Tribal Sub Plan study; studies on millets especially buckwheat, pulses and oilseed; organic farming; water use efficiency; health and life style; social media utilization; value chain analysis; marketing skills; use of choice-based conjoint analysis for estimation of willingness to pay; livelihood security factors; technological gap analysis; credits and subsidy analysis; seed demand and supply gap of selected crops; price behaviour, case study of referral veterinary polyclinic services and so on. Geographically and diversity wise, the manuscripts cover 18 Indian states and UTs, 30 Indian institutions (SAUs/CAUs/ ATARIs/ DUs/ SVUs/ KVKs) and contents with issues of agriculture, dairy, fisheries, veterinary sciences and community sciences. The IJEE is now getting wider circulation with the opportunity for citations and indexing. As on date indexed at CAB International; Science gate; Agricultural Science and Technology Information data base of FAO which has become possible by submitting metadata in desirable form to Crossref.

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 (Dr. Himanshu K. De, Dr. Kalyan Ghadei, Dr. Rajeev Bairathi, Dr. S. S. Dolli & Dr. V.P.S. Yadav) for their painstaking efforts. I extend my sincere thanks to all the authors for making valuable contributions. The support extended by Executive Council is duly acknowledged.

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

INDIAN JOURNAL OF EXTENSION EDUCATION

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Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (1-7)

ISSN 0537-1996 (Print)
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Conceptualizing and Validating a Framework of Climate Smart Village in Flood Affected Ecosystem of West Bengal

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ARTICLE INFO

Keywords: Climate smart village, Adoption, Impact

http://doi.org/10.48165/IJEE.2022.58201

ABSTRACT

Climate change is the major issue affecting the survival of human kind in the present day scenario. Farmers are the most vulnerable communities to these changes. Many climate smart technologies were devised and tried to promote through traditional extension system. But their adoption rate is very poor doe to multiple socio-economic and technological factors. Therefore focus extension approach were thought of and concept of climate smart village was introduced to promote climate smart technologies. But the past efforts on establishing climate smart villages were revolved around only on technological dimension ignoring socio-economic dimension of climate change. Hence, the present study conceptualizes the climate smart village integrating technological as well as social factors. The concept has been experimented during 2016-2021 at field level in the village Singimari, Jalpaiguri district of West Bengal in convergence mode with other related stakeholders line Krishi vigyan Kendra (KVK), state agricultural department, National Bank for Agriculture and Rural Development (NABARD), NGOs and farming communities. The findings revealed that adoption level of climate smart technologies and practices has increased significantly after establishment of climate smart village. Therefore, more number of climate smart villages should be established specially in vulnerable ecosystem for better adaptation to climate change.

INTRODUCTION

The production system in agriculture is supposed to change throughout the world under the changing climatic scenario. The past studies have already proven that the yield variability in recent past is mainly due to climate change (Agarwal et al., 2018; Ray et al., 2015 & Harikrishna et al., 2019). Though agriculture sector is the major victim of climate change but its role in this change has drawn attention from different policy corners. Vermeulen et al., (2012) reported that an agricultural food system, responsible for 19–29 per cent of global greenhouse gas (GHG) emissions, was the second largest contributor to climate change. Hence, the scientific community put sincere efforts to come up with new climate smart farming technologies for better adaptation to changing climate. At present, there are many options to averse the negative effects of climate change on agricultural systems (Porter et al., 2014 & Khatri Chhetri et al., 2016). But the uptake of these climate smart technologies was very weak (Campbell et al., 2014 & Westermann

Received 03-10-2021; Accepted 28-12-2021

et al., 2015). For example, new water management practices in India were adopted by only 12 per cent farmers in last 40 years (Palanisami et al., 2015). Oraon et al., (2020) found that only 22 per cent farmers belonged to high level adopter category for mechanical soil and water conservation technologies under NICRA in Jharkhand.

Many new extension approaches were devised to address the problem of low uptake of climate smart technologies. Among all these, community based extension approach has gained attentions that are pluralistic, demand driven and farmer-centered (Davis, 2008; Rivera, 2011; Wellard et al., 2013; Kiptot & Franzel, 2015; Chinseu et al., 2021). To generate the evidence on the efficacy of climate-smart options, the Consultative Group for International Agricultural Research (CGIAR) research program on Climate Change, Agriculture and Food Security (CCAFS) has implemented a climate-smart village (CSV) approach in Asia, Africa, and Latin America (Aggarwal et al., 2013). The CSV approach is conceptualized to test and demonstrate the effect of different technological and institutional options in climate change adaptation. It intends to showcase the evidences on result of diverse technological options to draw out lessons for policy makers. However, the CSV approach of CGIAR is mainly based on technological parameter ignoring the social dimension. In this regard, Dumenu & Tiamgne (2020) & Dupdal et al., (2021) emphasized on the need of capturing the social dimensions of climate change, and simultaneously expressed his concern on lack of study in this direction. The major reason for lack of studies on social aspects of climate change stems from the fact that it lacks in sound methodology in climate change context, lack of appropriate indicators and difficulties in quantifying them. So devising a climate smart village concept including socio-economic indicators becomes the rising concern of researchers. Hence, the present study was conducted to conceptualize the philosophy of 'Climate Smart Village (CSV)' integrating technological as well as social dimension under the project titled as "Devising innovative extension approaches for livelihood security" of Indian Agricultural Research Institute, New Delhi.

METHODOLOGY

The present study was conducted in Singimari area of Maynaguri, Jalpaiguri district, West Bengal. All the villages within a radius of nearly 10 KM were selected for the intervention under climate smart village. The villages were near the Teesta River and situated in flood affected ecosystem. Most of the land belong to low land area with high sensitivity to rainfall and flood. The farmers mainly depend on the rainfed farming system hence their vulnerability was more. The data for the findings on adoption of climate smart technology and impact of climate smart village was randomly collected from a sample of 400 respondents. The data were analysed using descriptive statistics like mean, frequency, and percentage.

To identify the indicator of climate smart village, an exhaustive lists of items were collected on concept of climate changes, its causes and consequences on society to represent the universe of the construct. Finally thirteen criteria were finalized based the highest mean score and agreement of the experts committee. Two approaches were followed for validating the present concept of climate smart village and its effectiveness. In first approach, validation refers to institutional validation i.e. a third party institution will investigate the different interventions, its impact and benefits received by the beneficiaries under the proposed model. This has been done by state agricultural department. The state agricultural department, Govt. of West Bengal has certified the village Singimari as "Climate Smart Village" in 2020. In second approach, the impact of climate smart village was assessed and its effectiveness was studied.

The study documented the changes in different farming scenario, technology adoption status, production scenario and changes in socio-economic scenario as an indicators of impact of present extension approach i.e. climate smart village. Before-after analysis was done to trace the changes within the project period.

RESULTS AND DISCUSSION

Conceptualization of climate smart villages

A climate smart village has been conceptualized a s a village where all the villagers contribute to climate change adaptation by adopting the required climate resilient technologies, follows the mitigation measures for reducing green house gas emission, brought positive behavioural change and devise local solution to reduce vulnerability towards future climate change impacts keeping the region's socio-economic, gender and bio-physical constraints in mind through community participatory approach. After selection of criteria through experts' judgement, a conceptual framework of climate smart village was designed for future work plan. The detailed framework of climate smart village has been presented in Figure 1.

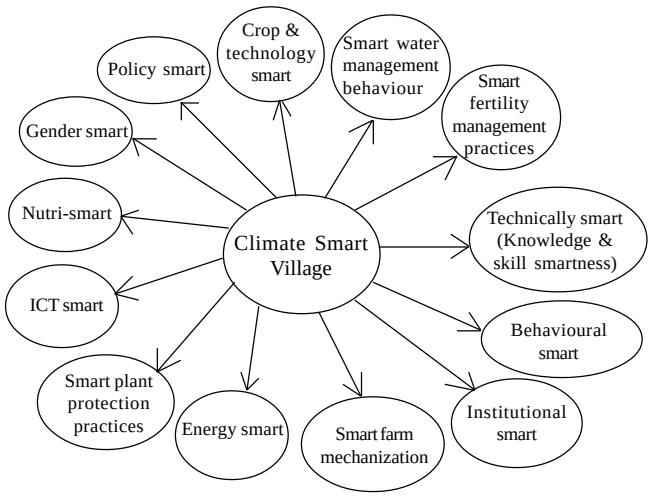

Figure 1. Conceptual framework of climate smart village

Institutional convergence framework

The study followed the approach Agricultural Innovation System theory for establishing convergence among the related institutions. Hence, the project tied up with Krishi Vigyan Kendra, Jalpaiguri; NABARD, state agricultural department, insurance Company, Bgajan Pragatishil Farmers Producer Organization for delivering different climate related products and services to the farmers of climate smart village (Figure 2).

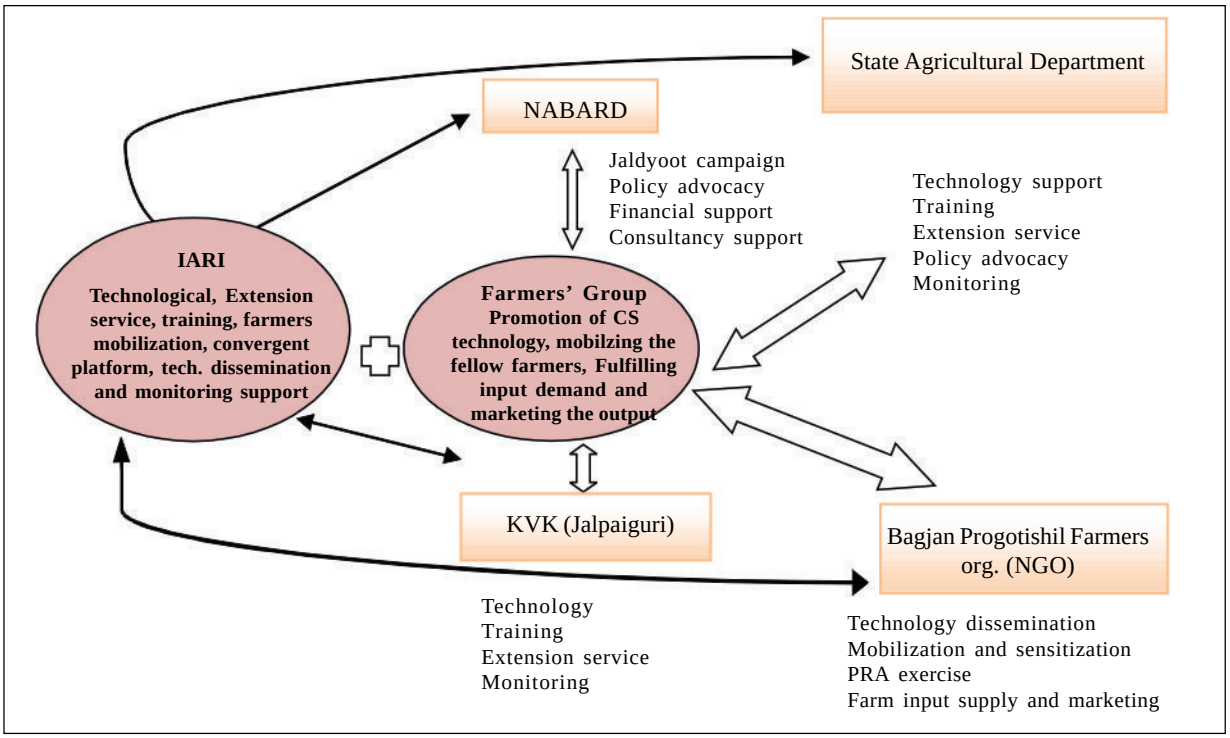

Figure 2. Institutional mechanism for establishing climate smart village

Interventions made to make the village climate smart

The major interventions made according to the different criteria of climate smart village are presented in Table 1.

Impact of climate smart village

The findings in Table 2 revealed that due to the intervention under climate smart village significnat increase in area under pulse and oilseed (65.78%) has been observed followed by irrigated area (42%), water bodies (41.02%), area under fruit/orcahrd/plantation crops (37.50%), land under forest (33.33%), area under vegetables (23.07%), area under cereals (11.11%). The decline of fallow land by 65.52 per cent indicates that unproductive or unused land was converted into farming land under the project. The introduction of pules like red gram, green gram into the cropping pattern ensured the soil helath and sustainable production system.

To unveil the impact of improved varieties and other climate resilient technologies on yield of major crops, the yield data of respective crops before the project intervention (2015) and at the time of the study (2020) were compared. The Table 3 depicted an increase in average yield for all the major crops in the project villages. Maximum yield improvement (33.33%) was witnessed in case of mustard crop. This is due to the introduction of new high yielding varieties like PM 26, PM 28 and PM30. In case of rice, the yield enhancement of 25 per cent was recorded due to adoption of climate resilient varieties like PS-5 and Swarna sub I. Among the pulses, the yield of green gram has increased by 30 per cent followed by red gram (28.57%). Demonstrations on improved varieties of off-season vegetables showed an increase in yield of Beans (Summer 25%), Peas (23.07%), Ladies finger (winter 18.75%), Cabbage (14.29%), Cauliflower (16.27%), Tomato (20%), Brinjal (summer). Zheng et al., (2014) & Edralin (2017) reported similar finding in his experiment and mentioned that due to adoption of CA practices crop yield was increased by 4.6 per cent on average. Jasna et al., (2014) found that a noticeable increase in production was achieved through introduction of improved climate smart varieties. So, all these studies proved that climate resilient technologies played a key role in transforming climate vulnerable agriculture to climate smart agriculture. Hence, more focused extension approach like 'Climate Smart Village (CSV)' should be promoted in different vulnerable ecosystem for adaptation to climate change.

Cropping intensity and diversity

Analysis of the data on average cropping intensity from all the villages has shown that average cropping intensity has increased significantly (Table 4). The cropping intensity has increased from 95.34 per cent to 127.12 per cent after the establishment of climate smart village, and the difference was statistically significant at <1 per cent level of significance. The findings indicate that there was an increase in crop diversification from 2.10 to 3.15 in the climate smart village. Jasna et al., (2017) also reported similar findings about increased cropping intensity in NICRA villages due to the introduction of climate smart technologies. Prasad et al., (2014) reported an increase in average cropping intensity across farmers by 17 per cent due to de-silting works. Medhi (2018) reported an increase in the cropping intensity even upto 204 per cent while studying impact of climate resilient technologies under NICRA project in Meghalaya.

Increased adoption of climate resilient technologies

The adoption of different climate smart technologies and incorporation of those technologies into the local farming system

Table 1. Interventions made in climate smart village

S.No.	Climate smart parameter	Interventions
1	Crop & technology smart	climate resilient rice varieties (PS-5, P 1612), flood resistant rice variety (swarna -sub I), DSR, green gram (Pusa bishal), and mustard (PM-26, PM-28, Pusa Vijay) varieties, cultivation of pulses (arhar, moong), intercropping of jute and moong, SRI, mulching techniques, raised bed panting, line sowing, crop rotation etc. were promoted in adopted villages.
2	Smart water management behaviour	Drip irrigation, sprinkler irrigation, mulching, water harvesting were promoted
3	Smart fertility management practices	Soil testing, INM, uses of micro-nutrient, vermi-compost, liquid fertilizer etc. were encouraged.
4	Technically smart (Knowledge & skill smartness)	Training on knowledge of different climate resilient technologies like DSR, zero tillage, SRI, IPM, INM etc. of different crops
5	Behavioural smart (having favourable attitude, value system and perception towards climate change and climate resilient technologies)	Awareness programme to create favourable attitude and value system towards climate change. They were encouraged to subscribe weather forecasting platforms, climate-informed agro-advisories, weather insurance as a tool for forward planning.
6	Institutional smart	Mobilizing for formation of community level institutions like producer company, water user group, custom hiring centre, seed village and linkage with different government as well as private agencies related to climate change.
7	Energy smart	Promotion of solar technologies for irrigation and spray.
8	Smart plant protection practices	INM practices, pheromone trap, yellow sticky trap, ITKs etc.
9	ICT smart	Trained to use mobile phone for accessing meteorological services
10	Policy smart	Awareness creation of different policies related to climate change like Pradhanmnatri Fasal Bima Yojana, Jaldoot, paramparagat krishi vikas yojana etc. and registering under those scheme for adapting to climatic risk.
11	Gender smart	Involving male as well as female members in each programme and intervention
12	Nutritional smart	Promotion of nutri-crops and varieties like black rice, PM-30 and PM-31 of mustard variety, iron rich leafy vegetables, nutri vegetables like moringa, broccoli, capsicum, red cabbage, summer squash, yellow cauliflower, ant-oxidant rich carrot etc.
13	ITK smart	Documentation & promotion of indigenous climate resilient technologies
14	Smart farm mechanization	Farm machineries like zero tiller, paddy trans-planter, paddy seeder, drum seeder etc. were promoted for adoption of climate smart practices.

Table 2. Change in land use pattern

S.No.	Crops	Before (ha)	After (ha)	% increase
1	Area under cereals	160	180	11.11
2	Area under vegetables	100	130	23.07
3	Area under fruit/orchard/plantation	45	72	37.50
4	Area under pulses and oilseed	13	38	65.78
4	Irrigated area	87	150	42.00
5	Fallow land	58	20	-65.52
6	Land under forest	10	15	33.33
8	Water bodies (Pond, Nala etc)	23	39	41.02

is the starting point to build up adaptation against climate change. Therefore, the present project introduced diverse climate smart technologies and practices and recorded their adoption status after completion of the project. The findings in Table 5 revealed that there was significant improvement in the adoption scenario of different climate smart technologies and practices after the project implementation. The adoption of different climate resilient cropping system like pulse based cropping system has increased from 11.25 per cent in 2015 to 52.50 per cent in 2020. The number of farmers who changed their planting or sowing time of crops to adapt with changing climate increased from 24.50 per cent to 53.75 per cent. Earlier only 19.75 per cent farmers were cultivating any climate smart crops as an adaptive measure. But now almost half of the farming communities (46.50%) adopted different climate smart

Table 3. Increase in yield level of major crops

S.No.	Crops	Mean yield before 2015 (q/ha)	Mean yield after 2020 (q/ha)	% increase
1	Rice (Amon)	30	40	25.00
2	Maize (Rabi)	18	22	18.18
3	Mustard	10	15	33.33
4	Jute (0li.)	18	21	14.29
5	Potato	200	250	20.00
6	Red gram	5	7	28.57
7	Green gram	7	10	30.00
8	Beans (Summer)	45	60	25.00
9	Peas	50	65	23.07
10	Ladies finger (winter)	65	80	18.75
11	Cabbage	210	245	14.29
12	Cauliflower	180	215	16.27
13	Tomato	200	250	20.00
14	Brinjal (summer)	145	170	14.70

Table 4. Change in cropping intensity and crop diversification

S.No.	Impact	Before	After	t-value
1	Cropping intensity (%)	95.34	127.12	7.157*
2	Crop diversification	2.10	3.15	2.89*

*Significant at $P < 0.01$

Table 5. Adoption status of climate smart technologies and practices

S. No.	Climate smart technologies and practices	Before f(%)	After f(%)
1	New cropping system	45(11.25)	210(52.50)
2	Change in planting time	98(24.50)	215(53.75)
3	Adoption of climate smart crops	79(19.75)	186(46.5)
4	Adoption of climate smart varieties	94(23.50)	230(57.50)
5	Line sowing	110(27.50)	250(62.50)
6	Raised bed planting	56(14)	149(29.80)
7	Crop rotation	78(19.50)	193(48.25)
8	Zero tillage	25(6.25)	210(52.5)
9	Direct seeded rice	30(7.5)	180(45)
10	Intercropping	85(21.25)	270(67.50)
11	Mulching	67(16.75)	225(56.25)
12	IPM	58(14.50)	235(58.75)
13	INM	69(17.25)	190(47.50)
14	Micro irrigation system	70(17.50)	260(65.00)
15	Water harvesting	80(20)	250(62.50)
16	Solar pump	0(0)	80(20)
17	Subscribe to weather advisory	50(12.50)	275(68.75)
18	Registration in crop insurance	40(10)	250(62.50)
19	Organic farming	25(6.25)	80(20)
20	Adoption of pulse based cropping pattern	65(16.25)	175(43.75)
21	Improved fodder management practices	50(12.50)	150(37.50)
22	Regular vaccination and deforming of animals	84(16.80)	246(49.20)
23	Adoption of fishery	90(22.50)	192(48)
24	Adoption of poultry	87(21.75)	143(35.75)
25	Adoption of goatery	63(15.75)	119(29.75)

crops to cope up with changing climate. Similarly, earlier just 23.50 per cent farmers adopted different climate smart varieties to reduce the impact of climate change in production system. As part of the project implementation plan, 18 new crop varieties were introduced in 10 villages of the Jalpaiguri district of West Bengal. The major technologies promoted were climate resilient varieties like PS-5, swarna sub-I of paddy, cultivation of pulses (arhar, moong), Pusa Vishal of green gram, PM 26, PM28, and PM 30 of mustard etc. After the project period, more than half of the farming communities (57.50%) adopted multiple climate smart varieties to enhance the production and productivity of their major crops in changing climatic scenario. Most promising response was found in case of line sowing as 62.50 per cent farmers now practicing line sowing for cereals, vegetables and oilseed. This may be due to the fact that the benefit of adoption of line sowing in term of yield enhancement, weed management, fertilizer and water management are easily visible to even small-scale farmers. Further, it involved very less risk in adoption of line sowing in their production system. Zero tillage and direct seeded rice was conceived to be as most promising climate resilient technologies and intensive efforts were made for its popularization. The study revealed that adoption of zero tillage has increased from 6.25 per cent to 52.50 per cent while the adoption of DSR has increased from 7.5 per cent to 45 per cent.

The number of farmers who now practiced intercropping as an adaptive measure towards climate change has risen from 21.25 per cent to 67.50 per cent. Mulching become highly popular among the farming communities as 56.25 per cent farmers practicing it for conserving soil moisture and arresting weed growth. The number of farmers who are following IPM as an adaptive measure has raised form 14.50 per cent to 58.75 per cent. The adoption rate of INM practices was increased from 17.25 per cent to 47.50 per cent. The importance of ICT in climate change adaptation has been highlighted by different studies and policy makers (Shafiq et al., 2014 & Adger et al., 2009). Hence, the present project registered the farmers under *Grami Krishi Mosuam Sewa* to receive weather based agro-advisory services in local language. Beside this, they were subscribed to different weather based platform for any weather related information. Findings revealed that the number of farmers subscribed and following weather based advisory services has increased from 12.50 per cent to 68.75 per cent. Similarly, the number of farmers who insured their crops against any climatic hazards has increased from mere 10 per cent in 2015 to 62.50 per cent by 2020. Now almost half of the respondents (43.75%) followed pulse based cropping pattern replacing cereal-cereal-vegetable as the major cropping pattern. Adoption of improved fodder management practices has increased from 12.50 per cent to 37.50 per cent. Regular vaccination was done by 49.20 per cent farmers in 2020 against 16.80 per cent in 2015. Almost half of the respondents (48%) adopted fishery for adaptation towards climate change beside regular farming. Similarly 35.75 per cent farmers started poultry and goatery by 29.75 per cent as off-farm enterprise for overcoming the climate related risks.

Though the findings of present study contradict with many previous findings. For example, Khati (2020) reported about the low adoption level of climate resilient technologies. Similarly, Anseera (2019) too mentioned that the results of adoptions of climate resilient practices are not very encouraging. The findings of Tiamiyu et al., (2018) indicated that adoption of most of the climate smart practices was very less due to the low awareness level. The low adoption scenario in past studies may be due to the fact that in all the past studies there was no focused extension approach unlike the present study where a specific extension approaches i.e. ‘climate smart village’ was followed. The climate smart technologies are highly complex in nature which need focused extension strategies for its promotion among the farming communities.

Socio-economic impact

The project interventions over the five year period made diverse impact among the socio-economic life of villagers. The Table 6 revealed that almost all the farmers (88.50%) agreed that the adoption of different climate resilient varieties and practices helped in enhancing their income while only 11.50 per cent viewed that it helps more in climate change adaptation than enhancing income. The findings of present study further reveals that majority of the farmers (77.50%) opined that the project interventions especially formation of FPO helped in accessing the different production inputs at much ease and at much lower cost. Effective local institutions are central to society’s ability to respond to the impacts of climate change. Institutions link individuals with collectives and provide the framework within which households and collectives choose adaptation practices. Two local institutions name Bagjan Progotishil Sangha (NGO) and Bangkandi Farmer Producer Organization supported the CSA adoption by integrating all the

Table 6. Socio-economic impact

S.No.	Impact	Yes f(%)	No f(%)
1	Farmers with increased income	354 (88.50)	46 (11.50)
2	Increased access to production inputs	310 (77.50)	90 (22.50)
3	More accessible finance	260 (65)	140 (35)
4	More specialized local livelihood strategies	400 (100)	0 (0)
5	Changes in capacity of local actors & socially embedded institutions	325 (81.25)	75 (18.75)
6	Emergence of cultural and gender friendly local institutions	275 (68.75)	125 (31.25)
7	Changes in capacity of R&D system & associated institutions	220 (55)	180 (45)
8	Increased convergence among the stakeholders	250 (62.50)	150 (27.50)
9	Increased mobile usage among the farming communities	330 (82.50)	70 (17.50)

stakeholders with each other. This makes their farming life easy and comfortable. Just more than half of the respondents (65%) revealed that now they access different financial services very easily through farmers group without any collateral security. This helped them to take additional risk for adaptation to climate change. All the farmers (100%) unanimously agreed that the present concept of climate smart village helped them to devise more specialized and focussed livelihood strategies keeping the local resources and climatic condition in mind. Similarly, majority of the farmers (81.25%) reported that the establishment of climate smart village raise the capacity of local actors and institutions. More than half of the respondents (62.50%) reported about increased convergence among the stakeholders at block level under the climate smart village. Majority of the respondents (82.50%) perceived that the usage of mobile among the farmers has gone up significantly under the climate smart village projects.

CONCLUSION

The promotion of climate smart technology needs focussed extension approach. The significant increase in adoption rate of different climate smart technologies and practices. The farmers showed positive response and actively participated in establishment of climate smart village. The poor adoption rate of climate resilient technologies through traditional extension system can be overcome through focussed extension approach like climate smart village. The incorporation of social dimension in the concept of climate smart village accelerates the adoption rate of climate smart technologies by igniting the social diffusion process. Therefore this type of innovative extension approach should be up-scaled and out-scaled especially in the vulnerable ecosystem for better adaptation to climate change.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (8-14)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Farmers Decision Making Pattern on Agricultural Innovations: A Process Analysis

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ARTICLE INFO

Keywords: Decision making pattern, Decision process analysis, Indian farmers, Informed decisions, Extension education

http://doi.org/10.48165/IJEE.2022.58202

ABSTRACT

Decision making on new practices in crop production and marketing among farmers was studied in different agro-climatic situations of Gujarat and Karnataka. The process was analyzed using the initiation pattern, activities engaged in and sources consulted before decision-making based on primary data collected from 787 farmers cultivating paddy, cotton, groundnut, maize and potato. Five patterns of initiation to decision making were identified, which varied for different functional areas and crops. Activities that followed indicated that majority of farmers resorted to quick decision making, mostly based on a single source of information. Based on the pattern of initiation, sources of information and activities, decision making was broadly categorized as imitation, induced and informed. Informed decision-making was more prevalent in the case of groundnut and maize crops, which were less problematic crops. On the contrary, cotton and potato farmers resorted to induced decision-making, probably due to complexity of problems in pests, micronutrient and marketing. In paddy, a traditional food crop cultivated in a more homogenous environment, farmers resorted to imitative decision making. Maximizing informed decisions while facilitating purposeful imitation could be a desirable strategy, although the specific strategies could be location and context-specific.

INTRODUCTION

Right farming decisions can improve farmers' livelihoods and support national goals. Farmers need to make decisions often in an environment of uncertainty. Improving the quality of farmers' decisions is therefore one of the primary concerns of the extension education across the globe and extension systems must understand farmers' decision-making process clearly. Decision-making is one of the basic cognitive processes of human behaviors. Classical economic theory argues for rational behavior in which decisions are made based on all available information. It may not be possible to obtain all the needed information and might make decisions that are good enough for reasonably acceptable outcomes. Farmers' decisions are influenced by several situational factors including access to technological information, extension agency's efforts, input availability etc. The five-stage adoption process "awareness-interest-evaluation-trial-adoption" (Ray, 1991), the innovation decision process "knowledge-persuasion-decision-implementation-confirmation" (Rogers, 1983) and "ignorance- aware-interest-compare-test –adopt/reject" suggested by Botha and Atkins (2005) were linear in nature. Bo Ohlmer et al., (1998) suggested four phases and four sub-processes in the decision-making process using case analysis approach. Problem detection, problem definition, analysis and choice were the phases. Searching and paying attention, planning, evaluating and choosing, and checking the choice were the sub processes. Most studies of innovation-decision making have

Received 19-01-2022; Accepted 27-01-2022

analyzed the pattern of diffusion of one specific technology, whereas it is a common phenomenon that farmers do not adopt innovations as they appear on the market (Paul et al., 2003). Zachary et al., (1982) identified the constituents in decision making as the decision situation, the decision maker, and the decision process. The normative approach suggested eight-stage process of "aware – goal setting - diagnose problem - review alternatives – evaluate - choose the best option - implement and evaluate". Bos model of group opinion formation includes "Knowledge – Facts/ Interpretation of facts – Goals and Means – Choices (Van den Ban & Hawkins, 1998).

It is of paramount importance to educate and empower farmers to make informed decisions to sustain crop production with good agricultural practices. Pluralistic extension system of India has multiple service providers, each having its own network of establishment and activities to reach farmers, mainly to promote their products and services. Farmers are often faced with the challenge of making choices from these parallelly operating input and information providers. Ground realities indicate that farmers often lack adequate investment capacities in buying required seeds, fertilizers, micronutrients and pesticides, thus making them dependent on someone who provides these on credit basis. In such cases, farmers may not have complete control over the choices and decisions they make. Therefore, it is hypothesized that farmers' innovation-decision pattern is not the same for all innovations and situations. It is a dynamic process depending on the situation; hence the investigation was planned to understand the decision-making pattern of farmers for different crops and innovations and analyze the decision making process.

METHODOLOGY

The study was conducted in Karnataka and Gujarat states of India, with funding support from National Agriculture Science Fund (NASF) of the Indian Council of Agricultural Research (ICAR). Agro-climatically, Karnataka and Gujarat states have many similarities, having both irrigated and rainfed situations, and cultivating common crops under cereals, oilseeds, vegetables and commercial crops. Based on the secondary data on major crops, cotton (commercial crop), paddy and maize (cereal crops), groundnut (oilseed crop), and potato (vegetable crop) were selected as crops for studying farmers' decision-making process.

In each state, district with largest area under the selected crop was identified based on secondary data. The districts identified in Karnataka were Raichur (cotton), Dharwad (groundnut), Haveri (maize), Koppal (paddy) and Kolar/Chikkaballapur (potato). In Gujarat, Botad, Junagad, Panchmahal, Khed and Banaskantha districts were selected for the study. Further, clusters of villages were identified in consultation with the officials of the development departments for each crop. Informal discussions with the village leaders/ key informants were held to confirm the cultivation of the crop by majority of farmers. Finally, two villages for each of the five crops per state, 20 villages in total, constituted the study area. Households were arranged based on landholding and then 50 households were randomly selected as the initial sample. Households that consented to serve as respondents for the study were retained and others were dropped. The final sample size was 425 in Karnataka, which included 73 cotton, 90 groundnut, 89 maize, 73 paddy and 100 potato farmers. The sample size in Gujarat was 362, which included 85 cotton, 62 groundnut, 78 maize, 70 paddy and 67 potato growers. The total sample was 787 farmers from both the states.

Farmers' decision-making process was studied by using survey research method with ex-post research design. Five areas of crop production (i) varieties/hybrids, (ii) micro/secondary nutrients, (iii) pest management (iv) irrigation method and (v) marketing were considered for studying the farmers' decision-making. During the project period 2014-2016, each farmer was visited multiple times by the field invigilators to document the new practices adopted and the decision making process. Farmers' decision-making was ascertained keeping the "Context-Source-Goal" as the basis. Farmers were asked (i) what was the context / situation that demanded a change /continuation of a practice? (ii) what were the sources of information and the activities carried out? and (iii) what was/were the expected output/outcome? The results are presented using the descriptive statistics frequency and percentage.

RESULTS AND DISCUSSION

Context analysis

Five distinct contexts could be observed from the situations that triggered farmers' decision on innovations while cultivating crops and marketing their produce. These contexts were (i) within the village, purposeful and informal interactions; (ii) extension (public/private) functionaries visit to villages or farmers' participation in formal extension activities organized elsewhere; (iii) individuals facing problems in the farm / crop that required immediate solutions; (iv) individuals coming across new information accidentally, within and outside the village; and (v) individuals in search of new information, within and outside the village.

Source analysis

Sources varied widely from context to context and the number of sources differed substantially. Informal but known sources included family members, peer-groups, friends, and neighbors. Unknown sources from the outside the system included the agricultural/general exhibitions, fairs and road shows. Formal sources, both known and unknown included all types of media including television, radio, print and mobile/telephone. Officials representing both public and private extension systems, scientists and technical personnel from the research system, traders, intermediaries and agents were the sources of information at different stages.

Goal analysis

The main goal of farmers was to maximize yield from the crop/ farm and earn higher income. Except the marketing activity where higher price and maximization of income were the prime goals, the remaining four functional areas were related to enhancing yield and production. When faced with problems such as pest attack, moisture stress, or plant nutritional deficiency, farmers had a short-term goal to find immediate solutions. Trying a new idea and doing something new was the goal of some farmers who were "in pursuit

Table 1. Context-Source-Goal based identification of Initiation to Decision-Making Process

Context / Situation	Source of innovations	Goals of the decision maker (farmer)	Initiation pattern
Within the village, purposeful and informal interactions	Informal sources mostly family members, peer-groups, friends, neighbors	Produce a good crop by replicating successful practices observed in the neighborhood. Be part of the peer group / social clique by adopting the practices	Community sharing
Extension (public/private) functionaries visit to villages or farmers' participation in formal extension activities organized elsewhere	Formal sources from public / private extension functionaries, mostly known	Receive the material benefits offered by extension system. Establish and maintain relation with extension agency/personnel for continued support.	Extension agency-initiated
Individuals facing problems in the farm / crop that required immediate solutions	Input agencies, known sources	Get solutions to a suddenly noticed problem, along with necessary input	Problem-driven
Individuals coming across new information accidentally, within and outside the village	Formal / informal unknown sources	Not sure, but try the new information in the farm with the hope for better results	Incidental
Individual in search of new information, within and outside the village	Multiple sources - mostly institutional, media and officials	Look for new product/practice, satisfy the urge to try/test and introduce something new in the farm. Earn/maintain the innovator tag by trying new seed / practices that lead to higher yield or explore new markets that fetch higher price.	Self – driven

of something new". Broadly, five types of initiation were identified and the "Context-Source-Goal" paradigm that resulted in the five "Decision Initiation Patterns" is presented in Table 1.

The initiation pattern to the decision making differed within the five functional areas of crop management, among the five crops and between the states, although there were some commonalities (Table 2). Community-initiated decision-making was more in Gujarat (54.05%) compared to Karnataka (46.4%) and so was the case with extension-initiated decision making, 19.37 per cent and 8.18 per cent respectively. Problem-driven decision initiation was more in Karnataka (19.53%) than in Gujarat (11.80%). Incidental initiation was least in Gujarat (5.63%) whereas self-initiated decision-making was similar in both the states.

Within a state, the initiation process differed from crop to crop. Community sharing varied from 41.63 per cent among potato farmers to 74.19 per cent among rice farmers in Gujarat, whereas in Karnataka, it ranged from 31.55 per cent (potato) to 62.57 per cent (maize). Community sharing varied across the regions. For example, in Gujarat, brothers though lived separately, shared the experiences and resources with other members of the family. In Karnataka, peer group and friends' cliques played a similar role. This may be due to the difference in socio cultural constitution of the family structure, the social structure and also due to the nature of innovations predominant in each crop. The way they interact socially can affect diffusion of technologies and agricultural productivity. Greater the interaction between community leaders and other individuals, better the knowledge diffusion (Jennifer, 2008). Social learning of information reduces the uncertainty about a technology's performance in the community (Uaiene et al., 2009). Social networks and learning are the important factors in adoption of technology (Mamudu et al., 2012).

Incidental initiation of decision-making was more evident among maize farmers in Gujarat and cotton farmers in Karnataka (about 34%), although the ground situations that were responsible for this kind of behavior differed in the two states. In Karnataka, cotton is being promoted intensively by multiple agencies and farmers had plenty of opportunities to see many developmental activities in and around their villages, in a planned way for some and incidentally for many. Maize cultivation in Gujarat village was practically done without major support from outside agencies and

Table 2. Decision-initiation in different crops in the two states

Decision Initiation	Cotton	Groundnut	Maize	Rice	Potato	Overall
Gujarat						
Self-Initiation	9.79	15.63	0.00	0.00	6.53	9.15
Problem-driven	14.35	15.28	0.00	7.74	6.12	11.80
Incidental	5.01	1.39	33.33	1.29	13.47	5.63
Community-sharing	61.50	42.36	55.56	74.19	41.63	54.05
Extension-initiation	9.34	25.35	11.11	16.77	32.24	19.37
Karnataka						
Self-Initiation	4.59	24.12	7.02	12.46	2.52	9.31
Problem-driven	10.16	21.11	10.53	20.06	31.86	19.53
Incidental	33.77	5.53	13.45	7.60	17.98	16.58
Community-sharing	46.23	34.67	62.57	59.57	31.55	46.40
Extension-initiation	5.25	14.57	6.43	0.30	16.09	8.18

hence farmers' only way of getting to learn new things was incidental during their visits outside their system. Incidental initiation was also noticed among potato farmers in both the states, more in Karnataka (17.98%). The situation was characterized by limited time and opportunity to enquire / analyze the information as in the case of pesticides for potato crop in Karnataka. It occurred with no intention from either the learner or the source, happened without specific motive or formal instruction. Incidental initiation could be unintentional, unplanned (Baskett, 1993), and spontaneous. The network of private companies and input dealers are known to influence farmers' decision on use of chemical pesticides (Singh et al., 2022).

Extension system-initiated decision making varied widely among the crops and between the states. In Gujarat, extension-initiation was very much evident in potato (32.24%) and groundnut (25.35%). It was probably due to the presence of agricultural university and research institute / research station of the Indian Council of Agricultural Research on groundnut and potato in the district. Public extension system organized *krishi mela*, exhibitions, and used mass media like radio and print to inform farmers about latest technologies. Mass media reach of information to a large heterogeneous population of farmers (Margarita et al., 2014) is very well documented. In the case of Karnataka, the level of influence of extension system was less and it ranged from 0.3 per cent in rice to 16.09 per cent in potato. This could be due to limited time available with public extension system for educational activities as the personnel gave more emphasis on subsidy distribution. Private companies and input dealers served as sources of information to farmers through individual, group and mass contact methods. Private companies conducted pre-season campaigns, displayed posters and distributed leaflets about their new technologies.

Problem-driven initiation to decision-making was ranging from zero in the case of maize cultivated by Gujarat farmers and 31.86 per cent among potato cultivators in Karnataka. Potato farming was done in an environment full of risks involving pests and extreme weather events in Karnataka**.** When faced with emergency, farmers mostly consulted input dealers who dealt with several products from different companies. Private company extension agents visiting problematic fields used the opportunities to push their products. Equipped with limited alternatives, farmers accepted the information received from these sources as the basis for decision-making, fearing that delay or not taking any action would cause crop loss.

Self-initiated approach to decision making was not observed for food crops like rice and maize in Gujarat for different reasons. Rice farmers in the study villages of Gujarat intentionally did not use external inputs, cultivated the crop without using pesticides and by using limited quantities of chemical fertilizers as part of a community decision. Maize farmers, located in the interior area, had neither enough resources nor extension contact to get support for trying new ideas. Groundnut farmers in both the states, 24.12 per cent in Karnataka and 15.63 per cent in Gujarat exhibited higher levels of self-initiated decision-making. Self-initiated decision initiation was particularly observed among farmers who had genuine concern to improve farming as seen with one groundnut farmer in Gujarat village, who went to Maharashtra and Tamil Nadu to fetch the seeds of new varieties. Such farmers also tried to acquire and assimilate information through searching media, participating in formal discourses like crop seminars and farmer-to-farmer experience sharing sessions. Some of the self-initiated farmers searched for new management practices in order to improve their farming, by consulting multiple sources. It included sources from public/private extension agency, agricultural universities, input dealers and even other successful farmers. Farmers by nature experiment as they had to live by the results (Roling, 2009), and were willing to experience failures (Schlag, 2011).

Stages in decision-making

Based on the nature of source, the number of sources contacted and the activities carried out, the decision-making process was categorized as "two-step", "three-step with and without active engagement" and "four-step" process. Higher proportion of farmers (43%) followed the two-step decision-making pattern, which varied from 26.9 per cent in the case of irrigation practices to as high as 69.7 per cent in marketing decisions (Table 3). Marketing related decisions mostly followed the quick two-step pattern, as farmers tried to dispose-off the produce as early as possible after harvest. Prior commitments with lenders was the primary reason followed by the need to meet out the contingencies in the family. Rational decision making in marketing of agricultural produce by choosing the right market/channel and selling at the right time was a dream for many farmers. Education and empowerment on marketing (Ghosh, 2013) was found as important as the education on production technologies. Capacity building on value chain aspects (Emmanuelle et al., 2011) that specifically build farmers' confidence levels in marketing sector are needed. Marketing management is essential to be an entrepreneur (Kahan, 2013), but farmers need to be equipped to do it with right information (Pierre and Julie, 2013 & Mawazo et al., 2014). Emerging e-marketing platforms with transparent dealings (Vivek et al., 2021) could boost farmers' confidence for participating in marketing activities. The decision-making process on choice of micronutrients for majority of farmers (59.6%) was also a two-step process. Micronutrient was an unknown domain and most farmers were ignorant of the extent of the problem and the remedial measures. This helplessness is often exploited by the input dealers forcing farmers to make on-the-spot decisions. Potato and cotton farmers were seen spraying more than two chemicals at a time, some sold as tonic by the input dealers. For about 42.5 per cent farmers, decision making on plant protection chemicals was also a two-step process. This was more out of anxiety about the possible crop loss due to pests and diseases. The choice of micronutrient and chemicals was made mostly in the case of incidentally initiated and problem-driven decision-initiation. It mostly occurred in situations that forced farmers to take very little time (Bo Ohlmer et al., 1998) between initiation and action.

The three-step process involved both active engagement (discussions and consultations to understand) as well as passive engagement (observations and internal thinking). Active engagement (overall 26.9%) involved understanding through discussion but without actually seeing the innovation or its results. These were different from the two-step model as it took time for them to gather

Table 3. Activity stages of the decision-making process on five functional areas of crop production

Activity Stages	Variety	Irrigation	Micronutrient	Chemical	Market	Overall
Initiation – Action	32.3	26.9	59.6	42.5	69.7	43.0
Initiation – Understand - Action	29.5	38.9	19.7	25.2	24.6	26.9
Initiation – Observe - Action	22.6	15.4	9.8	28.1	4.3	21.5
Initiation – Understand / Observe - Try/ Verify - Action	15.6	18.8	10.9	4.2	1.4	8.6
Total	100.0	100.0	100.0	100.0	100.0	

additional information before getting convinced. Understanding the new methods/practices by listening to friends, relatives and input dealers was mostly evident for irrigation practices (38.9%) and while deciding on choice of varieties (29.5%). The informal discussion among the peer group (Sharma et al., 2020) affirming the performance of a particular product /innovation was a proof enough to believe the information and to make a decision. This was also noticed among a majority of farmers who were initiated from extension professionals (mostly public extension) through government's promotional activities. The passive three-step process was mostly based on observation and internal consultation, which happened with 26.9 per cent farmers, most probably among those who were initiated from the community sharing. Observation was an important aspect of assessing the performance of chemicals (28.1%) and varieties (22.6%), as these have higher observability attribute than that of markets (4.3%) and micronutrients (9.8%). Visibility of successful technologies (Mendola, 2007) influence decisions of neighborhood farmers.

There were also farmers who did not just believe in seeing or hearing, but wanted to try out for themselves before deciding to act. Trying innovative ideas before others was their professional goal. The multi-step process (overall 8.6%), ranged from 1.4 per cent in marketing related decisions to 18.8 per cent in irrigation methods. Self-initiated individuals, who are normally regarded as innovators and venturesome, mostly followed this process. Farmers had access to sources of innovation, opportunity to understand, and to try on a small scale. Studies indicated that most consulted sources of information by farmers were friends and relatives, their personal experience, extension agency, (public and private), input dealers, extension professionals, and mass media like radio.

Decision making patterns

Three broad decision patterns were identified based on the combination of initiation process and activity stages (Figure 1). Community-initiated decision-making was most prevalent, leading to all four types of activities and all three patterns of decision-making. Both passive and active three-step engagement were the majority leading to mostly imitation decisions. Community-initiated decisions that followed two-step and multi-step activity stages were few (connected by dotted lines). Extension-initiated decisions strongly resulted in three-step (both active and passive) as well as multi-step decision-making, and ended up mostly as informed or imitation decisions. Incidental and problem-initiated decisions followed a quick on the spot decisions or at the most passive three-step process leading to imitation decisions. Self-initiated decision-making followed multi-step process and ended up as informed decisions.

Crop-wise data (Figure 2) revealed that informed decision-making behavior was predominant in the case of groundnut (57.2%) and maize (56.5%). These crops have less infestation of pests and diseases compared to cotton (both the states) and potato (Karnataka). Induced decision-making behavior was frequently observed in commercial crops like potato (39.2%) and cotton (30.8%). The decision-making pattern largely depended upon cost and risk involved

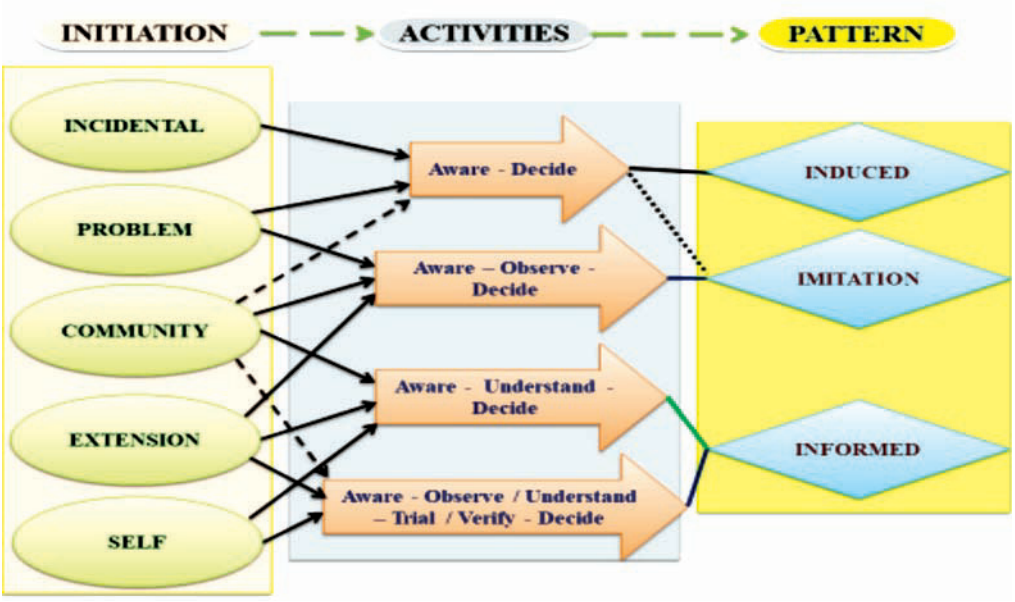

Figure 1. Decision Patterns based on Initiation - Activity Interrelationship

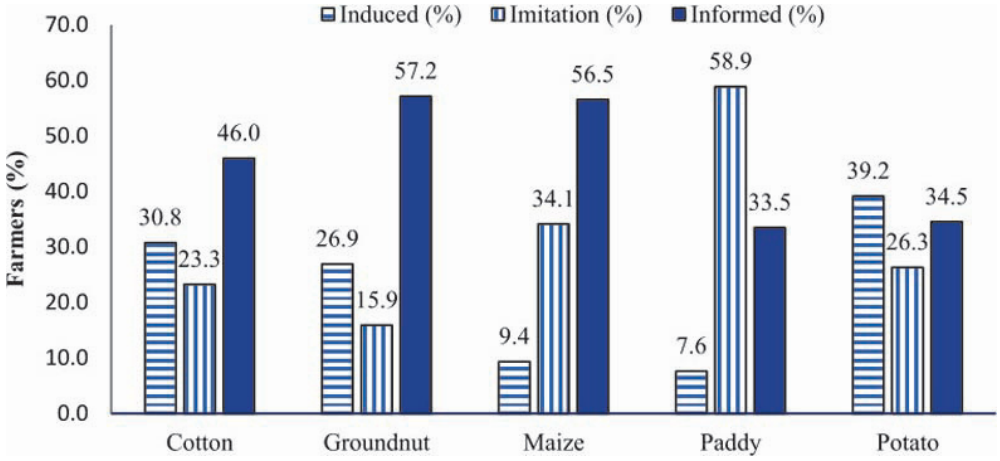

Figure 2. Farmers' decision making pattern in different crops

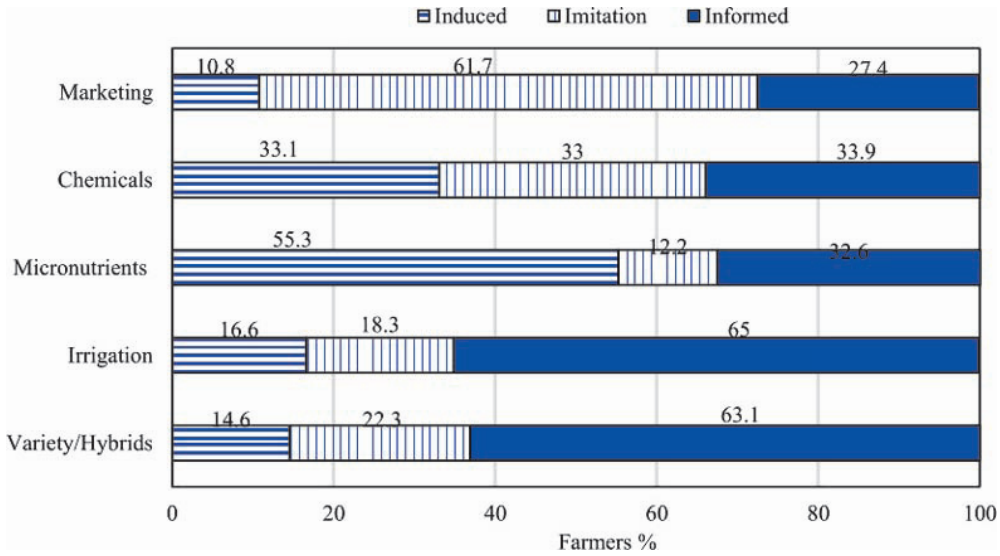

Figure 3. Patterns of decision making in different functional areas in crop production and marketing

in production of crops. In paddy, induced decision-making was least as there were more imitative decisions (58.9%) due to community sharing and peer-group learning. The imitation-decision behavior in paddy might be due to similar ecosystem in the command area of cultivation and similar management practices adopted by most farmers. Farmers cultivating two other food crops viz., groundnut and maize practiced informed decision-making. Imitation, a form of social learning, was an easy act for many farmers to avoid failures when taken together (Schlag, 2011).

In terms of different components within a crop (Figure 3), decision-making on irrigation (65.0%) and varieties (63.1%) were mostly informed. Farmers' decisions on choice of variety was mostly informed as they had more time to decide. An 'informed' decision was based upon a clear appreciation and understanding of the facts, and consequences of the action. Informed decisions were determined by the availability and accessibility of information (Ballantyne, 2009). Applicable and relevant knowledge must be made available to such farmers by the extension system. Micronutrients related decisions (55.3%) and decisions on use of plant protection chemicals (33%) were mostly induced in nature. Many induced decision making farmers were not even sure about their problems. For some even when the problem was known, the required information to overcome the problem was hard to find and thus they had to take induced decisions. 'Induced' decisions had both positive and negative contexts. It could be, positive when induced by the promotional activities of public extension system and negative when it was forced upon hapless farmers by the private extension system.

Educating the input dealers and continuously updating them with latest technological advances on managing emerging field problems will help minimizing induced decisions. The ongoing programme of Diploma in Agricultural Extension Services for Input Dealers (DAESI) offered by the Ministry of Agriculture and Farmers Welfare, Government of India must cover every input dealer in the country within a stipulated time frame. In the short-run, it is also possible to minimize the induced decision by facilitating the farmers to imitate the informed farmers, which is easier to achieve through well-planned extension activities. On a continuous basis, extension education must support, groom and encourage informed decision makers to access new information, adopt and share the successful aspects with others for imitation and replication. By enabling and supporting such farmers to search, access and use new information, the dependency on private input dealers could be reduced. Establishing model demonstrations can influence other farmers to facilitate cross-learning and farmer-to-farmer extension.

CONCLUSION

Dynamic nature of decision-making was evident where the same farmer followed divergent processes for different situations. The process of decision-making was analysed using context-source-goal approach. Initiation pattern and activities carried out before making decisions were different for different practices for different crops. Community-initiated and single-source based quick decision-making was a dominant process. All three patterns of decision making imitation, induced and informed decision-making were evident for different crops for different purposes. The study suggests "Max-Min-Facilitate" approach which implies maximized informed decisions, minimize induced decisions and facilitate imitation decisions. Priority is to minimize induced decisions, which mostly happened in problem-driven situation where private extension system played a critical role. Informed decisions by majority cultivators must be the long-term goal of the extension system. Availability of location-specific technical information drawn from reliable sources and ensuring its sharing at local level is the key to accelerating the process of informed decision-making.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (15-20)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Forecasting of Sweet Potato (*Ipomoea batatas* L.) Prices in India

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ARTICLE INFO

Keywords: Market intelligence, Price forecasting, Exponential smoothing model, Seasonal autoregressive integrated moving average, Time delay neural network

http://doi.org/10.48165/IJEE.2022.58203

ABSTRACT

Due to the semi-perishable nature of sweet potato the price fluctuation occur based on demand and supply. Hence, it becomes necessary to precisely forecast market price of sweet potato. Price forecasting of sweet potato was carried out for six selected states in India using time series monthly market price, collected from AGMARKNET price portal from January 2010 to December 2021. Exponential Smoothing Models (ESM), Seasonal Autoregressive Integrated Moving Average (SARIMA) model and Time Delay Neural Network (TDNN) model were used for forecasting of sweet potato price. It was observed that among the forecasting models, the TDNN model predicted accurate future prices of sweet potato based on the lowest Mean Absolute Percentage Error (MAPE), Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) than SARIMA and ESM. The forecast indicated that the average market price of sweet potato in selected states of India viz., Kerala, Odisha, Gujarat, Karnataka, Maharashtra and Telangana, would be in the range of Rs. 684 to Rs. 2757 per quintal during January 2022 to December 2022. The forecasted price of sweet potato would provide valuable information to the sweet potato growers, government institutions and other stakeholders in the sweet potato value chain to take appropriate decisions on production, marketing and consumption of sweet potato.

INTRODUCTION

Sweet potato is one of the most important tuber crops in terms of production, economic values, contribution to calories and protein. Besides, it is also an important staple food for many developing nations. With an annual production of 92 million tones, it is ranked as fifth most important food crop in the world in terms of its fresh weight (FAOSTAT, 2021). In India, sweet potato serves as an important staple food crop among the disadvantaged population, and majority of farmers consider it as major source of food but used to a limited extent as animal feed and industrial raw materials (Prakash et al., 2017; Prakash et al., 2018; Srinivas & Nedunchezhiyan, 2020). Total area under sweet potato cultivation in India was 0.13 million hectares with a production of 1.5 million tons during 2017-2018. Even-though sweet potato is cultivated in almost all the states in India, it is mainly grown in Odisha (25%), Kerala (23%), Uttar Pradesh (15%) and West Bengal (15%) which contribute about 78 per cent of the total sweet potato production in the country (Government of India, 2019). About 2560 tons of sweet potato was exported to United Arab Emirates, Saudi Arab, United States, Oman, United Kingdom and Kuwait and 72 tons of sweet potato was imported from China, Thailand, United States and Australia during 2019-2020 (Government of India, 2020). In India, sweet potato is cultivated during both Kharif and Rabi seasons, usually takes three to four months to attain maturity. Due to high fluctuations between seasons, growers do not always capitalize on the best price for the crop (Beach et al., 1995; Farmer & Foley, 2009). Hence, there is a need to apply appropriate methods to aid in forecasting of price of different crops. Accurate price prediction of agricultural products is useful for planning

Received 06-01-2022; Accepted 01-02-2022

agricultural production and for developing a balance between demand and supply (Zhang et al., 2014). Due to the semi perishable nature of sweet potato, price fluctuates occurs based on demand and supply. Further, it cannot be stored for longer time. These characteristics of sweet potato production make the farmers prone to exploitation by the traders and other actors in the supply chain. The farmers make production planning mainly on past year prices. The harvesting can be delayed or preponed to a certain extent based on current market prices whose knowledge is available with the farmers with the development of information and communication technologies (Nain et al., 2015; Kumbhare et al., 2019; Hadiya, 2019; Jat et al., 2021). Hence, forecasting of market price of sweet potato in different markets will help traders to make decisions on whether to import from other markets or to take advantage of higher prices in local markets compared to international markets. Forecasting of sweet potato prices can provide critical and useful information to sweet potato growers for making production and marketing decisions. It can provide valuable information to the entrepreneurs also to make decisions. In this context, the study was undertaken to develop a model for the price forecasting of sweet potato of major markets in India.

METHODOLOGY

Time series data on monthly market prices of sweet potato from January 2010 to December 2021 for six selected states in India were collected from the AGMARKNET price portal (https://agmarknet.gov.in) and the data on the sweet potato prices prevailed in different markets for the past 12 years was analyzed. The econometric price forecasting methods viz., Holt winters multiplicative method of Exponential Smoothing Models (ESM), Seasonal Autoregressive Integrated Moving Average (SARIMA) model and Time Delay Neural Network (TDNN) model were employed. All the forecasting analysis was performed using R Software v. 1.4.1106.

Exponential smoothing models (ESM) were proposed in the late 1950s and were emerged as one of the most successful forecasting methods. Forecasts produced using exponential smoothing methods are weighted averages of past observations, with the weights decaying exponentially as the observations gets older. There are three main types of ESM viz. i) single exponential smoothing, ii) Holts linear trend method and iii) Holt-winters seasonal method. In this case, Holt winters multiplicative method was used and determined following Holt (1957) & Winters (1960).

Seasonal ARIMA model is most used for forecasting time series. Appearance of past values and past forecasted errors in the models are the autoregressive and moving average. An ARIMA model is determined following Jha & Sinha (2013); Areef et al., (2020); Kumar et al., (2021); Goyal et al., (2021). ARIMA model are denoted as ARIMA (p, d, q) where p is the non-seasonal AR order (number of time lags); d is the non-seasonal differencing (number of times the data have had past values subtracted) and q is the non-seasonal MA order. ARIMA models have been applied on a time series of prices of some of the horticultural crops without considering the seasonal effects (Ansari and Ahmad, 2001). In this study included seasonal effects to predict sweet potato prices as there is strong seasonal variation in prices. The seasonal ARIMA incorporates non-seasonal and seasonal factors in a multiplicative model. The SARIMA models are denoted as ARIMA (p, d, q) X (P, D, Q) s, Where, is the number of observation per year; P is the seasonal AR order; D is the seasonal differencing and Q is the seasonal MA order. The different stages in establishing a forecasting model are determined following Amarender Reddy (2019).

Time delay neural network model (TDNN) has emerged as an efficient tool for modeling and price forecasting (Lama et al., 2021). TDNN at various combinations of the input nodes (lags) and hidden nodes was implemented. As a result, different numbers of neural network models were tested for each series before reaching at the final structure of the model. A typical TDNN structure with one hidden layer is denoted by I: Hs: Ol, where I is the number of nodes in the input layer, H is the number of nodes in the hidden layer, O is the number of nodes in the output layer, s denotes the logistic sigmoid transfer function and l indicates the linear transfer function. Figure 1 shows a graphical representation of the employed time-delay neural network.

The accuracy of the forecasted model is assessed with the use of mean absolute percentage error, mean absolute error, and root mean square error was determined following Kumar et al., (2021).

RESULTS AND DISCUSSION

The average monthly market price of sweet potato prevailing in different markets was analyzed and the results are presented in Table 1. It was observed that the highest price prevailed in the Kerala market (Rs. 2079 per quintal) followed by Odisha (Rs. 1526 per quintal), Gujarat (Rs. 1497 per quintal), Maharashtra (Rs. 1444 per quintal), Telangana (Rs. 1058 per quintal) and Karnataka (Rs. 571 per quintal). Further, price behavior based on the seasonality index shows that the highest price of sweet potato was observed in the Kerala market prevailed during September followed by October and November. The lowest price was observed in the Karnataka market during July and December. Thus, it is revealed that the markets viz., Kerala, Odisha, and Gujarat have provided an opportunity for both farmers and traders to exploit economics of scale and take advantage of recent institutional changes in agricultural marketing like the National Agriculture Market (eNAM).

Exponential smoothing model

Under exponential smoothing models, Holt winters multiplicative techniques was considered for forecasting the prices of sweet potato for the selected states in India and the results are presented in Table 2. Forecast indicated that the average market price of sweet potato in selected states of India viz., Kerala, Odisha, Gujarat, Karnataka, Maharashtra and Telangana would be in the range of Rs. 788 to Rs. 2854 per quintal during the period January 2022 to December 2022.

Seasonal autoregressive integrated moving average model

A seasonal autoregressive integrated moving average model was used for forecasting of sweet potato prices. It was observed that the SARIMA (1,1,1) (1,1,1), SARIMA (2,1,1) (0,1,1), SARIMA (1,1,1) (0,1,1), SARIMA (0,1,3) (2,0,0), SARIMA (0,1,2) (0,1,1) and SARIMA (2,1,1) (0,1,1) were found suitable for Kerala, Odisha, Gujarat, Karnataka, Maharashtra and Telangana respectively. These

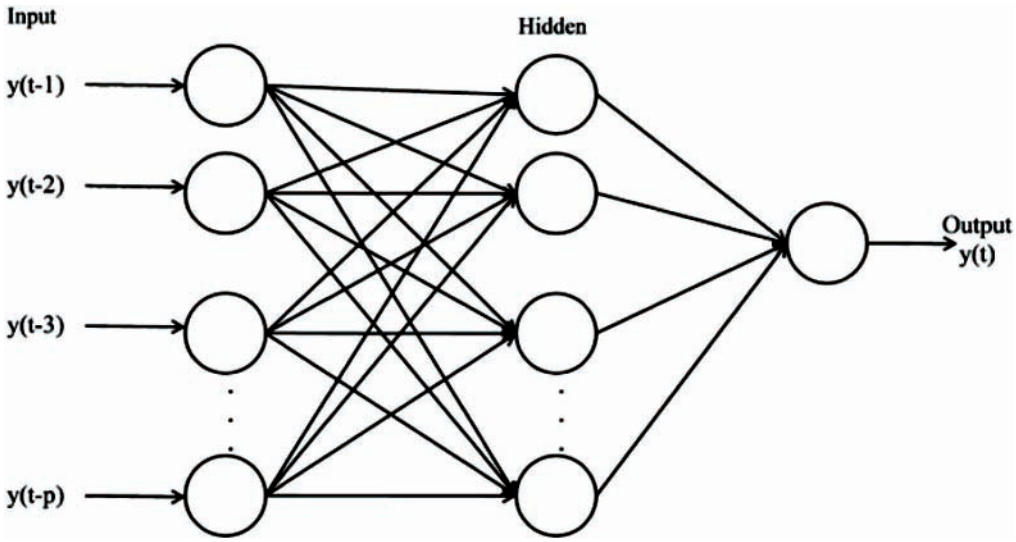

Figure 1. Schematic illustration of TDNN

Table 1. Average monthly market price of sweet potato in selected markets in India during 2010-2021 (Rs. per quintal)

Months	Kerala	Odisha	Karnataka	Gujarat	Maharashtra	Telangana
January	2039	1450	527	1185	1250	910
February	2030	1655	542	1246	1305	850
March	1966	1633	593	1331	1248	768
April	1941	1760	572	1312	1326	727
May	1877	1839	570	1401	1440	901
June	1834	1709	551	1703	1454	1210
July	1850	1441	483	1772	1669	1322
August	2182	1388	572	1907	1667	1491
September	2364	1649	729	1888	1942	1478
October	2336	1287	671	1437	1536	1155
November	2298	1192	532	1428	1266	926
December	2225	1316	515	1349	1225	957
Average price	2079	1526	571	1497	1444	1058

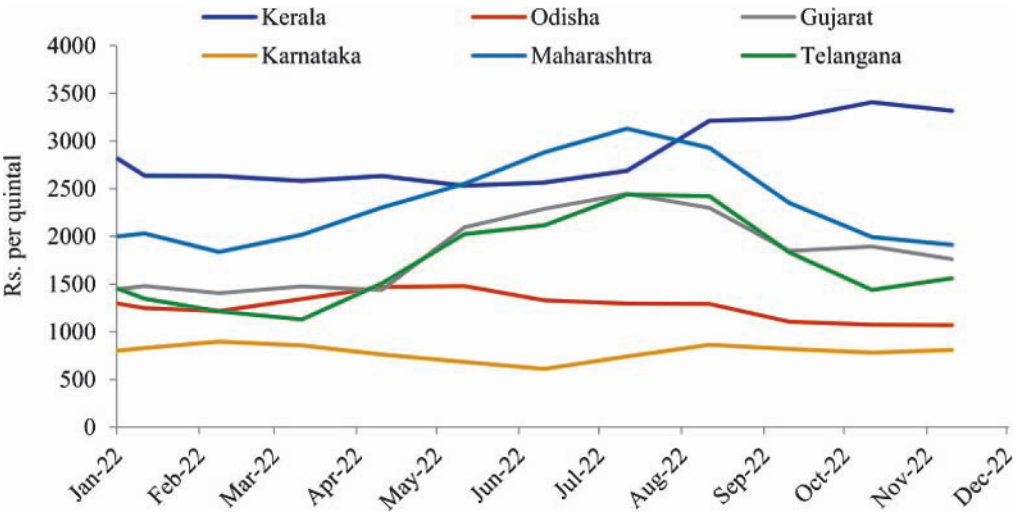

Figure 2. Forecasted price of sweet potato in selected states of India

were found to be the best fit models as they had the lowest Akaike information criteria (AIC) and Bayesian information criteria (BIC) values. So, a unique model does not apply to different markets of sweet potato. The parameters estimated through an iterative process using a least square technique which gave the best model were presented in Table 2. The coefficients were also found to be statistically significant and hence the selected models were considered best fit and were used for forecasting.

Ex-ante forecast prices of sweet potato for the selected markets in India was done for the month of January 2021 to December 2021 using the identified models and they were compared with actual prices of the same period (Table 3). Further, ex-post

Table 2. Coefficients of SARIMA model estimated of major markets in India

Market		Coefficient	Standard error	Z-value	Pr(>|z|)
Kerala	AR(1)	0.665	0.089	7.496	6.607e-14 ***
	MA(1)	-0.930	0.050	-18.644	< 2.2e-16 ***
	SAR(1)	-0.157	0.092	-1.700	0.08921
	SMA(1)	-1.000	0.147	-6.822	8.953e-12 ***
	σ^2= 90890; log likelihood=-949.17				
	AIC=1908.34; AICc=1908.82; BIC=1922.71				
Odisha	AR(1)	0.658	0.091	7.240	4.473e-13 ***
	AR(2)	-0.110	0.088	-1.252	0.2106
	MA(1)	-1.000	0.038	-26.104	< 2.2e-16 ***
	SMA(1)	-0.889	0.132	-6.741	1.574e-11 ***
	σ^2=350626; log likelihood=-1032.28				
	AIC=2074.55; AICc=2075.03; BIC=2088.93				
Gujarat	AR(1)	0.473	0.089	5.290	1.227e-07 ***
	MA(1)	-0.968	0.033	-29.065	< 2.2e-16 ***
	SMA(1)	-0.798	0.099	-8.057	7.813e-16 ***
	σ^2=95642; log likelihood=-943.25				
	AIC=1894.51; AICc=1894.83; BIC=1906.01				
Karnataka	MA(1)	-0.274	0.083	-3.311	0.0009308 ***
	MA(2)	-0.362	0.087	-4.172	3.026e-05 ***
	MA(3)	-0.222	0.083	-2.678	0.0074171 **
	SAR(1)	0.167	0.084	1.995	0.0460431 *
	SAR(2)	0.199	0.091	2.178	0.0294451 *
	Intercept	6.259	3.052	2.051	0.0402846 *
	σ^2=26700; log likelihood=-929.85				
	AIC=1873.69; AICc=1874.52; BIC=1894.43				
Maharashtra	MA(1)	-0.518	0.083	-6.218	5.032e-10 ***
	MA(2)	-0.306	0.088	-3.468	0.0005239 ***
	SMA(1)	-0.754	0.096	-7.832	4.817e-15 ***
	σ^2=87007; log likelihood=-935.04				
	AIC=1878.08; AICc=1878.39; BIC=1889.58				
Telangana	AR(1)	0.437	0.085	5.138	2.783e-07 ***
	AR(2)	0.257	0.086	2.999	0.002707 **
	MA(1)	-1.000	0.050	-20.041	< 2.2e-16 ***
	SMA(1)	-0.625	0.076	-8.234	< 2.2e-16 ***
	σ^2=43830; log likelihood=-889.23				
	AIC=1788.47; AICc= 1788.95; BIC=1802.85				

***, ** and * significant at 1, 5 and 10 percent level

forecasts for the period January to December 2022 was made and the accuracy of the forecasts was tested using the test statistics. It was observed that the forecasted price of sweet potato in selected markets was very close to the actual value. The accuracy of the models was empirically verified with the help of MAPE, MAE and RMSE statistics.

The model was validated for the accuracy; it was observed that there were wide variations between upper and lower confidence limits of forecast prices of sweet potato from January 2022 to December 2022. The forecast indicates that the average market prices of sweet potato in selected states of India viz., Kerala, Odisha, Gujarat, Karnataka, Maharashtra and Telangana, would be in the range of Rs. 1178 to Rs. 3187 per quintal during January 2022 to December 2022 (Table 4).

Time delay neural network

The time delay neural network model was applied for forecasting sweet potato prices in selected states of India and the results are presented in Table 5. The neural network architecture used consists of single hidden layer, six input nodes and one output node was selected for modelling and forecasting of sweet potato prices. The forecasted average market price of sweet potato in selected states of India viz., Kerala, Odisha, Gujarat, Karnataka, Maharashtra and Telangana, would be in the range of Rs. 684 to Rs. 2757 per quintal during January 2022 to December 2022. The prices would be high in some markets viz., Kerala (Rs. 2757 per quintal), Odisha (Rs. 2202 per quintal), Maharashtra (Rs. 1928 per quintal) and Gujarat (Rs. 1898 per quintal) and low in other markets viz., Karnataka (Rs. 684 per quintal) and Telangana (Rs. 1712 per quintal).

Among the different forecasting techniques, the time delay neural network model predicted accurate future prices of sweet potato in selected states of India as compared to Seasonal auto regressive integrated moving average and exponential smoothing models based on the lowest MAPE, MAE and RMSE. Findings from other studies reported that ANN model predicted accurate future prices of paddy and onion in Nizamabad and Bangalore market compared with ARIMA and exponential smoothing models (Areef et al., 2020). ARIMA models predicted accurate future prices of vegetables compared with exponential smoothing models,

Table 3. Comparison of forecasted (F) and actual (A) prices of sweet potato (Rs. /quintal)

Month,	Kerala		Odisha		Gujarat		Karnataka		Maharashtra		Telangana	
Year 2021	F	A	F	A	F	A	F	A	F	A	F	A
January	3161	3397	2121	2562	1497	1502	1032	980	1750	1976	1324	1132
February	3198	2980	2629	2579	1563	1514	979	1275	1962	1955	1263	1000
March	2998	3096	2409	2597	1542	1499	1221	1365	1840	1542	960	1000
April	3066	2901	2568	2615	1648	1261	1304	1487	1767	1703	893	1000
May	2888	2906	2531	2632	1573	982	1390	1508	2069	1677	1282	1367
June	2956	2860	2322	2650	1684	2057	1348	1428	1911	2080	1953	1565
July	2924	2859	2278	1237	2174	2266	1308	1250	2252	2718	1762	1762
August	3280	2681	1394	1132	2506	1962	1294	1397	2475	3331	2095	1960
September	2996	2991	1851	1067	2068	2054	1489	1050	2979	2710	1927	2157
October	3037	2752	1098	1440	1662	1933	976	864	2325	1762	1648	1613
November	2910	2985	1605	1545	1884	1870	1000	770	1688	1847	1298	1468
December	2992	2950	1888	1156	1616	2161	965	735	1854	1889	1452	1638
Accuracy tests												
MAPE (%)	8.44		23.54		15.19		20.18		12.35		13.46	
MAE	172.02		369.64		209.35		117.74		186.76		135.48	
RMSE	283.13		556.09		291.57		159.38		278.10		196.61	

Table 4. Forecasted price of sweet potato in selected states of India (Rs. /quintal)

Month, Year 2022	Kerala Estimate	Odisha Estimate	Gujarat Estimate	Karnataka Estimate	Maharashtra Estimate	Telangana Estimate
January	2985	1673	1827	902	2016	1589
February	3057	2132	1732	1065	2048	1489
March	2995	2246	1663	1134	1909	1335
April	3020	2401	1675	1243	2000	1234
May	2958	2448	1688	1262	2176	1531
June	2922	2268	2148	1253	2284	1968
July	2956	1933	2279	1222	2546	2011
August	3384	1884	2444	1322	2735	2288
September	3546	2205	2349	1317	2758	2251
October	3552	1837	1912	1169	2327	1791
November	3473	1764	1921	1103	2010	1493
December	3397	1938	1800	1141	1957	1607
Average price	3187	2061	1953	1178	2230	1716

Table 5. Forecasted price of sweet potato in selected states of India (Rs. /quintal)

Month, Year 2022	Kerala	Odisha	Gujarat	Karnataka	Maharashtra	Telangana
January	2887	1596	1814	781	1906	1768
February	2872	1780	1645	656	1897	1520
March	2812	2442	1672	601	1602	1295
April	2821	3654	1462	635	1640	1231
May	2771	3904	1359	655	1965	1367
June	2778	2782	1683	656	2357	1856
July	2729	2250	1800	635	2333	1600
August	2765	1899	2063	640	2076	2669
September	2669	1798	2558	689	1941	2318
October	2717	1453	2291	828	1780	1789
November	2645	1599	2187	752	1759	1481
December	2620	1269	2241	682	1885	1652
Average price	2757	2202	1898	684	1928	1712
Accuracy tests						
MAPE (%)	6.18	15.54	9.20	11.80	7.71	10.65
MAE	118.49	214.31	127.91	64.39	108.94	94.22
RMSE	154.88	329.16	168.02	86.09	148.45	129.47

generalized autoregressive conditional heteroscedasticity and SARIMA models (Weron, 2014).

CONCLUSION

The study employed three forecasting time series models in order to know the best model for forecasting sweet potato prices in the selected states of India. Based on the indicators viz., MAPE, MAE and RMSE values, the TDNN model is adjusted as the best and accurate forecasted method. The forecasted price of sweet potato would provide empirical evidence to the farmers for making production decisions and alternative market avenues. It will also help the government and policy makers to make decisions about market intervention. Further it will also help all the stakeholders involved in the sweet potato value chain to plan for their future activities.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (21-25)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Food Consumption Pattern of Farming Families in Punjab

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ARTICLE INFO

Keywords: Food consumption pattern, Farming families, Dietary choice

http://doi.org/10.48165/IJEE.2022.58204

ABSTRACT

The present study was conducted in Punjab state to analyze the food consumption pattern of farming families. Empirical data was collected from a total of 180 respondents i.e. 60 males, 60 females and 60 children from farming families of Punjab with the help of a self-structured interview schedule. Findings revealed that cent per cent of the respondents had their breakfast and dinner daily. Further, it was found that there was a low consumption of fruits and nuts & oil seeds in the majority of the respondents and high consumption of fats & oils in nearly half of the respondents. The frequency of consumption of all the other food groups was found to be in medium category. The mean frequency consumption of milk & milk products, other vegetables (non-green leafy vegetables) and non-vegetarian food showed significant differences between the three categories of respondents. An imbalance was found in the consumption of different food groups by the respondents. So, based on the findings of the research, the paper recommends that there is a need for special efforts to change the consumption pattern of farming families in Punjab and spread awareness among the population to include a variety of food items from different food groups in the diet.

INTRODUCTION

India has a rich and diverse variety of food, and its various diets are strongly related to religion, social identity, and other cultural factors, as well as local farming practices. In the period of last fifty years, India has changed astoundingly as a nation, which has a major effect on the individuals' diet pattern. In the year 1961, the daily average intake of an Indian was considered to be 2,010 kcal, and the daily average diet of an individual consisted of 43 per cent grains (378g), 12 per cent fats and sugar (108g), 12 per cent eggs and dairy, 2 per cent meat (17g), and 8 per cent others (68g). In 2011, the daily average calorie intake of an Indian consisted of 2,458 kcal, and the daily diet included 32 per cent grain (416g), 10 per cent fats and sugar (129g), 18 per cent eggs and dairy (235g), 2 per cent meat (29g), and 4 per cent others (58g). The daily average consumption of protein has increased from 55g per day to 59g per day in the past 25 years from 1990-2015 and the protein from the animal source has increased from 9g per day to 12g per day. There is a decline in the dietary energy supplied by cereals and roots from an average of 66g per day to 59g per day. This shows that the consumption of calories by an average Indian has increased in fifty years. Intake of dairy, eggs, and plant products by Indians has increased more than twice during this period. The consumption of non-vegetarian food products has also increased but the average diet of an Indian remains primarily vegetarian. In addition to this, there is a decrease in grain consumption whereas the daily average intake of fats and sugar has increased (Plummer, 2017).

Indian people consume fewer cereals and have replaced them with more fat and snacks, beverages, and processed foods. It has been observed that protein consumption has declined in the rural areas whereas it remains the same in urban areas (Anonymous, 2014).

As the eating habits of the people are getting more and more westernized, and the consumption of processed and packed food is in practice people have started abandoning most of the traditional

Received 09-09-2021; Accepted 01-02-2022

foods and cooking methods (Dhir & Singla, 2019). Due to the rapidly fast-growing world, modernization has touched every corner of the world even the rural areas. It has been observed that even the consumption pattern of the people living in rural areas has also changed to a great level (Amoura et al., 2020). Keeping the changing trend in mind, the present study has been planned to assess the food consumption pattern of farming families in Punjab.

METHODOLOGY

The research was carried out in, the three socio-cultural zones of Punjab i.e. Malwa, Majha, and Doaba with the purpose to have a representative sample of all farming families of Punjab. From each zone, twenty farming families were selected purposively to ensure that the sample consists of each family with, one adult man, one adult female, and one child in the age group of 9-12 years. Thus, the total sample consisted of 180 respondents. The selected respondents were interviewed personally with the help of a self-structured interview schedule. The data collected were tabulated and statistically analyzed to interpret the results. The statistical tests i.e. percentage, frequency, arithmetic mean, analysis of variance (ANOVA) test were used for analyzing the data.

RESULTS AND DISCUSSION

Data shown in Table 1 indicates that 46.67 per cent of the respondents were vegetarian and 47.22 per cent were non-vegetarian. However, the gender-wise distribution of dietary choice revealed that the majority of the female respondents (60%) had the vegetarian diet as compared to male (48.33%) and child (31.67%) respondents. Findings are in conformity with those of Bathla et al., (2018) who revealed that 63.3 per cent of the rural women were vegetarian. More than half of the children (55%) had the non-vegetarian diet which was higher than both male (50%) and female (36.67%) respondents. A small percentage of the respondents (1.67% of males, 3.33% of females and 13.33% of children) had ova-vegetarian choice i.e. they consumed eggs but not meat and meat products. In contradiction, Yadavar (2018) reported that only eight percent of males and four percent of females were non-vegetarian in Punjab.

The meal frequency pattern of the farming families is presented in Table 2. A perusal of data shows that cent per cent of the respondents had their breakfast and dinner daily. Singh et al., (2015) also revealed in their study that the majority of the adult and children consumed two main meals a day. The data further showed that majority of the respondents i.e. 98.33 per cent of the females, 96.67 per cent of the males and 90 per cent of the children used to have their evening tea daily. It was observed that a large percentage of child respondents (86.67%) were having their lunch daily as compared to male (68.33%) and female (78.33%) respondents. Ahmad et al., (2009) also reported that 82.8 per cent of the children took lunch regularly. Data further reveals that 61.67 per cent of male and female respondents and 55 per cent of child respondents had early morning meals. Findings are in conformity with those of Mahajan (2011) who revealed that 65 per cent of the rural population had early morning meals. About 50 per cent of the respondents in all the three categories had bedtime tea or milk. Only 23.33 per cent of the respondents were having mid-morning meals in the selected farming families out of which 31.67 per cent were male, 21.67 per cent female and 16.67 per cent children.

Overall, 41.11 per cent of the respondents had a medium frequency of consumption of cereal items followed by respondents with low frequency of consumption of cereals (39.44%) and high consumption of cereals (19.44%). The findings are in contrast to Sangeetha et al., (2018) who reported that cereals and cereal products were consumed frequently by a considerable large segment of children. It can be concluded from the data that out of various food items chappati and rice were frequently consumed by the respondents. Overall mean frequency consumption of cereals was 3.88 (female, 4.35; male, 3.71 and child, 3.58). However, no significant difference was found between male, female and child respondents in the frequency consumption of cereals.

The data reveals that 48.33 per cent had a medium frequency of consumption of pulses items and only 17.78 per cent of the total respondents had a high consumption of items of pulses items. The findings are in contrary to Singh et al., (2019) who studied that the pulses consumption was higher in farming respondents. The data also reveals that 21.67 per cent of the children had higher

Table 1. Distribution of the respondents based on their dietary choice

Dietary Choice	Male (n_1=60) f(%)	Female (n_2=60) f(%)	Child (n_3=60) f(%)	Total (n=180) f(%)
Vegetarian	29(48.33)	36(60.00)	19(31.67)	84(46.67)
Non- vegetarian	30(50.00)	22(36.67)	33(55.00)	85(47.22)
Ova-vegetarian	1(1.67)	2(3.33)	8(13.33)	11(6.11)

Table 2. Distribution of the respondents according to meal frequency pattern

Meal Pattern	Male (n_1=60) f(%)	Female (n_2=60) f(%)	Child (n_3=60) f(%)	Total (n=180) f(%)
Early morning	37(61.67)	37(61.67)	33(55.00)	96(53.33)
Breakfast	60(100)	60(100)	60(100)	180(100)
Mid-morning	19(31.67)	13(21.67)	10(16.67)	42(23.33)
Lunch	41(68.33)	47(78.33)	52(86.67)	140(77.78)
Evening Tea	58(96.67)	59(98.33)	54(90)	171(95)
Dinner	60(100)	60(100)	60(100)	180(100)
Bed Tea/Milk	30(50.00)	30(50.00)	31(51.67)	91(50.55)

consumption of items of pulses, which was also higher than that of male (18.33%) and female (13.33%) respondents. The majority of female respondents (63.33%) had medium frequency consumption of items of pulses which was higher in comparison to male (51.67%) and child respondents (30%) respondents. Consumption of pulses was more among the female respondents (3.21) compared to the child (2.93) and male respondents (2.75). Overall mean frequency consumption of pulses was 2.96 and no significant difference was found between different categories of respondents.

Nearly half of the respondents from each category male (43.33%), female (53.33%) and child (48.33%) had medium consumption of milk and milk products. The findings are in contrary to that of Singh et al., (2015) who found that half of the respondents had low consumption of milk and milk products. Further, results reported that overall 22.78 per cent of the respondents had a high consumption of milk & milk products. In comparison between male, female and child respondents it was found that 40 per cent of child respondents consumed less milk & milk products as compared to males (31.67%) and females (15%). A cursory glance at the table indicated that more percentage of females (31.67%) were found in the high category as compared to males (25%) and children (11.67%). Milk & milk products consumption was more in females (5.21) than the child (5.01) and male (3.96) respondents. A significant difference was observed in the mean frequency consumption of milk & milk products between the male, female and child respondents.

Large proportion i.e. 43.33 per cent of the respondents fall under medium level of consumption of green leafy vegetables and 25 per cent who had low consumption. The findings of the low consumption of green leafy vegetables are in conformity with the finding of Abudayya et al., (2009) & Kumari et al., (2019). Among all the respondents 36.67 per cent of males were in the high consumption category as compared to female (30%) and child (28.33%) respondents. Whereas, more percentage of female respondents (28.33%) were in the low consumption category of green leafy vegetables as compared to male (23.33%) and child (23.33%) respondents. On the perusal of data, it was revealed that the overall mean frequency of consumption of green leafy vegetables was 3.55. Comparison between male, female and child respondents was observed with a mean frequency of 3.72 for males, 3.62 for females and 3.31 for children. Findings are in line with those of Abudayya et al., (2009) who while assessing the food consumption pattern of adolescents also observed that the mean frequency consumption of green leafy vegetables was 3.5.

The frequency of consumption of roots and tubers was medium with 46.67 per cent. The results are in conformity with Singh et al., (2015). Further, it was observed that 20 per cent of the male respondents had higher consumption of roots and tubers in comparison with female (18.33%) and child respondents (10%). More than half of the children have medium consumption of roots and tubers (56.67%) in comparison to male (42.33%) and female (40%) respondents. More percentage of female respondents (41.67) were observed in low consumption of roots and tubers in comparison to male (36.67%) and child (33.33%) respondents. The overall mean frequency of consumption of roots & tubers was 3.90, with a non-significant difference between female (4.15), male (3.92) and child (3.62) respondents.

The majority of respondents had medium consumption of other vegetables. Further, the consumption of other vegetables by 48.33 per cent of the child respondents was lower than that of male (36.67%) and female (18.33%) respondents. The findings of the data are in conformity with Leal et al (2010). Large proportion of females (66.67%), males (48.33%) and child (41.67) respondents were found under medium consumption category. It may be due to the reason that some of the vegetables like cucumber, tomato and onion were consumed on daily basis. The same percentage (15%) of male, as well as female respondents had higher consumption of other vegetables as compared to child (10%) respondents. The result highlighted that the total mean frequency of consumption of other vegetables was noted as 3.90, with a significant difference favouring female respondents (4.21) over the child (3.86) and male (3.64) respondents.

It was further observed that the mean frequency of fruit consumption for male, female and child respondents were 3.14, 3.37 and 3.08 respectively, with a non-significant difference between the mean of all categories of the respondent. The same result was also reported by Mahajan (2011). 40.56 per cent had a low frequency of consumption of fruits and 32.78 per cent of the total respondents had medium consumption, whereas only 26.67 per cent of them had high consumption. Around 43.33 per cent of the male respondents were observed to have low consumption followed by 38.33 per cent female and 40 per cent child respondents. The findings on the consumption of fruits by the children are in conformity with Rethiaia et al., (2010) who reported that consumption of fruits were lower than the recommended allowances. There was not a major difference in the percentage of respondents who had a high consumption of fruits i.e. 26.67 per cent of males, 28.33 per cent of females and 25 per cent of children were found in this category.

The data regarding the consumption pattern of sweets was calculated on the basis of frequency consumption of (honey, jaggery and sugar). The majority of the respondents (48.33%) had medium consumption of sweets followed by low (31.67%) and high (20%) consumption. The findings are in contrary with Arlappa (2016) who revealed that the majority of the respondents consumed a high frequency of sweet items. Category wise difference shows that 23.33 per cent of the female respondents had higher consumption of sweets which was higher in comparison to male (15%) and child (21.67%) respondents, this may be due to females consume more sugar in tea, coffee etc while staying at home as most of the rural women are homemakers. Further, the data depicts that 41.67 per cent of male respondents had low consumption followed by female (25%) and child (28.33%) respondents. The sweet consumption was found to be 4.96 for males, 4.97 for females and 4.74 for children displaying a non-significant difference between the three groups. The result is in confirmation with the finding of Leal et al., (2010).

The 49.44 per cent of the respondents were having high consumption of fats & oil products followed by 35.56 per cent having medium and 15 per cent having low consumption. The findings are in conformity with Arlappa (2016) who found that majority of the respondents were consuming a high proportion of fats & oils than recommended. Further, the data indicates that more

Table 3. Consumption pattern of food items under different food groups

Food Groups	Frequency of Consumption	Male (n_1=60) f(%)	Female (n_2=60) f(%)	Child (n_3=60) f(%)	Total (n=180) f(%)
Cereals	Low (11-33)	23(38.33)	23(38.33)	25(41.67)	71(39.44)
	Medium (33-55)	26(43.33)	23(38.33)	25(41.67)	74(41.11)
	High (55-77)	11(18.33)	14(23.33)	10(16.67)	35(19.44)
Pulses	Low (11-33)	18(30.00)	14(23.33)	29(48.33)	61(33.89)
	Medium (33-55)	31(51.67)	38(63.33)	18(30.00)	87(48.33)
	High (55-77)	11(18.33)	8(13.33)	13(21.67)	32(17.78)
Milk & Milk Products	Low (6-18)	19(31.67)	9(15.00)	24(40.00)	52(28.89)
	Medium (18-30)	26(43.33)	32(53.33)	29(48.33)	87(48.33)
	High (30-42)	15(25.00)	19(31.67)	7(11.67)	41(22.78)
Green Leafy Vegetables	Low (5-15)	14(23.33)	17(28.33)	14(23.33)	45(25.00)
	Medium (15-25)	24(40.00)	25(41.67)	29(48.33)	78(43.33)
	High (25-35)	22(36.67)	18(30.00)	17(28.33)	57(31.67)
Roots & Tubers	Low (6-18)	22(36.67)	25(41.67)	20(33.33)	67(37.22)
	Medium (18-30)	26(43.33)	24(40.00)	34(56.67)	84(46.67)
	High (30-42)	12(20.00)	11(18.33)	6(10.00)	29(16.11)
Other Vegetables	Low (12-36)	22(36.67)	11(18.33)	29(48.33)	62(34.44)
	Medium (36-60)	29(48.33)	40(66.67)	25(41.67)	94(52.22)
	High (60-84)	9(15.00)	9(15.00)	6(10.00)	24(13.33)
Fruits	Low (18-54)	26(43.33)	23(38.33)	24(40.00)	73(40.56)
	Medium (54-90)	18(30.00)	20(33.33)	21(35.00)	59(32.78)
	High (90-126)	16(26.67)	17(28.33)	15(25.00)	48(26.67)
Sweets	Low (3-9)	25(41.67)	15(25.00)	17(28.33)	57(31.67)
	Medium (9-15)	26(43.33)	31(51.67)	30(50.00)	87(48.33)
	High (15-21)	9(15.00)	14(23.33)	13(21.67)	36(20.00)
Fats & Oils	Low (5-15)	13(21.67)	6(10.00)	8(13.33)	27(15.00)
	Medium (15-25)	23(38.33)	20(33.33)	21(35.00)	64(35.56)
	High (25-35)	24(40.00)	34(56.67)	31(51.67)	89(49.44)
Nuts & Oil Seeds	Low (7-21)	38(63.33)	33(55.00)	37(61.67)	108(60.00)
	Medium (21-35)	15(25.00)	20(33.33)	21(35.00)	56(31.11)
	High (35-49)	7(11.67)	7(11.67)	2(3.33)	16(8.89)
		(n_1=31)	(n_2=24)	(n_3=41)	(n=96)
Non-Vegetarian foods	Low (4-12)	10(16.67)	4(6.67)	11(18.33)	25(26.04)
	Medium (12-20)	8(13.33)	16(26.67)	23(38.33)	47(48.96)
	High (20-28)	13(21.67)	4(6.67)	7(11.67)	24(25.00)

Table 4. Mean frequency consumption of food items under different food groups (n=180)

FoodGroups	Male (n_1=60) Mean	Female (n_2=60) Mean	Child (n_3=60) Mean	Total (n=180) Mean	f-value
Cereals	3.71	4.35	3.58	3.88	0.20^{NS}
Pulses	2.75	3.21	2.93	2.96	0.95^{NS}
Milk & Milk Products	3.96	5.21	5.01	4.73	3.83*
Green Leafy Vegetables	3.72	3.62	3.31	3.55	0.31^{NS}
Roots & Tubers	3.92	4.15	3.62	3.90	0.12^{NS}
Other Vegetables	3.64	4.21	3.86	3.90	3.05*
Fruits	3.14	3.37	3.08	3.20	0.16^{NS}
Sweets	4.96	4.97	4.74	4.89	0.16^{NS}
Fats & Oils	4.59	4.78	4.91	4.76	2.42^{NS}
Nuts & Oil Seeds	2.30	3.47	2.77	2.85	0.97^{NS}
	(n_1=31)	(n_2=24)	(n_3=41)	(n=96)	
Non-Vegetarian Foods	4.25	2.19	2.32	2.92	5.89*

Mean score range 1-7

than half (56.67%) of the female respondents had higher consumption of fats & oil products in comparison to male (40%) and child (51.67%) respondents. It was also found that 21.67 per cent of male respondents had low consumption of fat & oil products in comparison to female (10%) and child (13.33%) respondents. The mean frequency of fats & oils was 4.59 for males, 4.78 for females and 4.91 for child respondents. The difference in mean frequency was reported to be non-significant between different categories.

The mean frequency of nuts & oilseeds consumption was reported to be 2.30 for males, 3.47 for females and 2.77 for children. Variation in the mean was found to be non-significant. 60 per cent were having a low intake of nuts and oilseeds and 31.11 per cent were having medium consumption. Further, it was also indicated

that the majority of males (63.33%) had low consumption compared to females (55%) and child (61.67%) respondents. Only 3.33 per cent of child respondents had high consumption which was low in comparison to males and females, both with 11.67 per cent consumption. 48.96 per cent had medium consumption of non-vegetarian food items followed by low (26.04%) and high (25%) consumption. In categories wise difference it was observed that 21.67 per cent of the male respondents had high consumption whereas only 6.67 per cent of the female and 11.67 per cent of child respondents were having high consumption. The data also reported that there were 18.33 per cent of child respondents who had low consumption of non-vegetarian foods followed by 16.67 per cent male and 6.67 per cent female respondents. It was further observed that the mean frequency of non - vegetarian foods was 4.25, 2.19 and 2.32 for male, female and child respondents respectively. A significant difference prevailed between the mean frequency of non - vegetarian foods of the three groups with the male respondents reporting the highest frequency of consumption. Whereas female reported the lowest frequency of consumption.

CONCLUSION

It may be concluded from this study that there was a lack of variation in the consumption of different food groups by the respondents. It was found that the food consumption pattern of the males was better than that of females as they consumed more balanced and diverse food as compared to their counterpart. So, it is suggested that Eating habits should be set according to the seasonal availability of the food items in an area as the environment grows different varieties of food according to the area and the requirements of the people living in a particular region. This practice will lead to a variation in diet and will naturally help in balancing the consumption of certain food items and products.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (26-29)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Knowledge of Farmers on Functioning of e-NAM

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ARTICLE INFO

Keywords: e-NAM registered farmers, Knowledge, Awareness, APMC, Market and Functioning

http://doi.org/10.48165/IJEE.2022.58205

ABSTRACT

National Agriculture Market (e-NAM) is a pan-India electronic trading portal that networks the existing APMC *mandis* to create a unified national market for agricultural commodities. The study investigated the knowledge level of e-NAM registered farmers about the features and functioning of e-NAM in Duggirala market of Andhra Pradesh during 2019-2020. A total sample of 120 farmers was randomly selected from six mandals *viz*. Kollur, Kollipara, Bhattiprolu, Tenali, Mangalagiri and Duggirala of Guntur district in Andhra Pradesh. The data were collected with pre-structured interview schedule. The knowledge on functioning of e-NAM was measured in three phases *viz.* gate entry, quality assaying and e-bidding. Majority of the farmers had knowledge on details of registration fee, details of quality assaying fee and provision of choice to accept or reject the bid in the gate entry, quality assaying and e-bidding phases of e-NAM respectively. Further, it was observed that majority of the farmers had medium level of knowledge on functioning of e-NAM. Knowledge scores were significantly related with education, extension contact, market orientation, income orientation, mass media exposure, risk orientation and social participation. All the selected eleven variables of the profile put together explained about 59.90 per cent variation in the knowledge of respondents. There is a large scope for imparting training to the farmers about various aspects of e-NAM in order to enhance its utilization effectively and efficiently.

INTRODUCTION

National Agriculture Market (e-NAM) was launched on 14th April, 2016 as an electronic trading portal that interconnects physical existing wholesale markets across states and union territories. It enables online trade of agriculture and horticulture commodities using a transparent price discovery mechanism and provide remunerative prices to the farmers produce (Bisen & Kumar, 2018). The concept of e-NAM was evolved from a pilot project of e-tendering done in Karnataka state (Pavithra et al., 2018). Small Farmers Agribusiness Consortium (SFAC) is the lead agency for its implementation and Nagarjuna Fertilizers and Chemicals Ltd. is the strategic partner which is accountable for development, operation and maintenance of the platform (Deshmukh et al., 2018). Directorate of Marketing and Inspection (DMI) provides technical support for harmonization of standards for different trading commodities and assaying facilities, National Information Centre (NIC) provides necessary servers to the portal (Reddy, 2018). The key stakeholders include Farmers, Traders, APMCs, Assaying Bodies, Farmer Producer Organisations (FPOs), Banks, Logistics operators, Warehouses, Mandi board *etc*. The aim of scheme is to provide quality commensurate price realization, improve the

Received 26-01-2022; Accepted 02-02-2022

mechanism of price discovery, streamline the procedures across the integrated agricultural markets in the country, remove information asymmetry between buyers and sellers and also to create the "One Nation, One Market" concept for agricultural products. It provide the farmers with multiple options of sale of their produce and enhance market accessibility through warehouse based sale (Yadav & Sharma, 2017) and can be regarded as a technology that bring a social change in markets (Gupta & Badal, 2018).

The e-NAM portal also provides single window services for all Agricultural Produce Market Committee (APMC) related information and services which includes commodity prices and arrivals, quality, settlement of e-payment settlement *etc* (Aditya & Bhaskar, 2017). So far, one thousand Agricultural Produce Market Committees (APMCs) markets have been integrated to this innovative marketing platform in 18 States and 03 Union Territories with over 1.69 crore farmers and 1.55 Lakh registered traders (Goswami & Jatana, 2021). To strengthen e-NAM, the Government of India had launched various features such as FPO trading module, warehouse trading module, GPS based mandi locator, integration with Agmarknet and Rashtriya e-Market Services (ReMS) portals and display of portal in English and eleven Indian languages for easy and effective use of farmers (Press Information Bureau, 2021). However, it has been found that markets are facing various challenges in implementation of e-NAM, which include difficulty in understanding its process flow and lack of awareness of farmers on various phases of e-NAM such as entry gate registration, quality assaying, e-bidding and online payment (Reddy & Mehjabeen, 2019; Bhusanar & Singh, 2019). Knowledge acquirement certainly leads to effective utilization of any new online technologies along with the support of various profile characteristics of farmers (Kanthisri et al., 2019). The socio-economic and psycho-personal variables had positive and significant relationship with knowledge level, also, education, and scientific orientation were positive and significant contributor to the knowledge level (Ravikumar et al., 2015). Therefore, a systematic study was conducted to measure the knowledge level of farmers towards features and functioning of e-NAM.

METHODOLOGY

The study was conducted in Guntur district of Andhra Pradesh during 2019-2020 by adopting Exploratory and Ex-post facto research designs. Duggirala e-NAM integrated APMC in Andhra Pradesh was purposively selected for the study. Six mandals with highest number of Duggirala e-NAM registered farmers namely Bhattiprolu, Kollur, Kollipara, Tenali, Mangalagiri and Duggirala in Guntur district were selected purposively. From each of the selected mandal, twenty e-NAM registered farmers were selected randomly, making a total of 120 respondents. The respondent for the study was operationally defined as the farmers who registered and traded with e-NAM in Duggirala APMC of Andhra Pradesh. The data were collected by personal interview method through a pre-structured interview schedule consisting of both open and close-ended questions. A teacher made test was prepared in consultation with mandi officials and experts in the field of agricultural marketing in order to study the knowledge level of the respondents regarding functioning and features of e-NAM. The knowledge on e-NAM was categorized in to three phases *viz.* gate entry, quality assaying and e-bidding. It consists of twenty three items in total and were presented in the form of multiple choice questions, fill in the blanks, true/false *etc*. covering all the aspects of e-NAM. A score of 1 was given to right answer and 0 for the wrong answers. The maximum scores that a respondent could obtain was 23 and the minimum score that a respondent could obtain was zero. Later the responses were tabulated and analysed by using statistical tools such as frequency, percentage and standard deviation. The total knowledge score was categorized into three categories of the level of knowledge *i.e*. low, medium and high. To study the influence of profile characteristics on knowledge level of respondents, correlation and multiple regression analysis were used.

RESULTS AND DISCUSSION

The data on classification of sample respondents according to their level of knowledge on e-NAM is given in Table 1. Majority of the respondents (58.33%) had medium level of knowledge, followed by low (22.50%) and high (19.17%) levels of knowledge on e-NAM. The medium to low level of knowledge of respondents on e-NAM can be attributed to the fact that the respondents had tried to learn about basic features of e-NAM which are must for involving the trading operations. They obtained this minimum knowledge through observation and direct experiences that were encountered during the trading process. The findings are accordance with the study reported by Kaur et al., (2020); Rajan et al., (2021); Pandya (2015) & Girish (2017).

Table 1. Distribution of respondents according to their level of knowledge on e-NAM (n= 120)

Category	Frequency	Percentage
Low	27	22.50
Medium	70	58.33
High	23	19.17

Knowledge of respondents regarding different aspects of three phases in e-NAM

The data presented in the Table 2 revealed that majority (95.00%) of the respondents were having knowledge about entry gate registration fee details followed by requisite documents of registration (93.33%), process of entry gate registration (85.83%), creation of unique lot ID (80.00%) and timings of entry gate registration (52.50%). Only 5.83 per cent respondents had knowledge about pre-registration process. Similar results were reported by Sonawane et al., (2020).

The data presented revealed that majority (96.67%) of the respondents were having knowledge about fee details of quality assaying followed by quality enhancement practices (74.17%), procedure of quality assaying (55.83%), optionality of quality assaying (50.83%), usage of digital moisture meter (40.83%), tradable parameters of produce (37.50%), categorization of produce (36.67%) and weight of sample (11.67%). Only 9.17 per cent of respondents had knowledge on prescribed curcuminoid content ranges of turmeric in e-NAM. The findings are accordance with the studies reported by Sonawane et al., (2020); Reddy & Mehjabeen (2019); Prasad & Rao (2019).

Table 2. Knowledge regarding various phases

Item	Percentage	Rank
Entry gate phase		
Timings of entry gate registration	52.50	V
Pre-registration process	05.83	VI
Registration fee	95.00	I
Process of entry gate registration	85.83	III
Creation of Unique lot ID	80.00	IV
Requisite documents	93.33	II
Quality assaying phase		
Optionality of quality assaying	50.83	IV
Tradable parameters of produce	37.50	VI
Quality assaying fee	96.67	I
Usage of Digital Moisture Meter	40.83	V
Weight of the sample	11.67	VIII
Quality enhancement practices	74.17	II
Curcuminoid content ranges in e-NAM	09.17	IX
Procedure of quality assaying	55.83	III
Categorization of produce	36.67	VII
e-bidding phase		
Time period of e-bidding	75.00	IV
Participants of e-bidding	31.67	VIII
Provision of choice to accept or reject bid	85.00	I
Generation of sale agreement	35.83	VII
Bid winner declaration process	84.17	II
Mandatory signatures in sale bill	41.67	VI
Creation of e-auction	78.33	III
Platform of bidding	73.33	V

The data further revealed that majority (85.00%) of the respondents were having knowledge about provision of choice to accept or reject bid followed by bid winner declaration process (84.17%), creation of e-auction (78.33%), time period of e-Auction (75.00%), Platform of bidding (73.33%), mandatory signatures in sale bill (41.67%) and generation of sale agreement (35.83%). Only 31.67 per cent respondents had knowledge about participants of e-bidding. The findings are accordance with the study reported by Sonawane et al., (2020); Reddy & Mehjabeen (2019); Prasad & Rao (2019).

Relationship and regression analysis between independent variables and knowledge of respondents on e-NAM

The observations of Table 3 reveals that variables such as education, extension contact, income orientation and market orientation had positive and significant relationship with the knowledge of respondents at 1 per cent level of significance. Social participation, mass media exposure and risk orientation had positive and significant relationship with the knowledge of respondents at 5 per cent level of significance. Remaining independent variables *viz*. landholding, telescopic faculty and economic motivation were positive but, non-significantly correlated with the knowledge level of respondents. Whereas, age was negatively correlated but, non-significant with knowledge level of respondents. These results are in agreement with the findings of Fathima (2019).

Education equips a person with necessary comprehension skills. Literate individuals are very keen to get information and use it. Extension functionaries are best and reliable sources of information and are instrumental in creation of awareness and knowledge of new potential marketing avenues to the farming community. The farmers with high market orientation have propensity towards gathering market information, market trend, prevailing infrastructure and various marketing means. Income oriented farmers have inclination towards acquiring more knowledge about anything and everything which has potential to hike their income levels. This attribute might have aroused their interest to know more about benefits and operational mechanism of e-NAM. The farmers with high risk taking ability tend to acquire more details about the functioning, operational procedure and benefits of the scheme before utilizing the marketing platform. Mass media plays an important role in providing awareness and creation of knowledge on recent market reforms, innovative marketing platforms and their functioning. Social participation provides an opportunity to interact with fellow farmers and members of different institutions. These factors might have facilitated the respondents to gain knowledge on e-NAM. Enhancements of knowledge of farmers through appropriate methods with description and explanation of process and casual relationship have the capacity to go a long way (Nain & Chandel, 2013).

The regression analysis was performed to find out the effect and extent of influence of each variable towards the level of knowledge on e-NAM. It is evident that the coefficient of determination 'R^2' value was significant. The 'R^2' value of 0.599 depicted that all the eleven variables of the profile put together

Table 3. Relationship between independent variables and knowledge and determinants of Knowledge on e-NAM

Correlates	Coefficient of correlation (r) Knowledge (Y1)	Regression Coefficient	Standard Error	't' Value
Age	-0.068^{NS}	0.685	1.895	-1.045^{NS}
Education	0.333**	-0.020	0.019	1.939*
Land Holding	0.139^{NS}	0.207	0.112	-0.125^{NS}
Social participation	0.190*	-0.004	0.036	0.920^{NS}
Mass Media exposure	0.193*	0.069	0.074	1.920*
Extension contact	0.420**	0.173	0.091	3.008**
Risk orientation	0.198*	0.208	0.069	0.419^{NS}
Market orientation	0.375**	0.026	0.061	2.614**
Income orientation	0.670**	0.169	0.065	7.985**
Telescopic faculty	0.025^{NS}	0.413	0.052	0.245^{NS}
Economic motivation	0.116^{NS}	0.015	0.061	1.506^{NS}
Intercept value = 68.48		R^2 = 0.599		F = 14.65

R^2= 0.599 NS = Non- Significant * Significant at 5% level of significance, **Significant at 1% level of significance

explained about 59.90 per cent variation in the knowledge of respondents. Remaining 40.10 per cent was due to extraneous factor effect. The findings also reveal that out of eleven variables, five variables *viz.* education ($p<0.05$), mass media exposure ($p<0.05$), extension contact ($p<0.01$), market orientation ($p<0.01$) and income orientation ($p<0.01$) were found to contribute to the knowledge of respondents to a greater extent.

CONCLUSION

The farmers were having minimal basic knowledge which is must for involving in trading operations. This knowledge also might have acquired through experience gained during the trading operations through e-NAM. On the other side, some of the enthusiastic e-NAM registered farmers might have gone through the e-NAM guidelines to facilitate their transactions in a better way. However, there is no full-fledged knowledge among the e-NAM registered farmers due to lack of access as well as lack of comprehension on National Agricultural Market guidelines. The National Agricultural Market (e-NAM) is undoubtedly a landmark initiative that may go a long way to ensure remunerative prices and transparent price discovery to farmers. However, success of this scheme will largely depend upon knowledge of farmers to utilize e-NAM more effectively and efficiently. Hence, there is requirement to develop a scientific method of sensitization and organization of training programmes to enhance understanding and popularize the e-NAM.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (30-34)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Adoption of Climate Resilient Agricultural Technologies by Farmers in Nalgonda district of Telangana State

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ARTICLE INFO

Keywords: Climate change, Climate resilient agricultural technologies, Adoption, Nalgonda, NICRA

http://doi.org/10.48165/IJEE.2022.58206

ABSTRACT

Over the past few decades, climate change has become inevitable. In the present scenario, the focus from yield intensification is switched over to the adaptation to climate change. Climate Resilient Agricultural (CRA) technologies are observed as the best adaptation options available which could enhance the resilience of agriculture. The present study investigates the extent to which CRA technologies are being adopted by the farmers in the National Innovations in Climate Resilient Agriculture (NICRA) project implemented villages of Nalgonda district in Telangana state. It further examined the association of profile characteristics of respondents with the extent of adoption of CRA technologies. A structured interview was used to obtain data from 120 respondents. Results revealed medium to high levels of adoption of CRA technologies by the farmers with renovation and/or use of farm ponds, introduction and raising of medium duration variety in red gram *viz.*, LRG-52 and preventive vaccination in livestock among the highly adopted technologies. The profile characteristics *viz.*, farm size, annual income, innovativeness, information seeking behaviour, achievement motivation, and Weather Based Agro Advisory Services had positive and significant association with the extent of adoption of CRA technologies by the farmers.

INTRODUCTION

Climate change has become a global concern demanding attention and action due to the rising global temperatures, widespread melting of ice, changes in the intensity and frequency of occurrence of extreme events. In a densely populated country like India, particularly the effects of climate change are more detrimental in view of its highly vulnerable nature. The projected change in climate for 2100 indicated an increase in the temperature and rainfall between 2.5- 4.4°C and 15 and 24 per cent respectively (Bal et al., 2016). In view of these extreme climatic uncertainties, it is obvious that Indian agriculture is highly vulnerable to climate change as climate is the direct input for production. In addition, more than 60 per cent of the total cropped area under irrigation in India is still dependent on the vagaries of monsoon (Saxena & Kumar, 2014).

In view of the increased importance to address the development needs of more vulnerable populations of the country, Indian Council of Agricultural Research (ICAR) has launched a major network project on February, 2011 *i.e.*, National Initiative on Climate Resilient Agriculture later renamed as National Innovations in Climate Resilient Agriculture (NICRA). Under this project, location specific Climate Resilient Agricultural (CRA) technologies are being recommended and implemented in the project villages to enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change.

During the present times, it has become vital to take action in encouraging the farmers adopt the CRA technologies in order to

Received 23-09-2021; Accepted 18-01-2022

enable them to cope up with the aberrant effects of climatic variability and change (Archana, 2017). The present study was undertaken with an objective to assess the extent of adoption of these recommended practices in the selected villages in Nalgonda district of Telangana state.

METHODOLOGY

For the purpose of drawing sample, multistage simple random sampling technique was used for the study. Nalgonda district of Telangana State was selected purposively as it is one among the 100 districts selected for the NICRA (National Innovations on Climate Resilient Agriculture) project implementation. The important climatic vulnerabilities of the district were high drought proneness, heat stress, mid and terminal dry spells etc. Three villages namely Nandyalagudem, Boring thanda and Kotha thanda of Athmakur (S) Mandal in the erstwhile Nalgonda district of Telangana State were selected purposively as the NICRA interventions are being implemented in these villages. A sample size of 40 farmers was selected at random from each village thus comprising a total sample size of 120. The data collected were analysed using frequency distribution, percentage and mean. Pearson Correlation was used to test the hypothesis of the study.

The list of CRA technologies recommended under NICRA project and implemented by Krishi Vignan Kendra (KVK), Gaddipally in the respective locale of study was considered for the present study. These technologies were implemented under four modules namely, National Resource Management (NRM), Crop production, Livestock and fisheries, Institutional interventions. The extent of adoption of CRA technologies by each respondent was obtained from the responses of the individual on a three-point continuum (fully adopted, partially adopted, not adopted with scores 2,1,0) by summation of the scores obtained from all the items included in the four modules. The possible minimum and maximum scores were 0 and 40, respectively. Based on the obtained minimum and maximum scores, the respondents were classified in to five groups *i.e.,* very low, low, medium, high and very high using exclusive class interval technique. The ranking of CRA technologies under each module was given based on the mean scores of the extent of adoption. The total score of each technology was obtained by multiplying the frequency under each category (not adopted, partially adopted, fully adopted) with their respective scores (*i.e.,* $f_i*0+f_j*1+fk*2$). Further, the mean score for each technology was obtained by dividing the total score with total sample size (120) and the ranks were given accordingly for the technologies under each module.

The Pearson correlation analysis was performed with the extent of adoption of CRA technologies and profile characteristics of farmers *viz.,* Age, gender, education, family size, farming experience, farm size, annual income, source of irrigation and socio-political participation, innovativeness (Verma, 1970), information seeking behaviour (Rao, 1985), risk taking ability (Supe, 1969), decision making behavior (Sobhana, 1990), Achievement motivation (Kota, 2017), Weather based Agro Advisory services (Archana, 2017) and scientific orientation (Supe, 1969).

RESULTS AND DISCUSSION

Extent of adoption of CRA technologies by the farmers

The ranking of CRA technologies under each module based on the mean scores of extent of adoption were presented in Table 1.

Table 1. Ranking of Climate Resilient Agricultural (CRA) technologies based on mean scores of extent of adoption

Intervention		Responses		
		Total Score	Mean Score	Rank
Natural resource management				
1.	*In-situ* moisture conservation practices in cotton and/or Red gram	190	1.58	III
2.	Soil test based fertilizer application	198	1.65	II
3.	Red gram sowing with BBF planter	183	1.53	IV
4.	Cotton sowing with Ridge and Furrow planter	145	1.21	VI
5	Renovation and/or use of farm ponds	207	1.73	I
6.	De silt and tank silt application to red chalka soils (light soils)	177	1.48	V
Crop production				
7.	Introduction of medium duration variety LRG-52	202	1.68	I
8.	Cotton + Red gram (6:1) inter cropping system	184	1.53	III
9.	Foliar nutrient management in cotton and red gram	175	1.46	IV
10.	Seed production of red gram PRG-158	156	1.30	V
11.	Installation of sticky traps in cotton	194	1.62	II
12.	Vegetable cultivation rather than growing cereal and pulse crops	140	1.17	VI
Livestock and podder production				
13.	Popularization of backyard poultry	99	0.83	III
14.	De- worming to livestock	118	0.98	II
15.	Improved fodder production APBN-1 and Co-4	86	0.72	IV
16.	Preventive vaccination	129	1.08	I
17.	Green fodder cultivation (MP- Chari)	62	0.52	V
Institutional interventions				
18.	Custom hiring center for timely field operations (i.e., rotavators, chaff cutters, puddlers, sprayers etc.)	132	1.10	I
19.	Gaining climate literacy through village weather station	97	0.81	III
20.	Village seed bank/ fodder bank	124	1.03	II

Natural Resource Management (NRM) module

The ranks assigned to each technology under the NRM module revealed that renovation and/or use of farm ponds was highly adopted (I Rank) followed by soil test based fertilizer application (II Rank). The probable reason may be because the farmers were educated by the officials on the importance of farm ponds in restoring water and utilizing it for providing supplemental irrigation during the periods of drought. Nearly all the farmers were found to have done soil testing in their fields and are following soil test based fertilizer application. Majority of the farmers were found to have adopted *in-situ* moisture conservation practices in crops *viz.*, cotton and red gram (III Rank) like bunding, deep ploughing, mulching, etc., probably due to the realization of the highly beneficial nature of these technologies. Some of the results obtained were similar to the findings of Brar et al., (2020), on the other hand meetings and discussions brought awareness of the changes happening in the villages due to global climate change and rains becoming quite unpredictable and erratic leading to creation of water sharing groups (Gupta et al., 2021).

Crop production module

It was observed that majority of the farmers were found to have fully adopted the introduction and raising of medium duration variety in red gram *viz.*, LRG-52 (I Rank) which was frequently distributed under the project followed by installation of sticky traps in cotton (II Rank) to protect the crop from sucking pest attack, cotton + red gram (6:1) inter cropping system (III Rank), foliar nutrient management in cotton and red gram (IV Rank), seed production of red gram PRG-158 (V Rank) and vegetable cultivation rather than growing cereal and pulse crops (VI Rank). The reason for low adoption of vegetable cultivation was probably because it was grown only as contingent crop and for home consumption rather than a commercial crop by the respondents.

Livestock and fodder production

The results of the ranks assigned to each technology under livestock and fodder production revealed that majority of the farmers who possess livestock adopted the preventive vaccination to protect from diseases (I Rank) followed by de-worming in livestock (II Rank), popularization of backyard poultry (III Rank), improved fodder production APBN-1 and Co-4 (IV Rank) and green fodder cultivation (MP- Chari) (V Rank). The farmers were found to have low adoption of cultivation of fodder varieties due to the limited water resources and occurrence of drought. The results were similar to the findings of Chouksey et al., (2021).

Institutional interventions

It was observed that utilization of Custom Hiring Centre (CHC) for timely field operations (I Rank) was highly adopted as it saved up to 80 per cent of field costs and enabled timely field operations to the farmers followed by partial adoption of village seed bank/ fodder bank (II Rank) and low adoption of gaining climate literacy through village weather station (III Rank).

From the data presented in Table 2 on the extent of adoption of CRA technologies it was apparent that two-fifth (39.17%) of the respondents had high levels of adoption of CRA technologies followed by one- fourth (25.84%) of the respondents with medium level of adoption. Whereas, one-fifth (20%) of the respondents were observed to have very high level of adoption of CRA technologies. The probable reason for medium to higher level of adoption of CRA technologies might be attributed to the higher information seeking behavior, scientific orientation, innovativeness, achievement motivation, and utilization of WBAAS (Weather Based Agro Advisory Services) by majority of the respondents. Additional reasons may be due to the satisfying results produced by the technologies in coping with climate change through reduced exposure and sensitivity towards agriculture and increase in the adaptive capacities of the farmers through crop diversification, contingency plans and enhanced incomes.

Table 2. Distribution of respondents based on the extent of adoption of CRA technologies

S.No.	Category	Percentage
1	Very low	11.66
2	Low	3.33
3	Medium	25.84
4	High	39.17
5	Very high	20.00

Association of profile characteristics of respondents and extent of adoption of CRA technologies by the farmers

It can be inferred from the data presented in Table 3 that farm size, annual income, innovativeness, information seeking behavior, achievement motivation and WBAAS had positive and significant association at one per cent level of probability whereas, education, risk taking ability, decision making behavior, scientific orientation had positive and significant association at five per cent level of probability with the extent of adoption of CRA technologies by the farmers. The probable reason for the positive and significant association of farm size with the extent of adoption of CRA

Table 3. Association of profile characteristics of respondents and adoption of CRA technologies

S.No.	Characteristics	Correlation coefficient (r)	p value
1	Age	0.21	0.796
2	Gender	0.16	0.14
3	Family size	1.49	0.151
4	Farming Experience	-0.41	0.633
5	Education	0.19*	<0.05
6	Farm size	2.81**	<0.01
7	Source of Irrigation	0.27	0.502
8	Annual Income	0.25**	<0.01
9	Innovativeness	1.21**	<0.01
10	Information Seeking Behavior	2.86**	<0.01
11	Risk Taking Ability	0.19*	<0.05
12	Decision Making Behavior	0.18*	<0.05
13	Sociopolitical Participation	1.28	0.07
14	Achievement Motivation	0.28**	<0.01
15	Weather Based Agro Advisory Services (WBAAS)	0.25**	<0.01
16	Scientific Orientation	1.63*	<0.05

Note: **- at 1% level of significance; *- at 5% level of significance

technologies may be that medium and large farmers had high extension contacts to receive required information, the capacity to invest money and readily try new technologies. In contrast, the small and marginal farm land holders tend to take low risks due to various limitations. The results are similar to the findings of Chouksey et al., (2021); Mohokar et al., (2019); Rai et al., (2018) and Harikrishna et al., (2019), while they are in contrast with Manjunath et al., (2018). Similarly, individuals with higher annual income were generally enthusiastic to take up new enterprises *viz.*, mulberry cultivation and raised their crop fields by adopting CRA technologies to further enhance their income levels. Realization of the beneficial nature of CRA technologies in terms of income earned might have contributed to the high level of adoption of CRA technologies.

Innovativeness has a positive and significant association of with the extent of adoption of CRA technologies may be because an individual with higher innovativeness will basically show willingness to try new ideas by which he tends to collect more information regarding those ideas or practices. Further, the beneficiaries gathered information from the officials of KVK, NICRA and through discussions with other farmers in the village about the benefits and problems in the adoption of CRA technologies, which may have contributed to the positive and significant association of information seeking behavior with the adoption of CRA technologies by the farmers. The obtained results are in agreement with the findings of Mohokar et al., (2019) & Manjunath et al., (2018). The possible reason for the positive and highly significant association of achievement motivation with the extent of adoption of CRA technologies could be the desire for excellence, which motivated the farmers to take up certain activity, accomplish it in a certain direction and achieve the aspired results. Achievement motivation encourages farmers to try new ideas, take higher risks and seek necessary information on CRA technologies in order to attain the desired results. The results are in concordance with Nyasimi et al., (2017); Mohokar et al., (2019) & Manjunath et al., (2018).

The probable reason for positive and significant association of utilization of WBAAS by the farmers and adoption of CRA technologies at one per cent level of probability might be that, increase in the utilization of WBAAS prepared the farmers in taking up contingency crop planning, reduced their exposure and sensitivity towards climatic variabilities, which may have further contributed towards the higher levels of adoption of CRA technologies by the farmers. Education level had positive and significant association of with the extent of adoption of CRA technologies at five per cent level of probability may be due to the normal tendency of individuals with higher education to analyse, interpret and understand the beneficial effects of technologies with less trouble may be. The results are in line with the findings of Mohokar et al., (2019) & Manjunath et al., (2018).

The high risk taking ability of the farmers may have favored them to overcome the limitations through managing the available resources and recognize the positive results from the adoption of CRA technologies. Additionally, better decision making behavior might have helped the farmers think of all possible opportunities available and decide the best course of action, that could bring them profits by reducing the risks associated with climate related stimuli. Furthermore, discussions, field days, meetings and trainings conducted by the NICRA officials on scientific farming methods, which enhance climate resilience may have contributed to their understanding of the things scientifically with interest. These may be the possible reasons for the positive and significant association of risk taking ability, decision making behavior and scientific orientation with the extent of adoption of CRA technologies at five per cent level of significance. Similar results were reported by Chouksey et al., (2021) & Manjunath et al., (2018).

CONCLUSION

The study revealed that majority of the respondents had high level followed by medium level of adoption of CRA technologies. Certain technologies in the four modules *viz.*, renovation and/or use of farm ponds, introduction and raising of medium duration variety in red gram *viz.*, LRG-52 and preventive vaccination in livestock were found to have higher level of adoption whereas other technologies *viz.*, vegetable cultivation, popularization of backyard poultry, green fodder cultivation (MP- Chari), gaining climate literacy through village weather station were low in adoption by the farmers. An extension plan may be framed keeping in view the findings of the study so that the technologies being adopted in medium and low extent can be up scaled to higher extent of adoption to gain superior benefits.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (35-41)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Capturing Community Participation in Rural Tourism through PRA: A Study in Meghalaya

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ARTICLE INFO

Keywords: Community participation, Rural livelihood, Rural tourism, Stakeholders

http://doi.org/10.48165/IJEE.2022.58207

ABSTRACT

Rural tourism as an agri-business enterprise has potential for socio-economic development of rural area and yields numerous benefits to strengthen culture, livelihood and technological outlook of communities, for which sustainability in the development venture depends on community participation. The study was taken up in two popular rural tourism centers viz., Mawlynnong (cleanest village of Asia) and Sohliya (Strawberry village) of Meghalaya state that has heavy tourist traffic; to carry out community stakeholder analysis of rural tourism. Through key informant technique, personal interview and observation, 15 categories of community stakeholders were identified. This was followed by a community level meeting of the key stakeholders and few residents in each tourism center where PRA exercises were conducted for information generation and discussion. It was found that community stakeholders organize rural tourism for various reasons through various means. The village council (*Dorbar Shong*) performed multiple roles and had high influence in village. Efforts in mobilizing community to undertake homestays and *dhabas*, emphasis on creation of exclusive tourism cooperatives within village to coordinate vital activities between stakeholders may ensure effective and sustainable participation by community members.

INTRODUCTION

Agriculture alone cannot help farmers to come out of distress (Barbuddhe & Singh, 2014) and help India achieve its goal of Doubling Farmers' Income (Chetan et al., 2020). The need to explore non-farm activities to serve as an alternative source of income has been emphasized many times (Yugang et al., 2021; Kobba et al., 2020). Rural tourism is one such non-farm activity which can be done by individual farmers or on cooperative basis to generate extra income with the same piece of land available. Rural tourism is tourism in rural areas showcasing rural life, art forms, culture and traditions of place, farm activities; by which tourists' share-in village life. With urban population seeking detachment from city life and willing to experience rural lifestyle, closer to nature, rural tourism is an evolving enterprise (Singh et al., 2016). With abundant natural and human resources available for tourism promotion within the villages of India, rural tourism industry has the capacity for employment to locals in terms of attractions, accessibility, accommodation and amenities regarded as 4A's of tourism (Andrianto & Sugiama, 2016); to supplement family income, women empowerment, household decision making, enhanced participation in educational activity (Slathia et al., 2015), thereby making all-inclusive rural development possible. Meghalaya, with its charming landscape, cascading waterfalls, rich traditional ethnicity and hospitable locals has tremendous potential to offer rural tourism. However, local community's involvement in rural tourism is important for proper tourism planning and development. Community participation in rural tourism is the involvement of

Received 17-12-2021; Accepted 15-01-2022

local people in the planning and development activities, to contribute to solve problems locally with available resources. Resident communities have a major role in the decision-making process (Zhao & Ritchie, 2007) of development programs. The effectiveness of alternate extension model is ensured by addressing the stakeholder's preferences for its validation and further replication. Choi & Sirakaya (2005); Edgell et al., (2008) emphasized the importance of community participation to tourism planning and development for positive economic, environmental and social effects and development of the whole ecosystem.

METHODOLOGY

The study was conducted in two popular tourism destinations in the Khasi Hills Division of Meghalaya *viz*., Mawlynnong in East Khasi Hills district and Sohliya in Ri-Bhoi district. From each of the tourism centers, community stakeholders with a significant stake in the project were identified using techniques like key informant interview, personal interviews and direct observations. The people contacted in this stage were members of *Dorbar Shnong* (Village Council), taxi drivers, eatery owners, members of farmers' association, were interacted on a one-to-one basis. Through this exercise a list of community stakeholders was delineated, followed by a meeting at the community level where representatives of the stakeholder categories participated. Certain Participatory Rural Appraisal (PRA) exercises were carried out in the meeting which led to identification of few other stakeholder categories. For Mawlynnong village 27 community members were present in the meeting, while in Sohliya 21 members participated. Their responses were utilized for the analysis of stakeholder items and results were provided. For soliciting the first three categories of information, methodology described in ODA (1995) was employed.

1. Stakeholders' description: The stakeholder categories were characterized through their roles and interests in rural tourism. Roles implied the activity performed with respect to the stake in rural tourism. Interest is a stake or involvement in an undertaking, especially a financial one. The likely impact of these interests on tourism activities project was highlighted.

2. Stakeholders' prioritization: The identified stakeholders were prioritised based on their 'influence on' and 'importance to' rural tourism. 'Influence' was measured as formal or informal power possessed by a stakeholder category in terms of socio-economic status, leadership and degree of resource control whereas, 'importance' was referred to the priority of needs, expectations and benefits that are to be addressed first for a stakeholder category in relation to rural tourism. Participants were asked to rate community stakeholder categories in terms of their importance and influence in rural tourism on a scale of 0-10. Scores assigned to the stakeholders by the participants were plotted on a graph with influence on X-axis and importance on Y-axis. With the mid-point 5 as the criteria for diving the score as high or low, a 2X2 matrix was constructed with 4 quadrants.

3. Stakeholders' participation: Stakeholders' participation was defined in terms of degree of involvement of the stakeholder in an event/activity related to rural tourism. In order to assess the involvement of community stakeholders, a total of 5 tourism related activities in each village were identified during community meeting. The level of participation of the stakeholders in the activities was ascertained through the perception of concerned stakeholder participant(s).

4. Stakeholders' interrelationship: To show interrelationship among stakeholders, Actor Linkage Matrix developed by Biggs & Matsaert (1999) was used which allows for the exploration of linkages among actors. All the stakeholders were asked to indicate the presence or absence of relationship among each other and those having relationship were to indicate strength of linkage as strong (S), medium (M) and weak (W), especially business relations of tourism operations. In each of the exercises the responses generated were arrived at a consensus through deliberation among the participants so that a data which was in agreement by one and all was finalised and recorded. The exercises were conducted during February 2020.

RESULTS AND DISCUSSION

A total of 15 categories of community stakeholders who operate locally at the community level with or without any significant aid from external agencies were identified along with their interest and impact on rural tourism (Table 1), of which 14 and 11 categories were spotted in Mawlynnong and Sohliya villages respectively. In community meeting, stakeholders reported that the tourist traffic ranged between 300 to1000 persons per day all-round the year in Mawlynnong while it was around 100 persons per day in peak seasons in Sohliya. In the former village 40-45 households had constructed homestay facilities depicting typical *Khasi* lifestyle while in the later boarding and dining facilities were absent. Though there were Self-help Groups (SHGs) operational in both the villages but they were in no way related to the tourism activities. Forest produce collectors who lost livelihood, due to cut down of forest area for rapid tourism development as expansion of residential area and policy measures restricting their rights to collect forest produce, were the only stakeholder category to be affected negatively. Rakesh (2011) reported similar roles of tourism stakeholders. Among all the categories, the village council was found to perform multiple roles since it is the key nodal organization at village level responsible for village governance. Although certain stakeholder groups like farmers, local residents, farmers' cooperatives and forest produce collectors do not play direct role, they have an indirect impact with certain interest held that affect rural tourism activities. The category 'tourist' though not a community stakeholder has been included in the list since they form the central element in any rural tourism enterprise.

Stakeholder's prioritization

The stakeholder prioritization matrix for Mawlynnong and Sohliya are presented in Figure 1 and 2 respectively. The matrix results show that tourist though form the central element rural tourism, does not have much power. Fruit and vegetable vendors and handicraft vendors provide their services in tangible form, which serve as souvenir for the tourists. The home stay providers, restaurants, dhabas, recreation providers and hotels provide services to tourists in intangible form. Though their operation was independent, without them, tourism cannot flourish. Recreation providers offer attractions like tree house, trekking, boating, etc. in

Table 1. Stakeholders' roles, interest and impact

S.No.	Stakeholder	Role	Interest	Impact
1	Homestays	Rent their home for stay of tourists/Create local hospitality and home like feeling the tourists	Loans or subsidies from local government for housing	(+)
			Stable income without fluctuations	(+)
2	Hotels	Provide accommodation for tourists.	Long term profits	(+)
			Networking and collaboration with travel agencies	(+)
3	Resorts	Offers holiday experiences for tourist along with food and accommodation facilities.	Long term profits	(+)
			Set up adventurous and unique holiday experiences to engage tourists	(+)
4	Restaurants	Offer dine-in services with wide range of dishes.	Increase sales margin	(+)
			Loan and credit facilities	(+)
			Long term profits	(+)
5	*Dhabas*	Local cuisine and take-away provider	Promote local cuisine	(+)
			Increase sales margin	(+)
6	Recreation providers	Staging events for tourists.	Ensure memorable experiences to tourists	(+)
			Insurance coverage for constructions	(+)
7	Freelancers	Assist tourists as local guides/language translators.	Alternate source of livelihood	(+)
			Fixed charge per hour basis	(?)
			More foreign tourists	(+)
8	Village Council (*Dorbar Shnong)*	Administration; Advisory; Facilitation; Community mobilization	Cleanliness promotion	(+)
			Community livelihood improvement	(+)
			Capacity building	(+)
			Sustainable use of resources	(+)
9	Agricultural & allied farmers	Cultivation practices and agri. allied practices.	More productivity/unit	(?)
			Market linkages	(+)
			Additional source of income	(+)
			Low cost inputs	(?)
10	Fruits & vegetables vendors	Collect and sell local fruits and vegetables.	Technical expertise and storage facilities	(+)
			Branding and marketing	(+)
11	Handicrafts vendors	Sell local handicrafts.	Uninterrupted electricity	(+)
			Separate shopping area	(+)
			Market linkages	(+)
12	Tourist	Service taking consumers.	Time for leisure	(+)
			Experience rural lifestyle	(+)
			Easy transportation	(+)
13	Local residents	Represent local community interests	Infrastructure development	(+)
			Better sanitation and cleanliness	(+)
			Less tourist mobility	(-)
			Less noise and disturbance in regular lifestyle	(?)
14	Farmers' cooperative	Organize grouping of farmers for collective trade.	Lower involvement of middlemen	(?)
			Better prices	(+)
			Better market	(?)
			Branding and storage facilities	(+)
15	Forest produce collectors	Collect and sell minor forest produce.	Protect tribal forest dwellers rights.	(-)
			Adequate compensation.	(?)

Legend: (+)=desirable impact; (-)=undesirable impact; (?)=unknown/ undecided

Mawlynnong but in Sohliya these are very little and unorganised. Debatably, the village council, farmers and local residents were classified to have high influence but low importance as their interests were not project targets, corroborating the findings of Timur and Getz (2018). Their interests are to be satisfied regularly, by consulting them for any tourism related activities and sensitising them with the pros as well as cons of rural tourism development. The *dhabas* were usually less preferred by tourists as the facilities and hygiene condition needed improvements. In Sohliya (Figure 2) resorts although owned and managed by people living in towns and cities, were influential and important as they were the only source of accommodation of tourists and offer many recreational activities in package form. Farmers' cooperative worked parallel with rural tourism development, with a view of tourists as the customers. The freelancers and forest produce collectors had low levels of importance and influence. Freelancers worked part time as tourist guides and sometimes for free without realising the job potential. Stakeholders which fall under each of the four quadrants were given the following recommendation. Box A: This category needs special initiatives to protect their interests; Box B: These are key stakeholders with whom strong relationships need to be maintained regarding project activities; Box C: Regular monitoring and management were recommended as they might be a potential risk source; Box D: Less priority stakeholders and need limited monitoring and evaluation.

Participation of community stakeholders

In each of the centers, 5 tourism related activities were identified by the participants of PRA. The results of the stakeholders' participation in these activities are presented in Table

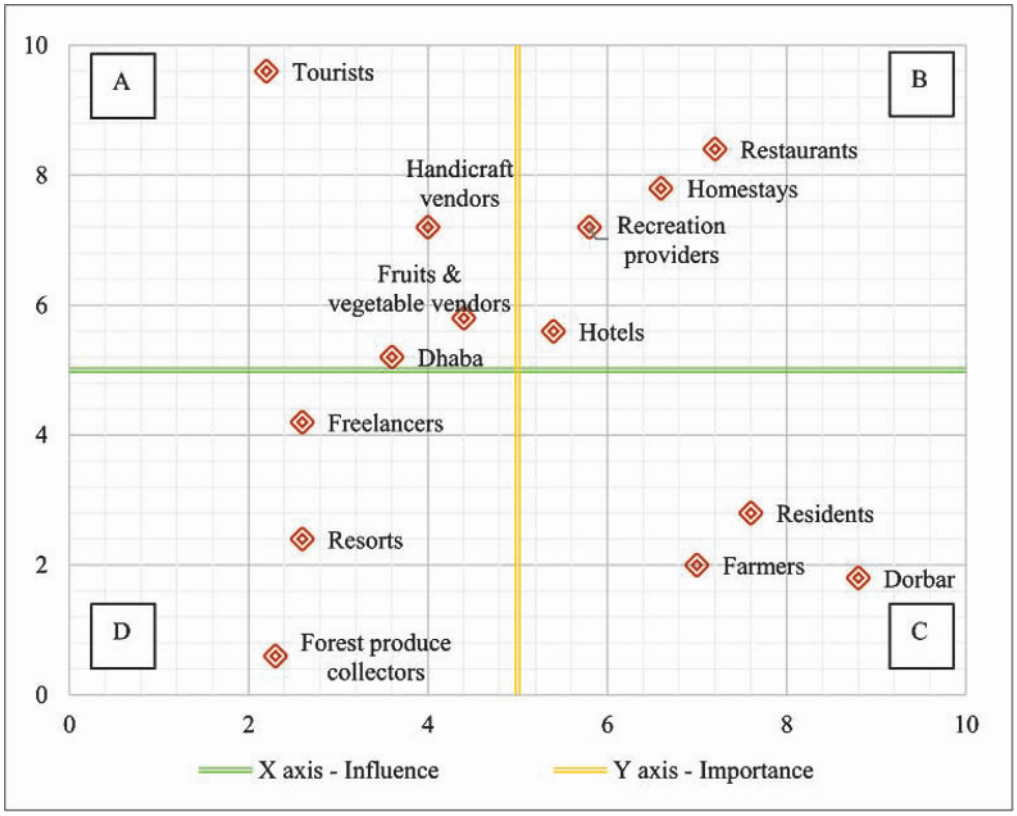

Figure 1. Stakeholder prioritization matrix of Mawlynnong village

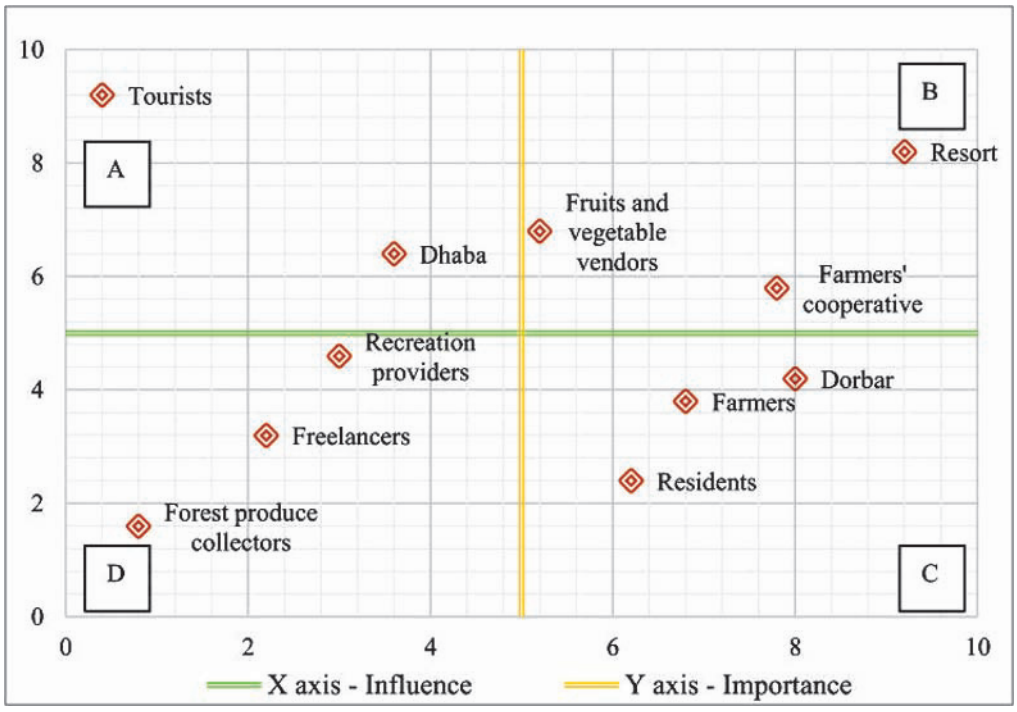

Figure 2. Stakeholder prioritization matrix of Sohliya village

2 and 3 respectively. All the stakeholders were informed about any activities of village through community meetings organized through or by the village council. The council was reported to be involved in all activities at various levels of participation and forms the major decision-making body in both the villages. In parking area construction of Mawlynnong village, residents and handicraft vendors were involved in resource sharing by contributing money and land. Since there was no per tourist charge, a sum of INR 50/- per vehicle per day was fixed as charge to visit the village. Cleanliness meetings are held for households twice a week in Mawlynnong, during which they were also taught hospitality towards tourists. Every resident irrespective of age and gender was

Table 2. Stakeholder participation matrix of Mawlynnong village

Activities	In	C	DM	RS	Im	C
Parking area construction – Infrastructure development	o All	o Dorbar o Vendors o Residents o Farmers o Resort	o Dorbar o Vendors o Residents	o Residents o Vendors	o Dorbar	o Dorbar
Cleanliness maintenance	o All	o All	o Dorbar o Residents		o All	o Dorbar
Vehicle parking meetings	o Dorbar o Vendors o Residents o Farmers o Resort	o Dorbar o Residents o Vendors	o Dorbar o Residents	o Dorbar	o Dorbar	o Dorbar
Sustainable management of local resources and village development activities	o All	o Dorbar o Residents o Farmers	o Dorbar		o Dorbar	o Dorbar
News story coverage/documentary shootings.	o Dorbar	o Dorbar o Restaurant o Homestays o Resorts o Vendors o Residents				

Note: In=Informed; C=Consulted; DM=Decision Making; RS=Resource Sharing; Im=Implementation; C=Control

Table 3. Stakeholder participation matrix of Sohliya Village

Activities	In	C	DM	RS	Im	C
Tourism infrastructure development meetings	o Dorbar o Residents o Farmers o Resort o Dhaba	o Dorbar o Resort	o Dorbar	o Dorbar		o Dorbar
Sohliya strawberry festival	o Dorbar o RBSGA o Residents o Farmers o Vendors o Resort o Freelancers	o Dorbar o RBSGA o Residents	o RBSGA	o Farmers		
Cleanliness/sanitation maintenance		o Residents	o Dorbar			o Dorbar
Sustainable management of local resources and village development activities	o All	o Residents			o Dorbar	o Dorbar
News story coverage/documentary shootings.	o Dorbar o RBSGA	o Dorbar o Residents o RBSGA o Resort				

Note: In=Informed; C=Consulted; DM=Decision Making; RS=Resource Sharing; Im=Implementation; C=Control

voluntarily involved for cleanliness maintenance. The village maintains cleanliness on a strict basis, with the area to be cleaned clearly demarked for each household. Tourism in Sohliya is concentrated around agriculture activities and tourists spend most of their time in fields, so farmers and vendors sell their produce directly to tourists. The strawberry festival in Sohliya is celebrated every year on 14th of February (Valentine's Day), as the fruit is considered as the 'symbol of love'. Technology Mission in Horticulture and Strawberry tourism were operating in the village under the guidance of Meghalaya State Departments of Horticulture and Tourism respectively. A farmer's cooperative named Ri-Bhoi Strawberry Growers Association (RSGA) was set up for effective marketing of produce. The festival was organised almost every year since 2004 to promote business and sales through provision of trade platform to growers. Resources were shared by strawberry growing farmers that make required contributions to arrange for the festival. Tourists can visit farmers' fields for fruit pickings or can also buy packaged fruits in stalls. Efforts are being made to introduce value added strawberry products with proper packing and shelf life. Krishna et al., (2021) also reported changes in social participation of stakeholders as one of the most important components of the socio-economic impact of agri-tourism. Iqbal et al., (2021) reported

Table 4. Actor linkage matrix of Mawlynnong village

S.No.	Stakeholders	Strength of linkage													
		Homestays	Hotels	Resorts	Restau-rants	Dhaba	Recrea-tion providers	Freela-ncers	Village council	Agriculture & allied farmers	Fruits & vegetable vendors	Handi-crafts vendors	Tourists	Local residents	Forest produce collectors
1	Homestays		S	M	S	S	M	M	S	S	M	W	S	S	W
2	Hotels	S		S	S	M	S	S	S	M	S	S	S	W	-
3	Resorts	S	S		W	-	W	M	W	-	S	-	M	W	-
4	Restaurants	S	S	S		S	M	S	S	M	S	W	S	M	W
5	Dhaba	M	M	M	S		M	S	M	S	S	M	S	S	W
6	Recreation providers	M	S	M	W	W		S	M	-	-	S	M	W	M
7	Freelancers	M	S	S	-	M	S		W	-	M	S	S	M	-
8	Village council	S	S	M	S	S	S	M		S	S	M	-	S	W
9	Agriculture and allied farmers	M	W	-	S	S	W	-	S		S	W	-	S	S
10	Fruits and vegetable vendors	W	M	W	S	S	S	M	M	S		M	W	S	S
11	Handicrafts vendors	W	W	-	-	M	S	S	M	W	M		W	S	M
12	Tourists	S	S	S	S	M	S	S	M	-	S	S		W	-
13	Local residents	M	W	-	M	S	M	W	S	S	S	S	W		M
14	Forest produce collectors	-	-	-	W	W	M	-	M	M	S	W	-	W	

Note: S = Strong; M = Medium; W = W

Table 5. Actor linkage matrix of Sohliya village

S.No.	Stakeholder	Strength of linkage										
		Resort	Dhaba	Recreation providers	Freelancers	Village council	Agriculture & allied farmers	Fruits & vegetable vendors	Tourists	Local resident	Farmers cooperative	Forest produce collectors
1	Resort		-	W	M	S	-	W	S	-	-	-
2	Dhaba	-		W	M	S	M	S	W	M	W	W
3	Recreation providers	W	W		S	M	W	W	M	M	W	-
4	Freelancers	M	-	S		W	M	M	M	S	-	W
5	Village council	M	S	S	W		S	S	-	S	S	S
6	Agriculture & allied farmers	W	S	W	-	S		S	-	S	S	S
7	Fruits & vegetable vendors	M	S	M	W	S	S		S	S	S	S
8	Tourists	S	W	M	S	W	-	M		W	-	-
9	Local residents	-	S	S	M	S	S	M	W		S	S
10	Farmers' cooperative	-	W	-	W	S	S	S	-	S		M
11	Forest produce collectors	-	M	W	-	M	M	M	-	W	W	

Note: S = Strong; M = Medium; W = W

JFM (Joint Forest Management) platform to increase forest tourism in rural areas for enhancing the employment opportunities and income of the communities residing in close proximity of forests.

Stakeholder's interrelationship

The stakeholder interrelationship matrix of Mawlynnong and Sohliya are presented in Table 4 and 5 respectively. Tourists and local residents had weak linkages in both the villages indicating less interaction. *Dhabas* also had weak linkages with tourists and other tourism service providers, signifying less preference. However, restaurants had strong linkages with tourists, accommodation providers and vegetable vendors in Mawlynnong. The village council and freelancers had medium to strong relationships with tourism service providers since most of them had alternative livelihood means apart from tourism activities. Farmers, vendors and residents had strong relationships amongst them and function within the control of RBGSA and the village council in Sohliya. Strong linkage with tourists was maintained by almost all the stakeholders because they form the customers of tourism industry. Pavlovic et al., (2015) found out that stakeholders had stronger relations with visitors and their interactions with others offering services was also significant. These findings mapped the scenario of stakeholders' linkages and functioning, which in turn will help to frame necessary action measures for promoting coordination amongst them.

CONCLUSION

Participation of stakeholders at all the levels of project ensures successful and sustainable rural tourism venture. All the stakeholders identified had a significant place in the community. In both the villages studied, the tourism activities had positive impact on almost all stakeholders' interest except few. However, the participation of the key stakeholders in the tourism related activities were limited with the village council exhibiting maximum influence in most activities. Many weak linkages were found among stakeholders that need to be strengthened. The findings of the study will help the stakeholders to plan their business policy and also provide valuable feeds to key external stakeholders for strategic planning and policy making for development with optimum participation and benefit to the community members. Mobilizing residents to establish tourism enterprises in forms of homestays and dhaba and integration of the community stakeholders by constitution of grass roots level tourism cooperative (working body) within each village to ensure sustainable participation and livelihood is required

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (42-46)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Farmer's Field Evaluation of Direct Seeded Rice *vis-à-vis* Puddled Transplanted Rice in Kapurthala, Punjab

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ARTICLE INFO

Keywords: Direct seeded rice, Puddled transplanted rice, Economic analysis, Yield difference, Establishment methods, Farmer's perception

http://doi.org/10.48165/IJEE.2022.58208

ABSTRACT

The direct seeded rice (DSR) has emerged as an economically viable and sustainable option for timely rice establishment due to labor shortage amid Covid-19 pandemics. The crop production practices differ greatly among puddled transplanted rice (PTR) and DSR. Therefore, we compared the performance of different rice varieties viz. PR-121, PR-126 and Pusa-44 under two contrasting establishment methods (PTR vs. DSR). The study highlights that of the total area under rice, the highest area under DSR was in Sultanpur Lodhi block (about 68.2%), while the lowest area in Dhilwan block (about 41.9%). Results revealed higher benefit-cost ratio of rice establishment under DSR technology, compared with the PTR technology, regardless of the rice variety due to reduced (about 23.9%) cost of cultivation associated with rice establishment under DSR technology. About 68.9 per cent of the respondents perceived PTR as low cost effective, while about 4.7 per cent perceived PTR as highly cost effective. Conversely, about 16.0 per cent of respondents perceived DSR as low cost effective, while a large proportion (about 55.7%) perceived DSR as highly cost effective. About 14.1, 76.4 and 10.4 per cent of PTR farmers, while about 10.4, 69.8 and 14.1 per cent of DSR farmers perceived it as low, medium and highly profitable.

INTRODUCTION

Rice (*Oryza Sativa*) is an important cereal crop cultivated on about 13.5 million ha (Mha) in South Asia (Bhatt et al., 2021). It has been highly resources-, labor- and energy-intensive crop established after wheat (*Triticum aestivum* L.) in rice-wheat cropping system (Singh et al., 2019; Dhillon & Vatta, 2020). During the last few decades, rice productivity has either diminished or stagnant in the region (Bhatt and Kukal, 2015; Singh et al., 2021) with rapid decline in underground water in north-western India (Bhatt et al., 2021), large production of rice residue and its open field burning (Gupta et al., 2020), besides large emission of greenhouse gases (GHGs) (Singh et al., 2020; Singh et al., 2021) and deterioration of soil health (Bhatt et al., 2021). Recently, amid Covid-19 pandemics, rice growers have faced another problem of severe human labor shortage (Chaba & Damodara, 2020; Singh et al., 2020), due to imposed restrictions for the migratory labor from the adjoining states (Mukhra et al., 2020; Bhatt & Singh, 2021). The pandemics have changed the rice establishment method from traditionally puddled transplanted rice (PTR) to direct seeded rice (DSR) in entire north-western India (Singh et al., 2005; Bhatt & Singh, 2021). Under these water and labor shortage situations, farmers searched for some suitable alternative, of which un-puddled DSR emerged as economically viable option (Pandey & Velasco 2005; Kumar & Ladha, 2011; Bhardwaj & Sidana, 2019). The DSR has advantage of timely rice establishment and efficient weed management in a single tractor operation. Additionally, the DSR has co-benefits of avoiding puddling (a wet tillage), transplanting and maintaining standing water for initial two weeks after seedling transplanting (Gill & Bhullar, 2021). During *kharif*-2020, the majority of the farmers

Received 10-01-2022; Accepted 18-01-2022

adopted DSR for the first time, and therefore, adopted diverse crop production and management practices which are entirely different from those adopted under PTR fields. The yield performance of DSR depends largely on effective weed management, efficient nutrient management, and ensured poor germination and optimum plant population besides several and other factors (Gautam et al., 2021; Reddy et al., 2018; Dhillon & Mangat, 2018). The present study was therefore, conducted to compare the performance of different crop production and management practice adopted by the rice growers in two different rice establishment methods viz. DSR vs. PTR in different administrative blocks of Kapurthala district of Punjab (north-western India).

METHODOLOGY

The present study was conducted in the Kapurthala district of Punjab during March-2021. Kapurthala district has 5 administrative blocks viz. Sultanpur Lodhi, Kapurthala, Phagwara, Dhilwan and Nadala. The data on total rice area under DSR, varieties established, weed management, crop grain yield were recorded from the respondent farmers in semi-structured questionnaire through face-to-face interviews. In the present study initially there were 106 respondents, of which about 13.2 per cent study sites were ploughed by the farmers due to partial to complete crop failure. Therefore, the present study analyzed data on only 92 respondents, who by the adoption of diverse management practices harvested their crops at maturity. The list of the DSR farmers was obtained from the state Department of Agriculture and Farmers' Welfare, Punjab are the respondents were randomized selected from different villages representative of each administrative block. The data on total area under DSR and PTR method of rice establishment were recorded from each selected respondent. The information on rice variety established and weed management measures followed for pre-and post-emergence control measures was recorded. All data were compared among DSR and PTR and the yield difference from crop yield potential, district average, state average and national average were estimated. The economic analysis of DSR and PTR technology was done based on average cost of cultivation, average gross returns, average net returns, benefit-cost ratio etc. The average gross returns were calculated as a product of rice grain yield and the minimum support price decided by the Government of India (GOI) for 2021. The average net returns were calculated by subtracting the average cost of cultivation from average gross returns. The benefit-cost ratio was calculated as a ratio of average gross returns and average cost of cultivation.

Average gross returns (Rs. ha^{-1}) = Rice grain yield (Mg ha^{-1}) x MSP (Rs. Mg^{-1})

Average net returns (Rs. ha^{-1}) = Average gross returns (Rs. ha^{-1}) - Average cost of cultivation (Rs. ha^{-1})

$$\text{Benefit - cost ratio} = \frac{\text{Average gross returns (Rs. ha}^{-1}\text{)}}{\text{Average cost of cultivation (Rs. ha}^{-1}\text{)}}$$

Farmer's perception on DSR and PTR method of rice establishment was evaluated based on problem solving, understandability, practicability, cost effectiveness, profitability, sustainability, compatibility, accessibility, acceptability and on preference scale.

RESULTS AND DISCUSSION

Area, varieties and weed management under DSR *vis-à-vis* PTR

These results revealed that of the total area under rice, about 54.2 per cent area was under DSR, while about 45.8 per cent area was under PTR (Table 1). Among different blocks, the highest area under DSR was in Sultanpur Lodhi (about 68.2%), and the lowest in Dhilwan (about 41.9%). In other blocks, the per cent area under DSR technology was about 56.5 per cent in Kapurthala, about 43.5 per cent in Phagwara and about 60.9 per cent in Nadala. About 82.3 per cent of total area was laser leveled by the farmers before rice establishment under DSR technology. The laser leveled area was lowest in Phagwara (about 64.9%) and the highest (about 94.8%) in Sultanpur Lodhi block. These results revealed that PR-121 was the most preferred variety in the study region, covering about 80 per cent of total rice area. The highest DSR area under PR-121 was in Sultanpur Lodhi (about 91%), and the lowest (about 70%) in Phagwara block, while about 85 per cent in Kapurthala and Nadala, about 86 per cent in Nadal blocks. Average across the blocks, PR-126 covers about 9 per cent, while Pusa-44 covers about 11 per cent of total rice area in Kapurthala district. The dominance of PR-121variety over PR-126 and Pusa-44 has been ascribed to its better performance in the region (Bharaj et al., 2014). The study highlights that of the total area under rice, the highest area under DSR was in Sultanpur Lodhi block (about 68.2% of total rice area), which could be ascribed to heavy textured soils, higher water table and the highest area under laser leveled technology (Table 1). On the other hand, the lowest area under DSR technology was in Dhilwan block (about 41.9% of total rice area) which was ascribed to light textured soils particularly near *Beas* river (Rafie & Kumar,

Table 1. Area and rice varieties under direct seeded rice (DSR) in Kapurthala district of Punjab, India

Particular	Administrative blocks					
	Sultanpur Lodhi (n=22)	Kapurthala (n=23)	Phagwara (n=20)	Nadala (n=21)	Dhilwan (n=20)	Mean
% of total rice area under DSR	68.2	56.5	43.5	60.9	41.9	54.2
% of total land area laser leveled before DSR	94.8	74.1	64.9	89.7	84.8	82.3
Number of DSR farmers and sown cultivars						
PR-121	20 (91)†	17 (85)	13 (70)	18 (85)	17 (86)	85 (80)
PR-126	–	03 (10)	04 (17)	02 (10)	02 (10)	09 (09)
Pusa-44	02 (09)	03 (5)	03 (13)	01 (5)	01 (4)	12 (11)

†Figures in parenthesis represent values in percent of farmers in a particular block

2021). Averaged across the administrative block, about 54.2 per cent of the total rice area was under DSR. The PR-121 was the most preferred variety under DSR and PTR in all blocks of Kapurthala districts covering about 70-91 per cent of total rice area (mean = 80% of total rice area). However, there was no much difference in the area under short duration PR-126 and long duration Pusa-44 variety in different administrative blocks of Kapurthala district.

These results revealed that 100 per cent farmers adopted post-emergence weed management measures in PTR method of rice establishment. However, under DSR fields, farmers prefer weed management through pre-emergence application of recommended herbicides. In DSR, about 4.4 per cent of the respondent farmers practice manual weed control measures, while about 78.6 and about 85.1 per cent prefer pre- and post-emergence weed control measures, respectively. Table 2 showed the majority (27.2-95.0%) of DSR was established under *tarr wattar* (field moist) conditions, while about 5.0-63.6 per cent was established under dry seeded conditions due to inherent farmer's practice of applying irrigation water before seed sowing as true during wheat. The highest area was *tarr wattar* DSR establishment was in Phagwara, while the lowest in Sultanpur Lodhi blocks. However, coming to weeds diversity, DSR fields, commonly observed with weeds such as Khora Kah (*Leptochloa chinensis*), Madana (*Datyloctenium aegyptium*), Motha (*Cyprus rotundus*) and Swank (*Echinochlo acolona*) which needs to controlled through either pre or post weed control (Dhillon & Mangat, 2018; Kumar & Ladha, 2011).

Grain yields and farmers perceptiveness

The mean grain yields of PR-121, PR-126 and Pusa-44 were 7.50, 7.33 and 7.68 Mg ha^{-1} under PTR, while 6.73, 6.54 and 6.75 Mg ha^{-1} under DSR in Kapurthala district (Table 3). The mean rice grain yield of three varieties under PTR was significantly higher (by about 11.4-13.8%), compared with DSR. However, within each rice establishment method, the mean rice grain yield of three varieties did not differ significantly. As compared with the yield potential of each rice variety, the mean grain yield of PR-121, PR-126 and Pusa-44 under PTR method was lower by 0.13, 0.17 and 0.13 Mg ha^{-1}, respectively. The corresponding yield gap under DSR method was of higher magnitude; about 0.90, 0.96 and 1.06 Mg ha^{-1}, respectively. As compared with the state average yield, the mean rice grain yields of PR-121, PR-126 and Pusa-44 were higher by about1.33, 1.16 and 1.51 Mg ha^{-1}, respectively under PTR, and about 0.56, 0.37 and 0.58 Mg ha^{-1}, respectively under DST technology. However, the mean rice grain yields of studied fields were higher by about 1.02, 0.85 and 1.20 Mg ha^{-1} under PTR and about 0.25, 0.06 and 0.27 Mg ha^{-1}, respectively under DSR technology (Table 3). The higher grain yield under PTR technology could be ascribed to lesser weed population, regular supply of moisture and nutrients while poor yields at DSR fields associated with poor germination, heavy weeds and nutrient deficiencies particularly at light textured sandy soils (Bhatt & Kukal, 2015; Gautam et al., 2021). Moreover, farmer's practiced DSR technology for the first time at their fields, therefore, may be because of less awareness regarding different soil management and crop production technologies the crop yield was decreased. The poor seed germination particularly in the fields with deep seed placement by untrained drivers, heavy weed pressure and frequent iron (Fe) deficiency in DSR fields has been ascribed to reduced grain yields (Kumar & Ladha, 2011; Dhillon & Mangat, 2018).

Farmer's perception towards different rice establishment methods was evaluated based on different scales (Table 4). In the study area, farmers adopted DSR technology under compulsion due to scarcity of migratory labor during *kharif*-2020 (Bhatt & Singh, 2021). These results revealed that only about 14.1 per cent of the respondents had low understandability for PTR technology, which was about 32.1 per cent for DSR technology. About 17.9 per cent of respondents had high understandability for PTR, while only about 3.8 per cent had such understandability for DSR technology. About 68.9 per cent of the respondents perceived PTR as low cost effective, while about 4.7 per cent perceived PTR as highly cost effective. Conversely, about 16.0 per cent of respondents perceived DSR as low cost effective, while a large proportion (about 55.7%) perceived DSR as highly cost effective. About 14.1, 76.4 and 10.4 per cent of PTR farmers perceived it as low, medium and highly profitable, while about 10.4, 69.8 and 14.1 per cent of DSR farmers perceived it as low, medium and highly profitable. These results revealed that about 17.9, 16.0 and 66.0 per cent of PTR and about 28.3, 57.5 and 14.2 per cent of DSR farmers perceived low, medium and high preference for future planning.

Economics of DSR in comparison to PTR

PTR option required more cost to cultivate as compared to DSR due to absence of puddling operations and required lower labor requirements. Under PTR, net return per hectare was reported to be 7.1, 7.9 and 10.4 per cent higher as compared to the DSR (Table 5). The mean cost of cultivation was Rs. 39.4 x 10^3 ha^{-1} for three

Table 2. Weed management practices and moisture regime for direct seeded rice (DSR) establishment in Kapurthala district

Blocks	Weed management method (% of total respondents)				Moisture regime for DSR establishment	
	PTR	DSR			*Tarrwattar* DSR	Dry DSR
	Post-emergence	Manual	Chemical			
			Pre-emergence	Post-emergence		
Sultanpur Lodhi	100	3.4	77.3	81.8	27.2	63.6
Kapurthala	100	4.3	65.0	78.3	56.5	30.4
Phagwara	100	4.7	80.0	100	95.0	5.0
Nadala	100	5.0	90.5	95.2	71.4	19.0
Dhilwan	100	4.5	80.0	70.0	50.0	50.0
Mean	100	4.4	78.6	85.1	60.0	33.6

Table 3. Grain yield differences under puddled transplanted rice (PTR) and direct seeded rice (DSR) in Kapurthala, Punjab, India

Rice variety	Grain yield potential (Mg ha^{-1})[†]	Farmers field rice grain yield (Mg ha^{-1}) under different methods[Δ]		Difference in rice grain yield (Mg ha^{-1}) at farmers' fields over yield potential	
		PTR	DSR	PTR	DSR
PR-121 (*n*=85)	7.63	7.50bA	6.73aA	0.13 (1.7)[#]	0.90 (11.8)
PR-126 (*n*=9)	7.50	7.33bA	6.54aA	0.17 (2.3)	0.96 (12.8)
Pusa-44 (*n*=12)	7.81	7.68bA	6.75aA	0.13 (1.7)	1.06 (13.6)

Yield gaps (t ha^{-1}) for different varieties

Particular	PTR			DSR		
	PR-121	PR-126	Pusa-44	PR-121	PR-126	Pusa-44
P.A.U.'s recommended yield[†]	7.63	7.50	7.81	7.63	7.50	7.81
State average yield[¶]	6.17					
District average yield[**]	6.48					
Actual yield at farmers' fields	7.50	7.33	7.68	6.73	6.54	6.75
Yield difference from demo average	0.13	0.17	0.13	0.90	0.96	1.06
Yield difference from state average	-1.33	-1.16	-1.51	-0.56	-0.37	-0.58
Yield difference from district average	-1.02	-0.85	-1.20	-0.25	-0.06	-0.27

[Δ]Mean values followed by different letters was significantly (p<0.05) different by least significant difference (LSD) test.
[#]Values in the parentheses represent percent variation in rice grain yield over potential yield.

Table 4. Farmer's perceptiveness towards different rice establishment methods.

Perception indices	Perception point scale (Number of respondents)					
	Puddled transplanted rice (PTR)			Direct seeded rice (DSR)		
	Low	Medium	High	Low	Medium	High
Problem solving	21	74	11	6	70	30
Understandability	15	72	19	34	68	4
Practicability	34	59	13	40	61	4
Cost effectiveness	73	28	5	17	30	59
Profitability	15	81	11	17	74	15
Sustainability	19	81	6	28	70	8
Compatibility	25	66	15	30	74	2
Accessibility	8	47	51	57	23	25
Acceptability	19	19	68	15	85	6
Preference	19	17	70	30	61	15

Table 5. Economic analysis of puddled transplanted rice (PTR) *vis-à-vis* direct seeded rice (DSR)

Economic indices	Puddled transplanted rice (PTR)			Direct seeded rice (DSR)		
	PR-121	PR-126	Pusa-44	PR-121	PR-126	Pusa-44
Cost of cultivation (Rs. 000' ha^{-1})	39.4	39.4	39.4	31.8	31.8	31.8
Average gross returns (Rs. 000' ha^{-1})	140.1	136.9	143.4	125.7	122.2	126.1
Net returns (Rs. 000' ha^{-1})	100.7	97.5	104.1	94.0	90.4	94.3
Benefit-cost ratio	3.56	3.48	3.64	3.95	3.84	3.97

rice varieties under PTR, while Rs. 31.8 x 10^3 ha^{-1} under DSR depicting saving of Rs. 7,600 ha^{-1}. The higher cost of cultivation for PTR technology was ascribed to expenditure on nursery establishment, diesel cost for wet-tillage (*puddling*) and seedling transplanting cost (Chauhan et al., 2012; Bhatt et al., 2021). The average gross returns were Rs. 140.1, 136.9 and 143.4 x 10^3 ha ^{1} for PR-121, PR-126 and Pusa-44, respectively under PTR technology. However, under DSR technology, average gross returns were Rs. 125.7, 122.2 and 126.1 x 10^3 ha ^{1}, respectively. These results revealed higher benefit-cost ratio of rice establishment under DSR technology, compared with the PTR technology, regardless of the rice variety. It could be ascribed to reduced (about 23.9%) cost of cultivation associated with rice establishment under DSR technology than the PTR technology. Lower required labor and un-puddled conditions were main factors for better economic profitability of DSR (Singh et al., 2005; Dhakal et al., 2015).

CONCLUSION

As compared to the PTR that suffered from higher labor, water and energy issues, DSR proved to be more profitable and environment friendly rice establishing option in the region. In spite of reported lower yields in all the studied blocks of the district due to higher weed pressure DSR reported with higher profits in all preferred rice cultivars due to required lower labor requirements and cost of field preparation than PTR. Hence, the present study concludes that DSR must be preferred in the water and labor scarce region over the PTR due to its lesser costs of cultivation and drudgery.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (47-52)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Impact of Jharkhand State Cooperative Milk Producers' Federation on Socio-economic Status of Dairy Farmers

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ARTICLE INFO

Keywords: Dairy, Impact, Jharkhand, Propensity score matching

http://doi.org/10.48165/IJEE.2022.58209

ABSTRACT

The paper assesses the impact of membership of dairy cooperative i.e. Jharkhand State Cooperative Milk Producers' Federation (JMF) on the performance of dairy production systems using propensity score matching techniques. Dairy cooperative members differed significantly from non-members in terms of outcome variables. The mean difference value explained that the socio-economic condition of members was better than non-members. The findings revealed that membership of JMF contributes towards improving yields of dairy animals, net dairy income, and also, to household milk consumption. The non-members reaped better price for the milk in the wet market as compared to the members. Nonetheless, the member-producers recorded higher proportion of milk sale as compared to the non-members which also indicated their intensity of market participation. These results indicate towards the need to improve dairy farmers' linkages through cooperatives or other such institutions for their socio-economic development.

INTRODUCTION

India is the world's largest producer of milk, with 22 per cent of global production (FAO, 2019). According to NDDB (2019), India produced 187.7 MT of milk with per capita availability of 394 g/day. The dairy industry accounts for 27 per cent of agricultural GDP and 67 per cent of overall livestock output, thus providing employment opportunity for over 70 million people (GoI, 2018). The co-operative framework of dairy development initiatives is credited with much of the success of India's "White Revolution". India with the world's largest Dairy Cooperative structure, at present, constitutes 163 lakh dairy farmer members, 1.77 lakhs village dairy cooperative societies, 218 district milk cooperative union and 27 state milk federations. Previous research indicates that farmers' participation in dairy cooperatives has resulted in a significant increase in milk production and productivity, as well as a reduction in per-unit milk production costs, allowing them to achieve higher output prices, lower transaction costs, and increased profits (Labrecque et al., 2015). Cooperatives have been found to increase farmers' bargaining power, resulting in more competitive prices for both inputs and outputs, as well as to reduce transaction costs, improve information symmetry, and improve agro food safety and quality standards (Holloway et al., 2000; Valentinov, 2007; Hellin et al., 2009; Markelova et al., 2009; Moustier et al., 2010; Jia et al., 2012; Trebbin, 2014; Singh et al., 2014) Farmers can ensure a stable market and fair prices by cooperatively establishing their own collection system and processing facilities (Uotila & Dhanapala, 1994; Birchall, 2004; Das et al., 2015). Dairy farming entails a high level of market dependence as well as socio-economic values (Bor, 2014), wherein DCs help dairy farmers to vertically integrate to countervail power against oligopolistic powers in distribution and retailing (Van der Krogt et al., 2007) by organizing dairy supply chains with better strategic logistics between production, processing and distribution (Berre et al., 2014) in emerging markets (D'Antoni and Mishra, 2012) and reducing financial risk and economic uncertainty faced

Received 28-12-2021; Accepted 12-01-2022

by members in a mature market (Maynard, 2009) due to increasing volatility in milk and feed prices (Wolf & Widmar, 2014) and paying dairy farmers the milk price at levels that far exceeds market prices (Charlebois & Labrecque, 2009).

Even though India is self-sufficient in milk production following the Operation Flood Programme, milk production in India is not uniformly distributed, resulting in a large demand and supply gap for milk and milk products in a few states such as Jharkhand. The state currently ranks 17th in both milk production and milk productivity (GoI, 2019). With a view to give impetus to dairy development in Jharkhand, the State Government formed the Jharkhand State Cooperative Milk Producers' Federation (JMF) in August 2014, with an aim to promote dairying as a source of livelihood in the rural parts of the State and propel Jharkhand towards self-reliance in milk and milk products. Therefore, the study attempts to assess the overall impact of JMF on member-producers.

METHODOLOGY

The study was conducted in Jharkhand State. A total sample of 360 respondents, comprising of JMF members (180) and non-members (180) were purposively selected from three districts of Jharkhand viz. Ranchi, Latehar and Ramgarh for this study. To access the impact of JMF on socio economic status of dairy farmers, Propensity Score Matching (PSM) was espoused for this study since PSM based on conditional independence assumption (CIA) can address the problem of selection bias by conditioning on the observed characteristics by pairing each member household with one or more non-member households with similar observed characteristics, according to Rosenbaum & Rubin (1985), Heckman et al., (1997); Caliendo & Kopeinig (2005). Matching models, in essence, replicate the conditions of a random assignment of members and non-members in an experiment. Finally, PSM must meet the balancing property, which states that after matching, the covariate means of members and non-members must be equal (Chagwiza et al., 2016; Mojo et al., 2017). We calculate the average treatment effect on the treated (ATT) after satisfying these assumptions, which is the influence of dairy cooperative membership on the dairy farm performance metrics of interest. The ATT is calculated as follows:

$$ATT = E(Y_1 - Y_0/C_i = 1) = E(Y_1/C_i = 1) - E(Y_0/C_i = 1) \quad \ldots. (1)$$

Where, Y_1 and Y_0 are the performance indicators of dairy production system in the treated and untreated conditions, respectively; and C_i is an indicator variable denoting cooperative membership status.

Probit model was used to estimate the conditional likelihood that a household will join a dairy cooperative based on the observed features. The age and education of the household head, family size, herd size, ownership of dairy animals, distance to market, access to institutional credit, and experience in dairy farming are all independent variables. The definitions and measurements of these variables are listed in Table 1. Matching algorithms are employed in the second stage to match treatment and control groups. The ATT is estimated using standard matching methods such as nearest neighbour matching (NNM), Epanechnikov kernel based matching (KBM) with bandwidth 0.06, and radius matching (RM) with calliper 0.1. PSM necessitates the balancing property, i.e., matching the observed covariate distribution to eliminate systematic differences in the distribution of covariates and ensuring common support in the two groups after matching.

RESULTS AND DISCUSSION

The impact of dairy cooperatives on a few key farm performance indicators in Jharkhand (both members and non-members) was investigated. Due to the non-experimental character of the data, the selection bias was addressed using the propensity score matching technique. The findings show that there was bias in the distribution of variables across treatment and comparison groups, implying that self-selection bias must be taken into account in order to generate unbiased estimates of outcome indicators. Table 1 shows the descriptive and inferential statistics. An analysis of t-test indicates that there was statistically significant difference

Table 1. Descriptive statistics for outcome and explanatory variables

Variables	Member		Non-member		Mean
	Mean	S.E.	Mean	S.E.	difference
Milk yield	11.59	0.58	8.81	0.26	2.78**
Net Dairy Income	105614.28	5861.41	90606.66	4087.69	15007.61*
Proportion of dairy income	0.62	0.008	0.52	0.005	0.10**
Milk price	33.26	0.49	37.14	0.18	-3.88**
Proportion of milk sold	1.42	0.03	1.19	0.02	0.23**
Per capita milk consumption	195	0.54	165	0.27	30.0**
Age	46.21	1.08	42.26	1.07	3.95
Education	8.61	0.50	4.64	0.38	3.97**
Family size	7.45	0.27	6.42	0.18	1.03
Herd size	13.27	0.39	6.24	0.20	7.03
Milch animals	5.56	0.20	2.94	0.09	2.61**
Market distance	6.64	0.25	3.62	0.12	3.02**
Access to credit	0.96	0.01	0.86	0.02	0.09**
Experience in dairy farming	10.99	0.23	10.15	0.28	0.84
Extension services	0.85	0.07	0.72	0.21	0.13*
Provision of veterinary services	0.92	0.22	0.68	0.17	0.24*
Input supply	0.82	0.05	0.74	0.02	0.08**

** and * denote significance at 1 and 5 per cent level, respectively

between members and non-members in terms of different socio-economic attributes. Dairy cooperative members differ significantly from non-members in terms of outcome variables. The mean difference value explained that the socio-economic condition of members was better than non-members. Members and non-members were similar in age, family size, herd size, and dairy farming experience, but not in education, ownership of dairy animals, market distance, access to credit, extension services, veterinary services, or input supply, according to the results corresponding to the observed covariates. Heads of member families, for example, were better educated than their non-member counterparts and were more likely to use advanced breeding, feeding, and healthcare technology. Furthermore, compared to non-member farmers, most farmer-members had better access to credit through formal sources. Members also have better access to extension services, veterinary services, and input supplies than their non-member competitors. This further indicates that farmers with better access to credit could meet the daily expenses of feed, fodder and mineral mixture for their dairy animal herd. The majority of the members accessed credit facilities through banks and government schemes in the form of short-term loans. Besides this, extension services like training, demonstration and advisory services are provided through different field level extension functionary regarding improved dairy farming practices. This empowered dairy farmers in better decision making and influenced their participation in dairy cooperatives. Provision of regular veterinary services like vaccination, A.I., treatment of chronic diseases etc. by JMF veterinary staff or government veterinary officers created health awareness among dairy farmers to timely diagnose and treat their animals, thus maintaining proper healthcare of their milch cattle and buffalo. In addition to this, the members are largely benefitted from a wide range of extension and input services offered by JMF. The grassroots extension workers and dedicated staffs employed by JMF offers solutions and caters to various aspects of dairy farming viz. breeding, feeding, healthcare, management and extension and advisory needs of the member-producers from time to time. Again, farmers residing farther to market are more inclined to be associated with dairy cooperative (JMF) as most of the member-producers resided near to the vicinity of the milk pooling points (MPPs), wherefrom JMF regularly procured the milk.

Table 2. Probit estimation: Socio-economic variables influencing farmers' participation in Dairy Cooperative (JMF)

Variables	Coefficient	Standard error	Marginal effect
Age	0.03	0.03	0.00
Education	0.28*	0.09	0.04
Family size	0.01	0.05	0.00
Herd size	0.10	0.05	0.01
Milch animals	1.78**	0.25	0.57
Market distance	0.23**	0.08	0.08
Access to credit	0.98**	0.33	0.37
Experience in dairy farming	0.32	0.38	0.02
Extension services	0.25*	0.04	0.50
Provision of veterinary services	0.62**	0.02	0.09
Input supply	0.75**	0.29	0.28
Constant	-1.05	0.67	
LR Chi^2 (11)	116.42**		
Prob> Chi^2	0.000		
Pseudo R^2	0.4368		
Number of observation	360		

** and * denote significance at 1 and 5 per cent level, respectively

Determinants of participation and impact of participation in dairy cooperative

The Probit regression findings described in Table 2 show that a few observable covariates can be used to estimate the conditional Dairy Cooperative (JMF) membership density. The explanatory variables had a combined statistical significance of 116.42 (LR Chi^2 test statistics) (p-0.000). The pseudo R^2 (0.4368) was relatively high, indicating that the model is a good fit. The education level of the household-head had a significant and positive impact on the likelihood of becoming a member of a dairy cooperative (JMF) (p-0.01). Theoretically, knowledge allows a person to better understand the potential benefits of cooperative membership. Other variables that were positively and significantly associated with JMF membership include the number of milch animals, market distance, access to institutional credit, provision of extension services, provision of veterinary services and input supply. Dairy cooperatives are more likely to be joined by farm households that owned at least one crossbred cow or buffalo and have access to formal credit. Herd size had a positive but non-significant effect ($p>0.05$) on the likelihood of joining a dairy cooperative, showing that herd size may not be a determinant in membership decisions. Dairy cooperative participation is also unaffected by a farmer's past dairy farming experience. Cooperative membership, on the other hand, shows a positive and significant correlation with access to extension services, veterinary services, and input supply. The decision to join a cooperative is influenced by the distance from the nearest market. This suggests that farm households located farther from market had a higher rate of cooperative participation, confirming the notion that proximity to the market gives farmers additional possibilities for selling their produce through alternate channels.

The propensity score, as noted by Lee (2008); Becerril & Abdulai (2009), is primarily used to match the distribution of observable covariates between treated and control groups. As a result, the success of the propensity score is dependent on the resultant matching. The Pseudo R^2 has decreased significantly from 44 per cent before matching to 4-6 per cent after matching, as indicated by the covariate balancing test (Table 3). The likelihood-ratio of the joint significance of all regressors before matching was high across the matching estimators, showing that the treatment and comparison groups differed in a systematic manner. After matching, the differences between the two groups were eliminated, and the two groups became comparable (insignificant p-values after matching). Furthermore, after matching, there was a significant reduction in bias (66.98-76.44%). Finally, a visual examination of the propensity score distributions for JMF members and non-members after matching reveals that the groups are highly overlapping (Figure 1). Cooperative members and non-members who are a good match are labelled as 'treated on support' and 'untreated,' respectively. JMF members with bad matches from among the non-members are referred on the graph as 'treated off

Table 3. Indicators of matching quality before and after matching

Matching algorithm	Pseudo R^2 before matching	Pseudo R^2 after matching	LR χ^2 (p-value) before matching	LR χ^2 (p-value) after matching	Mean standardized bias before matching	Mean standardized bias after matching	Total % bias reduction
NNM[a]	0.44	0.06	116.42(p=0.000)**	0.47 (p=0.234)	53.9	17.8	66.98
KBM[b]	0.44	0.04	116.42(p=0.000)**	7.18 (p=0.517)	53.9	15.4	71.43
RM[c]	0.44	0.04	116.42 (p=0.000)**	7.00 (p=0.537)	53.9	12.7	76.44

** indicate significant at 1% level, [a]NNM= five nearest neighbor matching with replacement and common support, [b]KBM= kernel based matching with band width 0.06 and common support, [c]RM= radius matching with caliper 0.1 and common support

Figure 1. Distribution of the propensity scores and common support

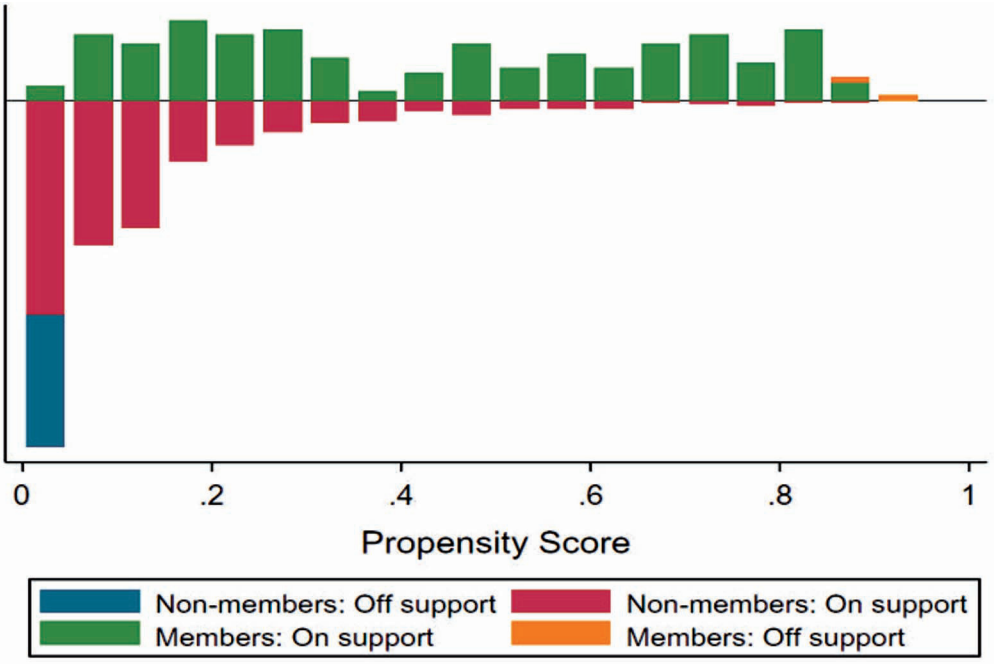

Table 4. Estimation of ATT: Impact of JMF on socio-economic status of the dairy farmers

Outcome variables	NNM (5)[b]	KBM (0.06)[c] ATT[a]	RM (0.1)[d]
Milk yield	1.99 (3.09)**	1.61 (2.05)**	1.80 (2.78)**
Net Dairy Income	70184.69 (2.97)**	67356.44 (2.95)**	68486.11 (2.98)**
Proportion of dairy income	0.09 (1.28)	0.09 (1.73)*	0.09 (1.78)*
Milk price	-4.90 (3.02)**	-4.26 (2.64)**	-4.50 (3.43)**
Proportion of milk sold	0.13 (1.68)*	0.11 (1.62)	0.10 (1.30)
Per capita milk consumption	134.86 (3.10)**	96.39 (1.94)*	110.58 (2.55)**

[a]ATT estimates of all matching algorithms are obtained through implementation of 'psmatch2'command (Leuven and Sianesi, 2003) in STATA 14. Figures in parentheses are bootstrapped z statistics using 50 replications;
* and ** indicate significant at 5% and 1% level, respectively.
[b]NNM (5) = five nearest neighbour matching with replacement and common support.
[c]KBM (0.06) = kernel based mathing with bandwidth 0.06 and common support.
[d]RM (0.1) = radius matching with caliper 0.1 and common support.

support'. Table 4 shows estimates of the influence of dairy cooperatives on selected farm performance indicators as an average treatment effect on the treated (ATT). Although the ATT results for different matching algorithms varied statistically, they are qualitatively identical. The milk yield of cooperative members is shown to be considerably higher than that of non-members. They, on the other hand, receive a lesser price than the open market price. Cooperatives give their members easy access to markets, as well as inputs and services, ensuring a greater yield. As a result, these advantages compensate for the cheaper milk price. Additionally, at the end of the year, cooperative members earn dividends. This is reflected in the higher annual net dairy income, higher consumption and higher milk sales. Furthermore, Kumar et al., (2013) discovered that DCS members possessed much more improved cattle breeds than independent farmers, resulting in significantly increased market participation. It is interesting to note

that members of dairy cooperative societies have significantly higher per capita household milk consumption compared to that by non-member households. This indicates that the commercialization of milk production has no negative impact on milk consumption. These findings are in line with those of previous investigations (Chagwiza et al., 2016; Kumar et al., 2013; Bardhan & Sharma, 2012). These studies, unlike ours, did not account for confounding factors that could impact farmers' self-selection.

The impact of JMF on smallholder dairy farmers across Jharkhand has been quite significant. It serves as the best alternative source for income generation and employment opportunities among dairy farmers. The data presented in Table 4 inferred that member-producers reaped higher milk yield than non-members. This was because members reared large herd sizes of milch animals comprising of high yielding crossbred cattle and buffalo. As a result of this members accrued higher net dairy income, as well as proportions of dairy income since they regularly disposed bulk quality of milk to the dairy cooperative. Besides this, the proportion of milk sold by the member-producer was also higher as compared to the non-members, and a statistically significant difference between them was observed at a 5 per cent level of significance. This also indicated dairy farmers' increased participation in the dairy cooperative. The per capita milk consumption of member-producers was also significantly higher than non-members, indicating that members had enough market surplus of milk to meet their daily household consumption. However, milk price was the only outcome indicator where non-members outperformed non-members. The non-members reaped better prices for their milk in the market, this was due to a lack of price regulation in the market. Unlike dairy cooperatives, the milk price was fixed based on the Fat and SNF percentage. Even though non-members received higher milk prices but their cost-benefit ratio was less. Unlike JMF members who received all the input, extension and veterinary services at the subsidised price, non-members on other hand had to incur additional transaction costs. Similar findings were revealed by Das et al., (2020); Sudhanshu (2019); Karthikeyan et al., (2019). Therefore, the net profit or net dairy income was more in the case of members as compared to the non-members. The ATT estimates of all matching algorithms confirmed that members were socio-economically sound than their non-member counterparts.

CONCLUSION

Farmers' participation in JMF has a positive and statistically significant influence on milk yield, farm income, and marketable surplus while having no negative impact on household milk consumption. Cooperative pricing, on the other hand, are lower than open market prices as non-members reaped better milk price than the members. These findings have significant implications for Jharkhand's dairy growth. JMF can help boost milk output in the state by improving producers' access to markets. As a result, a level playing field for different stakeholders is required to attract cooperative investment in dairying. Aside from that, cooperatives must examine milk price policy while taking open market prices into account. Furthermore, updated technologies must be disseminated to farmers for better efficiency and productivity.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (53-57)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Organic Manure in Conservation Agriculture: Perception, Reality and Interpretation

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ARTICLE INFO

Keywords: Conservation agriculture, Ecological resilience, Organic carbon level, Organic manure, Perception

http://doi.org/10.48165/IJEE.2022.58210

ABSTRACT

The excessive reliance on chemical fertilizers and the negligence shown to the conservation and use of organic manures (OM) have led to the exhaustion of organic carbon level, soil moisture level, and retention of microorganism population in the soil. The present study reveals that the farmers merely have any perception or they are not technically aware of the importance of the application of OM into their farming for the restoration of ecological resilience. Elucidating the factors, impacts, and perceptions of farmers, fifty respondents have been selected from Dalilpur and Kastodanga village of Nadia district by systematic random sampling for the study. The responses are collected through a structured interview schedule. The study envisaged that the livestock count, size of homestead land, size of landholding, production of organic manure, education variables have been found to exert strong and determining contribution to the application of organic manure. The socialization of proper cognitive adoption of organic manure among the farmers for the restoration of ecological resilience and popularization of resource-saving agricultural crop production is the need of the hour.

INTRODUCTION

The major difficulties of present agriculture involve ensuring food security for a rising population and alleviating poverty while maintaining agricultural production in the face of decreasing natural resources, negative impacts of climate variability, increasing input costs, and volatile food prices (Bhan & Behera, 2014). Conventional agriculture has turned both genetically fatigued and operationally tired as reflected through plateauing of agricultural productivity and quality (FAO, 2011). Indiscriminate use of chemical fertilizers in soil is causing soil to turn into less fertile or even toxic which are slow poison to human beings (Pesticide Residues in Food, 2018). Excessive dependence on chemical fertilizers, as well as a disregard for the conservation and utilization of organic sources of nutrients or OM, has resulted in soil nutrient depletion, as well as soil health issues, which have become a barrier to enhancing agricultural productivity (Chandra, 2015).

Conservation agriculture (CA) has come into view as an important priority area across the globe for fulfilling the growing demand for safe and healthy food and environmental sustainability (FAO, 2014) along with mitigating food security, biodiversity, climate change impacts on agriculture, and water scarcity (Choudhary et al., 2016). A combination of diversified farming and farming experiences helped to significantly increase income through CA (Saha et al., 2022) whereas adoption of CA is linked not only to ecological aspects, but also to the socio-ecological factors like adopter's characteristics, level of perception, and decision-making process (Chatterjee et al., 2021). Regular recycling of organic wastes in the soil is the best technique for maintaining optimum levels of soil organic matter (Chatterjee et al., 2017). Application of OM is the need of the hour to support soil fertility by enhancing the carbon content of the soil and therefore uplifting the agricultural production while minimizing environmental impacts (Diacono & Montemurro, 2010; Urra et al., 2019). It (OM) also substantially

Received 02-01-2022; Accepted 10-01-2022

reduces the chemical fertilizer application up to 30 per cent in the soil while incorporating it in the soil (Zhou et al., 2022). Long-term application of OM in the field leads to higher soil organic matter, microbial biomass carbon, and beneficial nematode diversity (Su et al., 2021).

India is a country endowed with indigenous knowledge and the potential for organic agriculture. Even though India lags in the adoption of organic farming for a variety of reasons (Das et al., 2020), the key concern is that most farmers are not technically competent or aware of the importance of using organic manures in their farming to restore ecological resilience and improve soil health by increasing organic carbon levels, soil moisture levels, and microorganism population retention. So, they must have brought under proper cognitive improvement and a better understanding of the role and contribution of organic matter in terms of its ecological contribution and productive behavior and function of the ecosystem (FAO, 2017). The present study tried to understand the contribution and science of organic manure in CA from farmers' perspectives, their perception, and interpretations.

METHODOLOGY

The study was conducted in the Nadia district of West Bengal during the year 2020-21. Purposive as well as simple random sampling techniques were adopted for the study (Ray & Mondal, 2014). A score of fifty farmers of Kastodanga and Dalilpur village of Haringhata block from the aforesaid district were selected. The district, block, and villages were purposively selected for the study as the area was under high-intensity agriculture, rice and vegetable-based farming, decline trend of productivity, livestock count, and organic carbon. The number of respondent selection limitations depended upon the COVID-19 situation, socio-political situation, and level of responsiveness from the farmers. Although the study focuses on the Nadia district, it is held that the results generated from this study are relevant to many nearby areas of Nadia district with similar climate and socio-economic conditions. The study on farmers' perception, reality, and interpretation of organic manure in conservation agriculture operationalized through two sets of variables (i) independent variables (x_1-x_{23}) and (ii) dependent variable (y). Application of organic manure (y) by the farmers is collected through a pre-tested structured interview schedule and relationships among selected twenty three variables are analyzed through quantitative methods i.e., Coefficient of Correlation, Multiple Regression, Stepwise Regression, and Path Analysis with the help of IBM SPSS v26.0 and the web-based application OPSTAT (Sheoran et al., 1998).

RESULTS AND DISCUSSION

Relation between application of organic manure and selected socio-ecological variables

Table 1 presents the coefficient of correlation and multiple regression between the application of organic manure (y) and 23 independent variables (x_1-x_{23}). The variable number of land fragments (x_6) has recorded a significant but negative correlation with the dependent variable, application of organic manure (y). It is well discernible that when the number of land fragments is increasing, the application of organic manure has been reduced. The more is the number of land fragments; the complex is the land and resource management. If the number of land fragments is more, then another possibility is that some few fragments are taken care of for better management while others are left aside. The variable on farm income (x_{14}) has recorded a positive but significant correlation with application of organic manure (y). The relation is obvious because whenever farm income is generating more, the intensity of management and caring goes up. The respondents, who are experiencing more income from their farms, are becoming more sensitive to soil health and land care and the application of OM has been upscaled. The variable livestock count (x_{20}) has recorded a significant and positive correlation with application of organic manure (y). This relationship is quite noticeable because the primary source for OM for the farmers in this region is the count of livestock and crop residues. Whenever the count of livestock is increasing, the application of organic manure in their lands is also increasing simultaneously. The variable production of organic manure (x_{23}) has recorded a strong positive correlation with the application of organic manure (y). The relationship is quite discernible simply because whenever at the house and farms production of organic manure is increasing the application of organic manure will also be increasing proportionately. Beta coefficient of the variable total hours of irrigation (x_{19}) has been positive and significant implies that for proper decomposition of organic manure to transform it into available plant nutrients; a dedicated supply of water is a must. A dedicated supply of water depends on total hours of irrigation given. Whereas beta coefficient of the variable total input cost has been recorded positive and significant which implies that input cost has been reduced in a response to better application of organic manure. Whenever organic manure is applied to the soil it will replace the need for the application of chemical fertilizer then ecological resilience will be maintained and cost of input will be downsized and sustainability will be enhanced. The beta coefficient of the causal variable land under irrigation has also been positive and significant. It implies that in an irrigated agro-based ecosystem the energy and input management system are very much sensitive and we have to be careful because the number of irrigations involves energy. When energy is more, then the application of fertilizers will become more. At the same time when it is intensive agriculture under irrigated agro-based ecosystem, the total number of labours engaged will before means it has got energy equivalent. So, that is how it has got tremendous associating effect or ability to influence characters of other variables. The R square value stands at 96.40 per cent can be inferred that the combination of 23 causal variables has been quite justified, effective, and able to explain 96.40 per cent of the variance in the consequent variable application of organic manure. A similar study also revealed that the most stable yield and the highest yields were obtained when socio-ecological variables were handled over recurring crop cycles by integrating biennial fallow, gravity flow irrigation, and manure application (Altaweel, 2008).

Predicting application of organic manure from selected variables

Table 2 presents the stepwise regression analysis which elicits those five causal variables livestock count (x_{20}), size of homestead

Table 1. Coefficient of Correlation and Multiple Regression Analysis of Application of organic manure (y) vs. selected causal variables (x_1-x_{23})

Independent Variables	'r' Value	Unstandardized Coefficients		Standardized Coefficients	t Value
		Reg. Coef. B	S.E. B	Beta	
Age (x_1)	0.071	-3.406	9.605	-0.058	-0.355
Education (x_2)	0.130	98.716	51.968	0.283	1.900
Functional education (x_3)	-0.124	-108.100	78.577	-0.299	-1.376
Family size (x_4)	0.113	-44.179	56.499	-0.103	-0.782
Size of land holding (x_5)	-0.244	-4.558	41.694	-0.014	-0.109
Number of land fragments (x_6)	-0.446**	-2.386	4.498	-0.108	-0.531
Average size of land fragment (x_7)	-0.120	-0.280	0.631	-0.115	-0.444
Mean distance between two land fragments (x_8)	-0.025	21.762	14.515	0.295	1.499
Size of homestead land (x_9)	0.105	-132.406	76.095	-0.344	-1.740
Number of crops cultivated (x_{10})	-0.150	0.008	0.014	0.115	0.572
Total yield of crops cultivated (x_{11})	-0.116	0.009	0.007	0.192	1.280
Total marketed surplus of crops cultivated (x_{12})	-0.078	0.003	0.001	0.284	2.399
Total input cost (x_{13})	0.010	0.001	0.000	**0.382**	2.239
On farm income (x_{14})	0.438**	0.003	0.002	0.239	1.646
Family expenditure (x_{15})	0.138	-0.001	0.002	-0.090	-0.700
Annual savings (x_{16})	0.059	-22.808	41.021	-0.136	-0.556
Land under irrigation (x_{17})	-0.226	2.842	1.399	**0.358**	2.031
Cropping intensity (x_{18})	-0.064	0.026	0.325	0.013	0.080
Total hours of irrigation (x_{19})	-0.074	180.378	43.116	**0.626**	4.184
Livestock count (x_{20})	0.916**	-0.562	3.217	-0.030	-0.175
Communication variable (x_{21})	0.023	0.090	0.092	0.106	0.980
Consumption of coal, firewood, fuelwood (x_{22})	0.136	0.078	0.061	0.251	1.280
Production of organic manure (x_{23})	0.330*	-3.406	9.605	-0.058	-0.355

**Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level; R square: 96.40%; The standard error of the estimate: 258.639

Table 2. Stepwise Regression Analysis: Application of organic manure (y) Vs. 23 Causal Variables (x_1-x_{23})

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t value
	Reg. coef. B	S.E. B	Beta	
Livestock count (x_{20})	165.152	22.540	0.574	7.327
Size of homestead land (x_9)	33.749	5.762	0.458	5.858
Size of land holding (x_5)	-64.023	14.058	-0.381	-4.554
Production of organic manure (x_{23})	0.098	0.025	0.314	3.863
Education (x_2)	62.346	28.627	0.179	2.178

R square: 86.90%; The standard error of the estimate: 268.368

land (x_9), size of landholding (x_5), production of organic manure (x_{23}) and education (x_2) has come out with stronger determining character on the application of organic manure (y). These five causal variables together have contributed 86.90 per cent of the variance. This indicates that the contribution of these causal variables has been substantive that rate of (23-5) i.e. 18 causal variables has contributed (96.40-86.90) per cent i.e. only 9.5 per cent. This indicates that to increase the application of organic manure, livestock count should be increased. Both the homestead land and the size of landholding are conjointly contributing to the application of organic manure and soil health. Homestead land plays a very determining role in inviting and managing livestock resources and when it is managed at homestead ecology, the possibility of the requirement of family members for livestock management grows high. Homestead land perhaps has not been able to draw much attention from agricultural scientists and ecologists. The social ecology of farming cannot be possible without comprehensive analysis and interpretation of homestead land ecology and its dynamics. The obvious advantage of owning a big and organized homestead land is that it provokes and promotes horticulture, kitchen garden, livestock, fishery, and poultry enterprises. Perhaps most or all of these enterprises generate a steady income as well as a dedicated volume of organic residues that can be applied in other components of farming. Education has also come out as one of the crucial determinants in scaling up organic characters of farming. These five variables have got a strong and disciple impact from the consequence of organic manure in the operative form for both the restoration of soil health and ecological management of farming. These five variables vis-a-vis should be dealt with attention and management skills. A similar study also revealed that the farmers' traditional knowledge is vital for the sustainable agricultural development of the country (Lenka & Satpathy, 2020).

Table 3 presents the path analysis wherein the total effect of the exogenous variable on the consequent variable has been decomposed into direct, indirect, and residual effects. It has been found that the variable total hour of irrigation has exerted the highest direct effect. This implies that for proper decomposition of organic manure to transform it into available plant nutrients; a dedicated

Table 3. Path Analysis: Decomposition of Total Effect into Direct, Indirect and Residual Effect: Application of organic manure (y)

Independent Variables	TE	DE	IE	HIE
Age (x_1)	0.071	-0.058	0.129	0.048(x_5)
Education (x_2)	0.130	0.282	-0.152	-0.169(x_5)
Functional education (x_3)	-0.124	-0.299	0.175	0.060(x_5)
Family size (x_4)	0.113	-0.103	0.216	-0.130(x_5)
Size of land holding (x_5)	-0.244	-0.014	-0.230	0.831(x_{17})
Number of land fragments (x_6)	-0.446	-0.108	-0.338	-0.742(x_5)
Average size of land fragment (x_7)	-0.120	-0.115	-0.005	-0.754(x_5)
Mean distance between two land fragments (x_8)	-0.025	0.293	-0.318	-0.311(x_5)
Size of homestead land (x_9)	0.105	-0.344	0.449	-0.138(x_5)
Number of crops cultivated (x_{10})	-0.150	0.114	-0.264	0.194(x_{18})
Total yield of crops cultivated (x_{11})	-0.116	0.192	-0.308	0.701(x_5)
Total marketed surplus of crops cultivated (x_{12})	-0.078	0.284	-0.362	0.790(x_5)
Total input cost (x_{13})	0.010	0.382	-0.372	0.134(x_9)
On farm income (x_{14})	0.438	0.237	0.201	-0.174(x_5)
Family expenditure (x_{15})	0.138	-0.090	0.228	-0.383(x_5)
Annual savings (x_{16})	0.059	-0.136	0.195	-0.832(x_5)
Land under irrigation (x_{17})	-0.226	0.358	-0.584	-0.988(x_5)
Cropping intensity (x_{18})	-0.064	0.013	-0.077	0.170(x_5)
Total hours of irrigation (x_{19})	-0.074	**0.626**	-0.700	-0.958(x_5)
Livestock count (x_{20})	0.916	-0.030	**0.946**	0.425(x_5)
Communication variable (x_{21})	0.023	0.106	-0.083	-0.180(x_5)
Consumption of coal, firewood, fuelwood (x_{22})	0.136	0.251	-0.115	0.491(x_5)
Production of organic manure (x_{23})	0.330	-0.055	0.385	0.239(x_5)

TE- Total effect; DE- Direct effect; IE – Indirect effect, HIE- Highest Indirect Effect; Residual effect: 0.036

supply of water is a must. A dedicated supply of water depends on the total hours of irrigation given. The variable livestock count has exerted the highest indirect effect and it is also an important determinant for the volume of organic manure to be produced by the farmer. The real concern in West Bengal agriculture is that the count of livestock is alarmingly declining hence the natural source of organic manure in the form of cow dung has been jeopardized i.e., how to escalate the possibility and performance of CA, the count of livestock must have to enhance otherwise that the restoration and augmentation of ecological resilience will remain an illusion. On the other hand, the size of the farm indicates the land resources and it also implies the resource endowment of the farmer. The higher is the size of holding, the bigger would be the investment ability and risk absorbing capability and that is how this variable has figured up as many as 20 out of 23 times to correct ionized the consequent variable application of organic manure. The residual value is 0.036 it infers that a little over 3 per cent cannot be explained with this combination of 23 variables. It has been supported by the R square value 96.40 per cent as well. Similar study also revealed that the achievement motivation of the farmers plays a crucial role in practicing organic farming (Bhattacharjee et al., 2021).

CONCLUSION

Land remains and continues to be the prime determinant in ecofriendly agriculture. The crux of Indian land crisis is that the holdings are not only small but fragmented as well. The marginalization and fragmentations of holding invite to make average farmland energy and resource prodigal. This also offers a barrier to socializing conservation agriculture effectively for the small land size category. The study also reveals another shocking fact regarding a sharp decline in livestock count at village level. This is one of the reasons why the organic carbon level is dipping so fast for Indian soils. The strong path coefficient between livestock count and application of organic manure has been self-explanatory. The study also reveals the domination of non-cognitive adoption of organic manure in Indian farming, this is high time to transform each of these non-cognitive adoptions into a logical, assertive, and conscious ecological tradeoff between farm and resource ecosystems.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (58-64)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Perceived Knowledge and Attitude of Fisheries Extension Professionals on Usage of ICTs in Tripura

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ARTICLE INFO

Keywords: Fisheries extension professionals, Fisheries information, Knowledge and attitude level, Information and communication technologies, Challenges on usages of ICTs

http://doi.org/10.48165/IJEE.2022.58211

ABSTRACT

Applications of Information and Communication Technologies (ICTs) offer excellent possibilities for strengthening transfer of technology between research and extension systems and onward transmission to the end-users. The study aims at studying the perceived knowledge and attitude levels of fisheries extension professionals of Tripura on the usage of ICTs concerning their socio-personal characteristics and explores the associated challenges. Data were gathered by pre-tested semi-structured interview schedule from completely enumerated 81 extension professionals of the department of fisheries, posted in the three purposively selected districts of Tripura during April- August 2021. The majority of respondents belonged to the middle age group (61.73%) and had medium level knowledge (78.57%) and attitude (85.18%) towards the use of ICT tools. Age and designation were negatively correlated, whereas education was positively and significantly correlated with knowledge and attitude level of fisheries extension professionals on usage of ICT tools separately. The Directorate of Fisheries of the state should develop meticulous strategies for each level of fisheries extension professionals to address the main challenges related to the use of ICT tools revealed in the study, which may bring a paradigm shift in fisheries farm information communication.

INTRODUCTION

Fisheries and aquaculture play a vital role in providing food and the cheapest source of protein for the growing population (Majagi et al., 2020; Sajeev et al., 2021). The fishery is one of the important sources of livelihood for more than 1,92,249 people of Tripura, and more than ninety-five per cent of people of Tripura are consuming fish (DoE&SP, 2021). The fisheries sector in the north-eastern region of India holds an important position in the socio-economic upliftment and the cultural context of the people in the area (Singh et al., 2017). To meet the domestic demand for fish, the role of public extension service has vital role for the transfer of technology (FAO, 2004). One of the major factors behind decreased farm output is limited access to extension services by the farmers, limits the exploitation of production potential of culture fisheries in Tripura (Akuku et al., 2014). In this regard, Information and Communication Technologies (ICTs) have the tremendous potential to address this issue through quick delivery of the farm information in far flung areas of the state to increase and sustain the fish production and productivity in the state (Sebeho, 2017; Joshy, 2018; Mishra et al., 2020).

The development of affordable ICTs over the past twenty-five years created an environment for people across the globe to have greater access to telecommunication and Internet services (Yates et al., 2010; Schwab, 2016). ICTs in agriculture evolved as an emerging field focused on enhancing development of agriculture and

Received 16-12-2021; Accepted 28-12-2021

allied sectors in India (Patra et al., 2020). At present, the extension personnel in state line departments have the major responsibility of transferring technologies to the farming community from time to time (Lahiri et al., 2017; Panda et al., 2019; Kavaskar & Sharmila, 2020). ICTs are essential for extension workers because they enable them to access up to date information and expert knowledge that facilitate in dissemination of farm information as front liners in extension service delivery (Richardson, 1997; Tologbonse et al., 2011). Those frontline extension workers who are a direct link between farmers and other actors in the farming knowledge and information system are well-positioned (Jat et al., 2021). The use of ICT to access expert knowledge or other types of information could be beneficial to them and farmers as well (Rajalahti & Swanson, 2010; Kahenya et al., 2014; Ravikumar et al., 2015; Kale et al., 2016). ICT tools offer an opportunity for cost-effective dissemination of fishery information and knowledge to remote locations and diverse populations (Kapange, 2010, Lahiri et al., 2020). So there exists a need to understand and measure the utilization of ICT tools by the different categories of extension personnel in the fisheries line department in Tripura. The present study aims at studying the perceived knowledge and attitude levels of fisheries extension professionals of Tripura on the usage of ICTs in relation to their socio-personal characteristics and explores the associated challenges in accessing ICT tools for the fisheries extension professionals.

METHODOLOGY

The study was conducted at the three purposively selected districts of Tripura, based on a higher concentration (West Tripura) and lower concentration (Unakoti and North Tripura) of fisheries extension professionals under the Department of Fisheries, Govt. of Tripura (DoF, 2018). The respondents for the study were the Fishery Inspectors (FI), Fishery Officers (FO), and Fishery Assistants (FA), posted in different blocks of the selected districts who were selected through complete enumeration of the fisheries extension professionals (FI, FO, and FA) under all the twenty-one (21) blocks of the selected districts as part of primary data collection, and the sample size was eighty-one (81). The knowledge level and attitude towards the use of ICTs tools in fisheries extension on the use of ICTs of the respondents were considered as dependent variables. Knowledge scores were obtained on Yes/No (Yes-1, No-0) on a pretested scale having set of questions on knowledge level on usage of under different ICT tools (Total possible score ranged from 0 to 84), whereas attitude scores were obtained on Likert type scale on 5-point continuum ranging from strongly agree and strongly disagree. The total obtainable score ranged from 21 to 105. Based on literature review and consultation with the experts, certain relevant explanatory variables were selected that might be adequately able to address said purposes and scopes of objectives of the study. Data were collected in pre-rested semi-structured interview schedule during April- August 2021.

Analyses and interpretation of collected data were done to draw a logical conclusion by utilizing frequency and percentage, arithmetic means, and standard deviation, Spearman's Rank Correlation Coefficient (Spearman, 1904), and Kruskal-Wallis test (Kruskal & Wallis, 1952). The Statistical Package for the Social Sciences (SPSS 20.0) was used to analyze the collected data. A set of eighteen important challenges was identified in consultation with extension professionals and also experts in the field of ICTs to assess the challenges associated with the use of ICT tools by fisheries extension professionals. The responses were ranked by using the Garret ranking method (Garret, 1969).

RESULTS AND DISCUSSION

Knowledge and attitude perspectives of ICT usage relating to socio-personal features

The majority of respondents belonged to the middle age group (61.73%) and old age group (35.80%), as depicted in Figure 1, similar to the study of Baruah and Mohan, (2021). It might be due to the less new recruitments of the extension personnel in the recent past. On the other hand, a higher percentage of the respondents under the middle age group with higher work experience that helps to strengthen the department with a skilled and experienced workforce. 37.04 per cent of the respondents in the study area belonged to Schedule Tribes followed by general category (28.39%), which was in line with the existing reservation criteria of various post recruitment in the department, and found satisfactory compared to their proportionate representation (DoE&SP, 2021). But, there was a dismal gender ratio in terms of fishery extension professionals in the Department of Fisheries in the state, as the majority of respondents were male (81.48%) in comparison to female (18.52%), well supported by Thomas & Laseinde (2015). The existing gender imbalance in the fisheries extension professionals in the department might be resulting in some sort of gender bias in the dissemination of information to the fish farming communities in the state. As expected, the majority of the respondents had small families (up to 5 members) (60.49%) and used to stay in a nuclear family (70.37%), as most of them were posted away from their native place and live separately, Kusumalatha et al., (2021) also reported on similar line. The respondent had heterogeneous education qualifications in the study area as the majority of the respondents had secondary education because the criteria for the recruitments for fisheries assistant (FA) is secondary level education. But, education was necessary for the respondents for using ICT tools (Shashidhara, 2020). Hence, FAs were hypothetically always in a disadvantageous position in handling ICT tools, whereas performances might be better in the case of higher officials, as 33.33 per cent of officials had education up to Graduation or above (Al-Zahrani et al., 2017). The respondents had a medium level of social participation, which was not a healthy sign for fishery extension work. The extension service has weak relationships and professional links with other agricultural research and development organizations (Baig & Aldosari, 2013). The annual income of the professional was reasonably on the higher sides as they were the salaried staff. The majority of the respondents (59.26%) were having annual income between Rs. 300000- Rs. 600000 because of their work experience and also their level of designation in the department.

The majority of the respondents (90.12%) had medium exposure to ICTs based information dissemination tools like radio, TV, cell phone, computer, and internet etc. (Shashidhara, 2020).

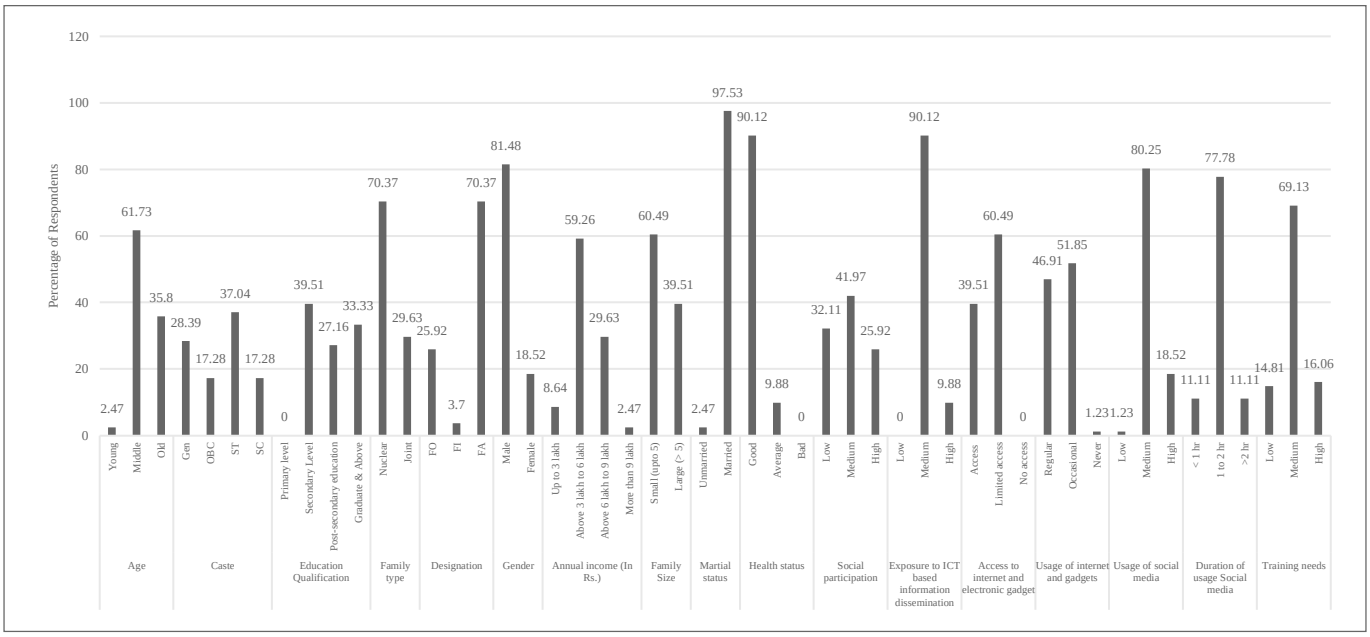

Figure 1. Socio-personal characteristics of fisheries extension professionals (n=81)

Table 1. Descriptive variables

S.No.	Variables	Mean	Standard Deviation	Range
Dependent variables				
1.	Knowledge level of fisheries extension professionals on usage of ICT tools	25.18	17.56	18-62
2.	Attitude of fisheries extension professionals on usage of ICT tools	66.49	4.55	59-84
Socio-personal variables				
1.	Age	43.55	8.50	28-59
2.	Designation	2.44	0.88	1-3
3.	Caste	2.23	1.05	1-4
4.	Gender	1.18	0.4	1-2
5.	Family size	4.5	1.4	2-10
6.	Family type	1.3	0.46	1-2
7.	Educational qualification	4.0	0.85	3-5
8.	Marital status	1.97	0.16	1-2
9.	Health status	1.09	0.30	1-2
10.	Annual income	4.99	2.04	3-10
11.	Social participation	4.75	3.99	1-12
12.	Exposure to ICT based information dissemination	3.02	1.32	2-10
13.	Access to internet and electronic gadgets	1.4	0.50	1-2
14.	Usage of internet and electronic gadgets	1.46	0.52	0-2
15.	Usage of social media	1.74	0.83	0-4
16.	Duration of usage social media	1.64	0.79	0-4
17.	Training needs on ICTs and cyber extension based on perceived level of difficulties	74.37	14.92	27-103

This finding indicates that the respondents had knowledge and skills about ICTs to disseminate the extension services to the farmers. The majority of the respondents (60.49%) had limited access to the internet and electronic gadgets because many rural areas of this study had limited access to the basic telecommunication services that support key ICTs like the telephone, internet, etc. The majority of the respondents (51.85%) were using the internet and gadgets occasionally in their daily work because they were faced with problems operating ICTs devices and also poor internet connectivity in remote areas. The majority of the respondents (80.25%) were using social media up to the medium level in their daily life because they were sharing knowledge and information through social media (Mishra et al., 2021). But, it might not be sufficient, as the majority of the respondents (77.78%) were using social media for only 1-2 hours in a day. The reason mostly they were busy with fieldwork and also office work. These were found to be some grey areas in terms of ICT mediated extension approaches in farm information dissemination in the department of fisheries in Tripura. The majority of the respondent (69.13%) come under a medium level of training need, as they perceived a medium level of difficulties on ICTs and cyber extensions like the computer, mobile phone, internet, TV, radio, and email. 16.06 per cent of the respondents also had high need of training on ICTs (Patel et al., 2020; Kusumalatha et al., 2021).

Table 2. Knowledge and attitude level of fisheries extension professionals on usage of ICT tools

Variables	Categories	Percentage	Mean	Standard deviation
Status of Knowledge on usage of ICT tools	Low (<8)	2.38	25.18	17.56
	Medium (8 to 42)	78.57		
	High (>42)	15.48		
	Total	100		
Status of Attitude on usage of ICT tools	Low (<61)	1.19	66.49	4.55
	Medium (61-71)	85.18		
	High (>71)	13.10		
	Total	100		

The results reveal that the majority of respondents (85.18%) had a medium level of attitude towards the use of ICTs tool, as depicted in Table 2. The findings indicate that the respondents were enthusiastic about using different ICT tools to disseminate required farm information to farmers. The higher educational status of the respondents must have helped them in creating a positive attitude towards emerging technologies. But, only 13.10 per cent of them had a high level of attitude towards ICT tools. So, there is a need for significant transformation in levels of attitudes to high-level towards the use of ICT tools in fisheries extension (Helen et al., 2020). The knowledge level of fisheries extension professionals on usage of ICT tools indicates again that majority of the respondents (78.57%) had a medium level of knowledge on usage of ICTs tools. It shows that the fisheries extension personnel need to be trained on the use of ICTs so that they can facilitate extension services up to a great extent (Sharmila & Kavaskar, 2017).

Table 3 suggests that there was a significant difference in the knowledge level of fisheries extension professionals on usage of ICT tools among the respondents in the three districts because test statistic (0.042) suggests rejecting the null hypothesis at an asymptomatic significance level of 0.05. On contrary, no significant difference was found in attitude level of fisheries extension professionals on usage of ICT tools among the respondents in the three districts because test statistic (0.879) suggests retaining the null hypothesis at an asymptomatic significance level of 0.05. The results of knowledge level and attitude of the fisheries extension professionals on ICT tools among the three districts differ. It was probably because the fisheries extension professionals posted in the remote areas, where ICT facilities were less, had the similar attitude like the professionals posted in better areas, but better exposure and frequent use of ICT tools by the fisheries extension professionals posted in better areas helped them to acquire more knowledge on ICT tools than those were posted in the remote areas.

The Spearman Rank Correlation Coefficient was calculated to find out the relationship about knowledge level and attitude of fisheries extension professionals on usage of ICT Tools with socio-personal variables by considering knowledge level and attitude of fisheries extension professionals on the use of ICT tools separately as dependent variables and different socio-economic characteristics, the extent of utilization of ICT tools and training needs of fisheries

Table 3. Kruskal-wallis test for spatial differences knowledge level and attitude of fisheries extension professionals

S.No.	Null Hypothesis	Test	Sig.	Decision
1.	The knowledge level is same among respondents of three selected district	Independent-Samples Kruskal-Wallis Test	0.042	Reject the null hypothesis.
2.	The attitude score is same among respondents of three selected district	Independent-Samples Kruskal-Wallis Test	0.879	Accept the null hypothesis.

Asymptotic significances are displayed. The significance level is 0.05.

Table 4. Spearman rank correlation coefficient between independent variables and knowledge level and attitude score of the respondent on usage of ICT tools

Dependent Variables →	Knowledge Score		Attitude Score	
Independent Variables ↓	Correlation Coefficient	Sig. (2-tailed)	Correlation Coefficient	Sig. (2-tailed)
Age	-0.417**	0.0001	-0.301**	0.006
Designation	-0.270*	0.0148	-0.317**	0.004
Caste	-0.131	0.2447	0.10	0.394
Gender	-0.020	0.8565	0.10	0.387
Family size	0.064	0.5699	0.05	0.648
Family type	0.101	0.3683	0.11	0.334
Education	0.350**	0.0014	0.274*	0.013
Marital status	-0.218	0.0506	-0.11	0.313
Health status	0.130	0.2466	-0.18	0.102
Annual income	0.211	0.0581	0.19	0.098
Social participation	0.156	0.1652	0.251*	0.024
Training needs	-0.737**	0.0000	-0.348**	0.001

* 5% level of significance, ** 1% level of significance

Table 5. Garret score of the constraints faced by respondents

Constraints	Total Garret score	Percentages	Rank
Insufficient modern ICTs equipment	3431	5.13	12
Supply of electricity	3503	5.24	11
Unavailability of ICTs device	3802	5.69	10
Load-shading/power-cut/low voltage	4483	6.71	5
Unavailability of UPS/Generator	4550	6.81	3
Power instability	4561	6.82	2
Unavailability of Wi-Fi services	4700	7.03	1
Faulty internet connectivity	4509	6.74	4
Limited internet coverage	4336	6.49	6
Lack of useful software to run internet	4321	6.46	7
Shadow mobile/Internet connectivity	4014	6.00	8
Unavailability of computer antivirus	3882	5.81	9
Lack of expertise on usage of ICT tools	3349	5.01	13
Lack of motivation to acquire the required skill set	3199	4.79	14
Low computer literacy among extension workers	2470	3.69	17
Time management problems in learning to use ICT	2271	3.40	18
Use of ICT causes health problems like eye pain, body pain etc.	2529	3.78	16
Lack of confidence to use ICT	2944	4.40	15

extension professional on ICT tools as independent variables. The Spearman Rank Correlation Coefficients are presented in Table 4.

The age was negatively correlated with both knowledge level and attitude towards ICT tools of the fisheries extension professionals (Shashidhara, 2020) whereas designation was negatively correlated at 5 per cent level of significance with knowledge level and 1 per cent level of significance with attitude towards ICT tools of the fisheries extension professionals. These signify that higher age group and higher level (designation) fisheries extension professionals possessed lesser knowledge and lesser positive attitude towards information and communication technologies. But, quite expectedly, education was positively correlated at 1 per cent level of significance with knowledge level, and at 5 per cent level of significance with attitude towards ICT tools of the fisheries extension professionals, whereas training need was negatively correlated at 1 per cent level of significance with the both (Patra et al., 2020).

Challenges associated with use of ICT tools by the fisheries extension professionals

The major problems faced by respondents, as presented in Table 5 were unavailability of Wi-Fi services (C7), power instability (C6), unavailability of UPS/Generator (C5), faulty internet connectivity (C8), load-shading/power-cut/low voltage (C4) (Patra et al., 2020). Thus, the Department of Fisheries in the state should develop a meticulous strategy to improve the situation by augmenting high-speed internet facilities in all the offices with Wi-Fi facilities. Uninterrupted power facilities may also be assured by providing high capacity backup facilities in the offices so that the fisheries extension activities may not get disturbed due to load shedding.

CONCLUSION

The use of ICTs in fisheries extension systems in Tripura at present is far from satisfactory level. Young professionals are needed in the department, and the inclusion of fresh blood into the fisheries department may change the scenario drastically, as the study suggests. The dismal gender ratio among fishery extension professionals in the department needs also to be corrected. Internet facilities also need to be improved by augmenting high-speed internet with Wi-Fi facilities in all the offices, and uninterrupted power facilities may be assured by providing high capacity back-up facilities in the offices. Thus, a meticulous and comprehensive strategy needs to be adopted for different levels of fisheries extension professionals in the state department of fisheries for the inclusion and efficient utilization of ICT mediated fishery extension system in the state to fulfill the information demand of the fish farmers in the state.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (65-68)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Rice Productivity and Water Use Efficiency under Different Irrigation Management System in North-Western India

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ARTICLE INFO

Keywords: Alternate wetting and drying, Basmati rice yield, PAU *Tensiometer*, Water use efficiency

http://doi.org/10.48165/IJEE.2022.58212

ABSTRACT

Rice (*Oryza sativa* L.) is an important *kharif* cereal crop with huge irrigation water demand. Over the years, several water saving technologies have been developed, tested and disseminated among farming community for enhancing irrigation water productivity in rice. The present study, compared continuous flooding (T_1), alternate wetting and drying in which irrigation is done 2 days after seepage (AWD; T_2), soil matric potential (ψm; *tensiometer* guided) based irrigation scheduling at ψm=15kPa (T_3) and ψm=20kPa (T_4) using PAU tensiometer on basmati rice (*var*. Pusa Basamti-1121) productivity and water use efficiency (WUE). The results revealed significantly (p<0.05) higher rice grain yield (38.85 t ha^{-1}) under T_2, compared with the other irrigation scheduling methods. The AWD (T_2) method of irrigation scheduling resulted in saving of 27 per cent irrigation water, compared with T_1. The water productivity in basmati rice production was 0.285 kg m^{-3}, 0.446 kg m^{-3}, 0.414 kg m^{-3} and 0.528 kg m^{-3}, respectively in four compared irrigation scheduling methods. As in Punjab around 3.0 Mha area is under rice cultivation and if we adopt irrigation after 2-3 days of seepage it will save around 27 per cent water as compared to continuous flooding amounting about 9.6 billon m^3 of water.

INTRODUCTION

Rice (*Oryza sativa* L.), predominantly cultivated in rice-wheat cropping system is main cropping system in Indo Gangetic planes and also in Punjab (Gautam et al., 2021) which is a principal water guzzling cereal crop with significant impact on sustainability and national food security (Bhatt et al., 2019). Rice-wheat cropping system (RWCS) occupies ~4.1 Mha area in north-western states of India comprising Punjab, Haryana, Uttarakhand and western Uttar Pradesh (Singh et al., 2020). The rice based cropping systems are challenged due to decreased crop productivity, deteriorating soil health, emission of greenhouse gases and reduced carbon (C) sustainability (Singh et al., 2020). Among different agri-inputs, irrigation water has been the most lavishly used input by the farmers in north-western India, which enhanced the energy consumption in rice production (Singh et al., 2019). According to Timsina & Coonor (2001), the actual amount of water applied by farmers is much higher than the rice crop requirement in India.

World food demands are increasing consistently while the resources are declining. The reduced water supplies have created drought like conditions in many parts of the world (Wada et al., 2013). Use of water for diverse purposes, climatic changes and increased use in agriculture in response to high food demands may be the reasons for reduced water supplies throughout the world (Elliott et al., 2013). Achieving food security for India, with its rising population, is going to be a significant challenge, and water scarcity will make the goal tougher to attain. India will host >1.5 billion people by 2030 (Anonymous, 2019). It has been estimated that production of 1 kg dehusked rice, approximately 3702 liters (L) of water is required (Kumar & Jain, 2007), and India exports ~177.8 lakh metric ton of rice in different forms in 2020-21 (Anonymous, 2021). The north-western Indian state of Punjab

Received 09-12-2021; Accepted 28-12-2021

produces more than 10 per cent of India's rice and utilizes groundwater for meeting 80 per cent of its crops' irrigation needs, therefore, depleting its own and the country's groundwater resources (Saranga et al., 2018; Sidhu et al., 2020).

Several water saving technologies have been developed and advocated for rice cultivation in north-western India including matric potential based irrigation scheduling, direct seeding of rice, cultivation on beds, laser land leveling, intermittent irrigation etc. (Singh et al., 2020a). Alternate wetting and drying (AWD), helps in scheduling irrigation after 2-3 days of seepage of previously applied irrigation water. Another approach is to schedule irrigation in rice based on soil matric potential (ψm) for which *tensiometer* have been developed (PAU tensiometer). Earlier research showed that AWD reduce the water inputs by ~23 per cent compared to continuously flooded rice systems (Bouman & Tuong, 2001). Additionally, AWD also has the potential of reducing greenhouse gas (GHGs) emissions (Singh & Benbi, 2020). There are studies that showed AWD decreased crop yields by ~5.4 per cent; however, under mild AWD (i.e., when soil water potential was ≥ –20 kPa or field water level did not drop below 15 cm from the soil surface), yields were not significantly reduced (Carrijo et al., 2017). Therefore, the present study was conducted to investigate the effect of different irrigation scheduling methods on basmati rice productivity and WUE to promote water efficient technologies in north-western India.

METHODOLOGY

The experiment was conducted at fields of KVK Sri Muktsar sahib in 2020 on Pusa Basmati 1121. The crop was sown on 9th July 2020 by transplanting the seedlings from the nursery sown on 15th June 2020 by broadcasting the seeds on well prepared seedbeds. There was total three rainfalls in the crop growing period. The 36 kg urea was applied and application is done in two equal splits. The first dose was applied three weeks after transplanting and second dose applied after six weeks after transplanting. In this experiment Pusa Basmati 1121 was grown under four irrigation practices which were 1) T_1: Continuous flooding; 2) T_2: Alternate wetting and drying (AWD) in which irrigation is done 2 days after seepage; 3) T_3: Soil matric potential (ψm; *tensiometer* guided) based irrigation scheduling at ψm=15 kPa using PAU tensiometer and 4) T_4: Soil matric potential (ψm; *tensiometer* guided) based irrigation scheduling at ψm = 20kPa using PAU tensiometer.

In continuous flooding system, the most commonly used method by the farmers; a water layer was maintained to keep rice flooded for maximum part of the crop growing season. In AWD system, rice was transplanted in a manner similar to the conventional systems but water was not standing continuously in the field. In treatment T_2 the irrigation is done after 2 days of seepage, in treatment T_3 the irrigation is done based on soil matric potential after it exceeds the value of 15kPa and in treatment T_4 the irrigation is done based on soil matric potential after it exceeds the value of 20 kPa. The design of plot consisted of three replications of all four irrigation practices and each plot size was of 25 m^2. The various parameters recorded included number and quantity of water applied to each plot, number of tillers/m at time of harvesting and yield of crop in each plot.

The parshall flume is an open channel flow metering device. The water applied to each treatment was recorded through the Parshall flume of size 3 inches installed in the field using the formula given by the manufacturers:

$$Q = 0.1771\ ha^{1.55}$$

Where, ha = height of water observed at upstream side of Parshall flume (cm)
Q = Discharge of open channel (Lps)

To measure average number of effective tillers for a particular treatment randomly five spots were selected. From each spot no of effective tillers bearing grains from 1 m length of field were counted and their average was calculated. Productivity is a ratio between a unit of output and a unit of input. In the domain of agriculture, it is expressed as the net consumptive use efficiency in terms of yield per unit depth of water consumed per unit area of cultivation. It is generally expressed in kg/m^3. The concept of water productivity in agricultural production systems is focused on producing more food with the same water resources or producing the same amount of food with less water resources.

RESULTS AND DISCUSSION

The maximum yield was obtained under (T_2) alternate wetting and drying in which irrigation is done 2 days after seepage i.e. 15.54 qt/acre followed by field having (T_3) PAU tensiometer installed where soil matric potential (ψm; *tensiometer* guided) based irrigation scheduling at ψm=15kPa is done i.e. 15.12 qt/acre and lowest in

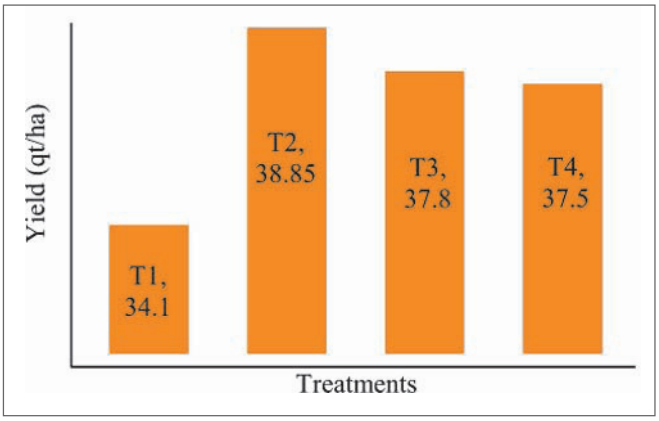

Figure 1. Yield of Pusa Basmati 1121 under different treatments

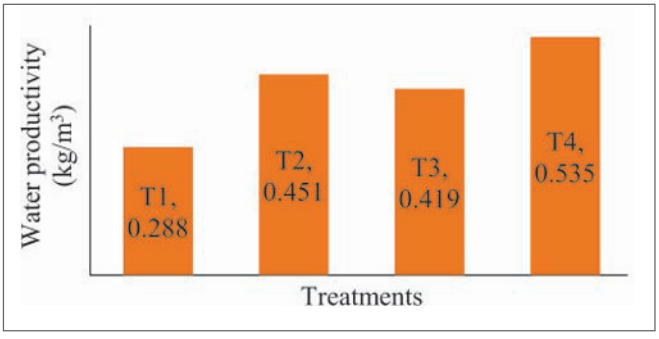

Figure 2. Water productivity of Pusa Basmati 1121 under different treatments

Table 1. Various parameters under different treatments of irrigation in Pusa Basmati 1121

Treatments	Yield (qt/ha)	No. of tillers/m	No of irrigations	Water used (m^3/ha)	Water productivity (kg/m^3)	Percentage of water saved	Percentage of increase in water productivity
T_1	34.10	54	27 + 3(rainfalls)	11827	0.288	-	-
T_2	38.85	61	19 + 3(rainfalls)	8619	0.451	27%	56.6%
T_3	37.80	58	20 + 3(rainfalls)	9020	0.419	23.7%	45.5%
T_4	37.50	59	15 + 3(rainfalls)	7015	0.535	40.7%	85.8%

(T_1) complete flooding condition i.e. 13.64 qt/acre. No of tillers per meter were maximum under irrigation after 2-3 days of seepage condition i.e. 61 and lowest under complete flooding condition i.e. 54 (Figure 1&2 and Table 1).

There was total 27 irrigation in complete flooding condition and lowest in field where (T_4) PAU tensiometer installed where soil matric potential based irrigation scheduling at ψm=20 kPa is done i.e. 15 irrigations. The maximum water productivity was observed in case of field where (T_4) PAU tensiometer installed where soil matric potential (ψm; *tensiometer* guided) based irrigation scheduling at ψm=20 kPa is done i.e. 0.535 kg/m^3 followed by field where water is applied 2-3 days after seepage i.e. 0.451 kg/m^3 and least was found in case of complete flooding situation i.e. 0.288 kg/m^3 (Table 2).

Table 2. Statistical parameters applied over yield and water productivity

Treatments	Yield (qt/ha)		Water productivity (kg/m^3)	
	Mean	Standard error	Mean	Standard error
T_1	34.10	1.129	0.288	0.01
T_2	38.85	0.787	0.451	0.009
T_3	37.80	1.913	0.419	0.021
T_4	37.50	2.002	0.535	0.029
C.D.	NS		0.046	
SE(m)	1.061		0.013	
SE(d)	1.501		0.019	
C.V.	4.959		5.382	

As per saving of water is concerned as compared to complete flooding maximum water is saved in case where (T_4) PAU tensiometer installed where soil matric potential based irrigation scheduling at ψm=20 kPa is done i.e. 40.7 per cent. In case where (T_2) irrigation was applied 2-3 days after seepage where we have gained maximum yield about 27 per cent water is saved as compared to complete flooding situation. Percentage of increase in water productivity over flood irrigation was about 56.6 per cent in case of irrigation after 2-3 days of seepage and 85.8 per cent in case of irrigation according to (T_4) PAU tensiometer installed soil matric potential based irrigation scheduling at ψm= 20 kPa is done.

As per statistics the variation in the yield of different treatments is non-significant while the water productivity of different treatments has critical difference of 0.046 at 5 per cent level of significance and has a coefficient of variation value of 5.382. Thus, different treatments of alternate wetting and drying have non-significant effect over the yield of Pusa Basmati 1121 while have significant effect over the water productivity. Numerous studies have shown that alternate wetting and drying (AWD) irrigation management can reduce water use which is valuable benefit in terms of achieving sustainable use of resources. However, it is also known that AWD can reduce rice yields if not implemented correctly. The growth behavior of rice under the recently developing water saving methods is importantly desired to be investigated. Owing to reduced water input, a negative influence of water-saving rice systems is presumed on the rice growth. However, the results of our study indicated that shifting from the flood irrigation to AWD systems had no negative effect on the growth and yield of rice. The results can be explained by the argument that a big portion of water applied to CFR is wasted in the form of percolation and evaporation, while a good rice growth can be attained even with the limited water supplied (Kukal & Aggarwal, 2002; Bouman et al., 2005; Tsubo et al., 2005). For example, the result of study conducted by Bouman et al., (2005) indicated that huge water losses were witnessed when rice was grown under conventionally flooded system compared with the water-saving rice system. The water losses of flood irrigation system included the ones which were recorded for land flooding and puddling (190 mm), evaporation (80 mm), percolation and seepage (250–300 mm), and transpiration (25 mm) (Bouman et al., 2005). Similarly, Bouman et al., (2007) concluded that a significant amount of water (200–900 mm) can be saved by growing rice by AWD instead of flood irrigation while not compromising the growth and productivity of the rice crop. The study undertaken by Tabbal et al., (2002) showed that the water input was reduced by 19 per cent when rice was grown by methods such as AWD, and the rice water-productivity was enhanced by 25–48 per cent. Our discussion concludes that improved rice growth is achievable by adding lower water inputs in rice-growing areas, meanwhile harnessing higher water-productivity.

CONCLUSION

As in Punjab around 3.0 Mha area is under rice cultivation and if we adopt irrigation after 2-3 days of seepage it will save around 27 per cent water as compared to continuous flooding amounting about 9.6 billon m^3 of water. The total water requirement for irrigation of Punjab has been estimated as 62.6 billion m^3 and the water saved makes about 15 per cent of the total irrigation water required which can be used for other domestic or industrial purposes. Hence, we can conclude that alternate wetting and drying saves a huge amount of water without compromising the yield.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (69-72)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Increasing Self-Esteem to Attract and Retain Farmers in Agriculture Profession

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ARTICLE INFO

Keywords: Agriculture, Brand, KVK, Model, Perception, Self-esteem

http://doi.org/10.48165/IJEE.2022.58213

ABSTRACT

Besides income, prestige also plays a major role in selection of profession. Lowering of self-esteem is perceived as one of the major setbacks for reducing attraction towards farming by the current generation. Krishi Vigyan Kendra, Deogarh, Odisha developed a strategy and worked upon it during 2018-19 and 2019-20 to increase the social status of farmers by increasing their human values. The selected farmers were branded as experts in certain fields before a public gathering. Their role and success story was highlighted through different mass media. The effect of such action was observed and recorded. The branded farmers felt their increased social status after branding by KVK. These young farmers served as a medium for technology transfer in their locality. Increasing of self-esteem was perceived as the greatest effect of branding by the farmers. The studied farmers were of the opinion that even after recognized by government, they had the least opportunity to easily avail government schemes. This novel approach was found a successful step towards encouraging farmers, rural agripreneurs as well as transfer of farm technologies. The model can be replicated successfully in agriculture and other such areas for a wholesome development.

INTRODUCTION

The contribution of farm sector to gross domestic product (GDP) of the nation has reduced from 17.03 per cent to 15.96 per cent during last decade. After the adoption of liberalized economy, the share of service, industry and manufacturing sectors in national (GDP) started growing rapidly reducing the share of farm sector. This also encouraged large scale migration of human resources from farming sector to non-farm sector. Gradually farming lost its attraction in the rural communities. The total workforce engaged in agriculture was observed to get reduced from 51.52 per cent in 2010 to 41.49 per cent during 2020. Most of the small and marginal farmers of the nation (86%) are now felt struggling with a profession having lower and unstable income, highest insecurity and with least prestige from the society (Nath, 2020). Singh et al., (2021) remarked that worldwide agriculture has witnessed a shift in the last few decades and extension mechanisms need to stay ahead and equip farmers by enhancing their management capacities. Maslow (1954) in his hierarchy of need structure stated that self esteem is the higher grade need of a human being in the society. O'Boyle (2011) in his study opined that enough studies have not yet been taken up to find out the effect of such attributes on farm outcomes and its effect on society. In this back ground, it was felt that the extension approach should be focused to tackle the poor prestige associated with farming.

Krishi Vigyan Kendra is working in all the rural districts of India in the field of extension research for holistic development of the farm families. They are one of the key extension systems and integral part of National Agricultural Research System (NARS). Without any sanctioned post of grass root level extension worker at village level and with limited number of scientific posts, KVK has been given the mandate to test location specific frontier technologies in agriculture and allied sectors and provide self employment avenues to the resource poor farm families (Nath & De, 2015). Doubling of farmers' income programme (2016) is perceived as an incentive to check professional migration from the farm sector. But no specific action has ever been taken exclusively to recognize the human values of the farmers by increasing their social prestige. Keeping the things

Received 14-09-2021; Accepted 05-01-2022

in view, KVK Deogarh, Odisha adopted a novel practice during 2018-19 and 2019-20 to enhance the social prestige of young farmers who will be the flag bearers for the fellow farming community in transfer of technologies in their respective areas. This study had the objectives to find out the effect of this approach in establishing and recognizing human values of the farmers, increase their self-esteem which will make farming profession attractive.

METHODOLOGY

This study was undertaken during the year 2018-19 and 2019-20 in the purposively selected agriculture predominated Deogarh district of Odisha. About 83 per cent of total farm families (55,000) of the district were small and marginal farmers. Besides the traditional agriculture, horticulture, animal husbandry and pisciculture, minor forest produces collection was their major means of livelihood support. From about 55000 farm families, more than seven thousand young rural youths have gone outside in search of employment in non-farm sector, as reported by district labor office, Deogarh. Poverty, malnutrition and unemployment were perceived as the main reasons of youths for migration from rural areas. Agriculture was not regarded as an alluring profession for them anymore. KVK, Deogarh took steps during the study period to encourage the specialised progressive farmers with an objective to make the profession attractive. Sixteen farmers belonging to different categories were selected purposively during the study period who was felicitated by KVK in different occasions. They were designated with some brands as per their domain of specialisation. Information was collected from those branded farmers in a semi-structured interview schedule. Their socio-economic status was studied. Perception of the farmers on the effect of branding was quantified in a 3 point continuum to come to a conclusion.

RESULTS AND DISCUSSION

KVK, Deogarh after identifying the progressive farmers, recognized their potentials and designated them as ambassadors of those specific practices. The brand names were selected according to their traditional profession or the activity which the farmer adopted following latest technical know-hows. These farmers were performing excellently in their sphere and earning more than the others using the latest available modern technologies. However, still they were treated as a poor farmer with low social prestige.

The sixteen farmers were the known faces in their locality for their specialization in the mentioned areas. Farmer professor designation was given to the farmer with a well maintained pond based IFS. His knowledge in farming as a whole was recognized in his locality. Integrated Farming System (IFS) is regarded as a panacea for small and marginal farmers against various biotic and abiotic problems (Nath et al., 2016). As it is comprised of crop and non-crop components, the expert farmer was aware of a number of technologies, so he was designated as farmer professor. Kisori Pradhan, a farmer of Reamal block was an expert in freshwater prawn culture as well as composite pisciculture. His expertise in aquaculture, i.e. the blue revolution was the factor for which he was designated as blue farmer of the district. Likewise, Ganduru Minz was designated as plant doctor seeing his knowledge in pest and disease management. Mrs. Sukumari Sahoo was the farmwoman producing highest quantity

Table 1. Process of branding and recognizing farmers

S.No.	Name of the farmer	Excelling area	Brand name given	Felicitated by	Newspaper publication (No.)	TV telecast (No.)	Farm Journal (No.)	Spl Govt. recognition
1	Debendra Dhal	Pond based IFS	Farmer professor	Chairman, ZP	2	1	1	Govt trainer
2	Kishori Pradhan	Pisciculture	Blue farmer of the district	DFO	-	-	-	Fish trainer
3	Ganduru Minz	Kharif Tomato	Plant doctor	State A& FW minister, QRT- ICAR	2	5	1	Udyan sathi
4	Pravash Mishra	Poly house	Hi-tech farmer of the district	CDAO	2	-	-	-
5	Randip Pradhan	Banana cultivation	Young farmer of the district	State A& FW minister	2	1	1	-
6	Arun Kumar Naik	Farm machineries	Farm Engineer	KVK	-	-	-	First SPRT
7	Amit Biswal	Seed production	Agripreneur of the district	KVK	-	-	-	Seed producer
8	Gosain Minz	Improved goat farming	Farmer Innovator	Dist Administration	1	1	-	-
9	Pradip Lakra	Kharif Tomato	Farm Captain	State A& FW minister	4	3	-	-
10	Reena Dwibedi	Organic Farming	Smart lady farmer	Agriculture University	-	-	-	OLM Coordinator
11	Geetanjali Behera	Organising lady farmers	Smart home maker	Chairman, ZP	3	1	1	Swatchha gram
12	Prasanna Pradhan	Sweet orange cultivation	KVK Bandhu	OUAT	2	1	1	Watershed asst.
13	Sukumari Sahoo	Mushroom cultivation	Mushroom lady of the district	KVK	2	2	1	Trainer
14	Chandan Kr Sahoo	Composting, dairy	e-farmer of the district	KVK	-	-	-	-
15	Kasturi Pradhan	Mushroom and veg. cultivation	Mahila Gaurav	DPM, OLM	3	-	-	-
16	Lalit Mohan Sahoo	Medicinal plants	People's doctor	Asst Director, Hort	3	1	-	-

of mushroom in the district. She was also catering mushroom to the district headquarter market throughout the year. She was the only lady in the district, producing mushroom around the year. She was designated as mushroom lady of the district. Prasanna Pradhan, a young sweet orange grower was taking all the latest technologies from KVK and disseminate them in the locality, hence designated as KVK Bandhu. Mrs Gitanjali Behera, a house wife made her village the *swatchha grama* of the district uniting all the women. Kasturi Pradhan set an example in leading the fellow women of her village and persuading them for mushroom cultivation. She herself was earning about 0.8 lakh rupees from mushroom cultivation only. She was conferred with the title of Mahila Gaurav Samman. All other farmers mentioned in the Table 1 were given the brands in similar way.

Table 1 also revealed the information how a progressive farmer became a brand ambassador of the society after recognised by the persons belonging to higher hierarchy of the society. It was observed that their names in the print media and electronics media gave recognition to them as a special person in their locality which encouraged them to adopt new technologies and become resource person in their profession. Major part of Deogarh district is under Complex-Diversified-Rainfed (CDR) agriculture production system, therefore the adoption rate of modern technology was obviously very poor. However some of the branded farmers were already recognized by the society for their innovativeness. During the survey, it was found that the income and uniqueness in farming had given them a special position among their farming community. Following model, i.e. Nath's model for harnessing human values (Figure 1) was followed during the study to select, designate, branding and highlighting the farmers to harness their human values.

A study on perception of the branded farmers on effect of branding was done in a three points scale where 0, 1, 2 scores were allotted to disagreed, partially agreed and totally agreed respectively. The mean score of each parameter was calculated and mentioned as Table 2.

From the Table 2 it is revealed that farmers perceived increasing of self esteem was the greatest effect after branding which scored the highest. During the survey, it was also found that their profession was recognized by the co-farmers which encouraged other farmers to follow them, thus paving a way for a fruitful farmer to farmer extension. The performance of the awarded farmer and social recognition accrued for this, had an impact on the fellow farmers. It promoted technology adoption in their farming practices. It supports the study of Froh (2004) which indicated positive psychology plays a major role in adoption of innovations. Makinen (2013) from his study also stated that attitude of farmers were associated with 25 per cent of the variation in farm performance. Most of these farmers were of the opinion that this branding hardly helped them to avail government schemes or providing schematic benefits to their co-farmers. They were treated more as resource persons by their co-farmers for the new technologies. Nath & Nayak (2008) in their study found that 92 per cent of farm families received knowledge on farming from their co-farmers only. Farmer to farmer extension is proved as the most effective technology transfer than the others (Meena et al., 2016; Franzel et al., 2019). Sarnaik et al., (2020) also indicated that in this era of globalization, effective, reliable and quick

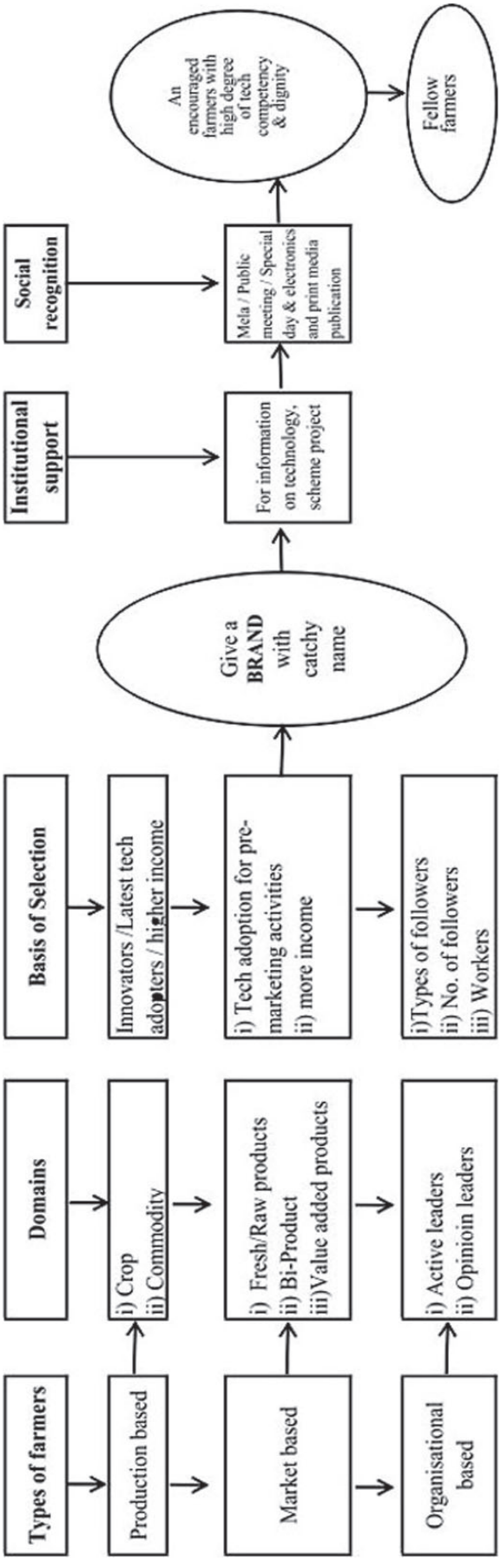

Figure 1. Nath's Model for Harnessing Human Values

Table 2. Farmers' perception on effect of branding

S.No.	Name of the farmer	Brand	On self					On co- farmers			On the Society			
			Social recogni-zation	Cosmopo-liteness	Govt. scheme availability	Self esteem	Resource person on techs.	Infor-mation get scheme	Input availa-bility	Contact person	Encoura-gement to the people	Increase in area	Adoption of tech-nology	Increase in income
1	Debendra Dhal	Farmer professor	2.0	1.0	1.0	2.0	2.0	1.0	2.0	1.0	2.0	1.0	2.0	1.0
2	Kishori Pradhan	Blue farmer of the district	1.0	1.0	2.0	1.0	1.0	0.0	2.0	0.0	1.0	1.0	2.0	1.0
3	Ganduru Minz	Plant doctor	2.0	2.0	1.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0
4	Pravash Mishra	Hi-tech farmer of the district	2.0	2.0	2.0	2.0	0.0	0.0	1.0	0.0	1.0	1.0	1.0	1.0
5	Randip Pradhan	Young farmer of the district	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	2.0	2.0	1.0	2.0
6	Arun Kumar Naik	Farm Engineer	2.0	1.0	1.0	2.0	2.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0
7	Amit Biswal	Agripreneur of the district	2.0	1.0	1.0	2.0	1.0	0.0	1.0	0.0	1.0	2.0	1.0	1.0
8	Gosain Minz	Farmer Innovator	1.0	1.0	0.0	2.0	2.0	0.0	2.0	1.0	1.0	1.0	1.0	2.0
9	Pradip Lakra	Farm Captain	2.0	1.0	0.0	2.0	2.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0
10	Reena Dwibedi	Smart lady farmer	2.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0	1.0	1.0
11	Geetanjali Behera	Smart home maker	2.0	1.0	0.0	2.0	0.0	1.0	0.0	1.0	2.0	1.0	1.0	1.0
12	Prasanna Pradhan	KVK Bandhu	1.0	1.0	0.0	1.0	2.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
13	Sukumari Sahoo	Mushroom lady of the district	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
14	Chandan Kumar Sahoo	e-farmer of the district	1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0
15	Kasturi Pradhan	Mahila Gaurav	2.0	2.0	1.0	2.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	2.0
16	Lalit Mohan Sahoo	People's doctor	2.0	1.0	0.0	1.0	2.0	0.0	1.0	1.0	2.0	1.0	1.0	1.0
	Mean score		1.63	1.19	0.88	1.69	1.44	0.88	1.25	1.00	1.50	1.50	1.44	1.50

transfer of technologies to end users is important for increasing productivity. However, the effect of branding on the society in technology transfer was satisfactory with an average score of more than 1.44. It helped in horizontal and vertical spread of the technology as well as increasing in income from farming in the locality as a whole. It corroborates the findings of Boyle et al., (2010).

CONCLUSION

KVK, Deogarh had taken an innovative step of encouraging farmers by branding them who were the carriers of latest agriculture information. Branding farmers with a nomenclature highlighting their sphere of specialization boosted their morality, self-esteem and encouraged their work aptitude. It not only made them popular but also made their adopted technologies and innovations trustworthy by the fellow farmers. Nath's model of harnessing human values became successful in giving recognition to different types of farmers. Technology transfer through this model was easier and with least cost involved. It is expected that other agencies working for the benefit of rural society will adopt such novel extension approach to transfer technologies in agriculture and allied sectors.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (73-76)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Perceived Challenges of National Education Policy, 2020 by the Students

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ARTICLE INFO

Keywords: National education policy-2020, Challenges, Students, Perception

http://doi.org/10.48165/IJEE.2022.58214

ABSTRACT

National Education Policy, 2020 is a progressive shift towards a more scientific approach to education and if it is enforced in its true vision, the new education structure can bring India stood up with the leading countries in the world. It is aiming to develop creative potential, skills, and analytical thinking which will be the need in the global job market. The policy has challenges for the students and the teachers. The present study focused on the perception of college students in India about NEP, 2020 concerning challenges like overburden of syllabus, lack of infrastructure, and transportation facilities, focus on regional languages, Disparity between rural and urban areas in manpower and quality of education. The results of the study indicated that out of 120 respondents, 45(37.50%) respondents agreed, for the statement “Overburden of syllabus”, followed by “Universal access to education” were agreed by around half of the respondents i.e. 64(53.33%), and 11(09.16%) were disagreed.

INTRODUCTION

Education is a basis for human dignity. According to S Radhakrishnan (Occasional Speeches & Writings,1956), education is acquiring of knowledge beyond what is academic and professional. It is the base for developing a human beings potential and promoting national development. Access to quality education can act as tool for social mobility and reducing inequalities. India is expected to have the highest population of young people in the world over the next decade, so India must rush to invest in education. Our ability to provide high-quality educational opportunities to them will determine the future of our country.

India has a long and illustrious history of disseminating information and educating its people through the education of the Vedas, Brahmanas, Upanishads, and Dharmasutras being the oldest method of education. Our traditional education system evolved over time, focusing on the holistic development of the individual by taking care of both the inner and outer selves, beginning with the Rigveda. A new chapter in education policy began with India becoming independent. The first Commission to be appointed in independent India was the University Education Commission of 1948, under the chairmanship of Dr. S. Radhakrishnan. The Commission aimed to reorient the education system to face the challenges emerging from a long period of colonisation. The Secondary Education Commission was set up in 1952 under the chairmanship of Dr. A. Lakshmanaswami Mudaliar which suggested diversification of high school courses and the establishment of multipurpose high schools then the Indian Education Commission (1964-66) under the chairmanship of D.S. Kothari was formed.

After 34 years, we have a new policy that aims to bring about a revolution in education system. It has several opportunities and challenges to keep and appears to be timely in several regards. Much of its success will depend on its successful execution. It is opportunistic in a way to facilitate an inclusive, participatory and holistic approach which takes into consideration field experiences, empirical research, stakeholders· feedback, as well as lessons learned from best practices. The New Education Policy strives to meet the changing dynamics of the population’s requirement with regard to quality education, innovation and research. It plays important role to achieve United Nations fourth Sustainable Development Goal

Received 27-01-2021; Accepted 05-02-2022

which strives for quality education and ensures inclusive and equitable quality education and promote lifelong learning opportunities for all.

METHODOLOGY

An online survey method was used to collect data from the sample. The study was conducted on a sample size of 120 college students including students of Graduate, Postgraduate and Doctoral degree. Collected data were subjected to statistical analysis by using frequency and percentage, factor analysis (Principal Component Analysis). The data collected was analyzed using percentage and factor analysis. To assess the item reliability, Cronbach's alpha coefficient was considered equal to 0.850 for the items of perceived challenges suggesting that the research tool is acceptable enough to be used in data collection. The responses for perceived challenges were recorded on a five-point continuum representing Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree with scores of 5, 4, 3, 2, and 1, respectively. The perceived challenges score of each respondent was calculated by adding up the scores obtained by respondents on all the items. The overall perception of challenges opportunities score on this scale ranges from a minimum of 34 to a maximum of 48. Based on their scores respondents were divided into three categories *viz*. high, medium, and low. To find whether the selected dimension of challenges work independently to affect overall difficulties or rather act as part of broad factors the factor analysis method was adopted. To alleviate the dilemma factor analysis (Principal Component Analysis) with Oblimin rotation and Kaiser Normalization method was employed (SPSS 20) to find out how these separate dimensions behave in the broader setting of perceived opportunities and challenges.

RESULTS AND DISCUSSION

Perceived challenges of national educational policy, 2020 by college students

Table 1 depicts the perceived challenges of NEP, 2020 by the college students. The responses were categorized and ranked by using total weighted score and weighted mean score. This technique was applied to show a comparative analysis between the statements.

The data revealed that "Lack of infrastructure and transportation facilities" and "Corruption in the education sector" were perceived as major challenges with weighted mean score 4.00 and ranked 1st. followed by "Lack of optimum funds" ranked 2nd with weighted mean score 3.99. The "Disparity between rural and urban areas in manpower and quality of education" received weighted mean 3.90 with rank 3rd followed by fear of commercialization and privatization, policy framing by central government, universal access to education, vocational education, focus on regional languages, undermining English language, overburden of syllabus with weighted mean scores 3.94, 3.90, 3.84, 3.76, 3.60, 3.42, 3.20 ranked 4th, 5th, 6th, 7th,8th, 9th and 10th respectively. It is evident from the Table 1 that "Lack of infrastructure and transportation facilities", "Corruption in the education sector" and "Lack of optimum funds" perceived as major challenges of national education policy- 2020 by the college students.

Thus from the above table it can be concluded that students perceived "Lack of funds" as a major challenge for the implementation of NEP, 2020. If we look at the recommendation of increasing public spending on education to 6 per cent of GDP

Table 1. Perceived challenges of National Educational Policy, 2020 by college students

S. No.	Items	Extent of Agreement					TWS	WMS	Rank
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree			
		Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)			
1.	Lack of infrastructure and transportation facilities	39 (32.50)	57 (47.50)	13 (10.83)	07 (05.83)	04 (03.33)	480	4.00	1
2.	Corruption in the education sector	48 (40.00)	40 (33.33)	20 (16.66)	08 (06.66)	04 (03.33)	480	4.00	1
3.	Lack of optimum funds	40 (33.33)	55 (45.83)	13 (10.83)	08 (06.66)	04 (03.33)	479	3.99	2
4.	Disparity between rural and urban areas in manpower and quality of education	39 (32.50)	57 (47.50)	11 (09.16)	08 (06.66)	05 (04.16)	477	3.90	3
5.	Fear of commercialization and privatization	40 (33.33)	52 (43.33)	14 (11.66)	09 (07.50)	05 (04.16)	473	3.94	4
6.	Policy framing by central government	32 (26.66)	60 (50.00)	17 (14.16)	07 (05.83)	04 (03.33)	469	3.90	5
7.	Universal access to education	31 (25.83)	62 (51.66)	10 (08.33)	11 (09.16)	06 (05.00)	461	3.84	6
8.	Vocational education	23 (19.16)	62 (51.66)	22 (18.33)	10 (08.33)	03 (02.50)	452	3.76	7
9.	Focus on regional languages	28 (23.33)	47 (39.16)	22 (18.33)	15 (12.50)	08 (06.66)	432	3.60	8
10.	Undermining English language	23 (19.16)	42 (35.00)	26 (21.66)	21 (17.50)	08 (06.66)	411	3.42	9
11.	Overburden of syllabus	11 (09.16)	43 (35.83)	31 (25.83)	29 (24.16)	06 (05.00)	384	3.2	10

*****TWS - Total Weighted Score *WMS - Weighted Mean Score

was first made by the National Policy on Education 1968 and reiterated by the 1986 Policy. NEP 2020 reaffirms the recommendation of increasing public investment on education to 6 percent of GDP however, there are no specific provisions mentioned in the policy regarding the methods of mobilizing funds for the implementation of the policy. Another major perceived challenge was "Universal access to education". As per (Annual Survey of Education Report, 2019), only 16 per cent of children in Class 1 in 26 surveyed rural districts can read the text at the prescribed level, while almost 40 per cent cannot even recognize letters. As per the 2016 All India Survey on Higher Education, nearly 22 million students (65%) were enrolled in private institutions in various courses. The policy targets Gross Enrolment Ratio in higher education to be increased to 50 per cent (currently 26.3%) by 2035 and Universal literacy by 2025 for primary schools

The overall level of perception of the respondents has been presented in Table 2. The study indicated that, 68.33 per cent belonged to medium level of challenges, 20.00 per cent and 11.66 per cent perceived high and low level of challenges about National Education Policy, 2020.

Factor analysis: Suitability for the data

The KMO of present study was 0.847 thus confirming the appropriateness of Factor Analysis. Bartlett's test of sphericity indicated whether a given correlation matrix is an identity matrix, which would indicate that the variables are unrelated. In this case, the significance level has a very small value i.e. 0.000 which is less than 0.05 thus suggesting that the variables are highly correlated.

Table 2. Overall perceived challenges

Categories	Respondents (n) = 120	
	Frequency	Percentage
Low (score up to 34)	14	11.66
Medium (score between 35 to 47)	82	68.33
High (score 48 and above)	24	20.00

Mean: 41.65 SD: 7.31

Table 3. KMO and Bartlett's Test of Sphericity

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	Approx. chi-square	446.560
	df	55
	Sig.	.000

Factor analysis: Total variance explained

Table 4 indicates the total variance distribution model for extracted factors. In this case, first three factors as Eigen value for them is more than one (1) and account for a cumulative variance of 63.220 per cent which shows that the eleven dimensions of perceived challenges actually working as three factors to affect students' perception. The initial 3 dimensions which pose characteristic values greater than 1 can be extracted.

Factor analysis: Extracted pattern matrix

The Table 5 displayed rotated component matrix and reports the factor loadings for each variable on the components or factors after rotation. Each number represents the partial correlation between the item and the rotated factor. Eleven statements relating to perceived opportunities of National Education Policy, 2020 were factor analysed using principal component analysis with Oblimin rotation.

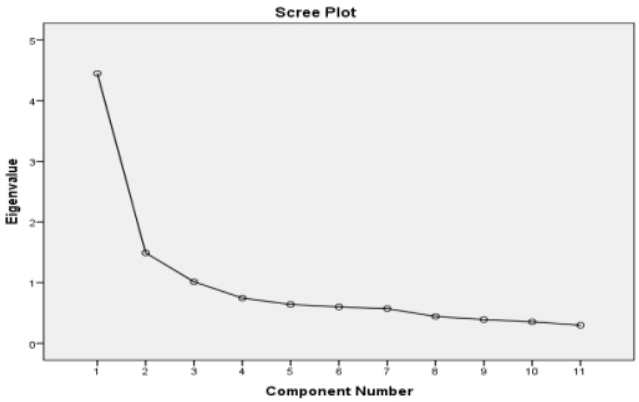

Figure 1. Factor Loadings of extracted factor

Table 4. Total variance distribution model for extracted factors

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative (%)	Total	% of Variance	Cumulative (%)	Total
1	4.449	40.441	40.441	4.449	40.441	40.441	3.222
2	1.491	13.557	53.998	1.491	13.557	53.998	2.834
3	1.014	9.222	63.220	1.014	9.222	63.220	3.011
4	0.746	6.781	70.000				
5	0.641	5.826	75.827				
6	0.600	5.458	81.284				
7	0.571	5.194	86.478				
8	0.443	4.030	90.508				
9	0.391	3.558	94.065				
10	0.355	3.223	97.289				
11	0.298	2.711	100.00				

Extraction Method: Principal Component Analysis.

[a]When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Table 5. Extracted pattern matrix for identified factor of perceived challenges of NEP, 2020 by the students

Items	Component		
	1	2	3
Policy framing by central government	0.849		
Undermining English language	0.709		
Corruption in the education sector	0.648		
Fear of commercialization & privatization	0.537		
Focus on regional languages		0.814	
Vocational education		0.698	
Overburden of syllabus		0.649	
Universal access to education		0.639	
Lack of infrastructure and transportation facilities			0.835
Disparity between rural and urban areas in manpower and quality of education			0.803
Lack of optimum funds			0.750

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization; [a]Rotation converged in 13 iterations.

The analysis yielded three factors explaining a total of 63.220% of the variance for the entire set of variables. Factor 1 was labelled as "Centralization of education" due to the high loadings by the following items, policy framing by central government, undermining english language, corruption in the education sector, fear of commercialization and privatization. This first factor explained 40.441 per cent of the variance. The second factor derived was labelled as "Educational disparity" due to the high loadings by the following items, focus on regional languages, vocational education, overburden of syllabus and universal access to education. The variance explained by this factor was 13.557 per cent. The third factor derived was labelled as "Financial and Coverage gap" due to high loadings by the following items, Lack of infrastructure and transportation facilities, Disparity between rural and urban areas in manpower and quality of education and Lack of optimum funds. The variance explained by this factor was 9.222 per cent. This means that we have identified three clear challenges of NEP-2020 among students that are "Centralization of education, "Educational disparity" and "Financial and Coverage gap". These three tendencies are independent of one another (i.e. they are not correlated).

CONCLUSION

This policy is alike to the concept of Basic Education of Gandhi Ji who talked of education that helps a person to earn his livelihood. The study had enhanced the knowledge on perception of challenges of NEP 2020 by the students. The study investigated "Centralization of education", "Educational disparity" and "Financial and Coverage gap" as challenging factors. Main thrust as contemplated is on multidisciplinary, holistic and broad-based education. There is also main emphasis on vocational education, which is supposed to start earlier in school phase itself.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (77-80)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Lifestyle of Farming Community in Punjab: A Major Health Determinant

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ARTICLE INFO

Keywords: Health, Lifestyle, Physical health, Mental health, Farming families

http://doi.org/10.48165/IJEE.2022.58215

ABSTRACT

The health status of the farming community and the various lifestyle factors which affect the health of the farming community is still an subject matter of less importance for researchers. The present study was aimed to find out the relationship of health with lifestyle of the farming community and data were collected using survey from a sample of 120 respondents from the farming community of Punjab, India during 2021. The overall health status was measured in terms of mental health status and physical health status. The lifestyle was measured through 8 parameters i.e. dietary diversity score, meal frequency, nutrition intake, physical activity, stress management, personal health habits, availing medical advice and substance abuse. The findings revealed that lifestyle was correlated with physical health, mental health as well as overall health. The results also showed that mental health, physical health and overall health of male respondents were better than female respondents. It was inferred that health was dependent on lifestyle. Therefore, there is need to create awareness and knowledge about importance of lifestyle among farming community.

INTRODUCTION

An undisturbed condition in physical health in the public is rare to find with the growing rates in various health problems. Most individuals are vulnerable to a number of health affecting conditions because of personal decisions and lifestyle changes (Sunitha & Gururaj, 2014). In many cases, lifestyle choices strongly act as the contributing factors to poor health. Lack of physical activity is considered to be a risk factor for cardiovascular diseases and other conditions. Poor eating habits are also a cause of concern. Balanced diet is important for maintaining a sound health and most of the rural household have lack of awareness about it and are found to be nutrient deficient (Gupta et al., 2019). Overweight and obesity is increasing and has tripled since 1975 (World Health Organisation, 2021). Weight gain is largely due to the high sedentary lifestyle of an individual (Agarwal et al., 2013) and it can be managed effectively through physical activities. Enhancing nutritional security by educating people to grow nutria-gardens is also an effective way to promote good health and keep health problems to a minimum (Kumari et al., 2019). Singh (2019) concluded that food consumption pattern of village people improved when the nutrition gardens were created by them. Healthy food habits and regular exercise can benefit a person towards leading a healthy life. So lifestyle has a significant impact on health (El-Kader & Mohammad, 2013). This should not be taken on a lighter note because in the bigger picture, health and lifestyle are related with workplace productivity of an individual (Mitchel & Bates, 2011). A person who is physically and mentally healthy can contribute in increasing the productivity at the workplace. Farmers would not be able to play a productive role if their health is poor.

Lifestyle includes the everyday activities of an individual which includes daily food intake, exercise, sleep etc. A healthy lifestyle comprises of healthy habits. Getting proper sleep, having adequate nutrition, regular physical activities are some of the essential elements that help in sustaining a good health. Exercise can also uplift the condition of mental health, improve oxygen uptake and cardiorespiratory fitness (Demers, 2013). Along with exercise having proper meals is necessary. Healthy diet not only

Received 07-01-2022; Accepted 27-01-2022

improves physical health but also mental health (Minhas, 2013). Besides these factors, timely medical checkups and other personal health habits are contributory in keeping a person healthy. Considering these factors, the current research was conducted on the farming community in the rural areas from Punjab, India with objective to determine relationship of lifestyle of farming community. Indian economy is dependent upon agriculture and farming community as it contributes 18 per cent to the total GDP and employs 60 per cent of the rural population (Statista Research Department, 2020). Therefore the health of the farming community impacts the GDP of the country to a great extent.

METHODOLOGY

In the current study, the widely adaptable descriptive survey research design was used to collect information and analyze the effect of lifestyle on health status of farming families. The study was conducted in the Punjab state. Random sampling technique was used and a questionnaire was developed pertaining to the various parameters of lifestyle (dietary diversity score, meal frequency, nutrition, physical activity, stress management, personal health habits, availing medical advice, substance abuse) and health (mental health and physical health). The data was collected from 120 respondents (60 male and 60 female) from farming families. Lifestyle (LS) of the respondents was assessed in terms of eight parameters i.e. meal frequency (MF), dietary diversity score (DDS), physical activity (PA), nutrition intake (NI), stress management (SM), personal health habits (PHH), availing medical advice (AMA) and substance abuse (SA). DDS was calculated using 24 hour recall method from the respondents and scored according to the 12 food groups laid down by Swindale & Bilinsky (2006). MF, NI, PA, SM, PHH, AMA and SA were measured using a four point scale from 0 to 3 (never, sometimes, fairly often and always). All the seven assessing factors except substance abuse were directly related to good lifestyle while scoring for substance abuse being negatively related, was reversed.

For health status, both mental and physical health of the respondents was assessed. Mental health status (MHS) was assessed by total of 31 statements and was measured on a four point scale with the assigned scores of 0 to 3 (never, sometimes, fairly often and always). The physical health status (PHS) was assessed by combination of health related statements and presence of severe lifestyle related disorders. A total of 13 statements related to general health disorder were measured on four point Likert scale having scores 0 to 3. Three severe health disorders were measured on a dichotomous scale i.e. yes or no. Overall health status (OHS) was calculated by summing up MHS and PHS. Retrieved data were analyzed using SPSS (Statistical Package for Social Sciences). For assessing the lifestyle and health of farming community, the average of the lifestyle and health parameters were calculated and were subjected to t test to find the difference between the male and the female respondents. The relationship between the lifestyle parameters and health parameters were calculated by Karl Pearson correlation coefficient and multivariate linear regression.

RESULTS AND DISCUSSION

Table 1 shows the overall DDS was 6.92 which depicts that respondents do not have much variety in their routine food items. Gender comparison for DDS shows that males ($\bar{x}$=7.00) had better dietary diversity than females ($\bar{x}$=6.83) but it was not statistically significant. Similarly no significant gender difference was observed for MF, PA, PHH and AMA while for rest of the parameters i.e. nutrition intake, stress management and substance abuse the gender difference was significant. The mean NI shows that males ($\bar{x}$=2.04) had more nutritional diet than females ($\bar{x}$=1.92) with a significant difference (t=2.223, p<0.05). For SM also, males ($\bar{x}$=1.92) had significantly (t=3.219, p<0.01) better score than females ($\bar{x}$=1.66). It shows that males manage their stress by participating in various social gatherings etc. Women is more inclined inside four walls of house, is not able to remove her stress. So overall males consume more nutritional diet and manage their stress better as compared to female counterparts. On the other hand, SA (substance abuse) among males ($\bar{x}$=0.37) was more than females ($\bar{x}$=.00) with a significant difference (t=6.012, p<0.01). This is because males in Punjab consume more alcohol as compared to females.

Table 2 depicts the gender wise health profile of the farming families. PHS of males ($\bar{x}$=2.77) was higher than females ($\bar{x}$=2.5) which shows that males had better physical health than females and the difference was statistically significant (t=3.867, p<0.01). MHS of males ($\bar{x}$=2.37) was also significantly (t=3.924, p< 0.01) more than females ($\bar{x}$=1.97). As physical and mental health of males was better than females, OHS for males ($\bar{x}$=2.55) was also reported to be higher than female ($\bar{x}$=2.29) and has shown significant difference (t=4.341, p<0.01). Thus, males were better than female respondents in terms of physical as well as mental health.

Table 2. Health status of farming community (n=120)

Health → Parameters ↓	$\bar{x}$ Male	$\bar{x}$ Female	t value	Overall mean
MHS	2.43	2.16	3.924**	2.30
PHS	2.77	2.54	3.867**	2.65
OHS	2.55	2.29	4.341**	2.42

**p<0.01

Table 1. Lifestyle Status of farming community (n=120)

Lifestyle → Parameters ↓	DDS	MF	NI	PA	SM	PHH	AMA	SA
Male	7	2.55	2.04	1.26	1.9	1.8	2.01	0.29
Female	6.83	2.53	1.92	1.13	1.68	1.89	2.05	0
t value	1.489	0.289	2.223*	1.449	3.219**	1.19	0.39	6.012**
Overall mean	6.92	2.54	1.98	1.19	1.79	1.85	2.03	0.15

*p<0.05, **p<0.01

Table 3. Relationship between lifestyle and health (n=120)

Lifestyle → Health ↓	DDS	MF	PA	NI	SM	PHH	AMA	SA	LS
MHS	0.073	.218*	0.134	.464**	.599**	0.124	.244**	-.233*	.540**
PHS	.231*	0.119	-0.031	.301**	.407**	0.012	-0.046	-0.165	.271**
OHS	0.133	.205*	0.091	.453**	.592**	0.098	0.17	-.233*	.501**

* p<0.05, ** p<0.01

Table 3 showcases the relationship of health with the lifestyle parameters of the respondents. DDS was significantly and positively correlated with physical health (r = .231, p<0.05). In the present study, DDS was found to be associated with physical health while previous literature shows it is also related with mental health (Minhas, 2013).

Further, MF of the respondents was significantly and positively correlated with MHS (r = .218, p<0.05) and OHS (r = .205, p<0.05). Overall health (OHS) and mental health (MHS) were found to be correlated with the meal frequency (MF) because timely and regular meals help to maintain proper metabolic conditions and nutrition levels.

It is further pertinent from the table that NI of the respondents was significantly and positively correlated with MHS (r = .464, p<0.01), PHS (r = .301, p<0.01) as well as OHS (r = .453, p<0.01). It is not surprising to see that nutrition intake was related to all the health parameters i.e., mental health (MHS), physical health (PHS) and overall health (OHS) as similar to meal frequency, consumption of nutritional foods helps in maintenance of health.

SM of the respondents was found to be significantly and positively correlated with both MHS (r = .599, p<0.01) and PHS (r = .407, p<0.01) and also OHS (r = .592, p<0.01). However, AMA was significantly and positively correlated only with MHS (r = .244, p<0.01). Data further revealed that SA of the respondents was significantly and negatively correlated with MHS (r = -.233, p<0.05) and OHS (r = -.233, p<0.05).Contrary to previous literatures physical activity showed no relation with any of the health parameters (Demers, 2013; Tennebo, 2013; Jadhav, 2017).

Overall, the two lifestyle parameters i.e. NI and SM were significantly associated with PHS, MHS and OHS. On the whole, LS was found to be significantly and positively correlated with both MHS (r = .540, p<0.01) and PHS (r = .271, p<0.01) and also OHS (r = .501, p<0.01). The present study further strengthens the literature that health is associated with lifestyle, a finding noted in India (Bhandari & Paswan, 2020; Singh & Mishra, 2012) and abroad (Jasiukaitiene et al., 2020; Menotti et al., 2015; Puddu & Menotti, 2015).

Table 4 depicts the regression coefficient of the lifestyle parameters in relation to health. Data shows that the adjusted coefficient of the multiple regression R^2 came out to be 0.437 indicating that 43.7 per cent of variation in OHS has been explained by the lifestyle parameters. Of the eight lifestyle parameters DDS, NI, SM and SA showed significant effect on OHS. Table depicts that DDS was positively significant (p<0.05) which means that with the increase in dietary diversity score by one per cent the resultant overall health of the individual increases by 4.069 per cent. NI was also positively significant (p<0.01) which means that with the increase in nutrition intake by one per cent the resultant overall health of the individual increases by 1.282 per cent.

Table 4. Multivariate regression analysis of lifestyle parameters with health (n=120)

Factors	Regression factor B	t value	Constant	Adjusted R^2
DDS	4.069*	2.159	51.236	0.437
MF	0.079	0.139		
PA	-0.118	-0.241		
NI	1.282**	3.320		
SM	2.197**	6.592		
PHH	-0.121	-0.298		
AMA	-0.725	-1.360		
SA	-3.156**	-2.383		

* p<0.05, **p<0.01

The regression factor of SM was 2.197 (p<0.01) which means that with the increase in stress management by one per cent the resultant overall health of the individual increases by 2.197 per cent. On the contrary, the regression coefficient of SA was negatively significant (p<0.01) which means that with the increase in substance abuse by one per cent the resultant OHS of the individual decreases by 3.156 per cent.

CONCLUSION

The present study revealed the fact that stress management is important for having a good mental health, physical health as well as overall health. The study adds to the existing literature of health and lifestyle by depicting that availing timely medical advice is correlated with mental health. The strong point that came up from the study is that lifestyle was related to health in the rural population i.e. farming community. It aligned with other previous literatures on other population group which states the importance of lifestyle and its various parameters in improving health. Lifestyle of the respondents had an effect on their mental health, physical health as well as overall health. The health of the farming community was found to be related to their lifestyle. So there is need to create awareness and knowledge about importance of lifestyle among farming community.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (81-85)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Adaptation Methods Practiced by Farmers in Response to Perceived Climate Change in Andhra Pradesh

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ARTICLE INFO

Keywords: Climate change, Adoption practices, Determinant factors, Multinomial logit model, Andhra Pradesh

http://doi.org/10.48165/IJEE.2022.58216

ABSTRACT

The study was aimed at analyzing adaptation methods practiced by farmers' and determining factors for adoption to climate change in the Andhra Pradesh (Zone-1 and Zone-6). A cross sectional household survey (by employing structured interview schedule), participant observations and focused PRA were conducted to collect the information on adaptation methods being practiced by 320 randomly selected farmers. The study employed descriptive statistics to types of adaptation measures exercised to cope up with the risk of the change in climate. The study also employed the multinomial logit regression to analyze the determinants of adaptation method extracted. Factors such as age, education, number of crops cultivated, use of new technology, extension participation, contact and farmer's commitment are the common determinants for adoption of practices.

INTRODUCTION

Climate change is affecting agricultural sector in India. The temperature will boom by means 1.7 to 4.78 °C by 2030-2080 with an increase in precipitation from 1.2 to 11.3 per cent influencing the agricultural and water sectors. Under medium-time period (2020–2039) weather alternate situation, crop yield is projected to lessen through 4.5 to 9 per cent, relying at the significance and distribution of global warming (Harikrishna et al., 2019). The solid drifts in climate change are evident, the likelihood of further changes occurring and the increasing measure of potential climate impacts give urgency to addressing agricultural adaptation practices more consistently (Chunera & Amardeep, 2018). The stable drifts in climate trade are obtrusive, the probability of further changes taking place and the growing measure of potential climate affects provide urgency to addressing agricultural adaptation practices greater continually. As agriculture zone has to face the antagonistic effects of climate change and climate variability, hence variation techniques are essential for farmers to deal with them (Chunera & Amardeep, 2018). There are various capability model options to be had for marginal trade of present agricultural practices, regularly versions of current weather chance management. The implementation of adoption methods is probable to have considerable advantages below moderate climate exchange for some cropping structures (Rakshit et al., 2016). However, there are limits to their usefulness under more intense climatic variations. Resent climatic condition there should be extra systemic changes in useful resource allocation want to be taken into consideration, consisting of targeted diversification of manufacturing structures, socio monetary circumstance and livelihoods (Dupdal et al., 2021). We say that achieving improved variation practices will require integration of weather trade-related problems with different risk factors, for example: climate variability and marketplace danger and with other coverage domains, inclusive of sustainable development. In order to support farm level decisions and minimize the loses 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). In India, climate change in Andhra Pradesh was highly

Received 11-01-2022; Accepted 08-02-2022

vulnerable and all the four districts of Rayalaseema area was highly vulnerable (Vincent & Balasubramani, 2021) then moderately in Krishna Godavari zone to climate change. State action plan on climate change for Andhra Pradesh was mentioned critical issues in agriculture was decrease in winter rainfall has a negative impact on winter crops (Rabi crops), especially in the rainfed areas, temperature fluctuations affect Rabi crops severely, decrease in area under crops on account of insufficient rainfall, particularly in the South- West Monsoon period, dryland areas of the state have annual rainfall less than 550 mm and farming is not viable and loss in fertility of soil in many areas due to excessive use of fertilizers and pesticides. The river basins and coastal areas are vulnerable to climate change influences due to converting precipitation and temperature styles.

In this context, in order to analyze adaptation methods practiced by farmers' and determining factors for adoption to climate change, two agro-climatic zones viz., Krishna Godavari zone-1 (Prakasam and Guntur Districts) and Scarce Rainfall zone-6 (Anantapur and Kurnool Districts) in the state of Andhra Pradesh were chosen to notice various diversification in their socio economic and agricultural practices by farmers.

METHODOLOGY

This study was undertaken within Andhra Pradesh, where farming is adversely laid low with weather variables which include rainfall and temperature. In Zone-1, two districts Guntur and Prakasam categorized as prone to climate variability were selected (Kumar et al., 2018). From every district, two mandals were selected based on 30 years' rainfall records and irrigated area of each mandal within the district. Selected two mandals were having deficit rainfall with high irrigated area (irrigated mandal) and deficit rainfall with low irrigated area (rainfed mandal). In Zone-6, districts viz., Kurnool and Anantapur, liable to climate variability (Kumar et al., 2018) were selected. One representative village from each selected mandals was selected to make a total of 8 villages. Forty farmers were selected randomly from each of the village randomly. Data collection was carried out through structured interview schedule, participant observations and focused PRA with farmers and local key informants. Adaptive measures practiced by farmers were categorized into soil and water conservation, crop cultivation, socio economic and livestock. The study employed descriptive techniques including multinomial logit regression. The MNL model was used based on the previous literature (Deressa et al., 2009 & Abid et al., 2015) on determinants of farmers' adaptation to climate change. The model is specified as follows.

$$P(-y = 1/x) = 1 - (P2 + P3 + \cdots Pj)$$

Y as dependent variables included; soil and water conservation practices, crop cultivation practices, livestock management and socio economic management practices. All were entered as individually in Stata software, whereas the X represents the factors that influence choice of the adaptation strategies and P1, P2…Pj as associated probabilities, such that P1 + P2 + … + Pj = 1. The change in X affects the response probabilities P (y = j/x), j = 1, 2 …J. The generalized form of probabilities for an outcome (dependent variable) with j categories is

$$\Pr(yi = j/x) - pr_{ij} = \frac{exp\,(X'\,\hat{a}_j)}{1 + \Sigma^{j}_{j=2} \exp(x'\,\hat{a}_j)} \quad j = 1,2, \ldots..j$$

For j>1, with respect to the explanatory variable provides the marginal effect of the independent variables which give as

$$\frac{\partial pi}{\partial xk} = p_j\,\beta_{jk} - \sum_{j=1}^{j=1} pj\beta jk$$

The marginal effects that shows the magnitude of the changes that occur on the dependent variable when there are corresponding changes in the independent variables was also estimated.

RESULTS AND DISCUSSION

Adaptation methods being practiced by farmers

The adaptation practices by farmers to cope with climate change can be used in combination. Four kinds of combination practices were identified and this section analyzes how respondents combined agronomic strategies, soil and water conservation, livestock and socio economic practices to adapt to climate change. Soil and water conservation practices comprises of maintaining of soil health, filed bunds, drainage channel and tillage operations according soil slope. Crop cultivation practices focused on farming system, selection of crops according to climate change and practices to enhance the situation in adverse condition. Livestock management practices are considering for study are rearing maintenance of livestock and their feeding pattern changes. A total 65 adoption practices considered for the study, in that 15 were soil and water, 25 crop cultivation, 10 livestock management and 15 as socio economic measures.

The detailed analysis revealed that cent per cent of farmers in the study area were found to practice laying of bunds along field boundary and deep summer ploughing shown in Table 1. But very less per cent found to practice provide stone pitching along terrace slopes (6.88%), vegetative soil coverage (17.50%), incorporating green manure crops (23.13%) and practicing digging farm pond for harvesting rain (23.75) followed by opening of trenches along field boundary (25.31%).

The results pointed out that high per cent of farmers found to adjusting sowing or planting dates based on rainfall (97.81%), cultivating drought resistant crops (85.63%) followed by crop rotation (83.75%), practicing seed treatment were followed by 80.63 per cent. Half of the sample farmers shifted mode of irrigation from flood to sprinkler/drip and taking up intercropping. 48.75 per cent of farmers following relay cropping. Nearly 30 per cent of farmers are adopting foliar spray of 2% KNO_3 or 2% urea solution and practicing broad bed furrow practices. Only 8.75 per cent of farmers are adopting reducing the quantity of use of fertilizers and pesticides followed by cultivating crops with tolerance to biotic stresses (7.5%). None of the farmers in study area are adopted agro-forestry system.

It was observed from Figure 1 that the major adaptation practices followed were feeding more concentrates to the livestock (77.78%) and change in feeding pattern to the livestock (73.91%). Less number of farmers sent some of livestock to relatives' house in other places/different village (9.66%). Least number of farmers adopted bringing fodder from government fodder depot/ cattle camps (9.18%). The results revealed that 93.75 per cent of sample

Table 1. Farmers' adaptive measures

S.No.	Adaptive measures	Practicing Farmers (%)
a)	*Through soil and water conservation practices*	
1	Practicing mulching using crop-residue	32.19
2	Laying of bunds along field boundary	100.00
3	laying of bunds across slopes	85.00
4	Optimizing drainage channels	31.56
5	Opening of trenches along field boundary	25.31
6	Vegetative soil coverage	17.50
7	digging farm pond for harvesting rain	23.75
8	Planting trees/ grasses on bunds	68.75
9	Planting trees/ grasses on slopes	27.81
10	Creating gully plugs to arrest soil erosion and free flow of water	55.00
11	Zero tillage system	35.63
12	Provide stone pitching along terrace slopes	6.88
13	Applying FYM in large quantity	77.19
14	Incorporating green manure crops	23.13
15	Deep summer ploughing	100.00
b)	*Through crop cultivation*	
1	Crop rotation	83.75
2	Cultivating new crop	46.25
3	Cultivating early maturing/short duration varieties	61.88
4	Cultivating drought resistant crops	85.63
5	Adjusting sowing or planting dates based on rainfall	97.81
6	Raising of nursery and transplant for possible crops	47.19
7	Taking up multiple crops / Diversification of crops	31.88
8	Practicing seed treatment	80.63
9	Taking up intercropping	52.19
10	Taking up mixed cropping	21.56
11	Adjusting spacing in crop cultivation	34.06
12	Making necessary changes in cropping pattern	60.31
13	Reducing the quantity of use of fertilizers & pesticides	8.75
14	Increase irrigation frequency	35.94
15	Shift mode of irrigation from flood to sprinkler/drip	55.94
16	Practice agro-forestry	0.00
17	Cultivating crops and cultivars with tolerance to biotic stresses	7.50
18	Emphasis more on livestock enterprise	40.00
19	Shift from farming to non-farming activity	24.38
20	Moving to IFS for climate resiliency	23.44
21	Foliar spray of 2% KNO_3 or 2% urea solution	31.56
22	Growing cover crops	17.81
23	Relay cropping	48.75
24	Strip cropping	9.06
25	Practicing broad bed furrow	30.94

farmers are borrowed money for farming and their needs (Figure 2). Three by forth of farmers are engage as wage labour in MGNREGA (78.13%) and wage laborers in others fields/other activities within the village (72.19%). 57.50 per cent of farmers are reduced daily expenditure on essential items like food grains, vegetables and fruits. Half of the sample farmers are migrating to cities for work, barrowing commodities and reducing their expenditure on non-essential items like clothing, phone recharge etc., It is observed that less per cent of farmers are postpone family functions like marriage, cradle ceremony etc., (11.56%).

Determinants of adaptation method

Regression analysis was employed to determine the relative influence of each independent variable considered in the study in explaining the variation in the adoption of practices of the farmer.

In adaptation of soil and water conservation factors (Table 2) of age and irrigation circumstance had negative effect on adoption, in comparison to old age farmers, young farmers were adopting greater and rather than irrigated circumstance farmers, rainfed farmers were adopting more technologies. Factors like education, wide variety of plants cultivated, material ownership, use of latest technology, extension contact and farmer's commitment are positively determining the adoption of soil and water conservation practices. Their marginal effects showed that increased the probability of adopting soil and water conservation practices by means of a component of 0.65, 0.61, 0.11, 1.02, 0.034 and 0.31, respectively.

In case of crop cultivation practices (Table 2) rainfed situation farmers were adopting more crop cultivation practices than irrigated as this variable showed negative impact and its marginal value showed that decreased the probability of adopting crop cultivation practices by a factor 0.021. Other factors of education, number of crops cultivated, annual income, livestock possession, use of new technology and farmer's commitment are positively determining and marginal effects indicate that increased the probability of adopting crop cultivation practices by a factor of 0.41, 1.04, 0.26, 0.07, 0.072 and 0.02 respectively.

With respect to livestock management adaptive measures (Table 3) factors determine are age, livestock possession, farmers' orientation, use of new technology, extension participation and trainings attended. Except age all are positively determines the adoption. The marginal effects indicate that livestock possession,

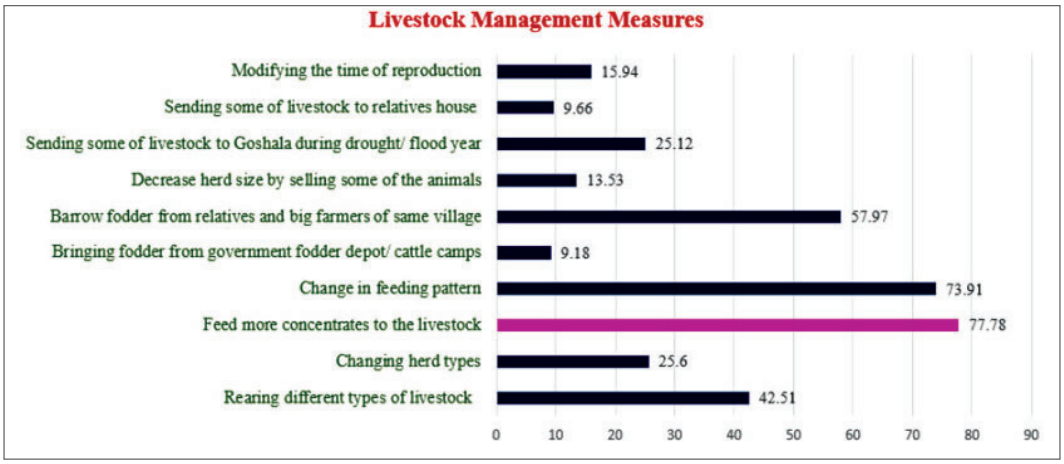

Figure 1. Livestock Management Measures

Figure 2. Socio Economic Adaptive Measures

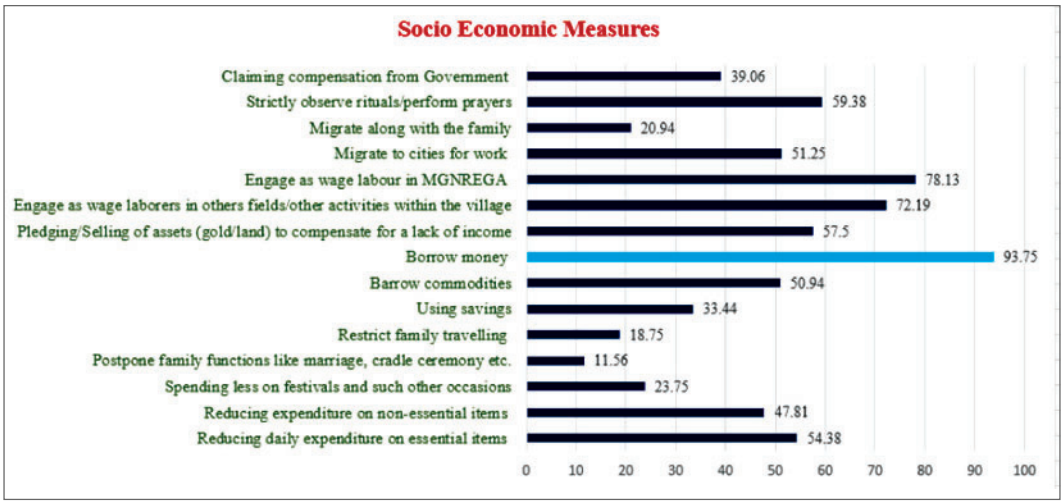

Table 2. Determining factors of farmers' adaptive measures for climate change

Variables	Soil and water conservation		Variables	Crop cultivation	
	Coefficient	Marginal effects		Coefficient	Marginal effects
Age	-1.56(2.34)	- 0.12	Education	0.14(1.81)	0.41
Education	1.23(2.01)	0.65	Rainfed/Irrigated condition	-1.71(3.01)	-0.021
Rainfed/Irrigated condition	-0.40(1.56)	- 0.34	Number of crops Cultivated	2.63(1.92)	1.04
Number of crops Cultivated	2.50(2.89)	0.61	Annual income	0.76(2.11)	0.26
Material Possession	0.57(2.64)	0.11	Livestock possession	3.03(1.27)	0.07
Use of New Technology	3.90(1.53)	1.02	Use of New Technology	0.04(2.85)	0.072
Extension contact	0.99(3.10)	0.034	Farmers commitment	1.51(2.67)	0.02
Farmers commitment	1.36(1.92)	0.31			
Prob > chi^2 0.0000			Prob > chi^2 0.0000		
Log likelihood - 359.62			Log likelihood -409.729		

Figures in parenthesis are Standard Error. Variables which are presented in table are significant at 5% level.

Table 3. Determining factors of farmers' adaptive measures for climate change

Variables	Livestock management		Variables	Socio-economic	
	Coefficient	Marginal effects		Coefficient	Marginal effects
Age	-2.02(1.60)	-0.305	Age	1.03(1.80)	1.23
Livestock possession	0.33(2.91)	0.20	Family Size	1.12(2.63)	0.96
Farmers Orientation	1.07(1.83)	1.90	Annual income	-1.35(2.34)	-0.41
Use of New Technology	0.04(1.84)	0.22	Use of New Technology	-0.32(1.68)	- 0.05
Extension participation	1.49(2.17)	1.26	Extension contact	2.12(2.13)	1.02
Trainings attended	1.10(3.11)	0.41	Trainings attended	-1.31(2.37)	-0.69
			Farmers commitment	-3.57(2.79)	-2.10
Prob > chi^2 0.0000			Prob > chi^2 0.0000		
Log likelihood -295. 93			Log likelihood -349.62		

Figures in parenthesis are Standard Error. Variables which are presented in table are significant at 5% level.

farmers' orientation, use of new technology, extension participation and trainings attended increased the probability of adopting livestock management practices by a factor of 0.2, 1.9, 0.22, 1.26 and 0.41 respectively. Age decreased the probability of adopting livestock management practices by a factor 0.305. Lastly socio-economic adaptive measures (Table 3) were determined by factors like age, family, size annual income use of new technology extension contact trainings attended farmer's commitment. Marginal effects indicate that age, family size and extension contact increased the probability of adopting by a factor of 1.23, 0.96 and 1.02 respectively. Annual income, use of new technology, trainings attended and farmers' commitment decreased the probability of adopting socio-economic management by a factor 0.41, 0.05, 0.69 and 2.10 respectively. Deressa et al., (2009); Deepthi et al., (2015); Ghanghas et al., (2015); Vanschoenwinkel & Passel (2018); Ntshangase et al., (2018) reported relationship of independent variables with adaption strategies.

CONCLUSION

This study revealed that farmers in the study area are aware of some climate change adoption practices. They have followed unique techniques encompass soil and water conservation practices,

socio economic measures and crop cultivation. There are few barriers which challenges the farmers to cope with the climate change. To increase the effectiveness in adoption of more practices by farmers, educate the farmers on impact of climate change, with respect to improve their farm income with mitigation of adverse effect of climate change (Fadina & Barjolle, 2018.). As the extension contact and participation was determining factors for adoption, through that contact informing about the risks they are exposed to climate change, knowledge on level of vulnerability, the adaptation practices, the existing capacity to adapt and the perceived barriers to adaptation may improve the situation.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (86-90)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Analysis of Marketing Facilities available for Tomato Growers of Haryana

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ARTICLE INFO

Keywords: Marketing facilities, Post-harvest losses, Tomato growers, Communication and factor analysis

http://doi.org/10.48165/IJEE.2022.58217

ABSTRACT

Market plays crucial role in the economic life of farmers, and essential in the chain of commodity distribution. Postharvest losses in tomato are a matter of concern for all tomato growers, therefore a need for farmers to sell their produce instantly after harvesting is felt. Provision of better marketing facilities would assist in better handling of the produce and reduce storage losses, thereby offering higher and remunerative prices to the growers. The present study was conducted during 2020-21 in four districts of Haryana, namely Nuh, Sonipat, Gurugram and Palwal. The investigation was focused on the marketing facilities available for the farmers, their knowledge and adoption level regarding post-harvest management practices. A total sample of 160 respondents were selected and personally interviewed. The results indicated that farmers had medium degree of mass media exposure, extension contact and extension participation. To test the adequacy of sample, factor analysis using KMO and Bartlett's test of sphericity was applied and yielded 10 factors and explaining a total of 69.58 per cent of the variance for the entire set of marketing facilities.

INTRODUCTION

The vegetable sector plays a vital role in farm income enhancement and alleviation of poverty in many developing countries. Food and agricultural sector in developing countries are being transformed as the relative importance of grains and staple foods declines and high-value agriculture, including vegetables, increases (Birthal et al., 2005; Gulati et al., 2007). A high demand for fresh vegetables created by the consumers, but major challenge in meeting this demand for fresh vegetables is postharvest losses which account about 30.00 per cent in India (FAO 2018). Tomato (*Lycopersicon esculentum* Mill.) is a vegetable crop popularly consumed all over the world. The global tomato processing in the year 2020 was approximately 38.777 million MT whereas, India accounts for 130 million tons of tomato processing. In India the total production of tomato is 205.72 lakh tonnes from 796.87 thousand hectares area (FAOSTAT, 2019-20), which is 08.00 per cent higher than the normal production as well as last year production. Postharvest losses in tomato are a matter of concern and their management plays key role in loss reduction, value addition, food security, employment and income generation. Whereas, availability of better marketing facilities aids in stimulating production and consumption of produce as it acts as critical link between farm production and non-farm sectors. Adoption of scientific practices in agri-horti system is dependent on knowledge of the farmers (Nain and Chandel, 2013) and as information sources the credibility is placed on localized sources (Bhagat et al., 2004: Ravikumar et al., 2015). Lack of efficient marketing system, more distance to the markets, manipulation of weighing machines, lack of proper grading and proliferation of middlemen who charge enormous commissions forced farmers to sell their produced at unregulated markets therefore, there is urgent need of competitive market system with adequate infrastructure facilities.

Development and establishment of new market complexes with modern amenities will influence the market structure and pricing mechanism by increasing the efficiency of markets. Thus,

Received 26-01-2022; Accepted 09-02-2022

an efficient regulated marketing system will attract greater market arrivals and offer remunerative prices to the growers. The present investigation makes an attempt to understand the role of marketing facilities in attracting the farmers to sell their produce at the right place and at the right time so as to reduce their postharvest losses.

METHODOLOGY

The present investigation was conducted purposively in four districts namely; Gurugram, Nuh, Palwal and Sonipat of Haryana state, as these districts are contributing highest production of tomato in the state. Primary data on tomato growers was collected by applying purposive and systematic random sampling procedures for the selection of districts and respondents. Further, two blocks were selected, randomly from each of four districts and from each of eight blocks, two villages were chosen, randomly and thereby a total number of sixteen villages were selected for the data collection. Finally, ten farmers were selected randomly from each village, thus making a total sample of 160 tomato growers. The data was collected with the help of a well-structured and pretested interview schedule comprising the items for assessment of the marketing facilities available with the farmers. The marketing facilities and communication profile were computed with the statistical measures like frequency, percentages, weighted mean score, rank order and factor analysis used to analyze the data to draw the tangible and meaningful inferences from the study.

RESULTS AND DISCUSSION

The results along with the relevant discussion have been presented in prime heads as communication profile and marketing facilities available with the tomato farmers so that they could reduce their post-harvest losses.

Communication profile of the respondents

Data presented in Table 1 reveals that majority (48.12%) of the tomato growers had medium degree of mass media exposure. Similar results were reported by Nagesha (2012) where majority of vegetable farmers had medium mass media exposure. Data further revealed that 49.80 per cent of the farmers had medium degree of extension contact. The probable reason might be that, the farmers had maintained good contact with the extension functionaries to get solutions of their problems. Similar results were obtained by Sindhu (2021) in adoption behavior of post-harvest practices by the farmers and found that majority of farmers were under medium category of extension contact followed by high. 43.75 per cent of the farmers had medium degree of cosmopoliteness. Factually such farmers are obliged to engage in marketing and acquire the necessary skills in addition to obtaining the necessary agricultural inputs. Thus, farmers had more contacts with the people outside and within the village leading to higher cosmopolite behaviour. Similar trend of results was reported by Singh et al., (2014).

Table 1. Communication profile of the respondents

S.No.	Categories	Percentage
1.	*Mass Media Exposure*	
a	Low (Less than 13)	22.50
b	Medium (13-17)	48.12
c	High (more than 17)	29.38
2.	*Extension Contact*	
a	Low (Less than 18)	22.50
b	Medium (19-23)	49.38
c	High (more than 23)	28.12
3.	*Cosmopoliteness*	
a	Low (Less than 9)	24.38
b	Medium (9-12)	43.75
c	High (more than 12	31.87

Marketing facilities available with the respondents

The data depicted in Table 2 indicates that regarding place of selling, cent per cent of the respondents were selling in the village markets itself indicated with weighted mean score 2.00 and ranked 1st followed by, selling in nearby markets (weighted mean 1.72), and in distant markets (weighted mean 1.62) respectively. Further, with regards to reasons for selling at a particular place, cent per cent of the farmers selling their produce at market which is very near to their place indicated with weighted mean score 2.00, followed by reasons as the better transport facilities available for that place (weighted mean 1.72), better marketing facilities available in the market (weighted mean 1.41) and the better prices are available in that market (weighted mean 1.35), respectively. Regarding reasons for selling at a particular period/time it is observed from that the tomato growers' were found selling their produce as there were no cold storage facilities and tomato is highly perishable indicated with weighted mean score 2.00, followed by indebtedness to traders (weighted mean 1.00). From Table 2 it can also be observed that regarding persons to whom produce is sold, majority of the farmers sold their produce to the wholesaler (weighted mean 1.91), followed by selling directly to the consumers (weighted mean 1.53), to village level baniyas/middlemen (weighted mean 1.38) and none of the selling their produce at government agencies/exporters directly.

The data from Table 2 implied that with regard to opinion of farmers about existing marketing facilities it can be observed that majority (weighted mean 1.74) of the respondents thought that market is insufficient, followed by quite sufficient (weighted mean 1.72) and sufficient (weighted mean 1.00), respectively. Further, regarding opinion of growers about prevailing market prices it can be observed that majority of them had low (weighted mean 2.00) perception about prevailing market prices ranked first, followed by medium (weighted mean 1.66) and high (weighted mean 1.00) perception regarding market prices indicated with 2nd and 3rd ranks, respectively. Therefore, it can be concluded that the farmers with more market orientation were more prone towards the markets and market prices, in order to get maximum returns they tend to get more knowledge and adopt more. The findings of the study were in agreement with the results obtained by Ramrao (2018) & Shriwas et al., (2015) revealed that majority of the respondents had medium marketing facilities, followed by low and high market facilities, respectively.

Factor analysis: Suitability of the data

It is evident from the Table 3 that two tests were applied to test the adequacy of data for factor analysis. The KMO measure

Table 2. Distribution of the respondents according to their availability of marketing facilities

S.No.	Statements	Frequency		WMS
		Yes (2)	No (1)	
1.	*Place of selling*			
a	In the village itself	160 (100.00)	00 (00.00)	2.00
b	Nearby market	115 (71.87)	45 (28.13)	1.72
c	Distant market	98 (61.25)	62 (38.75)	1.62
2.	*Reasons for selling at a particular place*			
a	Market is very near to place	160 (100.00)	00 (00.00)	2.00
b	The better transport facilities available for that place	115 (71.87)	45 (28.13)	1.72
c	The better market facilities available in that market	66 (41.30)	94 (58.70)	1.41
d	The better prices are available in that market	56 (35.00)	104 (65.00)	1.35
3.	*Reasons for selling at a particular period/ time*			
a	Highly perishable	160 (100.00)	00 (00.00)	2.00
b	Quality was not good	23 (14.37)	137 (85.63)	1.14
c	No cold storage facilities available	160 (100.00)	00 (00.00)	2.00
e	Indebtedness to trader	00 (00.00)	160 (100.00)	1.00
4.	*Persons to whom sold*			
a	Directly to the consumers	79 (49.40)	81 (50.60)	1.53
b	To village level Trader/ Baniya/middlemen	60 (37.50)	100 (62.50)	1.38
c	To the wholesaler/ exporters through commission agents	145 (90.6)	15 (09.40)	1.91
d	To the Govt. agencies/exporters directly	00 (00.00)	160 (100.00)	1.00
5.	*Opinion about existing market facilities*			
a	Insufficient	119 (74.40)	41 (25.60)	1.74
b	sufficient	00 (00.00)	160 (100.00)	1.00
c	quite sufficient	115 (71.90)	45 (28.10)	1.72
6.	*Perception about prevailing market prices*			
a	High	00 (00.00)	160 (100.00)	1.00
b	Medium	105 (65.60)	55 (34.4)	1.66
c	Low	160 (100.00)	00 (00.00)	2.00

Table 3. KMO and Bartlett's Test of Sphericity to test the suitability of the sample

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.641
Bartlett's Test of Sphericity	Approx. Chi-Square	1825.36
	d.f.	666
	Sig.	.000

of sampling indicates that if KMO value is >0.50 which is acceptable that means the sample is suitable for factor analysis. The KMO measure of sampling adequacy was 0.641 thus, confirming the appropriateness of the factor analysis. Whereas, Bartlett's test of Sphericity indicates whether a given correlation matrix is an identity matrix which would indicate the distinct variables. The table indicates that Bartlett's test of Sphericity is significant at the level of p=0.01 indicated that variables are highly correlated.

Normal varimax solution for identified factor of marketing facilities available for the tomato growers

Data presented in Table 4 &5 indicates that factors with eigenvalues greater than one considered being significant and other factors were ignored. Fourth-one items related to marketing facilities available with the tomato growers were factor analysed by using principal component analysis with varimax rotation. The factor analysis yielded ten factors with eigenvalue >1 and together these factors explaining a total of 69.58 per cent of the variance for the entire set of variables. Table shows the rotated component matrix and reports the factor loadings for each variable on the components or factors after rotation. Each number represents the partial correlation between the items and the rotated factors. Factor 1 was labeled as "Reasons for selling at a particular place" due to the high loadings by the items, viz, to village level Trader/Baniya/ middlemen, to the wholesaler through commission agents, previous agreement/ contract farming, directly to the consumers, transportation through tempo / Jeep, the better prices are available in that market, the better transport facilities available for that place and the better market facilities available in that market. The variance explained by this factor was 15.14 per cent. Factor 2 was labeled as "Opinion about prevailing market" three items had high loadings, viz, sufficient market facilities, high prevailing prices and medium prevailing prices. The variance explained by this factor was 22.36 per cent. The Factor 3 derived was labeled as "Reasons for selling at a particular time" two items had high loadings, viz, immediate cash payment and better price for produce. The variance explained by this factor was 28.91 per cent. Factor 4 derived was labeled as "Opinion about prevailing market facilities" due to the high loadings of items, viz, quite sufficient market facilities, trucks available for marketing and insufficient market facilities. The total variance explained by this factor was 38.42 per cent. The Factor 5 was labeled as "time of selling" three items had high loadings, viz, the agency is very nearer one, To the Govt. agencies/exporters directly and distant markets. The variance explained by this factor was 47.13 per cent. The Table 5 displayed factor 6 which was labeled as "Opinion about existing market situation" due to the high loading

Table 4. Normal Varimax solution for identified factor of marketing facilities for the tomato growers

Items	Factors				
	F1	F2	F3	F4	F5
To village level Trader/Baniya/ middlemen	0.781				
To the wholesaler through commission agents	0.775				
Previous agreement/contract farming	0.672				
Directly to the consumers	0.632				
Transportation through tempo / Jeep	0.571				
The better prices are available in that market	0.563				
The better transport facilities available	0.501				
The better market facilities available	0.412				
Sufficient market facilities		0.783			
High prevailing prices		0.771			
Medium prevailing prices		0.474			
Immediate cash payment			0.837		
Better price for produce			0.750		
Quite sufficient market facilities				0.733	
Trucks available for marketing				0.711	
Insufficient market facilities				0.633	
The market is very nearer one					0.716
To the Govt. agencies/exporters directly					0.535
Distant markets					0.769
Eigenvalues	5.605	2.671	2.423	1.725	1.583
Variance (%)	15.148	7.219	6.550	4.662	4.278
Cumulative (%)	15.148	22.367	28.917	38.423	47.139

Extraction Method: Principal Component Analysis, Rotation Method: Varimax

Table 5. Normal Varimax solution for identified factor of marketing facilities available for the tomato growers

Items	Factors				
	F6	F7	F8	F9	F10
Low prevailing prices	0.777				
Availability of consumers	0.634				
When it is convenient	0.548				
Polythene bags used for packaging		0.730			
Plastic crates used for packaging		0.456			
Proper handling while packaging		0.725			
When prices are attractive		0.577			
Highly perishable commodity			0.783		
Quality was not good			0.530		
Selling at nearby market				0.691	
Non-availability of cold storage facilities in market				0.686	
Market is very near to place				0.784	
In the village itself					0.781
Immediately after the harvest					0.562
The agency is very nearer one					0.784
Eigenvalues	1.464	1.341	1.219	1.167	1.003
Variance (%)	3.957	3.625	3.293	3.153	2.711
Cumulative (%)	51.096	54.721	58.016	61.170	69.582

Extraction Method: Principal Component Analysis, Rotation Method: Varimax

of items, viz, low prevailing prices, the agency is very nearer one and when it is convenient. The total variance explained by this factor was 51.09 per cent. With regard to factor 7 was labeled as “Mode of packaging” due to the high loading of items, viz, polythene bags, plastic crates, proper handling while packaging and highly perishable. The total variance explained by the factor was 54.72 per cent. The factor 8 was labeled as “Non-availability of storage facilities at market place” due to high loadings of items, viz, highly perishable commodity and quality was not good. The total variance explained by this factor was 58.01 per cent. The factor 9 was labeled as “Suitable market for selling the produce” due to the high loadings of the items, viz., selling at nearby market, no cold storage facilities available in the market and market is very near to place. The total variance explained by this actor was 61.17 per cent. The last Factor 10 extracted was labeled as “Place of selling” due to the high loadings of items, viz, in the village itself, immediately after the harvest and the market is very nearer one. The total variance explained by this factor was 69.58 per cent. These all the factors were independent on one another (i.e. they are not correlated).

CONCLUSION

From the above cited results it can be concluded that if farmers will get need based trainings and equipped with knowledge regarding better marketing facilities and will be provided well developed infrastructure at market places results in positive impact on their livelihood and will enhanced their income. The study investigated ten major factors regarding marketing facilities viz., "Reasons for selling at a particular place", "Opinion about prevailing market", "Reasons for selling at a particular time", "Opinion about prevailing market facilities", "time of selling", "Opinion about existing market situation", "Mode of packaging", "Non-availability of storage facilities at market place", "Suitable market for selling the produce" and "place of selling". All these ten factors together were explained the total variance of 69.54 per cent. Thus, to provide trainings regarding marketing system government organizations like SAUs, Extension education institutes and ICAR institutes should impart training from time to time to educate and make farmers aware marketing strategies and prevailing market prices so as to overcome the ill effects or post harvest losses.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (91-96)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Factors Contributing to the Stability of the Farmer Producer Organisations: A Study in West Bengal

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ARTICLE INFO

Keywords: Farmer producer organizations, Stability, Factors, West Bengal, Indicators

http://doi.org/10.48165/IJEE.2022.58218

ABSTRACT

The study was conducted to assess the stability of Farmer Producer Organizations (FPOs) and the factors contributing to the stability of FPOs in West Bengal during 2020. Using random sampling procedure, data were collected from 120 farmer members from ten FPOs from four districts of the state namely *Birbhum*, *Murshidabad*, *Purba Bardhaman* and *Nadia* through personal interview method. For measuring the stability of FPOs, stability index was developed taking mutual trust, role clarity of the members, level of involvement of members in group works, satisfaction of the members, sense of attachment and conviction and sense of ownership as the indicators. The significant difference between the mean scores of stability index of high and low performing FPOs were observed with respect to the dimensions like satisfaction of the members, mutual trust, role clarity and sense of attachment and conviction. Attitude of members towards their FPO and cooperation were found to be significant contributor in developing better group stability within a high performing FPO. Attitude towards FPO, assimilation and competition were found to be the reliable predictors for the variance in group stability in low performing FPOs.

INTRODUCTION

In India, small and marginal farmers own 86.21 per cent of the country's total land holdings (Agriculture census, 2015-16). These small farmers lack the requisite volume (both inputs and outputs) to profit from economies of scale. Furthermore, there is a long chain of intermediaries in agricultural marketing that frequently work in a non-transparent manner, resulting in a situation where the producer receives only a small portion of the value that the ultimate customer pays (Nikam et al., 2019). However, the transactional costs of the farm produce especially the fruits like mango can be reduced through farmers' federations (Partiban et al., 2015). In this background, Farmer Producer Organizations (FPOs) can be an important platform for transforming smallholder farming, increasing agricultural productivity and farmers' income (Mukherjee et al., 2018; Singh et al., 2018). In the Union Budget 2019-20, Government has approved the formation of 10,000 new Farmer Producer Organizations (FPOs) over the next five years to ensure economies of scale for farmers, for which a dedicated and comprehensive central sector scheme titled "Formation and Promotion of Farmer Producer Organizations (FPOs)" was proposed for development and sustainability of FPOs. For this purpose, the government has set aside a total budgetary allocation of Rs. 4496.00 crore for five years (2019-20 to 2023-24). Department of Agriculture and Farmers Welfare will assign clusters or states to Implementing Agencies, which will then construct Cluster Based Business Organizations in the States. Implementing agencies will create and promote FPOs through Cluster Based Business Organizations (CBBOs) engaged at the State or Cluster level (Press Information Bureau, February 09, 2021).

Received 29-01-2022; Accepted 09-02-2022

Social groups often show a high degree of dynamism (Lewin, 1936; Cartwright and Zander, 1968). Some groups thrive, while many others die over time. For a group to endure, members must remain together for a long period (Forsyth, 1999). A group's cohesiveness or integration is what gives it stability (Toseland & Rivas, 2009). These two are those forces that act on members of a group to make them remain in the group (Wageman, 2001). Inspite of the increasing emphasis on FPO at the central and state level, it was found that formation and growth of FPOs across the country has not been uniform (Manaswi et al., 2018). There are not many examples of FPOs and cooperatives being viable (Phansalkar & Paranjape, 2021). This is the current fact that has been worrying for FPO promoters who had put in to kick start these FPOs. Somehow the initial enthusiasm and energy got dried midstream making FPOs limp slowly, sink in dying. Although success has been tasted by many FPOs, it is the stability of these FPOs that the development professionals, thinkers and planners are currently concerned. This study has attempted to explore the factors contributing to the stability of FPOs to move further upwards for realising the long-cherished dreams of garnering major share of consumer rupee by small and marginal farmers.

METHODOLOGY

The state of West Bengal was selected purposively for the study. Ten farmer producer organizations, which were Farmer Producer Company (FPCs) under the section 581(C) of Indian Companies Act, 1956 as amended in 2013, were selected for the study. These FPCs were functioning for more than five years from the four districts namely Birbhum, Murshidabad, Purba Bardhaman and Nadia. Among these ten FPOs, five were high performing FPOs and five were low performing FPOs as graded by officials. From each farmer producer organizations 2 office bearers and 10 general members were selected randomly. Thus, the total sample size of the study was 120. A detailed interview schedule containing appropriate questions for obtaining the required data was prepared. The data were collected through personal interview method.

Stability of the group or FPO was operationally defined as the relative degree of consistent growth of FPOs in terms of financial and human resources over a period of time. For the study mutual trust, role clarity of the members, level of involvement of members in group works, satisfaction of the members, sense of attachment and conviction and sense of ownership were selected as the indicators for analyzing the stability of farmer producer organization. Stability Index for any individual in a Farmer Producer Organizations was calculated by dividing the total obtained scores on all indicators of stability of the group with the maximum possible scores on all indicators of stability and multiplying it by 100.

$$\text{Stability index} = \frac{\text{Total obtained scores on all indicators of stability of FPO}}{\text{Maximum possible scores on all indicators of stability}} \times 100$$

Appropriate variables for the present study were identified based on the objective of the study and review of literature. The following independent variables i.e. Socio-personal variables (Age, Educational status, Family size, Farming experience), Socio-economic variables (Occupational status, Total land size, Annual income), Socio-psychological Variables (Attitude towards FPO, Attitude towards group), Social process variables (Social interactions with people, Cooperation, Competition, Conflict, Accommodation, Assimilation) and Communication Variables (Extension personnel and cosmopolite channels contact, Mass media exposure, Personal localite channels contact) were selected. Simple correlation analysis was used to know the relationship between the independent variables and dependent variable i.e. stability of the farmer producer organisation. Multiple Linear Regression Analysis was done to find out the relative contribution of each of the significant independent variables as well as their combined effect on the dependent variable.

RESULTS AND DISCUSSION

Components of stability index and its computation

It can be seen from Table 1 that, among the six components of group stability, all the farmers of both samples appeared to be similar on two components of stability: level of involvement of members in group works and on sense of ownership of their FPOs. This can be explained that all farmers routinely participate and get involved in group works and experience moderate levels of sense of ownership among themselves. But, the farmer respondents of high performing FPOs have shown greater degrees of mutual trust, role clarity, sense of attachment and conviction and highly satisfied with the functioning of their FPOs, thereby providing positive forces of group stability to their FPOs, in comparison to the farmer respondents of low performing FPOs. The farmers of low performing FPOs suffered from lack of mutual trust, lack of role clarity, lack of sense of attachment and conviction in the functioning of their FPOs, and hence were not so much satisfied with their FPOs, which were affecting their group stability.

Further from Table 2, it can be seen that, the two samples of farmers were significantly different on their *group stability index* as evidenced from the t value being statistically significant at 0.01 level of probability. While farmers of high performing FPOs enjoyed very good *group stability* in their group, the farmers of low

Table 1. Distribution of respondents of FPOs based on different dimensions of group stability

	High Performing FPOs (n=60)	Low Performing FPOs (n=60)
Mutual trust		
Mean	10.06	7.18
t value	7.447**	
Role clarity		
Mean	19.63	13.68
t value	7.871**	
Involvement of members in group works		
Mean	12.61	12.25
t value	0.828^{NS}	
Satisfaction of the members		
Mean	18.93	17.83
t value	3.156**	
Sense of attachment and conviction		
Mean	20.50	15.00
t value	5.745**	
Sense of ownership		
Mean	17.86	17.83
t value	0.107^{NS}	

Table 2. Distribution of respondents of FPOs based on Group Stability Index Score

Stability Index Score	High Performing FPOs (n=60)		Low Performing FPOs (n=60)	
Mean	77.28		64.98	
Standard Deviation	5.74		9.50	
Range (Min - Max)	68.22 – 89.15		50.39 – 87.60	
t value	8.576**			
Frequency distribution				
Category	Frequency	Percentage	Frequency	Percentage
Low (< 61.17)	0	0.0	26	43.3
Medium (61.17 – 81.10)	45	75.0	28	46.7
High (> 81.10)	15	25.0	6	10.0
Total	60	100	60	100

performing FPOs felt not being stable in their group. So, group stability has indeed, played a significant role in the efficient functioning of the FPOs.

Identification of associated factors of group stability

The relationship of socio-personal, socio-economic, socio-psychological, social process and communication characteristics with Group Stability Index was established by simple correlation analysis and multiple regression analysis. First, the results of high performing FPOs were presented and later the results of low performing FPOs.

The results in Table 3 present the relationship between group stability index and the socio-personal, socio-economic, socio-psychological, social process and communication characteristics of members in high and low performing FPOs. It says that variables such as education, annual income, attitude towards FPO, attitude towards group, cooperation, accommodation, assimilation, extension personnel and cosmopolite channel contact, personal localite channel contact had positive association with group stability index of members in high performing FPOs and is significant at 0.01 per cent level of probability. Competition and conflict were negatively associated with group stability index of members in high performing FPOs and are significant at 0.01 per cent level of probability. Variables such as occupation and social interaction with people also had positive association with group dynamics effectiveness index of members in high performing FPOs, however they are significant at 0.05 per cent level of probability. Whereas, variables such as age, family size, farming experience, land holding and mass media exposure had no significant association with group stability index of members in high performing FPOs.

Table 3. Simple correlation analysis of Group Stability Index with characteristics of members in high and low performing FPOs

S.No.	Characteristics	Correlation coefficient (High performing FPOs)	Correlation coefficient (Low performing FPOs)
1.	Age	0.085	-0.068
2.	Education	0.346**	0.184
3.	Occupation	0.081*	-0.075
4.	Family size	0.037	-0.296*
5.	Farming experience	-0.142	-0.011
6.	Land holding	0.087	0.302*
7.	Annual income	0.465**	0.358**
8.	Attitude towards FPO	0.775**	0.483**
9.	Attitude towards group	0.683**	0.653**
10.	Social interactions with people	0.324*	0.382**
11.	Cooperation	0.645**	0.349**
12.	Competition	- 0.505**	-0.472**
13.	Conflict	- 0.451**	-0.266*
14.	Accommodation	0.445**	0.089
15.	Assimilation	0.357**	0.354**
16.	Mass media exposure	0.024	0.259*
17.	Extension personnel and cosmopolite channel contact	0.387**	0.524**
18.	Personal localite channel contact	0.416**	0.303*

Further it was also found from the Table 3 that annual income, attitude towards FPO, attitude towards group and social interaction with people, cooperation, assimilation extension personnel and cosmopolite channel contact had positive association with group stability index of members in low performing FPOs and are significant at 0.01 level of probability. Variables such as land holding, mass media exposure and personal localite channel contact also had positive association with group stability index of members in low performing FPOs, however they are significant at 0.05 level of probability. The results were in conformity with Trebbin & Hassler (2012), Venkattakumar et al., (2019) & Amitha et al., (2021). Variable such as family size, competition and conflict had negative association with group stability index of members in low performing FPOs. Variables such as age, education, occupation, farming experience and accommodation were not at associated with group stability index among respondents of low performing FPOs.

Multiple linear regression analysis

The method of multiple linear regression was used for predicting the relative contribution of independent variables to the dependent variable, group stability. For this a regression equation was fitted keeping group stability index scores as dependent variable with eighteen independent variables. The results of multiple regression analysis for high performing FPOs are presented in Table 4. The results showed that about 73.9 per cent of variance in dependent variable group dynamics effectiveness index of respondents of high performing FPOs could be explained by the variables included in the regression equation as can be seen from R^2 being 0.739, which is significant at 0.01 level of probability. F test value at 18, 41 degrees of freedom was statistically significant at 0.01 level of probability.

Among all the independent variables, only two variables were found to be significant, i.e., attitude towards FPO and cooperation which were significant at 0.01 level of probability. Indeed, these two variables were the most significant in running and managing the FPO, especially among respondents of high performing FPOs. In these high performing FPOs, farmers have seen and personally experienced success and various other benefits from FPO's activities. Since most of them were marginal and small farmers, they had accrued great benefits from the way the FPO is being run on democratic lines. This feeling of success had imbibed in them a positive attitude towards FPO, which indeed, played a pivotal role

Table 4. Multiple linear regression analysis with Group Stability Index in high performing FPOs

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	P value
	B	Std. Error	Beta		
(Constant)	52.824	18.443		2.864	.007
Age	-.058	.055	-.103	-1.061	.295
Education	.084	.245	.040	.345	.732
Occupation	-.303	1.861	-.019	-.163	.872
Family Size	-.263	.563	-.045	-.467	.643
Farming Experience	-.047	.091	-.046	-.514	.610
Land Holding	-.067	.181	-.039	-.370	.713
Annual Income	3.375E-5	.000	.116	1.118	.270
Attitude Towards FPO	.256	.058	.636	4.429**	.000
Attitude Towards Group	.118	.107	.184	1.103	.276
Social Interaction with People	-.042	.343	-.017	-.123	.903
Cooperation	.371	.137	.309	2.711**	.010
competition	.154	.219	.140	.704	.485
Conflict	.106	.140	.101	.758	.452
Accommodation	.160	.259	.105	.618	.540
Assimilation	.087	.178	.053	.490	.627
Mass Media Exposure	.104	.183	.050	.566	.574
Extension Personnel and Cosmopolite Channel Contact	-.452	.484	-.208	-.936	.355
Personal Localite Channel Contact	-.017	.853	-.005	-.020	.984

R^2=0.739; F= 6.456, df 18, 41; **significant at 0.01 level

Table 5. Multiple linear regression analysis with Group Stability Index in low performing FPOs

Independent Variables	Unstandardized Coefficients		Standardized Coefficients	t	P value
	B	Std. Error	Beta		
(Constant)	81.003	19.743		4.103	.000
Age	-.203	.214	-.114	-.949	.348
Education	.093	.542	.021	.171	.865
Occupation	-3.562	3.186	-.134	-1.118	.270
Family Size	-1.022	1.087	-.096	-.940	.353
Farming Experience	.000	.228	.000	-.002	.999
Land Holding	-.156	.387	-.045	-.403	.689
Annual Income	.000	.000	.195	1.361	.181
Attitude Towards FPO	.215	.073	.318	2.945**	.005
Attitude Towards Group	.234	.173	.171	1.354	.183
Social Interaction with People	-.085	.593	-.017	-.144	.886
Cooperation	.302	.170	.192	1.778	.083
Competition	-.817	.296	-.290	-2.763**	.009
Conflict	-.007	.253	-.003	-.028	.978
Accommodation	-.151	.182	-.091	-.828	.412
Assimilation	.413	.201	.264	2.057*	.046
Mass Media Exposure	.336	.347	.103	.968	.339
Extension Personnel and Cosmopolite Channel Contact	.021	.357	.009	.058	.954
Personal Localite Channel	.312	.812	.043	.385	.702

R^2=0.700; F= 5.305, at 18, 41 degrees of freedom; *significant at 0.05 level of probability; **significant at 0.01 level of probability

in persuading all members for strengthening and stabilizing the FPO for longer endurance. This positive attitude had also persuaded all members to cooperate and collaborate in efficient functioning of FPO. In fact, organising farmers for aggregating the produce from marginal and small farmers is in itself an activity of seeking cooperation from all members. When all members had themselves seen the benefits of coming together and working for common interest of all, the spirit of cooperation had already set in. Thus, cooperation had come out a reliable predictor for group stability of FPOs. Hence, attitude towards FPO and cooperation were found to be reliable predictors for the variance in group stability among high performing FPOs. The findings of the study were in agreement with Patkar et al., (2012) and Ragasa & Golan (2012). The results of multiple regression analysis for the low performing FPOs are presented in Table 5. The results showed that about 70 per cent of variance in dependent variable of group stability index of respondents of low performing FPOs could be explained by the variables included in the regression equation as can be seen from R^2 being 0.700, as F test value at 18, 41 degrees of freedom was statistically significant at 0.01 level of probability.

Only three variables were found to be significant, i.e., attitude towards FPO, and competition, which were significant at 0.01 level

of probability and assimilation which was significant at 0.05 level of probability. Indeed, attitude towards FPO and assimilation were the two variables most significant in proving positive forces in running and managing the FPO, especially among respondents of low performing FPOs. Members' activities of assimilation, i.e., reducing conflicts and encouraging cooperation among members was found to enhance and strengthen the group stability of their FPOs. But another social process variable, competition was found to be negatively contributing to the group stability among farmers of low performing FPOs. Members' activities of competing with one another has been providing negative forces adversely impacting the endurance and long life of the low performing FPOs.

Thus, attitude of members towards their FPO, assimilation and competition would thus, become reliable predictors for the variance of group stability of their FPOs. The results were in conformity with Ragasa & Golan (2012) & Amitha et al., (2021). Badatya et al., (2018) in their study in Maharashtra reported that the awareness level of the members about activities of the FPO was found to be extremely low, which in turn affecting their stability. Singh et al., (2018) stated that lack of trust among member farmers acts as serious impediment to the stability of FPOs in Punjab, whereas Kumar et al., (2021) reported that effective market linkage and suitable business plan for the company is important to make the FPOs sustainable and viable.

CONCLUSION

The important factors of group stability *i.e.*, attitude towards FPO, cooperation, assimilation should be given due importance. All these factors had in fact generated better and positive forces of group stability within the FPOs and so these key aspects have to be deliberately educated and promoted among members of FPO. Awareness of the members' duties and responsibilities, *i.e.,* what they need to do and what is expected from them was found to be very important to maintain the stability of FPOs. Moreover, there should be high sense of attachment and conviction among the members about their FPO. For this purpose, the activities of FPOs should be practical, need-based and economical. After the group formation, undertaking some group activities like field visit, group discussion and group training, *etc.*, and developing sense of higher cooperation and assimilation can enhance group stability. They should not compete each other, but cooperate and collaborate in group works and in production activities as per market demand. Also potentially damaging conflicts should be resolved. Social processes occurring in FPOs need to be properly monitored and guided through cooperation, assimilation and accommodation activities so that adverse social processes such as competition and conflicts could not harm the stability of FPOs.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (97-103)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Terms of Trade for Selected Crops in Rajasthan: Insights on Farmers' Complex Crop Choice Behaviour

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ARTICLE INFO

Keywords: Comparative advantage, Farming system, Farm harvest price, Minimum support price, Opportunity cost, Parity index, Procurement price

http://doi.org/10.48165/IJEE.2022.58219

ABSTRACT

This study estimated the Terms of Trade (TOT) between the input and output prices for pearl millet, wheat, paddy and gram crops cultivated in Jaipur, Sri Ganganagar, Hanumangarh and Ajmer districts respectively in Rajasthan state for the period 1996-97 to 2018-19. It was found that the Compounded Annual Growth Rate (CAGR) of Procurement Price Index (PPI) and Farm Harvest Price Index (FHPI) have increased consistently for all crops with a CAGR ranging from 5-8 per cent p.a. The CAGR of Composite Input Price Index (CIPI) was always higher (ranging from 6-8% p.a.) than the PPI and FHPI indicating that the input prices have increased at a much higher rate than the output prices during the study period. Analysis revealed that TOT (ratio of PPI to CIPI and ratio of FHPI to CIPI) for all crops for most of the years was unfavourable (<100) as evident from negative CAGR (ranging from -0.15 to -2.40% p.a.). The selection of the base year in which output prices are around 150% (i.e. 1.5 times the cost of cultivation) of the composite input prices for estimating TOT is recommended. The study further explored as to why farmers cultivated these crops despite declining and negative TOT.

INTRODUCTION

Agriculture not only supported livelihoods but also influenced the culture and traditions in rural India. However, lot of changes have occurred in Indian agriculture since independence on account of governments' regulation and policies and adoption of improved technologies. The important change has been the shift from farming system centric agriculture to crop/ commodity centric agriculture. The subsistence nature of farming has gradually transformed into commercial agriculture with the consequence of shift in decision making power from farmers/ regional factors to market forces. Commoditisation of agriculture has forced farmers to depend on external inputs and markets. Now the agricultural production in the country has become market oriented and marketable gluts of some agricultural commodities are very common in the country, and agriculture in Rajasthan is also not an exception to this change (Sharma & Singh, 2013). The shift towards monocropping/ few crops has made farmers vulnerable to volatile market prices.

The farmers' decision to grow crop in a season is influenced by a number of complex group of factors such as family consumption needs, weather conditions, level of technology and resources requirement of crop to be grown. Changes in relative prices of different commodities influence the farmers' decision to allocate area under a particular crop which in turn would affect the level of production of different crop enterprises. There has been an uncertain trend in prices of agricultural commodities in India (Koshta et al., 1990). In the distorted and unregulated market conditions prevailing for agricultural commodities in India, support prices are very crucial for farmers to get assured income from their crop cultivation. Agricultural price policy is aimed at intervening in agricultural produce markets to influence the level of fluctuations in prices which spread from farm gate to the retail level. The price

Received 01-02-2022; Accepted 10-02-2022

support scheme linked to procurement has served the country well in the past decades (Kalamkar et al., 2013). Among the major policies for farm sector, agriculture price policy is one of the instruments that has helped farmers and brought a noticeable change in production and productivity of agriculture sector. The state price support schemes have tremendous effects on the allocation of resources and distribution of income in agriculture and non-agriculture sectors (Niti Aayog, 2016). In this context, the present study was aimed at estimating the changes in terms of trade between input and output prices for selected crops in Rajasthan and the factors affecting the choice of these crops for cultivation by farmers.

METHODOLOGY

Rajasthan state was selected purposively for this study. Four major food crops such as pearl millet, wheat, paddy and gram cultivated in Jaipur, Sri Ganganagar, Hanumangarh and Ajmer districts respectively were selected purposively. These districts were selected based on the highest production of these crops in Rajasthan. These crops are covered under the Minimum Support Price (MSP) scheme and floor prices are announced regularly by the Government of India before sowing of crops. One tehsil each from Sri Ganganagar, Hanumangarh, Jaipur and Ajmer districts were selected purposively in which wheat, paddy, pearl millet and gram are cultivated as the principal crop. Two villages from each tehsil were chosen randomly, using chit method. Fifteen farmers from each village were selected randomly, making a total of thirty farmers from each selected tehsil of a district. The total sample size was 120 farm households. The study employed both primary and secondary data which were compiled from the different sources (DoE&S, 2022a; DoE&S, 2022b; DoE&S, 2022c; CACP, 2021; CACP, 2022) for the period 1996-97 to 2018-19.

To study the TOT between the input and output prices of the selected crops for the selected districts of Rajasthan, the Composite Input Price Index was constructed by giving the weights to the individual selected inputs in the total cost structure calculated under the cost of cultivation scheme and the Index of Farm Harvest Prices / Procurement Prices received by the farmers for the period 1996-97 to 2018-19 by taking agricultural year 1996-97 as base year.

To work out the indices of input prices, actual prices paid by the farmers for all important agricultural inputs viz., preparatory tillage, sowing, seed, fertilizer, irrigation, weeding, harvesting, threshing, interest on working capital, transportation charges, management charges, risk factor and rental value of land as used in the production of selected crops were considered. The input price indices were estimated by using weighted average of price relatives as given below (Laspeyres, 1871):

$$Itj = \frac{\sum_{i=1}^{n} \frac{P_{ti}}{P_{0i}} \times w_i}{\sum_{u=1}^{n} w_i}$$

$$I_{tj} = \frac{\frac{P_{ti}}{P_{01}} \times W_1 + \frac{P_{t2}}{P_{02}} \times W_2 + \ldots\ldots\ldots\ldots \frac{P_{tn}}{P_{0n}} \times W_n}{W_1 + W_2 + \ldots\ldots\ldots\ldots\ldots + W_n}$$

Where, I_{tj} = Input Price index of jth crop in year 't'; P_{ti} = Price of ith item of input in year 't'; P_{oi} = Price of ith item of input in the base year; n = Number of inputs used; and W_i = Weight of ith item of output in the base year.

Weights were used as the percentage contribution of individual input to the total cost of that crop in the base year. Output price index of jth crop in period 't' is the ratio of the Price of jth crop in the year 't' to the Price of jth crop in the base year. Finally, to study the terms of trade between input and output prices, the indices of output prices received by farmers were divided by the indices of input prices paid by them. The Compound Annual Growth Rate (CAGR) and the Cuddy-Della Valle Instability Index (Cuddy and Della Valle, 1978) methods were used respectively to measure the growth rate and the instability (or variation) of various price indices and TOT.

The exhaustive list of factors affecting choice of crop for cultivation by farmers was prepared and categorized into five broad themes/ factors (Table 5) based on extensive review of literature and discussion with key farmers, experts and stakeholders during a pilot study conducted in 2017. The primary data was collected from 120 households between January 2018 and December 2019 by personal interview method using a pre-tested semi-structured interview schedule. A survey research design was adopted for the study. Farmers were asked to rank these factors affecting the choice of crop for cultivation using Garrett ranking technique.

RESULTS AND DISCUSSION

Terms of trade (TOT) between input costs and output prices

Pearl millet and paddy are the kharif crops whereas wheat and gram are cultivated in rabi season. Pearl millet is grown under partially irrigated conditions (rainfed crop with 2-3 life saving irrigations) whereas paddy is a completely irrigated crop (canal irrigation). Wheat is a completely irrigated crop (canal irrigation) whereas gram is cultivated under the residual moisture of kharif season with limited irrigation. The TOT for pearl millet, wheat, paddy and gram in Jaipur, Sri Ganganagar, Hanumangarh and Ajmer districts respectively are presented in Tables 1 to 4.

The Procurement Price Index (PPI) and Farm Harvest Price Index (FHPI) increased constantly from 1996-97 to 2018-19 with a CAGR of 7.49 and 6.51 per cent p.a. respectively in case of Pearl millet (*Pennisetum glaucum*). The CAGR of PPI was higher than the FHPI indicating that MSP was higher than the market prices for higher number of years. The CAGR of Composite Input Price Index (CIPI) was 7.65 per cent p.a. which was higher than the PPI and FHPI. The TOT for pearl millet has shown mixed trend of ups and downs. The CAGR of TOT for the entire period was negative: -0.15 per cent p.a. (ratio of PPI to CIPI) and -1.06 per cent p.a. (ratio of FHPI to CIPI) indicating that the composite input price has increased at a much faster rate than output prices during the study period.

In case of wheat (*Triticum* sp.), the PPI and FHPI increased constantly from 1996-97 to 2018-19 with a CAGR of 5.65 and 5.63 per cent p.a. respectively. Further, it is to be noted that there was no significant difference between PPI and FHPI indicating that Minimum Support Price (MSP) was hovering around the market prices for most of the years. The CAGR of CIPI was 6.65 per cent p.a. which was higher than the PPI and FHPI. The TOT for

wheat was unfavourable (<100) throughout the period except during 2007-08 to 2012-13. The CAGR of TOT was negative: -0.85 per cent p.a. (ratio of PPI to CIPI) and -0.87 per cent p.a. (ratio of FHPI to CIPI).

The PPI and FHPI increased constantly from 1996-97 to 2018-19 with a CAGR of 6.63 and 5.32 per cent p.a. respectively in case of Paddy (*Oryza sativa*). The CAGR of PPI was higher than the FHPI indicating that MSP was higher than the market prices for higher number of years. The CAGR of CIPI was 5.84 per cent p.a. which was higher than the FHPI and lower than the PPI. The TOT for paddy was favourable (>100) from 2005-06 to 2007-08 and 2015-16 to 2018-19. In the remaining period, the TOT was unfavourable (<100). The CAGR of TOT was positive with PPI (0.74% p.a.) and negative with FHPI (-0.50% p.a.). It indicated that farmers who sold their produce at MSP to government procurement agencies were benefitted with positive TOT whereas farmers who sold in open market were at negative TOT. However, the question is how many farmers got benefitted from MSP since enforcement of MSP is successful in few crops in few selected states.

In some rice producing States like Punjab, Haryana, and Telangana, more than 80 percent of marketed surplus of rice was procured by Government agencies, which is primarily triggered by open-ended procurement policy (CACP, 2021). The Commission recommended the Central Government to review open-ended procurement policy for rice and wheat and take a policy decision to procure from small and marginal farmers, who constitute 86 per cent of total operational holdings, and a fixed quantity from farmers having more than two hectare farm size. Efforts should also be made to strengthen procurement operations in other major rice producing States like West Bengal, Uttar Pradesh, Assam, Bihar, etc. to meet at least the State requirements under NFSA and other welfare Schemes (CACP, 2021). The cost of production is an important factor that goes as an input in determination of MSP, but it is certainly not the only factor that determines MSP (CACP, 2022). The production of paddy in Rajasthan is confined to canal command area and farmers grow mainly basmati varieties for sale which fetch higher price than that of normal paddy.

For Gram (*Cicer arietinum*), the PPI and FHPI have increased constantly from 1996-97 to 2018-19 with a CAGR of 7.56 and 5.70 per cent p.a. respectively. The CAGR of PPI was much higher than the FHPI indicating that MSP was higher than the market prices for higher number of years. The CAGR of CIPI was 8.30 per cent p.a. which was higher than the PPI and FHPI. The TOT for gram was unfavourable (<100) throughout the period. The CAGR of TOT was negative: -0.68 per cent p.a. (ratio of PPI to CIPI) and -2.40 per cent p.a. (ratio of FHPI to CIPI).

The TOT for all the four crops was declining and mostly unfavourable throughout the period from 1996-97 to 2018-19 (compared to base year 1996-197) except for paddy when sold at MSP prices. Similar trends were observed for major oilseed crops in Rajasthan (Kumar et al., 2021). The trend in indices of TOT in Gujarat was in favour of farmers in case of castor, groundnut, and maize whereas in case of Tobacco (Bidi), Tobacco (Calcutti) and

Table 1. Terms of Trade for pearl millet crop in Jaipur district of Rajasthan

Year	Procurement price index (PPI)	Farm harvest price index (FHPI)	Composite input price index (CIPI)	Index of the ratio of PPI to the CIPI	Index of the ratio of FHPI to the CIPI	Acreage (ha)
1996-97	100.00	100.00	100.00	100.00	100.00	NA
1997-98	102.70	102.86	95.05	108.06	108.22	219100
1998-99	105.41	102.86	114.58	91.99	89.77	204151
1999-00	112.16	178.00	142.61	78.65	124.82	205164
2000-01	120.27	115.71	163.86	73.40	70.62	229018
2001-02	131.08	94.00	92.30	142.02	101.84	269972
2002-03	131.08	155.43	176.88	74.11	87.87	237581
2003-04	136.49	107.71	89.11	153.17	120.88	330319
2004-05	139.19	134.86	126.16	110.32	106.89	268113
2005-06	141.89	165.14	179.15	79.20	92.18	278884
2006-07	145.95	180.29	154.34	94.56	116.81	282245
2007-08	162.16	176.29	138.46	117.12	127.32	298431
2008-09	227.03	190.86	187.53	121.06	101.77	295678
2009-10	227.03	252.00	234.69	96.73	107.37	318687
2010-11	237.84	230.86	180.26	131.94	128.07	330657
2011-12	264.86	229.14	269.27	98.37	85.10	317293
2012-13	317.57	312.57	379.82	83.61	82.29	301504
2013-14	337.84	321.43	344.90	97.95	93.20	302960
2014-15	337.84	322.86	391.51	86.29	82.47	297162
2015-16	344.59	374.29	541.26	63.67	69.15	300104
2016-17	351.35	398.00	431.21	81.48	92.30	303965
2017-18	385.14	359.43	551.63	69.82	65.16	298579
2018-19	527.03	426.57	545.10	96.68	78.26	298195
CAGR	7.49	6.51	7.65	-0.15	-1.06	1.41
Instability Index	18.96	17.08	29.67	23.51	17.84	9.52

Note: (i) The Procurement price, Farm harvest price and Composite input price were Rs. 370, 350 and 420.45/qt respectively in 1996-97 (base year). Procurement price and Farm harvest price were 88 per cent and 83.24 per cent of the Composite input price in 1996-97. (ii) NA = Not available.

Table 2. Terms of Trade for wheat crop in Sri Ganganagar district of Rajasthan

Year	Procurement price index (PPI)	Farm harvest price index (FHPI)	Composite input price index (CIPI)	Index of the ratio of PPI to the CIPI	Index of the ratio of FHPI to the CIPI	Acreage (ha)
1996-97	100.00	100.00	100.00	100.00	100.00	NA
1997-98	103.85	101.89	102.63	101.18	99.27	254000
1998-99	105.77	103.77	112.29	94.19	92.41	265752
1999-00	111.54	122.64	122.82	90.81	99.85	267339
2000-01	117.31	116.04	138.93	84.44	83.52	218401
2001-02	119.23	120.75	123.03	96.91	98.15	213808
2002-03	119.23	125.09	144.69	82.40	86.46	154930
2003-04	121.15	121.51	134.03	90.39	90.66	173534
2004-05	123.08	132.64	130.10	94.60	101.95	149237
2005-06	125.00	148.11	136.66	91.47	108.38	191727
2006-07	144.23	163.77	149.07	96.76	109.87	192667
2007-08	192.31	199.25	161.61	118.99	123.29	202387
2008-09	207.69	200.00	162.36	127.92	123.18	213503
2009-10	211.54	212.08	187.24	112.98	113.26	202210
2010-11	215.38	218.87	159.73	134.85	137.03	236076
2011-12	247.12	241.32	213.92	115.52	112.81	252690
2012-13	259.62	271.89	235.86	110.07	115.28	243122
2013-14	269.23	287.92	271.71	99.09	105.97	262808
2014-15	278.85	295.66	340.50	81.89	86.83	256659
2015-16	293.27	303.40	337.57	86.88	89.88	274584
2016-17	307.69	308.87	325.91	94.41	94.77	248342
2017-18	333.65	317.92	381.98	87.35	83.23	262110
2018-19	353.85	352.45	431.04	82.09	81.77	261633
CAGR	5.65	5.63	6.56	-0.85	-0.87	0.13
Instability Index	11.26	9.28	21.17	15.18	14.70	15.84

Note: (i) The Procurement price, Farm harvest price and Composite input price were Rs. 520, 530 and 298.40/qt respectively in 1996-97 (base year). Procurement price and Farm harvest price were 174.26 per cent and 177.61 per cent of the Composite input price in 1996-97.

Table 3. Terms of Trade for paddy crop in Hanumangarh district of Rajasthan

Year	Procurement price index (PPI)	Farm harvest price index (FHPI)	Composite input price index (CIPI)	Index of the ratio of PPI to the CIPI	Index of the ratio of FHPI to the CIPI	Acreage (ha)
1996-97	100.00	100.00	100.00	100.00	100.00	NA
1997-98	103.75	103.66	112.89	91.90	91.82	22600
1998-99	110.00	104.88	130.96	83.99	80.08	31214
1999-00	122.50	118.54	136.04	90.05	87.13	37006
2000-01	127.50	120.98	134.46	94.82	89.97	33537
2001-02	132.50	118.54	140.22	94.50	84.54	28345
2002-03	132.50	106.10	167.46	79.13	63.36	22232
2003-04	137.50	106.10	167.63	82.02	63.29	20869
2004-05	140.00	81.10	168.59	83.04	48.10	17590
2005-06	142.50	81.10	141.51	100.70	57.31	16969
2006-07	145.00	79.27	144.61	100.27	54.81	15550
2007-08	161.25	85.37	147.50	109.32	57.87	18169
2008-09	212.50	113.78	212.92	99.80	53.44	24241
2009-10	250.00	126.34	243.52	102.66	51.88	24635
2010-11	250.00	202.56	285.25	87.64	71.01	22311
2011-12	270.00	152.20	311.42	86.70	48.87	22095
2012-13	312.50	234.15	295.68	105.69	79.19	21401
2013-14	327.50	337.56	303.61	107.87	111.18	23859
2014-15	340.00	281.71	343.71	98.92	81.96	28741
2015-16	352.50	206.34	342.26	102.99	60.29	32986
2016-17	365.00	310.49	341.67	106.83	90.87	34450
2017-18	387.50	334.15	298.43	129.84	111.97	31647
2018-19	437.50	329.39	369.25	118.48	89.21	33485
CAGR	6.63	5.32	5.84	0.74	-0.50	1.80
Instability Index	14.24	32.69	14.48	9.69	26.77	25.16

Note: (i) The Procurement price, Farm harvest price and Composite input price were Rs. 400, 820 and 263.23/qt respectively in 1996-97 (base year). Procurement price and Farm harvest price were 151.96 per cent and 311.51 per cent of the Composite input price in 1996-97.

Table 4. Terms of Trade for gram crop in Ajmer district of Rajasthan

Year	Procurement price index (PPI)	Farm harvest price index (FHPI)	Composite input price index (CIPI)	Index of the ratio of PPI to the CIPI	Index of the ratio of FHPI to the CIPI	Acreage (ha)
1996-97	100.00	100.00	100.00	100.00	100.00	NA
1997-98	101.73	101.79	123.44	82.42	82.46	98800
1998-99	103.47	102.86	140.22	73.79	73.35	123824
1999-00	117.34	114.73	218.36	53.74	52.54	30961
2000-01	127.17	155.80	194.75	65.30	80.00	19597
2001-02	138.73	126.70	270.06	51.37	46.91	21484
2002-03	141.04	147.05	276.52	51.00	53.18	16900
2003-04	161.85	141.96	249.76	64.80	56.84	13841
2004-05	164.74	125.71	188.93	87.19	66.54	20969
2005-06	165.90	180.89	235.66	70.40	76.76	25153
2006-07	167.05	186.25	264.07	63.26	70.53	79660
2007-08	184.97	212.23	292.80	63.17	72.48	36890
2008-09	200.00	206.88	301.91	66.25	68.52	20783
2009-10	203.47	206.52	326.17	62.38	63.32	35800
2010-11	242.77	201.34	254.20	95.51	79.21	111133
2011-12	323.70	296.70	423.69	76.40	70.03	87692
2012-13	346.82	268.84	417.06	83.16	64.46	90065
2013-14	358.38	257.23	388.99	92.13	66.13	167018
2014-15	367.05	298.84	630.64	58.20	47.39	82743
2015-16	395.95	459.82	614.86	64.40	74.79	19690
2016-17	424.86	457.14	523.80	81.11	87.27	149361
2017-18	508.67	337.77	551.36	92.26	61.26	66193
2018-19	534.10	357.95	625.32	85.41	57.24	91332
CAGR	7.56	5.70	8.30	-0.68	-2.40	-0.36
Instability Index	18.72	21.27	19.98	19.88	19.09	69.55

Note: (i) The Procurement price, Farm harvest price and Composite input price were Rs. 865, 1120 and 407.42/qt respectively in 1996-97 (base year). Procurement price and Farm harvest price were 212.31 per cent and 274.90 per cent of the Composite input price in 1996-97.

gram the parity indices were not in favour of farmers (Ganga et al., 2015). A study in major cotton growing states of India reported that the favourable quantity terms failed to offset the negative price terms and net terms became unfavourable. Though the quantity terms are above the base year level, they showed a declining trend during the terminal period (Reddy and Yelekar, 2014). The movement of inter-sectoral terms of trade in India since independence has been characterized by periodical shifts in favour and against agriculture (Rajesh, 2012).

The declining TOT was partly attributed to the methodology used. The TOT for each year was relative to the margin of net returns (output price minus input cost) in the base year. Higher this margin is in the base year, higher the chance of unfavourable TOT for the other years. It is equivalent to comparing the net returns in a given year with the best year. For instance, in wheat, the net returns margin was 74.26 and 77.61 per cent in the base year when sold at procurement price and farm harvest prices respectively. The TOT for a given year will be <100 if the profit margin in that year is less than the base year, even if the profit margin is positive. Such trend was observed in wheat, paddy and gram. In pearl millet, the margin of profit in the base year was negative. Procurement price and farm harvest price respectively covered only 88 per cent and 83.24 per cent of the input price in the base year. This partially explains the favourable TOT for pearl millet for higher number of years. It is equivalent to comparing the net returns in a given year with a year in which farmers incurred losses. Therefore, drawing inferences on profitability of crop cultivation based on indices of TOT alone may be misleading. Indices of TOT provide the direction of change in TOT when compared with the base year. Critical examination of net returns may provide better insights into profitability of crop cultivation. Therefore, selection of the base year in which output prices are around 150 per cent (i.e. 1.5 times the cost of cultivation) of the composite input prices for estimating TOT is recommended. Despite declining TOT, there was increase in area under pearl millet, wheat and paddy in Jaipur, Sri Ganganagar and Hanumangarh districts respectively whereas there was slight decline in area under gram in Ajmer district (Tables 1-4). This again is partially explained in wheat and paddy by the selection of the base year.

Farmers' crop choice behaviour

All the farmers unanimously agreed that agriculture as a whole was becoming less remunerative over time because of increase in input costs and uncertainties in output prices. Yet, farmers preferred to cultivate these crops indicated that their choice was affected by combination of many factors (Table 5) including suitability of these crops in their farming systems given the agro-ecological and socio-economic resource base, secondary uses of these crops and lack of other remunerative enterprises (opportunity cost). Diverse farming systems were practised by farmers in Rajasthan. For instance, in Jaipur district, farmers cultivate >8 crops in kharif season (pearl millet, pulses, fodder crops and diverse vegetables) under rainfed conditions and >15 crops under irrigated conditions in kharif, rabi (wheat, rapeseed & mustard, fodder crops, vegetable crops) and

Table 5. Factors affecting farmers' crop choice behaviour

S.No.	Factor	Mean score	Rank
1	Farming system approach practised in Rajasthan (crop(s) being one component of diverse farming systems)	91.12	I
2	Lack of alternative remunerative crops and enterprises (Opportunity cost principle)	84.52	II
3	Costs and returns are relative than absolute for farmers (Law of comparative advantage) and peer pressure	70.23	III
4	Policy interventions in favour of selected crops (canal irrigation and MSP)	66.12	IV
5	Farmers' view of costs and returns different from the true economics definition (costs "internal" and "external" to the farm)	64.28	V

occasionally summer season. Further, these crops are one component of farming system consisting of other components such as livestock, horticulture, agro-forestry trees and grasses/ fodder crops. Farmers sell 2-3 crops under rainfed conditions and >10 crops under irrigated conditions and rest of the crops are grown for domestic consumption. The nature and combination of crops and components vary but diverse farming systems exist in all districts in Rajasthan (Manjunatha et al., 2018; Singh et al., 2022). The TOT for crops in Rajasthan has to be looked from this context unlike in Punjab where monocropping (or few crops) is the dominant practice. Further, farmers generally cultivate the crops cultivated by majority of their fellow farmers except few innovative farmers (innovators constitute around 2.5 per cent of population as per most of the adoption studies) who take risk in trying completely new crops.

The costs and revenues were always "relative" than "absolute" to the farmers. The costs and returns of cultivation of a particular crop are valued by a farmer against the costs and returns of other crops cultivated in the same season in the same region. Further, the crops have multiple uses. Grains of pearl millet, wheat, paddy and gram are used for domestic consumption and rest is sold in the market. Pearl millet and wheat flour is used for consumption by human beings. Pearl millet grains are also used for preparing feed for lactating cattle/ buffaloes. Stover/ straw of pearl millet, wheat and paddy are used as dry fodder for livestock, which is an integral component of farming systems in Rajasthan. Further, farmers earned extra income from non-agricultural sources such as MNREGA and other enterprises while engaged in cultivation of these crops.

Composite input cost includes the family labour, rental value of land, interest on working capital and management charges. Though these costs are "costs" in true economic sense, farmers do not consider these as "costs" in their cost of cultivation. These costs are "internal to the farm" and farmer need not have to incur extra cost. These costs are perishable in nature in the sense that farmer cannot save these costs even if he doesn't use them. Further, cultivation of these crops is providing employment to the members of the household (making use of these perishable resources). For instance, rental value of land contributed 13 to 27 per cent of the cost of cultivation for major food and oilseed crops cultivated in Rajasthan (Kumar et al., 2018).

Farmers continue to grow these crops in the absence of other remunerative crops/ enterprises. The opportunity cost for cultivation of gram crop was leaving the land fallow. Therefore, farmer has no choice to go for any other crop than gram and tries to get some output with some occasional winter rains or lifesaving 1-2 irrigations. Access to canal irrigation in parts of Sri Ganganagar and Hanumangarh districts and MSP have incentivized farmers in intensive cultivation of paddy, wheat and other vegetables using very high levels of chemical pesticides (Singh et al., 2022).

The remunerative and profitable agriculture is in the interest of farmers and the Indian economy. This has to be achieved by combination of price and non-price incentives (such as investment in agriculture and promotion of improved technologies) aimed at increasing factor productivity and reducing the cost of cultivation. Water saving technologies can lower water use by 23% in wheat without yield reduction (Kumar et al., 2020). Adoption of stress tolerant varieties and resource conservation technologies like Direct Seeded Rice could enhance farmer capability and improve resilience against climate change (Brar et al., 2020). Drip irrigation has to be promoted through provision of subsidies to overcome high initial costs (Yadav et al., 2019). Adoption of micro-level agro-advisory services helped farmers in their farm planning, better crop management, efficient utilization of existing farm resources while improving the productivity and farm incomes (Dupdal et al., 2021). The farmers sustained crop yields by adopting climate resilient indigenous and modern scientific technologies like manipulating sowing dates, mixed farming, crop diversification, alternate cropping systems and drought tolerant varieties (Dupdal et al., 2022). It is suggested that ways and means of estimating TOT for the whole farm (farming systems approach) have to be developed to measure the profitability of agriculture at farm household level. Further, sustainability of agriculture has to be measured not only from economic perspective, but also from ecological and socio-cultural perspective (Manjunatha et al., 2019; Manjunatha et al., 2021).

CONCLUSION

The terms of trade (TOT) between input and output prices for pearl millet, rice, wheat and gram crops in Rajasthan were found declining and unfavourable for most of the years from 1996-97 to 2018-19 when compared to 1996-1997 (base year for the analysis). Yet, farmers preferred to cultivate these crops owing to comparative advantage and opportunity cost. Cultivation of crop(s) was one component of the diverse farming systems consisting of many other components predominant in Rajasthan. The selection of the base year in which output prices are around 150% (i.e. 1.5 times the cost of cultivation) of the composite input prices for estimating TOT is recommended. It is suggested that robust methodology for estimating TOT for the whole farm (farming systems approach) have to be developed to measure the profitability of agriculture at the farm household level.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (104-109)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Implementing Indian Innovations through Trained Extension Functionaries for Improving the Agriculture in Africa and Asia

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ARTICLE INFO

Keywords: Agribusiness, Management, Cooperatives, Good agricultural practices

http://doi.org/10.48165/IJEE.2022.58220

ABSTRACT

Agriculture in India has metamorphosed a lot during the last seven decades from being a subsistence farming to commercial agriculture. The innovations in Indian agriculture have paved the way for seeing agriculture as an agri-business enterprise. The creation of diverse agribusiness opportunities amidst the existing constraints and challenges has reoriented the farming in India. Having seen the positive changes in agriculture due to the agribusiness orientation in India, other countries in Asia and Africa are keen to adopt this approach in their countries. The selected officials representing Government, civil society and private firms from Africa and Asia were trained under Feed the Future India Triangular Training during 2019 on Agribusiness innovations in India and the opportunities for their countries. Following the training, the research study conducted showed that, Indian agribusiness innovations in supply chain management, good agriculture practices and promoting Farmer Producer Companies (FPCs) are perceived as best interventions by the trainees to address the problems of lack of improved technologies for small farmers, unorganized market, lack of institutional resources and lack of agri mechanization in their countries.

INTRODUCTION

Agribusiness is a combine term for increasing the scope of monetising production, processing and marketing in agriculture. The agribusiness sector is comprised of interrelated subsectors working in concert to provide goods and services to consumers around the world (Gunderson et al., 2014). It is the business sector consisting of agriculture and agriculture-related commercial activities. But the scenario of agribusiness varies among nations. Good policies, business environment, and support from governments can help agribusiness achieve its set objectives. The once food-deficient country, India is self sufficient now in its food grain requirement. The Indian agriculture has accumulated diverse experiences through the implementation of several programmes since independence. In the pre-liberalisation era (Prior to 1990s) India was primarily addressing the food security and employment issues. Post liberalisation, the programmes and the efforts in India were directed towards creating the agribusiness opportunities in Indian agriculture associated with several micro and macro financial reforms (Goyal & Shrama, 2013).

In Africa, the scenario of agribusiness is different. Africa is now at a crossroads, from which Africa need to focus on the steps to realize its potential or else Africa will continue to lose employment, food security, competitiveness and missing a major opportunity for increased growth (The World Bank, 2013). Many countries in Asia face similar challenges. These problems can be overcome by inclusion of more number of people in agriculture, value chain system, agricultural cooperatives and with better policies. In this context, several successful Indian innovations and experiences in the field of agribusiness can be helpful to the agriculture sector in several African

Received 04-01-2022; Accepted 14-02-2022

and Asian countries. With this idea, the field extension officers from Asian and African countries were trained on Indian experiences in agribusiness management practices so that, they can implement the successful Indian interventions in their countries. To meet this objective, the international training on 'Agribusiness and management' was organized under the Feed The Future India Triangular Training (FTF ITT) program supported jointly by USAID India and the Government of India. The present study primarily discusses the perception of field extension functionaries from Africa and Asia in framing the Back At Work Plan (BAWP) to address the problems identified by them in their country through Indian agribusiness innovations.

METHODOLOGY

The 35th FTF-ITT program on Agribusiness and Management was organized at National Institute of Agricultural Extension Management (MANAGE), Hyderabad during 18th June to 2nd July, 2019. The FTF ITT was part of the new agriculture partnership implemented by the USAID India representing US Government and National Institute of Agricultural Extension Management (MANAGE), Hyderabad representing Ministry of Agriculture, Government of India. FTF ITT is having a target of organising 44 training and capacity development programmes for the field level officers of Africa and Asia during 2016-20. The partner countries in the programme included: Afghanistan, Bangladesh, Botswana, Cambodia, Democratic Republic of Congo, Ghana, Kenya, Lao PDR, Liberia, Malawi, Mongolia, Mozambique, Myanmar, Nepal, Rwanda, Sri Lanka, Sudan, Tanzania, Uganda and Vietnam. As per the mandate of the FTF ITT, the nominations for the training program were invited from 17 countries of Africa and Asia. From the nominations received, 26 candidates representing 7 countries were selected based on their job profile and institutional mandate and were invited to attend the training. The profile of the trainees was assessed on parameters such as nationality, age, education, gender, marital status, professional field, type of institute they represent, present position, job role and number of years of experience.

As part of the training program, the trainees are expected to prepare a 'back at work plan' (BAWP), intended to implement the learnings from the training program in their respective countries. In this process, trainees may identify specific problems in their work area and prepare a plan of action to solve the same with the help of knowledge and skill acquired during the training programs in India.

In order to facilitate the trainees to prepare a BAWP, a set of 17 questions including the statement of problem, objectives, description of the problem, their action etc. was developed. The back at work plan is intended to ensure that new technology or knowledge or skill acquired by the participants may be implemented at their work place to find a solution for the specific problem identified by them. The responses of all trainees to the selected questions related to BAWP are analysed using descriptive statistics.

RESULTS AND DISCUSSION

Nationality and profile of the trainees

There were twenty six (26) participants from seven different nations. The details of the same is given in the Table 1. It is revealed from the table that highest number of participants were from Sri Lanka and Mongolia (6 each), followed by 4 each from Uganda and Nepal. Malawi was represented by 3 members followed by Cambodia (2) and Tanzania (1).

he majority of the trainees were graduates (65.38%) and 30.77 per cent were post graduates. Male members were higher in number (53.85%) as compared to female participants (46.15%). Majority of them are working in agriculture sector followed by livestock, rural development and academics. Majority of the trainees represented the government sector (76.92%) of different nations and 11.54 per cent trainees represented the NGO/SHG/FO and same number from private sector. Job role of the participants indicated that about 70 per cent of them were working in management positions followed by extension, training, technical and research. The profile of all the trainees appears apt for an International training program as they had higher education, representing agriculture and development sector and diverse background of type of institute and job roles.

The data on the professionals experience revealed that majority of the respondents (46.15%) had an experience of 3-10 years followed by 42.31 per cent of them with more than 10 years of experience and 11.54 per cent had less than 3 years of experience.

Problem identification for work implementation

Problem identification is the key step to take up the work as it will help to explore solutions to the causation of problems. The training enabled the trainees to identify a local problem in their country on which they want to work. The major problems identified by trainees in their provinces are discussed below. Most of the trainees (23.08%) quoted lack of improved technologies for small farmers as major problem in their area. Their problem is contextual as small farmers are unable to invest on expensive technology. Agricultural R&D institutions are unable to produce the technology which can be offered to small farmers.

Many of the trainees (11.54%) mentioned unorganized market as major problem in their area. Most often, marketing of agriculture produce is the major issue affecting the income generation of the farm in most of the developing countries. In fact, the cropping pattern for the next year often depends on lagged prices of agriculture commodities. The marketing constraints are compounded by the input supply market being not responsive to the temporal, spatial and package needs of farmers (Mutambara & Munodawafa, 2014).

Table 1. Problems Identified by trainees in their region

S.No.	Problem identified in service area/province/region	Per cent
1	Lack of improved technologies for small farmers	23.08
2	Unorganized market	11.54
3	Lack of institutional resources eg: Money	11.54
4	Lack of mechanization in agriculture	7.69
5	Pest and disease infestation	7.69
6	Excessive use of pesticides and chemical fertilizer	7.69
7	Lack of teaching aids	7.69
8	Migration of rural youth from farming	7.69
9	Lack of group approach from farmers	7.69
10	Post-harvest losses	3.85
11	Lack of technical skills among the farmers	3.85

Lack of institutional agencies for credit is another major issue identified by the trainees. Nationalized banks and co-operatives have not proved a successful means of bringing credit to the small farmers, in spite of special assistance and encouragement by the Government. Rural institutions designed to assist the small farmers could not ensure them access to needed resources of technical advice and information nor the cooperation of their peers (Jaiswal & Srivastava, 1976). There are several barriers to access Agricultural credit in Africa, and in other developing countries. Number of factors, including land tenure systems that prevent the use of land as collateral, the absence of physical collateral, the high risk associated with rain–fed agriculture and sharp commodity price fluctuations, and poor transport and communication facilities are few of the barriers. However, the experience of successful agricultural exporting countries, such as Côte d'Ivoire, shows that bank financing is plentiful for bringing export crops to the market, and to finance the production and processing (Sacerdoti, 2005). Access to bank credit can address the problems identified trainees such as lack of mechanization in agriculture, group approach from farmers (7.69% each) and post-harvest losses (3.85). Farm mechanization as problem to address can contribute significantly to on-farm and off-farm employment opportunities thereby leading to improved local food security status (Khatri et al., 2012). The farm mechanization has the potential to create new job opportunities like driving, marketing, agriculture tools trading and mending, agro-vet enterprises, vegetable stall keeping while it reduced the existing manual and works high on drudgery.

Pest and disease infestation was identified as a problem by 7.69 per cent, as it is a common problem in farming. One of the study shows that both primary (26%) and secondary yield losses (38%) caused by foliar pests and diseases can be severe in a perennial crop. Efforts to estimate yield losses have increased in the last decades, but most of them are continued to annual crops and focused on primary yield losses. Hence, identification of this problem assumes significance as it can potentially save the farmers from losses. Excessive use of pesticides and chemical fertilizer (7.69%), was also a major identified problem by trainees because indiscriminate use of pesticides and chemical fertilizers will lead to deplete all of the resources and also may cause potential threat to the ecology and environment. The adverse effect of these synthetic chemicals on human health and environment can only be reduced either by applying appropriate doses of pesticide and fertilizer or by the use of organic inputs such as manure, bio fertilizers, bio pesticides, slow release fertilizer and nano fertilizers etc. These practices could ensure efficiency of the fertilizers (Chandini et al., 2019).

Lack of teaching aids (7.69%) was another problem identified by the trainees. To develop one's knowledge and adequately apply the gained knowledge and information, it is important for the educational institutions, organizations, companies and the instructors to formulate proper extension teaching methods. Since the extension functionaries are professionally competent to train stakeholders to effect change in behaviour, lack of teaching aids affect their job performance. In view of higher proportions of small and marginal farms in Asian and African nations, aggregation of farmers into FPO is emerging as an effective tool for solving the problem of the farmers. Now a days farmer's group approach is an emerging tool in farming as well as marketing which made trainees to quote lack of group approach from farmers (7.69%) as problem in their area. Post-harvest losses (3.85%), is another area of problems identified by the trainees the post-harvest losses are a serious problem, and their scale is different for different crops, practices, climatic conditions, and the economic situation of a given country (Sawicka, 2020).

Back at work plan solutions and interventions identified by participants

A systematically organised training programme aids in the production of desirable changes in the behaviour of people (Singh et al., 2021). Training process is very much closely related to trainees' professions/jobs. If the examples and exercises presented during training are inspired by the trainees' job-related activities or the trainer demonstrated how the new knowledge and abilities should be implemented in the workplace, it is very likely that trainees' post-training behavior in their workplace would change according to what they have learned during their participation in the training programme (Diamantidis & Chatzoglou, 2014). The trainees in this case identified the back at work plans themes to bring desirable change in their region based on the 'theory of change'.

The solutions and first intervention identified by trainees for their Back at Work Plan by trainees are given in Table 2 and 3 respectively. Majority of the trainees have identified implementation of improved value chain system and methods (26.19%), followed by introduction of Indian Good Agricultural Practices (GAP) in their areas (14.29%), establishment of Farmer Producer Company (FPC)/ Farmer Producer Organization (FPO)

Table 2. Preference of trainees as solutions for BAWP (Multiple responses)

S.No.	Solutions identified by trainees for BAWP	Per cent
1	Implementation of improved value chain system and methods	26.19
2	Introduction of Indian good agricultural practices (GAP) to their areas	14.29
3	Establishment of farmer producer company (FPC), farmer producer organization (FPO) and farmers cooperatives	11.90
4	Promotion of cooperative Agribusiness system eg. Mulkanoor cooperative society	11.90
5	Application of improved supply chain management methods	7.14
6	Contract farming with increased security to tenant and owner	7.14
7	Simplification of export policies	7.14
8	Organized market system	7.14
9	Documentation and record keeping of business activities	4.76
10	Promotion of climate smart agriculture	2.38

and farmers cooperatives (11.90%), promotion of cooperative Agribusiness system (11.90%). Around 7.14 per cent of each of them identified supply chain management, contract farming, export policies and organized marketing system. About 4.76 per cent and 2.38 per cent of them identified record keeping and climate smart agriculture, respectively. The concept of FPOs appears very appealing and attractive to ensure economic empowerment of small holder farmers through innovative and entrepreneurial initiatives (Singh et al., 2022). For their obvious advantages, including the role of FPOs on value chain strengthening, the trainees have collectively given much importance to starting FPOs and Farmers cooperatives as part of their back at work plan to increase farmers income.

The first intervention planned by majority of the trainees is creating awareness among farmers about GAP and capacity building of subordinates to train farmers in their countries. Farmers training through formally arranged, well designed courses are considered instrumental for intensive teaching activity to educate the participants (Sajeev et al., 2021). Hence, the planned activity by the trainees is of significance for farmers and their stakeholders. The other notable interventions planned by the trainees are formation of FPOs through the help of local self-government and pursuing policy changes to augment value chain management environment to boost agriculture sector. Most of the interventions planned by the trainees reflect the sentiments of Indian farmers. In India farmers opined that, mobilizing and allocating resources for scaling up of technological activities, sharing of available knowledge on new technologies and innovations were major factors in maximizing farm income. Among others, the farmers had preference for introduction of innovative production enhancing technologies, development of commodity value chains with farmers' organisations and emergence of large-scale agribusinesses (Nain et al., 2019). The results also confirm that, the Indian innovations and technologies are most suited for agriculture system in Africa and Asian countries.

The duration of the back at work plan largely depends on nature of the task undertaken, administration, other responsibilities, resources available. etc. It was apparent that 34.62 per cent trainees proposed 6-12 months and 30.77 per cent trainees expected 1-2 years, to complete their responsibility of implementing the lessons learnt from the training. It can be inferred that, maximum trainees expect six months to two years to see the results of capacity development activities translating into implementation of actions. While 19.23 per cent of them planned for less than six month and 15.38 per cent of them proposed more than two years to complete their task. In less than six months the activities related to trainings and workshops are planned to implement the lessons learnt. In more than two years, the issues related to policy change and large stakeholder participation programs are planned by the trainees.

It is important to determine that individuals are making complete use of the knowledge and skills that they have acquired in the training program. But for this to happen, trainees should implement their BAWP. While pursuing implementation of BAWP, trainees have to overcome many hurdles such as archaic policies, outdated technologies, old methods etc. In anticipation of their efforts, the trainees were expecting the theory of change to effect changes through their identified solutions and first interventions.

The details of expected change indicated by trainees are very diverse and appear overlapping. Some have given more than one anticipated change. Hence, the data (Table 4) was tabulated and categorised for presentation based on key words and type of outcome. It is revealed from the table that 25.81 per cent of the respondents expect a change in policies related to value chain and supply chain. On the other hand, 22.58 per cent expected change in knowledge and in creating awareness among stakeholders. Sizeable number of respondents expected a change on creating and strengthening cooperatives (16.13) which was due to the exposure of trainees to many successful cooperatives in India including the Mulkanoor Cooperative society. Around 12.90 per cent each of the respondents expected helping farmers to realise remunerative prices to farmers through Farmer producer companies and accessibility of credit through rural cooperatives. Few members (9.68%) anticipated improvement in infrastructure, transport, mechanisation and storage from their work implementation.

The FTF ITT trainees anticipated some challenges during their BAWP implementation. The challenges foreseen by them are given in Table 5. The challenges mostly extend to low finance, distribution of inputs on time, administrative and technical problems and attitude of the people. The problems affecting implementation of planned activities mostly emerge due to infrastructure, human

Table 3. First intervention planned by trainees to achieve their objectives

S.No.	First intervention planned by trainees	Per cent
1	Creating awareness about good agricultural practices (GAP) among the farmers	26.92
2	Capacity building among the subordinates to train farmers on agribusiness solutions	26.92
3	Promote the establishment of farmer producer companies and farmer producer organization	23.08
4	Approaching higher authorities to frame new policies (on supply and value chain management and cooperative societies)	19.23
5	Approaching higher authorities to establish an organized market	3.85

Table 4. Expected change with identified solution (Multiple responses)

S.No.	Expected change with identified solution	Per cent
1	Change in policies related to value chain and supply chain system	25.81
2	Awareness about good agricultural practices and upgradation of knowledge	22.58
3	Establishment / strengthening cooperatives	16.13
4	Remunerative prices through Farmer producers organization, farmer producing company	12.90
5	Easy accessibility of credit through rural cooperative societies	12.90
6	Improvement in infrastructure, transport mechanisation and storage facilities	9.68

Table 5. Challenges in working with BAWP (Multiple responses)

S.No.	Challenges in working with BAWP	Per cent
1	Low financial capacity and high interest rates	23.08
2	Timely distribution of quality inputs	19.23
3	Non-cooperation from superiors and subordinates	15.38
4	Negative attitude of rural youth towards farming	15.38
5	Lack of technical guidance & technologies to promote good agricultural practices (GAP) among farmers	11.54
6	Resource barriers	11.54
7	Lack of time	11.54
8	Barrier in languages	7.69

resources and staffing issues, resources allocation and geography, referrals and marketing, leadership support, and team dynamics and processes (Sullivan et al., 2018).

Notable success of trainees

An Agricultural Extension Officer Mr. Alfred Kilama from Nyowa District, Uganda, took large interest in seed industry and their business in India during the training. Based on the training sessions on seed production and its importance for agribusiness and management, he took the initiation on sensitizing small farmers who were still practicing subsistence farming about commercial seed production technique to enhance their farm income. He conducted many trials and result demonstrations in the farm fields of small farmers of Nyowa district (County), Uganda with the help of his subordinate officers to spread the idea of quality seed production in large scale. Uganda government (Ministry of Agriculture) provided him a tractor with disc plough and disc harrow to help his team to expand acreages of seed production from 30 acres to 160 acres. In Malawi, a farmer group called 'Salima Dairy Farmers Cooperative Society Limited' formerly known as 'Liganga Milk Bulking Group'. The farmers here were always facing the problem of better breeds and lack of financial support. But due to practical visits to cooperative society during training program made a trainee from Malawi to bring the transformation in the life of those farmers. Trainee shared the knowledge on structure and operation of Indian cooperative society with the Malawi farmers and also trained them. Now, Salima Dairy Farmers Cooperatives Society Limited has managed to put an extra gear with adopting the approach of better technology adoption and planned commercial operations. Independency from government/NGO to set up office meetings and other infrastructure like milk coolants to reserve the milk and collection centers. Cooperative started procuring the maize mill in order to mill the left over maize ('Madeya' in Malawi) which will be used to make feed for the dairy animals at the cheaper fares. The practical visit to cooperative society during the training program made one of the trainee from Mangolia to organize a training program on "milk production technology" at Jargalant town, Khovd Province, Mongolia.

CONCLUSION

The twenty six trainees from Asia and African continents were trained on agribusiness ideas, incubation, commercialization and technology dissemination under Feed The Future India Triangular Training Program (FTF-ITT) at MANAGE, Hyderabad. At the end of the training program, the trainees were in a position to identify the problem in their region related to agribusiness based on a novel idea learnt during the training program. Trainees identified lack of improved technologies for small farmers, unorganized market, lack of institutional resources, mechanization, micro credit schemes as major problems. Value chain system, group farming, good agricultural practices, cooperatives were identified as desirable solutions to address their identified problem. The trainees based on their major problems related to farming, developed a back at work plan to implement the learnt technologies and practices to solve it. The trainees also planned the follow-up actions to their back at work plan.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (110-114)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Analysis of Factors Affecting Social Media Utilization of Extension Agents

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ARTICLE INFO

Keywords: Social media, Extent of usage index, Socio personal, Job-related characteristics

http://doi.org/10.48165/IJEE.2022.58221

ABSTRACT

Digitalization of communication networks through social media platforms is the most important tool to increase the reach and impact of agricultural advisory services. A profound need to study the extent of usage of social media by extension agents and factors influencing its usage was felt and to analyze the extent of usage, a composite index was developed during 2021 by using seven sub-indices that had a Cronbach alpha value of 0.903. To study the extent of usage 160 extension agents through a proportionate random sampling method were selected from Andhra Pradesh where the majority of the extension agents had a medium extent of usage which accounts for 44.37 per cent. Based on the correlational analysis it is found that innovative proneness ($p<0.05$), scientific orientation, job perception, technology management orientation, information management orientation, orientation towards extension service profession have a significant and positive correlation with the extent of usage of social media at 0.01 level of significance. Based on stepwise regression analysis it revealed that five variables were a good fit with an R-square of 35.7 per cent. The findings may help in framing a social media-led extension strategy by extension organizations and government bodies to reach the grassroots of the rural communities.

INTRODUCTION

For the farming community to form an informed decision it is an important factor to possess the appropriate information at the precise time and precise place through the correct channel. Extension agents play a serious role as a friend, philosopher, and guide to farmers in providing information. Hence, to form this spread of knowledge within an appropriate time to a majority of farmers, the advisor must adopt new models of communication such as social media. Having more than 483 million users in 2018, India had the world's second-largest internet population (Statista, 2021). Although mobile and

internet are considered as modern tools of dissemination had not found proper place in terms of usefulness and contact among the farmers (Ravikumar et al., 2015) but social media allows us to make sound opinions and build good social relationships. Access to the ICT tools is increasing but those tools are mostly used to get benefit of general communication and entertainment purpose and less for marketing and other productive purpose (Panda et al., 2019). According to Singh et al., (2021) due to ease of receiving, retrieving, and sharing, a majority of farmers (72.5%) were using social media for receiving and sharing agricultural information. Social media is a potential medium that helps extension professionals to get information about recent developments, build relationships, share information, and connect with a varied audience. According to Patel et al., (2020) platforms such as WhatsApp not only save time but are very economical for use and problem-solving. Since extension agents are the key role players in the dissemination of information, it is critical to include their viewpoints on the use of social media in transmitting the information. Some of the major

Received 17-01-2022; Accepted 16-02-2022

advantages of using social media as a research issue are decreased knowledge sharing costs, increased access to useful agricultural information, increased access to valuable advice, increased farmer extension ratio Iwuchukwu et al., (2019). Understanding the importance of social media, studies were conducted by James et al., (2020) on social media used by KVK scientists finding out that the overall extent of utilization of social media was low to medium in three fourth (79.15%). Lakshmi and Babu (2018) conducted a study and found that most of the extension officials (97%) use Gmail followed by WhatsApp (59%), Facebook (55%), and YouTube (47%) for information sharing. WhatsApp was able to create extension mechanism for purposeful farmer to farmer learning exchange which in turn was a step towards innovative farmer led extension delivery mechanism (Nain et al., 2019). Examining the usage trend and establishing strategies and rules to make social media an essential component of the dissemination of agricultural information are key steps in determining the extent of the reach of agricultural advisory services. Keeping in view the above facts and their importance, the present study was conducted to analyze the extent of usage of social media among extension agents and factors affecting its usage.

METHODOLOGY

To analyze the extent of usage of social media by extension agents an ex post facto study was conducted in Andhra Pradesh. From the pool of extension agents working in the three districts under the state department of agriculture, KVK, ATMA, Private sector firms, and NGOs, proportionate random sampling was used to select 160 extension agents, 60 from Guntur, 60 from Chittoor, and 40 from Srikakulam. Well-structured questionnaires were designed for data collection. The data was collected through a structured questionnaire through the survey method. The extent of usage of social media was operationalized as the art of putting the resources that are tangible or intangible to the proper use. It was measured by developing a composite index. Based on an intensive review of literature and suggestions from experts seven following sub-indicators were decided for the construction of the index

SI1: Experience in social media usage, SI2: Regularity of usage, SI3: Amount of time spent, SI4: The usefulness of social media, SI5: Priority of social media, SI6: Categories of the content, SI7: Purpose of accessing the social media

The Cronbach's Alpha calculated for the instrument was found to be 0.903 which states that the index was good to use. A sub-index was calculated by adding the score across all the items present in that particular sub-index where the total value indicated the score of that sub-index. Scores of all the seven components/sub-indices were normalized through the min-max method.

$$U_{ij} = \frac{Y_{ij} - \text{Min } Y_j}{\text{Max}Y_j - \text{Min}Y_j}$$

Where, U_{ij} = Unit score of the i^{th} respondent on j^{th} component, Y_{ij} = Value of the i^{th} respondent on j^{th} component, $MaxY_j$ =Maximum score on j^{th} component, $MinY_j$ = Minimum score on j^{th} component.

As equal weightage was considered for all the sub-indicators the summation of average index scores of those selected sub-indicators was chosen for the composite index of the extent of usage.

$$\text{The extent of usage index} = \frac{\sum Si}{n} = \frac{SI1 + SI2 + SI3 + SI4 + SI5 + SI6 + SI7}{7}$$

The respondents were grouped into low, medium, and high extent of usage based on the mean and standard deviation. The socio-personal and job-related variables taken for the study were 16 in number which was enumerated through different scales. To find the relationship of independent variables with the extent of usage of social media, different statistical analyses such as the chi-square and fisher's exact tests for categorical variables and correlational analysis for continuous variables were done. To study the most parsimonious variables that show the combined effect of independent variables in explaining the variation on the dependent variable (Extent of usage), the stepwise multiple regression analysis was carried out. The model excludes the variables which do not significantly contribute to the dependent variable.

$Y = b0 + b1\ X1 + b2\ X2 + b3\ X3$ .....bn x n

Where, b0 = Constant, Y = Dependent variable, X1 …X n = Independent variable, b1 …bn = Regression coefficient for respective variables.

RESULTS AND DISCUSSION

It can be inferred from Table 1 that a majority of the extension agents had a medium extent of usage of social media in agriculture extension service delivery which accounts for 44.37 per cent that was approximately half of the sample and with 30 per cent having a low extent of usage and 25.63 per cent having a high extent of utilization. These results are consistent in good agreement with other studies which have shown that the overall extent of utilization of social media among three fourth (79.15%) of the KVK scientists was under the low to medium category James et al., (2020).

Table 1. The extent of usage of social media by extension agents

Categories	Per cent
Low (<0.5)	30.00
Medium (0.5-0.68)	44.37
High (>0.68)	25.63
Total	100.00

Sub indices of the extent of usage of social media

Experience in social media usage (SI1), presented in Table 2 indicated that all the respondents had experience in using social media where the highest number of respondents are having experience from five years in using social media followed by less than one year experience which was followed by more than five years of experience in using social media. It can be inferred that most of them were using social media for the past five years where they can be considered as having full-fledged knowledge and digital literacy in using social media. It can be inferred that developing their skills along with their experience would prove fruitful in due course of time. Regularity of usage (SI2), indicated that the majority of the respondents belong to the category of very frequent use of social media that is, who use it daily, followed by those respondents who use it frequently on weekly basis, least number of respondents under the category of not utilized social media at all. Based on the findings it can be inferred that most of the respondents spend every

Table 2. Distribution of data of sub-indices

Experience	Per cent
SI1: Experience in social media usage:	
Less than one year	32.50
One to five years	46.87
More than five years	20.63
Total	100.00
SI2: Regularity of usage:	
Utilization	Per cent
Not used	2.50
Very rarely (Used at least once in 6 months)	18.13
Rarely (Used at least once in a month)	21.87
Frequently (Used at least once in a week)	26.25
Very frequently (Used at least once a day)	31.25
Total	100.00
SI3: Amount of time spent:	
Amount of time spent	Per cent
Less than One Hour	18.75
One hour	30.62
Two hours	21.88
Three Hours	13.13
Four Hours	4.37
Five hours	3.12
Greater than Five hours	8.13
Total	100.00
SI4: The usefulness of social media:	
Usefulness	Per cent
Very useful	40.00
Useful	56.88
Not Useful	3.12
Total	100.00
SI5- Priority of social media for utilization:	
Criteria	weighted Score / Rank
Saves time	411 / III
Easy to operate	423 / I
Connectedness	400 / IV
Need based	394 / V
Convenient	413 / II
SI6- Categories of content shared through social media:	
Category	weighted score / Rank
Text	378 / III
Audio	376 / IV
Images	420 / I
Video	402 / II

day some of their time on social media which indicated that it has become a part of their life. This can be considered as a platform where the time which they spend on social media can be made productive by empowering them with skills such as quality content creation and integration of multimedia technology in designing their content. The results obtained are broadly consistent with the major trends found by James et al., (2020) which stated that WhatsApp (91.93%) and Facebook (61.49%) were frequently used by KVK scientists regularly.

The amount of time spent (SI3) indicated that the majority of the respondents fall under less than one hour, one hour, two hours, and three hours category of their amount of time spent. It can be inferred that optimum time was being spent on social media by the majority of the respondents along with their work responsibilities daily. This can be made as quality time by enhancing different skills in them through which extension agents can use social media as a tool to make their work more efficient and effective. Much of their daily work where they need information sharing to farmers can be done easily with the use of social media-like technologies. The usefulness of social media (SI4) indicated that most of the respondents, more than half of the sample have stated that social media was useful for their development in job performance, and very few respondents have stated that social media was not useful for their development of job performance. It can be inferred that the importance of social media on individuals' job performance and efficiency was being acknowledged by many of the respondents.

Priority of social media for utilization (SI5) indicated that among all the priority ways, easy to operate was given the highest priority, next highest priority was given to convenience which social media provides, and need-based was the least priority among all others. It was evident from the results that most of the respondents felt that social media was very easy to operate and was very convenient. Providing social media applications that provide more advanced features on ease to operate, convenience, and time-saving will have a higher rate of adoption. Categories of content shared through social media (SI6) indicated that among all the categories of content, Images were given the highest priority followed by video, text, audio respectively. It was evident from the results that images are easily understood and a more attractive way of message dissemination. Videos are the next highest used medium of information dissemination as they will enhance the understanding and interest in learning of the farmers. The results thus obtained are compatible with Tamizhkumaran & Saravanan Raj (2020) which stated that YouTube has great potential in Extension and advisory services. Videos that have valuable information, pictures draw the attention of clients.

An important implication of these findings in Table 3 was that among all the given information, information about agricultural schemes was most prominent followed with Integrated pest management, Integrated disease management, and Integrated nutrient management which indicated that information needs of farmers and information shared by extension agents was mostly concerned about crop health and nutrition management.

These results are consistent and in good agreement with other studies, Iwuchukwu et al., (2019) which have shown that when

Table 3. Purpose of accessing the social media

Information	Weighted score	Weighted mean score
Information about agricultural schemes	413	2.58
Integrated pest management	410	2.56
Integrated disease management	406	2.53
Integrated nutrient management	405	2.53
Information about inputs & government subsidies	405	2.53
Weather forecast	401	2.50
Training and demonstrations	395	2.46
Market demand and supply	394	2.46
Availability of new agricultural machinery	393	2.45
Post-harvest management	391	2.44

Facebook alone was considered, the majority (70.1%) assumed it as a suitable medium for communicating the best soil for agricultural practices and (69.1%) assumed it to be useful for the creation of awareness and participation in agricultural projects. When considering WhatsApp (56.7%.), found it suitable to communicate market situation, agricultural product price, and (53.6%) considered it suitable for communicating the best soil for various agricultural practices. Joshi & Dhaliwal (2019) stated that information seeking was given rank one by the respondents, networking with fellow farmers was ranked two, and sharing the information further with others was ranked third. Similarly, for the solution of the farm-related problem, selling or buying of an agricultural commodity, to know the market rates and for branding of the agricultural commodity were ranked fourth, fifth, sixth, and seventh respectively.

Relationship between socio-personal, job-related variables with the extent of usage

The results in Table 4 indicate that among the categorical variables cross-tabulation was done and chi-square and Fisher's exact test were used to find out the association of the variables with the extent of usage. Based on the results derived from chi-square and Fisher's exact test it was evident that gender has a significant association with the extent of usage at 0.05 level of significance which indicated that males and females have a difference in their extent of usage, social participation also has a significant association with the extent of usage of social media at 0.001 level of significance and training received at 0.05 level of significance. The results of the correlational analysis state that age, achievement motivation, and perceived workload are the variables that were not significantly related to the extent of usage of social media. Innovative proneness has a significant and positive relationship with the extent of usage of social media at a 0.05 level of significance. Variables such as scientific orientation, job perception, job performance, technology management orientation, information management orientation, orientation towards extension service profession have a significant and positive correlation with the extent of usage of social media at 0.01 level of significance.

Based on regression analysis in Table 5 it was revealed that in a stepwise analysis of the independent variables with the extent of usage of social media, five variables namely job perception, technology management orientation, orientation towards extension service profession, social participation, and background were selected. The model with all these five variables was a good fit with

Table 4. Relationship between socio-personal, job-related variables with the extent of usage

Variables	Test	Values	Significance
Gender x Extent of usage	Chi-square test	7.065	0.029^{*}
Background x Extent of usage	Chi-square test	1.584	0.453^{NS}
Education x Extent of usage	Chi-square test	5.624	0.229^{NS}
Work Experience x Extent of usage	Fisher's Exact test	5.133	0.081^{NS}
Social participation x Extent of usage	Chi-square test	18.264	$<0.001^{**}$
Training x Extent of usage	Chi-square test	8.581	0.014^{*}
Pearson Correlation of continuous variables			
Age	Correlation	0.038^{NS}	
Achievement Motivation	Correlation	0.027^{NS}	
Innovative Proneness	Correlation	0.199^{*}	
Scientific Orientation	Correlation	0.273^{**}	
Perceived Work Load	Correlation	0.019^{NS}	
Job perception	Correlation	0.461^{**}	
Job Performance	Correlation	0.306^{**}	
Technology Management Orientation	Correlation	0.449^{**}	
Information Management Orientation	Correlation	0.341^{**}	
Orientation Towards Extension Service Profession	Correlation	0.392^{**}	

NS = Non significant; *Significant at 0.05 level of significance; **Significant at 0.01 level of significance

Table 5. Stepwise multiple regression

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. error	Beta		
(Constant)	-.432	.118		-3.664	.000
Job perception (X_{12})	.013	.003	.266	3.687^{**}	.000
Technology Management Orientation (X_{14})	.008	.002	.268	3.814^{**}	.000
Orientation towards Extension Service Profession (X_{16})	.007	.002	.224	3.224^{**}	.002
Social participation=Participation ($d_{participation}$)	.041	.021	.131	1.993^{*}	.048
Background=Urban (d_{urban})	.049	.025	.128	1.978^{*}	.050

a. Dependent Variable: Extent of usage

R^2 =35.7%

$$Y_2 = -0.432 + 0.013X_{12} + 0.008X_{14} + 0.007X_{16} + 0.041d_{participation} + 0.049d_{urban}$$

NS = Non significant, *Significant at 0.05 level of significance; ** Significant at 0.01 level of significance

an R-square of 35.7 per cent. It can be inferred that individuals' background, their social participation will determine their extent of usage. Job-related factors such as job perception, orientation towards extension service profession along with their technology management orientation determine the extent to which extension agents are using social media in their day-to-day life.

CONCLUSION

As social media is a user-generated content media, different content generation workshops and training can be taken up for the content development and presentation of information in images and video format which helps in the control of incomprehensible information taken from unreliable sources. Own content creation by different extension organizations will prevent the misinterpretation by the farmers and be helpful for the development of location-specific and crop-specific information which is tailor-made. As it is evident from the correlation and regression analysis that a few characteristics such as technology management orientation and orientation towards the extension service profession should be developed by the extension organizations among its agents as it is showing a significant relationship with their extent of usage. Information transfer through social media is accomplished through individual efforts and there is an immense need for organized efforts from the public extension system in India.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (115-119)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Utilization Pattern of Bamboo in North Eastern Region of India

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ARTICLE INFO

Keywords: Bamboo, Products, Uses, Livelihood, North Eastern Region

http://doi.org/10.48165/IJEE.2022.58222

ABSTRACT

The study was conducted in the states of Assam and Meghalaya of India in the year 2020-21. Total 380 respondents were selected using multistage sampling method. The states Assam and Meghalaya, were selected purposively based on availability of processing units and highest productivity, respectively among the North Eastern states. The utilization pattern was classified into household, construction, handicraft, agricultural purpose, and food and other uses. The results indicated of total of 42062 numbers of bamboo culms were utilized by sample respondents. The construction uses contributed highest number of culms and accounted of 35541 numbers (84.50%), followed by household uses 4001 culms (9.51%) and agricultural uses 1350 culms (3.21%). The food consumption was observed of 2.11 per cent while for making handicraft products use was only 0.62 per cent of the total uses. The least bamboo was utilized in the musical instruments (0.05%). The use of bamboo would remain a vital part of the livelihood of people of the region. Therefore, with advancement of technology, trainings and support from government schemes on bamboo in the region would provide ample scope to develop new products and marketing opportunities and thereby generating employment and income to the youth.

INTRODUCTION

Bamboo is the fastest growing plant in the world (FSI, 2017). India has 30 per cent of the world's bamboo resources (FSI, 2017) with the world's largest growing area of 16 million hectares and is producing a total of 39458 million culms with equivalent weight of 278 MT (FSI, 2019). Because of its diversified uses, the bamboo is now addressed with different names such as 'the plant with thousand faces', 'friend of the people' and 'green gold of forests', which was earlier popular as 'poor man's timber' (Goyal & Brahma, 2014). It is used for house construction, bamboo ply, agricultural implements, handicraft, irrigation, brooms, medicine, food, fuel, fodder, paper and pulp, especially bamboo as a perfect substitute for some wood based products (Ingram et al., 2011; Tamang et al., 2013; Sharma et al., 2018). The usual consumption pattern of bamboo in India indicated that 30 per cent of bamboo being consumed by pulp and paper industries (Borah et al., 2008) but the consumption has dropped from 50 per cent to 18 per cent in paper industry over the last four decades while increasing the supply of raw culms (40-63%) (Tambe et al., 2020). Bamboo craft has been practiced by the North Eastern states of India for centuries as their prime livelihood and income source (Unais et al., 2017). Forest cover in NER constitutes 65.05 per cent of its geographical area as compared to the national forest cover of 21.67 per cent. The region along with West Bengal contributes 50 per cent of the bamboo area of the country (FSI, 2019). The region harbour nearly 90 species of bamboos, 41 of which are endemic to the region (Loushambam et al., 2017). The economy of North Eastern states

Received 06-02-2022; Accepted 19-02-2022

of India, especially hilly states depends on organic crop production (Rajavardhan et al., 2020) as it is known to be organic hub of India (Chiphang et al., 2022), animal husbandry (Das et al., 2020), and also on non-timber forest products (NTFP) like bamboo, rattan, broom grass (Tiwari, 2000), bay leaf (Singh et al., 2021) *etc*. Bamboo is grown naturally in the forests and also homestead cultivation is practiced in few parts of the region. Therefore, the study was conducted with the objective to study the different uses of bamboo in the North Eastern Region of India at household level.

METHODOLOGY

The study was carried out using multistage sampling technique. The state Assam and Meghalaya were selected among the North Eastern purposivly. Assam was considered based on the availability of processing units of bamboo such as paper mills, furniture making units, handicraft units which collected bamboo from all other North Eastern states. Meghalaya was selected based on the highest productivity (19.28 ton/ha) of bamboo among all the North Eastern states (FSI, 2017). In Assam, Barpeta and Nalbari district were selected purposively based on highest producer of variety of products with involvement of very large group of artisans/ stakeholders. In Barpeta district, one block was selected purposively as there was highest concentration of the stakeholders available and total of 130 respondents were taken randomly using proportionate sampling method. Similarly in Nalbari district, two blocks were selected purposively and a total of 150 respondents were drawn randomly.

In case of Meghalaya, East Khasi Hills and Ri Bhoi districts were considered based on the pilot survey data which indicated maximum number of stakeholders engaged in the bamboo business among all the districts. In the East Khasi Hills district two blocks were selected purposively based on the concentration of the stakeholders and from each block one village was selected randomly for the study. Similarly in Ri-Bhoi district, Umsning block was selected and two villages were selected randomly. A total of 47 respondents from Ri-Bhoi, and 53 respondents from the East Khasi Hills districts were drawn randomly. Therefore the total sample respondents was summed up to a total of 380 from both the states. Primary data was collected from the sample respondent during 2020-21 through a pre-tested schedule comprising of the use of different products of bamboo, species used and the market price of the products. Simple percentage analysis was applied by taking the total number of bamboo culms used as hundred per cent.

The commercial uses of bamboo were classified into categories given by Unais et al., (2017) as; Household (bamboo furniture, baskets, broom, firewood, etc.), Construction (bamboo houses, scaffolding, bridge and fencing), Handicraft (wall hanging, flower vase, tray, show pieces), Agricultural purpose (grain storing basket, bamboo as support to crop, winnowing tray, ladder, fish traps and collecting baskets, honey collecting baskets etc.) and Food (traditional cuisine in the form of fresh, fermented, dried, shredded or pickled) (Padhan, 2015).

RESULTS AND DISCUSSION

The key bamboo uses in the study area included bamboo house construction, residential fencing, furniture, agricultural purpose, food, fuel and other minor cottage industry handicraft products like basketry, tray, showpiece, lamp and flower vase (Chihongo et al., 2000). The results indicated total of 42062 numbers of culms which were utilized by sampled respondents. The construction uses contributed highest number of culms and accounted of 35541 numbers (84.50%) to the total, followed by household uses 4001 culms (9.51%) and agricultural uses 1350 culms (3.21%). For food consumption, it was observed of 2.11 per cent while for making handicraft products its use was only 0.62 per cent of the total uses. The least bamboo was utilized in the musical instruments (0.05%). Hence, larger use of bamboo was found in construction work. Similar findings were reported by Gogoi (2020).

Household uses of bamboo

The use of bamboo at household level is further categorized into 11 uses namely, bamboo bed, sofa set, dining table, arm chair, sitting stool, broom, fuel, bamboo mat, basket, Polo and Khoh. Furniture use and making of different products has been reported highest use of bamboo culms followed by firewood and other traditional items (Table 1). Bamboo bed was prepared by artisans

Table 1. Household uses of bamboo

Uses	Species	Market price (Rs)	n	No. of bamboo culms
Bed	*Bambusa pallida, Bambusa nutans, Dendrocalamus hamiltoni*	20000-35000/unit	39(10.26)	653(1.53)
Dining table	*B. nutans, B. pallida*	12000-15000/unit	35(9.21)	280(0.67)
Arm chair	*Melocanna baccifera, Dendrocalamus strictus, B.nutans*	1000-1500/unit	44(11.57)	225(0.53)
Sofa set	*B.nutans, B. balcoa*	15000-25000/unit	50(13.15)	353(0.84)
Sitting stool	*B.nutans, B. balcoa*	500-600/unit	105(27.63)	155(0.37)
Firewood	All the species	50/bundle	380(100)	2090(4.97)
Broom	*B.tulda, B. pallida*	100-150/unit	380(100)	38(0.09)
Mat	*B.nutans*	250-300/unit	380(100)	198(0.47)
Basket (Khorahi)	*B.tulda*	100-150/unit	380(100)	291(0.69)
Polo	*Bambusa jaintiana*	120-200/unit	100(26.31)	98(0.23)
Cone basket (Khoh)	*Bambusa jaintiana*	150-200/unit	100(26.31)	101(0.24)
Sub total				4001 (9.51)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

using 15-16 numbers of bamboo culms from three different species of bamboo namely *Bambusa pallida, Bambusa nutans and Dendrocalamus hamiltonii* for commercial as well as home usage. The market price of such per bed ranged from Rs 20000-35000. On an average, total 653 (1.53% of total) numbers of culms were used by 10.26 per cent of respondents for bed making purpose. Similarly, dining table was made using *B. nutans and B. pallida* contributing to an average 280 numbers of culms. About 9.21 per cent of respondents were using dining table made of bamboo in their house. The price of the dining table was observed and prevailed in the market of Rs12000-15000/unit. Sofa set was found to be used by 13.15 per cent of respondents contributing to 350 numbers of bamboo culms use. It was prepared by the artisans using average 7 number of culms of the bamboo species of *B. nutans* and *B. balcoa* per sofa set. For the sofa set, the price was Rs 15000-25000/unit.

Arm chair and sitting stool were other furniture products which were lower priced compared to other products and it ranged from Rs. 1000-1500/unit and Rs. 500-600/unit, respectively. Bamboo species, *viz*, *Melocanna baccifera, Dendrocalamus strictus* and *B. nutans* were used to make arm chair which added upto an average 225 number of culms. On the other hand, 155 numbers of culms were used for making sitting stool from the bamboo species of *B. nutans, B. balcoa*. These results have been supported by Abdullah et al., (2019). Bamboo was used as firewood by all the respondents and its contribution was estimated of 4.97 per cent. All species of the bamboo when dried up used as fuel for cooking and other purposes. It has good fuel qualities like high heat values and volatile contents, as well as low ash and moisture content (Sharma et al., 2018). Bamboo mat, broom and baskets *(khorahi)* were used by all the respondents where it contributed to 198 culms (0.47%), 38 culms (0.09%) and 291 culms (0.69%), respectively. The market price of bamboo broom was observed as Rs 100-150/ unit, bamboo mat 250-300/unit and baskets were ranged from Rs. 100-150/unit, The bamboo species namely, *B. bambos, B. balcooa, B. nutans, B. tulda, B. jaintiana, B. cacharensis, D. hookeri, D. strictus, D. sikkimensis, D. hamiltonii, M. baccifera,* were used by a large population of rural Meghalaya as the principal construction material for building houses, for making mats, baskets, and handicrafts and as food (Lynser et al., 2014). *Polo* and *Khoh* were traditional bamboo baskets made in different forms for various uses in the state of Meghalaya. It was prepared using the bamboo species of *Bambusa jaintiana* (Skhen). The market price of these products ranged from Rs 100-200 based on the sizes. Nongkynrih et al., (2019) also reported similar uses of bamboo in Meghalaya.

Bamboo uses in construction and scaffolding

The highest share of bamboo used was in construction and scaffolding purpose. In rural areas of the NER, bamboo houses played important role in providing shelter, and bamboo for basic requirements like scaffolding, fence and bamboo bridges. All the respondents used bamboo for the same purposes in a larger quantity that made to the largest contribution in the utilization of 35541 culms (84.50%) (Table 2). Out of the this, 48.65 per cent (20462 culms) of bamboo were used for house construction, 25.91 per cent for scaffolding and 8.52 per cent for fencing purpose. Bamboo bridges were prevalent in the rural and hilly areas used on an average of 594 culms (1.41%). Similar studies reported by Kumar et al., (2017); Li & He (2019) on uses of bamboo by local communities to build their houses, scaffolding and fencing of bamboo and bamboo poles were also used as foot bridges over rivers and creeks in the rural areas (KoLwin & Garcia, 2015).

Bamboo uses in handicraft products

There were different handicraft products prepared and used by the respondents. Among them, most common products used in the households were documented (Table 3). *B. pallida, B. nutans* were the bamboo species commonly used for making the handicraft products. Tray contributed around 533 numbers of culms and 75 per cent of respondents used tray at their home and the market price was Rs. 200/unit. Similarly, the market price of the table lamp

Table 2. Bamboo uses in construction and scaffolding

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Bamboo house	*B. tulda, B. pallida*	100-120/culm	380(100)	20462(48.65)
Scaffolding	*B. tulda, B. pallida*	100-120/culm	380(100)	10900(25.91)
Fencing	*B. tulda, B. pallida*	100-120/culm	380(100)	3585(8.52)
Bridges	*B. tulda, B. pallida*	100-120/culm	23(6.05)	594(1.41)
Sub total				35541(84.50)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

Table 3. Bamboo uses in handicraft products

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Tray	*B. pallida, B. nutans*	200/unit	285 (75.00)	53(0.13)
Flower vase	*B. nutans*	80-100/unit	285(75.00)	34(0.08)
Showpiece	*B. pallida, B. nutans*	100-150/unit	276(72.63)	107(0.25)
Lamp	*B. pallida, B. nutans*	250-600/unit	254(67.10)	59(0.14)
Sub total				261(0.62)
Total				42062 (100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

was Rs. 250-600/unit according to the sizes and contributed 0.14 per cent of total utilization. Flower vase contributed lowest among all the handicraft products of bamboo (0.08%). The market price per unit ranged from Rs. 80-100 and 75 per cent of the respondents were using flower vase in their houses. Showpieces like pipe scenery, wall hanging contributed highest 107(0.25%) culms, costing around Rs. 100-150/unit. About 19 per cent of the bamboo is used in handicrafts all over India (Gogoi, 2020). Similar study by Gauli et al., (2018) supports this implication.

Agricultural uses of bamboo

Bamboo has different uses in agricultural purpose (Table 4). Among all the uses fish trap and fish collecting basket, honey collecting basket were mostly used by the respondents of Meghalaya. These products made upto 0.16 per cent, 0.18 per cent and 0.38 per cent respectively. Commonly *B. tulda and B. jaintiana* were used for making different products of agricultural purpose. Bamboo as *support to crops* was used by all the respondents for different crop production and on an average contributed 414 number of culms (0.98%). Traditional umbrella (*Halua Japi* in Assamese/ *Knup* in Khasi) used for land preparation and other activities by the farmers prepared using bamboo and leaves of a palm tree (*Trachycarpus martianus*) contributed of 0.29 per cent to total use which market price was Rs. 50-70/unit. Ladder is one of the important products prepared from bamboo in the region and 26.31 per cent respondents used in their household adding upto an average 220 number of culms. Market price for a ladder made of three bamboo culms rise upto Rs. 210/unit. Winnowing tray was used in every household of the respondents. It contributed on an average of 28 culms (0.07%) to the total. The market price was observed of Rs. 150-200/unit. Similarly, the market price of the grain storing basket was Rs. 500-800/unit and used around 266 (0.63%) number of bamboo culms by 86.31 per cent of total respondents.

Food and other uses of bamboo

Bamboo shoots have been used as food in all the states of NER. Bamboo shoots harvested were consumed or sold as unprocessed fresh shoots but only processed shoots were consumed at home (Hogarth & Belcher, 2013). In Meghalaya, all the respondents reported use of bamboo shoots for consumption, on the contrary in Assam, a very few were consuming bamboo shoots (Table 5). The bamboo shoots of different species like *B. balcoa and M. baccifera* were used as food. It was consumed in raw form (0.93%) by 31.50 per cent respondents, fermented shoot (0.80%) by 26.31 per cent and as pickle (0.39%) by 25 per cent respondents, which was prepared with oil, chilli and different spices. Bamboo pickle production and sale on a tourist spot in Meghalaya alone reported at 1,170 kg to 2,210 kg per annum (Gogoi, 2020).

It was identified that musical instruments were some other major products of bamboo used by the respondents (Table 5). *Gogona* (Assamese traditional) is an instrument prepared from bamboo used in the folk music (*Bihu*) of Assam. *Flute* was used in both the states as traditional musical instrument and contributed 0.04 per cent of total use whereas *Gogona* contributed very negligible quantity (0.01%). Similar study by Sharma et al., (2008) mentioned that, traditional musical instruments such as *flutes, rattles, wind chimes* were prepared from bamboo.

Table 4. Agricultural uses of bamboo

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Fish Trap	*B. tulda*	100-150	153(40.26)	66(0.16)
Fish container	*B. tulda*	100-150	153(40.26)	76(0.18)
Support to crop	All the species	70-150/culm	380(100)	414(0.98)
Umbrella (Halua Japi/Knup)	*B. tulda*	50-70/unit	150(39.47)	120(0.29)
Ladder	*B. tulda, P. mannii Gamble*	210/unit	100(26.31)	220(0.52)
Honey collecting basket	*P. mannii Gamble*	100-150/unit	50(13.15)	161(0.38)
Winnowing tray	*B. tulda*	150-200/unit	380(100)	28(0.07)
Grain storing basket	*B. tulda*	500-800/unit	328(86.31)	266 (0.63)
Sub total				1350 (3.21)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

Table 5. Food and other uses of bamboo

Uses	Species	Market price (Rs)	F	No. of bamboo culms
Raw bamboo shoot	*B. balcoa, M. baccifera*	20-30/shoot	120 (31.5)	390(0.93)
Fermented Bamboo shoot	*B. balcoa, M. baccifera*	150/kg	100(26.31)	337 (0.80)
Bamboo shoot pickle	*B. balcoa, M. baccifera*	100/150gm	95(25.00)	163(0.39)
Sub total				890 (2.11)
Musical instruments				
Flute	*D. strictus*	500/unit	17(4.47)	17(0.04)
Gogona (Assamese traditional)	*B. tulda*	150-300/unit	30(7.89)	3(0.01)
Total				42062(100)

Note: Figures in the parentheses indicate percentage to total; *Source:* Field Survey (2020-21)

CONCLUSION

Bamboo being one of the most important NTFP in the livelihood of the rural people of the NER of India was found to be used in more for the construction purposes. The study revealed that use of bamboo for engineered products and value-added high-quality products along with traditional products were negligible despite rising global demand for it. Therefore, it is recommended that the artisans/ stakeholders need to get acquainted to the demand for value added products in the global market especially the youth to be encouraged to produce and market it to have a better income and living. Alongside, hands on training for product development, use of new machines and tools, information on market linkages at global level need to be taken into consideration by the state governments of the NER.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (120-123)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Effectiveness of Personal versus Online Extension Methods in Disseminating Knowledge on Household Waste Management

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ARTICLE INFO

Keywords: Extension methods, Personal contact, Video conferencing, ICT based messages, Print material, Intervention, Gain in knowledge

http://doi.org/10.48165/IJEE.2022.58223

ABSTRACT

The article highlights the effectiveness of personal and online extension methods for disseminating knowledge on household waste management. A pre-test, post-test experimental design was used for the study. Thirty women, each from five randomly selected urban localities of Ludhiana district of Punjab were selected for the study, making a total of 150 respondents as the sample size. Of the five urban localities, four localities were randomly chosen for the experiment and one locality was chosen as the control group. Data was collected using a structured interview schedule consisting of a self-designed knowledge test on household waste management. Findings revealed that all the selected extension methods were effective in disseminating knowledge to the respondents. The most effective extension method was personal contact + print material followed by video conferencing + ICT based messages, video conferencing, and personal contact method. One-way ANOVA revealed significant differences in gain in knowledge by the respondents of the study groups' $p < 0.001$. Post-hoc analysis further revealed that the effect of both personal and online extension methods when supplemented with educational materials and when used solo, had statistically similar effects on gain in knowledge.

INTRODUCTION

Since years extension; the information and knowledge support system for people, has played a magnificent role in providing knowledge to the people and making them aware of betterment and realization of their settings. It plays a vital role in making people aware and convincing them to take action (Patel et al., 2019). The process of disseminating information requires a method to be put to use. Numerous extension methods like farm and home visits, demonstrations, study tours, field days, etc. till now have proved to be effective in disseminating knowledge and changing the behaviour of people on various issues (Olawale et al., 2013). But today, with the advancement in technology we have ample online extension methods like video conferencing, social networking applications, digital messages, etc. available for information dissemination (Barton et al., 2017; Capila & Sachdev, 2010). These methods contribute to a great extent not only in increasing knowledge of the people but also in meeting the developmental goals of communities (O'Donnell, 2009). History provides great evidence of extension methods being successfully used in disseminating an array of important information to the people (Mahra et al., 2017) and making them aware about certain drastic issues. From agriculture to health to hygiene, the use extension methods have proved to be effective in spreading awareness and providing people with necessary information (Kumari et al., 2019).

However, if we carefully gaze at the current and future issues affecting the planet, waste management is the most alarming, challenging, and threatening (Asteria & Haryanto, 2021). The world is increasingly generating chunks of trash the majority of which comes from the households (Kaza et al., 2018). The high rise in population, urbanization, and industrialization goes hand in hand with the rise in waste production (Hoornweg & Bhada-Tata, 2012). It is not only baleful to human health but also to the environment (Yoada et al., 2014). To deal with the waste produced at the

Received 30-01-2022; Accepted 21-02-2022

household level effective waste management strategies should be employed, however the lack of knowledge and interest can be a major loop hole in the process of employing waste management strategies by individuals. So it is more important to disseminate knowledge and increase the interest of people towards waste management. Therefore, the study was conducted with an aim to compare the effectiveness of personal and online extension methods in disseminating knowledge on household waste management and to investigate the effect of socio-personal characteristics on gain in knowledge by the respondents.

METHODOLOGY

The study was conducted in randomly selected five urban localities of Ludhiana district of Punjab. For the study, experimental research design was used having four experimental groups and a control group. Thirty women in the age group of 20-55 years were randomly chosen from each of the selected urban localities. Thus, a total of 150 respondents were selected for the study. Respondents of each selected group were subjected to a pre knowledge test followed by an intervention given only to the experimental groups through selected extension methods. For the intervention, experimental group 1 (E1), experimental group 2 (E2), experimental group 3 (E3), and experimental group 4 (E4) were exposed to personal contact method, personal contact + print material, video conferencing, and video conferencing + ICT based messages respectively. The control group (C) received no intervention. The intervention was given one month after the pre knowledge test, followed by a post knowledge test administered two weeks after the intervention. The difference between the pre and post knowledge test scores highlighted the gain in knowledge by the respondents and per cent gain in knowledge was used to determine the effectiveness of extension methods for disseminating knowledge on household waste management.

$$\text{Effectiveness of extension method} = \left\{\left(\frac{\text{Post knowledge test scores EG} - \text{Pre knowledge test scores EG}}{\text{Pre knowledge test scores EG}}\right) - \left(\frac{\text{Post knowledge test scores CG} - \text{Pre knowledge test scores CG}}{\text{Pre knowledge test scores CG}}\right)\right\}$$

Where, EG = Experimental Group; CG = Control Group

The data was collected in two stages (before and after the intervention) using a structured interview schedule consisting of a self-designed knowledge test (reliability score = 0.80 and validity score= 0.89) on household waste management.

Different statistical tools including percentages and means, Z-test, One-way Analysis of Variance (ANOVA) and post-hoc analysis (Tukey's Test) were used to analyze the data. Data were analyzed using Statistical Package for the Social Sciences Version 28 (IBM Corp).

RESULTS AND DISCUSSION

Knowledge level of the respondents on household waste management before and after the intervention

Table 1 depicts the knowledge level of the respondents before and after the intervention. It can be observed that before the intervention, in experimental group 1, more than one-fourth (26.67%) of the respondents had a low knowledge level, more than two-fifth (43.33%) of the respondents had a medium knowledge level, and 30.00 per cent respondents had a high knowledge level. Whereas, after the intervention (Personal contact) almost all (96.67%) the respondents reached to a high knowledge level. A statistically significant difference at 5 per cent level of significance was observed in each category of knowledge before and after the intervention. It can be concluded that there was gain in knowledge of the respondents after the intervention.

In experimental group 2, before the intervention most (80.00%) of the respondents had a low knowledge level, few (13.33%) respondents had a medium knowledge level, and only two (6.67%) respondents had a high knowledge level whereas after the intervention (Personal contact + Print media) nearly one-fourth (23.33%) of the respondents moved to a medium knowledge level and majority (76.67%) of the respondents moved to high knowledge level. A statistically significant difference at 5 per cent level of significance was observed in each category of knowledge before and after the intervention. Therefore gain in knowledge of the respondents was reported after the intervention.

In experimental group 3, before the intervention more than two-fifth (43.33%) of the respondents had a low knowledge level, more than half (53.33%) of the respondents had a medium knowledge level, and only one (3.33%) of the respondents was in high knowledge level. Whereas, after the intervention (Video conferencing) one-fifth (20.00%) of the respondents had a medium knowledge level, and most (80.00%) of the respondents reached to high knowledge level. A statistically significant difference at 5 per cent level of significance was observed in each category of knowledge before and after the intervention. Hence, it can be said that there was gain in knowledge of the respondents after the intervention. In experimental group 4, before the intervention two-fifth (40.00%) of the respondents had low knowledge level, more than half (56.67%) of the respondents had a medium knowledge level and only one (3.33%) respondent had a high knowledge level. After the intervention (Video conferencing + ICT messages), only one (3.33%) respondent had a medium knowledge and almost all (96.67%) the respondents moved to high knowledge level. A statistically significant difference at 5 per cent level of significance was observed in each category of knowledge before and after the intervention. It can be concluded that there was gain in knowledge of the respondents after the intervention.

And lastly, in the control group, 46. 67 per cent of the respondents had a low knowledge level, more than two-fifth (43.33%) of the respondents had a medium knowledge level, and very few (10.00%) of the respondents had a high knowledge level before the intervention. The proportion of the respondents in all categories of knowledge was exactly the same after the intervention. No percentage shift in the proportion of respondents was observed at all levels of knowledge. Hence, no change in knowledge was observed in the control group. Findings of the study are consistent with the results of the studies conducted by Salim et al., (2020) and Widiyanto et al., (2019) where respondent's knowledge increased after the intervention. D'Cruz & Aradhya (2013) in their study also reported no change in control group after intervention.

Table 1. Knowledge level of the respondents on household waste management before and after the intervention

Study Groups	Extension Method	Level of knowledge	Before F (%)	After F (%)	Per cent Shift	z test
E1	Personal contact	Low (0-18)	8 26.67)	0(0.00)	-26.67	3.04*
		Medium (19-37)	13(43.33)	1(3.33)	-40.00	3.66*
		High (38-56)	9(30.00)	29(96.67)	66.67	-5.36*
E2	Personal contact + print material	Low (0-18)	24(80.00)	0(0.00)	-80.00	6.32*
		Medium (19-37)	4(13.33)	7(23.33)	10.00	-1.00
		High (38-56)	2(6.67)	23(76.67)	70.00	-5.5*
E3	Video conferencing	Low (0-18)	13(43.33)	0(0.00)	-43.33	4.07*
		Medium (19-37)	16(53.33)	6(20.00)	-33.33	2.68*
		High (38-56)	1(3.33)	24(80.00)	76.67	-6.02*
E4	Video conferencing + ICT based messages	Low (0-18)	12(40.00)	0(0.00)	-40.00	3.87*
		Medium (19-37)	17(56.67)	1(3.33)	-53.34	4.51*
		High (38-56)	1(3.33)	29(96.67)	93.34	-7.23*
C	No intervention	Low (0-18)	14(46.67)	14(46.67)	0.00	0
		Medium (19-37)	13(43.33)	13(43.33)	0.00	0
		High (38-56)	3(10.00)	3(10.00)	0.00	0

*Significant at 0.05 level of significance

Comparison of effectiveness of selected extension methods in terms of gain in knowledge

The data given in Table 2 highlights the mean knowledge score of the study groups before and after the intervention, and mean knowledge score with regard to gain in knowledge. The table also highlights the per cent gain in knowledge by the study groups exposed to different extension methods. It can be observed that before the intervention, experimental group 1 had a mean knowledge score of 28.20 whereas, after the intervention through the personal contact method the mean knowledge score increased to 51.37. An increase of 23.17 scores was reported through personal contact method that contributed to 82.16 per cent increase in the knowledge of the respondents of experimental group 1. Personal contact provides the opportunity to have a rapport with the respondents and makes the concepts understandable. In experimental group 2, before the intervention the mean knowledge score was 16.23 (least as compared to any other selected group), although after the intervention through the personal contact method + print materials the mean knowledge score increased to 45.87. The per cent gain in knowledge by the respondents was reported to be highest i.e. 182.56 per cent ($\bar{x}$ = 29.63 Gain in knowledge mean score). It can be stated that personal contact along with the supplementary material can help respondents to retain the knowledge for a longer time. This may have contributed to the maximum gain in knowledge of the respondents of experimental group 2. Experimental group 3 had a mean knowledge score of 23.03 before the intervention however after the intervention through video conferencing the mean knowledge score increased to 44.97. The per cent gain in knowledge by the respondents was 95.22 ($\bar{x}$ = 21.93 Gain in knowledge mean score). It can be observed that per cent gain in knowledge through video conferencing method was slightly more than the personal contact method. It may be due to the fact that in video conferencing method all the respondents were addressed at the same time and they were able to attend the session attentively without any break. In experimental group 4, before the intervention the mean knowledge score was 21.70 but after the intervention through video conferencing + ICT based messages the mean knowledge score increased to 52.37. The per cent gain in knowledge by the respondents was 141.34 ($\bar{x}$ = 30.67 Gain in knowledge mean score). It can be stated that delivery of information at the same time to all the respondents and follow-up messages in the following week may have contributed to the second highest gain in knowledge of the respondents. The control group that received no intervention showed a percent increase of only 2.38 per cent which is negligible.

It can be stated that after the intervention the mean knowledge score of all the study groups increased except the control group. The findings are in line with the results of the study conducted by Van Campenhout et al., (2021) which reported increase in knowledge of the respondents after the intervention through audio-visual methods. Statistical observations show that there was a significant difference in the mean knowledge scores of the study

Table 2. Comparison of selected extension methods in terms of gain in knowledge by the respondents

Groups	Extension Method	Mean Knowledge Score			Per cent gain in knowledge	F value	Significance
		Before intervention (Pre-knowledge test)	After intervention (Post-knowledge test)	Gain in knowledge			
E1	Personal contact	28.20 [a]	51.37 [a]	23.17 [b]	82.16		
E2	Personal contact + print material	16.23 [c]	45.87 [b]	29.63 [a]	182.56		
E3	Video conferencing	23.03 [a,b]	44.97 [b]	21.93 [b]	95.22	66.99	p <0.001
E4	Video conferencing + ICT based messages	21.70 [b,c]	52.37 [a]	30.67 [a]	141.34		
C	(No intervention)	21.01 [b,c]	21.60 [c]	0.50 [c]	2.38		

Means with different superscript in a column differ significantly

groups exposed to the selected extension methods (F=66.99, p<0.001). Personal contact method + print material extension method was the most effective in increasing knowledge of the respondents on household waste management followed by videoconferencing + ICT based messages, videoconferencing alone, and the least effective was personal contact extension method. However, the effect of personal contact + print material and video conferencing + ICT based messages on gain in knowledge by the respondents was statistically similar. Also, effect of video conferencing and personal contact method alone, was statistically similar. Therefore, it can be concluded that personal contact or online extension method should always be supplemented with educational materials for more effectiveness. Further, the effect of socio-personal characteristics such as age, education, occupation, family size and family education on gain in knowledge was checked statistically but no significant correlation was reported. Thus, it can be said that the intervention given through the selected extension methods was the only factor that affected the gain in knowledge by the respondents and it has no effect of socio-personal characteristics.

CONCLUSION

The study revealed the comparative effectiveness of personal and online extension methods in disseminating knowledge to the respondents on household waste management. Though all the selected extension methods were effective in disseminating knowledge to the respondents, the highest effect on gain in knowledge by the respondents was observed through personal contact method supplemented with print material followed by videoconferencing method supplemented with ICT based messages then videoconferencing alone, and personal contact method alone. Statistically, the solo usage of the personal and online extension methods had similar effects on gain in knowledge by the respondents. Statistically similar effects on gain in knowledge by the respondents were also observed when the personal and online extension methods were supplemented with educational materials. Therefore the study concludes that personal contact or online extension method should always be supplemented with educational materials for more effectiveness.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (124-128)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Profitability Analysis and Stakeholders Perception of Banana Value Chain in Nadia District of West Bengal

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ARTICLE INFO

Keywords: Value chain, Marketing efficiency, Marketing margin, Stakeholders, Producer's share in consumers rupees

http://doi.org/10.48165/IJEE.2022.58224

ABSTRACT

Banana occupies the highest rank among India's fruit crops both in area and production. The study was conducted on four randomly selected banana marketing channels namely Habibpur to Kolkata marketing channel (Channel-I), Habibpur local marketing channel (Channel-II), Kalyani to Kolkata marketing channel (Channel-III), and Kalyani local marketing channel (Channel-IV) of Nadia District of West Bengal during 2019 to identify marketing efficiency of the channels and comparing them in respect of value chain management (VCM) abilities. The responses were collected from forty producers, sixteen commission agents, thirty wholesalers, forty-four retailers, and twenty consumers of the marketing channel through a structured interview schedule. It was observed that the marketing efficiency of the Channel-III for all of the four important banana varieties of *'Singapuri', 'Champa', 'Martaman' and 'Kanthali'* were higher than the Channel-I because of its better transportation management system, storage management facilities, and value distribution index. The marketing efficiency of the local marketing channel was distinctly higher in respect of Kolkata marketing channels. Less number of the stakeholder's intervention in the local market channels might be the determining factor for it.

INTRODUCTION

For a long time, India has achieved sufficiency in agricultural as well as horticultural production which justifies that increasing production is not a major concern in the present scenario. India has reported 320.76 million tons of horticulture crop production during 2017-18, among which 102.02 million tons of fruit crops. Among the total fruit crops, Banana alone occupies 0.92 million hectares area and production of 32.59 million tons which signifies its importance itself. West Bengal is one of the leading banana producing states of the nation. It accounts for 4% of the total country's share in banana production (Horticultural Statistics at a Glance, 2018). The major varieties grown in the state are *'Singapuri', 'Champa', 'Martaman',' Kanthali', 'Amritsagar', 'Giant Governor',' Lacatan'* etc. (Ghosh et al., 2013). The districts that have a great share of in-state production of bananas are Hooghly, Howrah, Nadia, North 24 Parganas., Murshidabad, Malda, Bankura, Burdwan, and Purulia (Fonsah & Amin, 2017; Saha et al., 2021). Though productivity of the state is too high, more than 90 per cent of the production follows the traditional way of the supply chain which causes a huge post-harvest loss at each stage of the value chain (Oberoi & Dinesh, 2019). In terms of profitability, employment, and air pollution emissions, the value chain has an advantage, but it also has constraints in terms of coordination, value share, profit margin, market diversity, product and market knowledge, transportation, waste management, and safety and hygiene (Gebre et al., 2020) while developing an integrated value chain can also be a low-cost method to increase farmer income and food security (Kuijpers, 2020).

Received 16-01-2022; Accepted 22-02-2022

Marketing of the fruit crop is a great challenge due to its high perishability and bulky nature. The fruits crops are mostly sold through unorganized marketing channels (Ray, 2020) which causes huge post-harvest wastage and quality inferiority. This leads to income fluctuation, affecting the livelihood of the farmers (Chand et al., 2021). India has noticeable area coverage, effective productivity, and year-wide availability of bananas. Despite having favorable geographical as well as climatic conditions actual potentials are yet to be realized due to poor post-harvest management, fragmented and small farm sizes, and inadequate connectivity to global markets (Wardhan et al., 2022). To mitigate these drawbacks a VCM can play a significant role which can be facilitated by forming a cooperative marketing network or the Farmer Producer Company (Roy et al., 2022) for analyzing effective marketing channels and ensuring equitable value distribution among the stakeholders engaged in every turn of the channel (Trienekens, 2011). It seeks to address the major constraints at each level of the supply chain, rather than focusing on just one group or one geographical location (Webber & Labaste, 2009). Development of the banana value chain requires technical feasibility with the system's innovation potential along with efficient management of constraints related to economic and cultural difficulties (Fiallos-Cárdenas et al., 2022). The present study tries to identify different marketing channels of bananas, analyzing the marketing efficiency of the channels and different stakeholders' perspectives of VCM in the Nadia district of West Bengal.

METHODOLOGY

The present study was conducted on four purposely selected banana marketing channels of Nadia district of West Bengal in the year 2019. The district was selected as it has a huge production capacity and the strongest marketing channels of the crops. Total 150 stakeholders (producers, traders/primary stakeholders, secondary stakeholders, retailers, and consumers) were randomly selected as a sample from all the marketing channels of the research. Some important terminology used in the research work are explained here-

Price spread = (Retail price - Producer price); Marketing margin = (Retail price- Production cost)

Producer's share in consumer's rupee (Ps) and Marketing efficiency (ME) were calculated by using the formula suggested by Acharya & Agarwal (2005),

$$Ps = (FP/RP) \times 100$$

Where, Ps = producer's share in consumer's rupees, FP = Producer's price, RP = Retail price

$$ME = FP / (MC+MM)$$

Where, Marketing Efficiency (ME), Total Marketing Costs (MC), Net Marketing Margins (MM), Prices Received by the Farmers (FP).

$$\text{Value Addition \%} = \frac{\text{Added value in each level}}{\text{Total added value in the channel}} \times 100$$

$$\text{Index value} = \frac{\{(f_1x_1) + (f_2x_2) + (f_3x_3) + (f_4x_4) + (f_5x_5)\}}{\text{Total frequency}}$$

Where, x_1, x_2, x_3, x_4 and x_5 were score value of the five-point scale and f_1, f_2, f_3, f_4 and f_5 were score wise frequencies (Ray & Mondal, 2011).

Spearman's rank correlation coefficient (r_s): It measures the degree of similarity between two rankings using a monotonic function (Kumar & Abirami, 2018),

$$r_s = \frac{1 - 6\Sigma d_i^2}{n(n^2-1)}$$

Where, d_i = Difference between the two ranks of each observation, n = Number of observations.

RESULTS AND DISCUSSION

Profitability analysis among selected marketing channels

Selected marketing channels of bananas were analyzed based on some imperative data viz. cost of production, value distribution, marketing margin, price spread, producer's share, etc. in the present study is diagrammatically presented in Figure 1. The study reveals that around sixty-seven per cent of banana producers of Ramlaxshmitala village of Santipur block was marketing their produce through Channel-I. They directly brought their produce to the Arat and sold it through commission agents. Small or marginal farmers of the village with a low volume of products was sold their product in the local market through Channel-II. In the case of Saguna village of Chakdah block, around eighty-five per cent of the banana growers follow Channel-III. The market was near the Kalyani Ghoshpara railway station which may reduce the transportation cost and post-harvest wastage and make the channel profitable for the bulk producer. In Channel-IV farmers brought their produce to the local market of Kalyani and sold through open auctions and brought a better price. The commission agent is not directly taking part in the marketing channels. They obtain six per cent of the producer's selling price due to developing and maintaining the bulk selling platform. Habibpur banana market was located beside the National Highway-34 which facilitates transportation of the market

I. Habibpur to Kolkata banana marketing channel (Channel-I): Producer → Trader/Primary wholesaler → Secondary wholesaler → Kolkata market retailer → Consumer

II. Habibpur local marketing channel (Channel-II): Producer → Wholesaler → Local market retailer → Consumer

III. Kalyani to Kolkata banana marketing channel (Channel-III): Producer → Trader/Primary wholesaler → Secondary wholesaler → Kolkata market retailer → Consumer

IV. Kalyani local marketing channel (Channel-IV): Producer → Wholesaler → Local market retailer → Consumer

Figure 1. Diagramatic representation of selected marketing channels

Table 1. Marketing margin, producer share in consumer's rupees, and marketing efficiency of selected marketing channels

Banana varieties	Marketing Channel	Rupees per bunch price levels (150 pieces)						
		FP	RP	TMC	MM	AV	ME	PS
Singapuri and Champa	Channel-I	132.50	715.00	185.00	582.50	475.00	0.17	18.27
	Channel-III	147.50	715.00	153.00	567.50	514.00	0.20	20.50
Martaman	Channel-I	167.50	900.00	289.50	732.50	534.00	0.16	18.50
	Channel-III	170.00	900.00	235.00	730.00	594.00	0.17	18.83
Kanthali	Channel-I	187.50	1025.00	331.00	837.50	612.50	0.15	18.20
	Channel-III	148.75	1025.00	307.50	837.50	645.00	0.16	18.19
Singapuri and Champa	Channel-I	132.50	715.00	185.00	582.50	475.00	0.17	18.27
	Channel-II	80.00	562.50	107.00	415.00	403.50	0.29	26.12
Martaman	Channel-I	167.50	900.00	289.50	732.50	534.00	0.16	18.50
	Channel-II	180.00	650.00	97.00	470.00	470.50	0.31	27.57
Kanthali	Channel-I	187.50	1025.00	331.00	837.50	612.50	0.15	18.20
	Channel-II	202.50	750.00	118.50	547.50	554.00	0.30	26.81
Singapuri and Champa	Channel-III	147.50	715.00	153.00	567.50	514.00	0.20	20.50
	Channel-IV	167.50	637.50	82.00	470.00	498.50	0.30	26.19
Martaman	Channel-III	170.00	900.00	235.00	730.00	594.00	0.17	18.83
	Channel-IV	187.50	687.50	88.00	500.00	531.00	0.32	26.97
Kanthali	Channel-III	148.75	1025.00	307.50	837.50	645.00	0.16	18.19
	Channel-IV	212.50	752.50	95.00	540.00	582.50	0.34	28.17

FP= Price Received by Farmers; RP= Retail Price; TMC= Total Marketing cost; MM= Marketing Margin; AV= Added Value; ME= Marketing Efficiency; PS= Producer's Share in Consumers Rupees.

by truck. Hiking price of petrol, fruit quality reduction due to jerking, loading-unloading cost make the marketing cost higher than the Channel-III, which was situated near to the Kalyani Ghoshpara railway station. The price received by the farmers for a bunch of 150 pieces of banana was about Rs. 132.50 for Singapuri and Champa, Rs. 167.50 for Martaman, and Rs.187.50 for Kanthali, for which the consumer paid Rs. 715, Rs. 900 and Rs. 1025 respectively in the Channel-I.

In case of Channel-III farmers received Rs. 147.50 for Singapuri & Champa, Rs. 170 for Martaman and Rs. 148.75 for Kanthali for the consumer rupees Rs. 715, Rs. 900 and Rs.1025 gradually. Table 1 presents the estimation of marketing margin, producer share in consumer's rupees, and marketing efficiency of selected three marketing channels. The margins earned by producers, primary wholesalers, secondary wholesalers, and retailers of channel-I were 13.51, 20.25, 24.74 and 39.93 per cent and for the channel-III, it was 15.98,17.13, 24.21 and 39.50 per cent consequently. Producers' share in consumer rupees was 18.27 for Singapuri and Champa, 18.50 for Martaman, and 18.20 for Kanthali banana variety, and the marketing efficiency of Channel-I was highest for Singapuri and Champa varieties (0.17) followed by Martaman (0.16) and Kanthali (0.15) banana varieties. Marketing efficiency (Singapuri and Champa - 0.20, Martaman - 0.17 and Kanthali - 0.16) and producers' share in consumer rupees (Singapuri and Champa - 20.50, Martaman-18.83 and Kanthali - 18.19) both are higher in the case of Channel-III for all the varieties than Channel-I.

Marketing efficiency and producer's share in consumer rupees in Habibpur local marketing channel (Channel-II) were highest for Martaman varieties (ME=0.31; PS=27.75) whereas Kalyani local marketing channel (Channel-IV) Kanthali varieties (ME=0.34, PS=28.17) seems as most suitable might be because of its high local consumers' preference which can be mitigated by value addition (Rajavardhan et al., 2020). It also reveals that both the local marketing channels are more efficient than the Kolkata market based on value distribution and producer share in consumers' rupees. A similar study also revealed that the losses incurred during the marketing is a main concern due to unavailability of scientific storage and packaging (Singh et al., 2021) along with reduction of stakeholders' interference was the prime reason behind the effectiveness of local marketing channels. Both the producer and consumer are at loss in the longer marketing chains and intermediaries reap the major portion of the benefit (Nain et al., 2019). Gibbon (2003) suggests that reduction of the strong influence of the intermediaries, establishment of alternative marketing channels, equivalent value distribution among the stakeholders can upgrade the marketing efficiency of the fruits and vegetables marketing channel. Local marketing channels also gain other advantages like low transportation cost, less wastage, no packaging and grading cost, etc. Development of a proper cold storage facility with various temperature settings for the different fruit crops and vegetables, which reduce the postharvest wastage and improve quality management was suggested by Chand et al., (2021) in their similar study. Though the study explains local marketing channels as most suitable for all the four banana varieties, the majority of the stakeholders prefer Kolkata marketing channels due to their profuse accessibility. A similar study also suggests that quick engagement of price indicators, logistical advantage, good communication facilities, and transport services play an effective role to improve marketing efficiency Saha et al., (2021).

Stakeholders' perception ranking on Value Chain management

The stakeholders' perception ranking on VCM (Table 2) suggests that the stakeholders of Habibpur marketing channels were specialized in mostly production management (4.16) followed by biosecurity management (4.09), stakeholder's perception power (4.08) whereas they have lacked in market information management

Table 2. Spearman's rank correlation of stakeholders' perception on VCM between selected marketing channels

S.No.	Particulars	HMC		KMC		Spearman's rank correlation
		Index value	Rank	Index value	Rank	
1	Biosecurity management	4.09	2	4.41	1	
2	Consumer preference	4.07	4	3.84	9	
3	Equivalent value distribution	2.67	13	3.80	11	
4	Grading and packaging	4.05	5	3.88	8	
5	Input management	3.88	7	3.91	6	
6	Market information management	2.89	12	3.51	15	
7	Post-harvest handling	3.25	9	3.83	10	$r_s = 0.675^{**}$
8	Product quality management	3.95	6	4.11	5	
9	Production management	4.16	1	4.21	2	
10	Proper channel management	3.12	10	3.91	7	
11	Skilled labour management	3.05	11	3.67	13	
12	Stakeholder's perception power	4.08	3	4.20	3	
13	Storage facilities	2.32	15	3.64	14	
14	Technology management	3.29	8	3.73	12	
15	Transportation management	2.53	14	4.11	4	

** n= 15; Correlation is significant at the 0.01 level (2-tailed); Habibpur marketing channels - (HMC); Kalyani marketing channel - (KMC)

(2.89), value distribution management (2.67), transportation management (2.53), and most extremely in storage management (2.32). In the case of Kalyani marketing channels, had revealed that stakeholders were focused on skills in bio-security management (4.41), production management (4.21), stakeholder's perception power (4.20), transportation management (4.11), whereas they are least concerned about technology management (3.73), skilled labour management (3.67), and storage facilities (3.64) and market information management skill (3.51). Spearman's rank correlation coefficient between stakeholders' perception about VCM of banana of Habibpur marketing channels and Kalyani marketing channels reveals that there is a strong relationship ($r_s = 0.675$) is present between the selected marketing channels which suggest that stakeholders' perceptions about VCM practices were closely related for all of the channels. While a similar finding also suggests that identification of consumer need-based value addition can played a significant role to make the channel efficient (Anastasiadis & van Dam, 2014).

CONCLUSION

Strategies to enhance marketing efficiency of fruits would vary according to nature of produce and the kind of marketing facilities in a particular region. The present study reveals that minimization of stakeholders' level can maximizing marketing efficiency and also producer's share. The producers are suffering with low margin from the middlemen because of their poor knowledge about market information, consumer demand, improper post-harvest handling, storage, transportation as well as the whole value chain management system. To overcome the problems, small fruit growers can be strengthened by cooperatives/ producer organizer groups for trouble-free disposal of produce and better bargaining power. Beside its endorsement of cold storage facilities, reduction of strong influence of the intermediaries, establishment of alternative marketing channels like contract farming and farmers' producer companies etc. and proper awareness about effective and efficient value chain management can enhance stakeholders' income through proper value chain management.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (129-134)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Marketing Skills and Sanitary Status of Retail Meat Shops In relation to Butchers' Educational Background in Maharashtra

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ARTICLE INFO

Keywords: Butchers shop, Education, Sanitary status, Skill development, COVID-19

http://doi.org/10.48165/IJEE.2022.58225

ABSTRACT

In India meat production is an unorganized business, although, ideally the butchers should possess basic education along sound understanding of sanitary practices and have standard infrastructure promoting meat business. A study was carried out in year 2021 to study the impact of butchers' education on marketing skills and sanitary status of retail meat shops. The data was collected on 118 butchers' shop through interview method. The study revealed that 42.37 per cent of the respondents had completed their secondary education with average age between 25-35 years. The study showed that 67.80 percent respondents running butchery as family business without undergoing any professional training. Butcher shops (42.37%) sales both chicken and mutton of which 68.64 and 80.51 per cent shops had registration with FSSAI and local body, respectively. COVID-19 has not affected meat business as compare to various religious festivals. Respondents (65.25%) believed that online marketing by corporate companies may not affect local meat business. Majority of butchers (85.59%) were unaware about modern slaughtering equipments. Considering the findings, a comprehensive skill development programme may be initiated on hygienic meat production.

INTRODUCTION

Livestock production and agriculture are intrinsically related to each other for overall food security. Livestock sector is an essential sub-sector of the agriculture of Indian economy. Livestock and poultry play an important role in improving the economic conditions of rural masses of India. Sustained income and economic growth, growing urban population, transportation and storage facilities and the rise of supermarkets in rural towns are crucial factors for the rapid increase in the consumption of animal-based food products. In India meat production is mainly an unorganized business, yet a vital segment of Indian agriculture. There are about 8000 registered and more than 20,000 unregistered slaughter houses in the country (Suwal, 2019). There is no specific data available on number of non registered retail meat shop across the India. Most of the retail meat shops have inadequate facility and usually located on side of roads and streets.

The nation holds world's largest population of livestock at about 535.78 million and showed a 4.6 per cent increase over the previous census. Also, there was 16.8 per cent increase in the population of poultry (Panda et al., 2022). Maharashtra is one of leading state in livestock production and marketing. It ranks 5th, 6th & 7th against poultry, goat & sheep populations in country, respectively (GOI, 2019). Protein availability from poultry and sheep meat is projected to grow 17.8 per cent and 15.7 per cent respectively by 2030 (OECD-FAO, 2021). The average meat consumption of world is 35 kg/capita/annum while in India it is 5.2 kg/capita/annum (OECD-FAO, 2021; Devi et al., 2014). The Indian consumer prefers freshly slaughtered chicken, fresh and healthy meat prepared in front of eyes at local meat retail or butcher

Received 14-01-2022; Accepted 24-02-2022

shops. Yadav & Singh (2022) reported that 27.50 per cent of people consume fish, poultry, and chicken weekly followed by alternative week (17.50%). Consumers in developing countries also expect quality meat, good sanitary practices and assurance of safety (Bafanda et al., 2017; Waghmare et al., 2021). COVID-19 pandemic changed the consumption and purchase patterns of the consumers globally. The COVID-19 had impacted chicken wet market and also the livelihoods of the small retailers and butchers in India (Kumar et al., 2020). Meat has been identified as major source of food borne disease in humans, however butchers and meat handlers are unaware about various health hazards occurring due to inadequate infrastructure & sanitary practices (Tagar & Ahmed, 2021; Waghmare et al., 2021). Ideally, the butchers should possess basic education along with good understanding on sanitary practices and basic infrastructure facilities required for hygienic meat production. Food borne diseases are more common in developing countries because of the poor food handling and sanitation practices, insufficient food safety laws, and lack of education for food-handlers (WHO, 2004). Therefore, present study was planned to find out the marketing skills and sanitary status of retail meat shops considering educational background of butchers in Maharashtra.

METHODOLOGY

A cross sectional study design based on the questionnaire and a brief interview was done to assess the butchers on the educational status, legal compliance, marketing skill, knowledge on sanitary measures and business constraints. The study was conducted in various districts of Maharashtra state from August 2021 to September 2021 under Department of Science and Technology Project being carried out at College of Veterinary and Animal Sciences, Parbhani. Butchers to be interviewed were randomly selected and were assessed with the personal interview by visiting their retail shop. A total of 118 shops were surveyed. A semi structured schedule was prepared and used for face-to-face interview. Interviews were conducted in the vernacular language. The questions included the details of butcher's educational status, structure of the shop, license details, sales, their awareness towards the personal hygiene, shop hygiene, equipment, training, waste disposal. Some observations were made regarding their maintenance of shop, equipment, level of hygiene and methods of disposal of the waste. Data were analyzed using Microsoft excel, 2007. The findings were depicted in the form of percentages. Grouping of the principals was done based on their educational qualification for comparative analysis. Logistic regression was used to understand their preference for training need.

RESULTS AND DISCUSSION

The level of education, training of meat handlers about the basic concepts, requirements of personal hygiene and its environment plays an important part in safeguarding the safety of products to consumers (Bersisa et al., 2019). The details of educational status with age of participants are described in Table 1. The study revealed that 19.49, 42.37 and 3.39 per cent of the respondents completed their primary, secondary and graduation education, respectively. 48.31 per cent of butchers under survey were of age group of 25 to 35 years. Jyoti et al., (2019) revealed that, 80.56 per cent of the butchers underwent primary school education and 47.22 per cent butchers had an average age between 18-30 years. Bafanda et al., (2017) reported that most of the meat handlers were from middle aged group and only males were involved in this profession, which holds true in our survey too.

Present study has shown that majority of butchers completed secondary & intermediate schooling, this data would help to justify educational backwardness of butcher community in higher education. As majority of butchers have secondary schooling indicate the basic literacy amongst the community.

Background information, training, licence status and market competition

The background information on business, training and licence status of butcher shop are described in Table 2. Significant ($p<0.05$) majority of the butchers (67.80%) adopted this business as a family business compared to self adoption. 77.12 per cent respondents had not undergone any formal training regarding meat hygiene and handling practices. The awareness about hygienic meat production was rare and non-availability such type of training centres in the area as major reasons. The results were in agreement with Gurmu & Gebretinsae (2013) and Jyoti et al., (2019) who reported that 58.3 per cent and 63.89 per cent of the respondents had not acquired any training regarding meat processing and hygiene, respectively. The study is quite similar to study of Jagadish et al., (2017) wherein they reported 94% of the butchers had not gone through formal training.

The majority of respondents (58.47%) were ready to participate in training on meat business. Tuneer & Madhavi (2015) & Rayees et al., (2017) reported that personnel engaged in meat business lacks knowledge and training regarding scientific operations in slaughter houses, therefore skill development and capacity building amongst the butcher community is very essential to promote hygienic meat business. The trainings enable the participants to do their jobs much agile and helps the possession of new skill, knowledge and attitudes (Jaiswal et al., 2019). The study indicates that 80.51 per cent of respondent had registered their shop to their local authority like Municipal Corporation and Village Panchayat but 68.64 per cent respondents had not registered their shop with Food Safety and Standards Authority of India/Food and Drugs Administration (FSSAI/FDA). The results are in agreement with Jagadish et al., (2017) where, only 57.6 per cent of

Table 1. Age and educational status of butcher in Maharashtra

Educational Status	Primary	Secondary	Intermediate	Graduate
	22(19.49%)	50(42.37%)	41(34.75%)	4(3.39%)
Age in years	18-25	25-35	35-45	45-55
	18(15.25%)	57 (48.31%)	40(33.90%)	3(2.54%)

Table 2. Background information, training, licence status and opinion about market competition

Information	Options	Result			
		Educational Status		Overall	Chi
		Primary & Secondary (N=73)	Intermediate & Graduate (N=45)	Percent data (N=118)	Square Statistic
Traditional or Non-traditional business	Self -started	18 (24.66%)	30 (66.67%)	38(32.20%)	20.359**
	Traditional	55 (75.34%)	15 (33.33%)	80 (67.80%)	
Training undertook	Yes	9 (12.33%)	18 (40.0%)	27 (22.88%)	12.080**
	No	64 (87.67%)	27 (60.0%)	91 (77.12%)	
Willingness for training	Yes	43 (58.90%)	26 (57.78%)	69(58.47 %)	0.015^{Ns}
	No	30 (41.10%)	19 (42.22%)	49(41.53 %)	
Received help from Municipal Corporation/ Gram Panchayat for business	Yes	30 (14.10%)	33 (73.33%)	63 (53.39%)	11.626**
	No	43(58.90%)	12 (26.67%)	55 (46.61%)	
Shop registered with Municipal Corporation	Yes	60 (82.19%)	35(77.78%)	95 (80.51%)	0.346^{Ns}
	No	13 (17.81%)	10 (22.22%)	23 (19.49%)	
Registration with FSSAI	Yes	19 (26.03%)	18(40.0%)	37 (31.36%)	2.525 ^{Ns}
	No	54 (73.97%)	27 (60.0%)	81(68.64%)	
Market competition	Low	24 (32.88%)	10 (22.22%)	34 (28.81%)	2.215^{Ns}
	High	40 (54.79%)	26 (57.78%)	66 (55.93%)	
	No	9 (12.33%)	9 (20.0%)	18 (15.25%)	
Opinion about New online Marketing by corporate companies	Affect local Business	13 (17.81%)	10 (22.22%)	23 (19.49%)	4.177 ^{Ns}
	No going affect	45 (61.64%)	32 (71.11%)	77 (65.25%)	
	Affect business after few years	15 (20.55%)	3 (6.67%)	18 (15.25%)	
Marketing Strategy	News Paper/Leaflet distribution	1 (1.37%)	1 (2.22%)	2 (1.69%)	11.180**
	WhatsApp	15 (20.55%)	10 (22.22)	25 (21.19%)	
	Advertise board in city/village	45 (61.64%)	32 (71.11%)	77 (65.25%)	
	Online App for Sale	0 (0.00%)	2 (4.44%)	2 (1.69%)	
	No	12 (16.44%)	0 (0.00%)	12 (10.17%)	

(Ns-Non Significant, * Significant at 5% (table value 3.84), ** Significant at 1% (table value 6.64)

the shops had a valid license from government agencies. Strict vigilance from FSSAI and Local bodies is necessary to control unauthorised meat business and FSSAI authorities need to undertake promotional activities and encourage butchers to register by organising special campaigns.

The study reported that (55.93%) respondents from primary intermediate and graduated group felt that they may have to face higher competition in retail meat business in future. The majority of butchers (65.25%) opined that new online marketing by corporate companies did not going to affect their traditional retail meat business ($p<0.01$). The local retail butchers practice preliminary type of marketing strategies. The retail vendors (65.25%) depended upon advertisement boards ($p<0.05$). Only 1.69 per cent retailers used online applications for selling meat products and significant difference were observed in marketing strategies adopted by retailers. Butchers may choose social network messaging platform WhatsApp for marketing as it found to be more popular among youth for exchange information (Nain et al, 2019; Singh et al., 2021). With growing population and swelling demand for meat, better and appropriate promotion systems were needed and should be adopted at local level.

Meat selling potential, sanitary measures and modernization of shops

The study reported that the 51.69 per cent of butcher shop in Maharashtra have only one worker (Table 3). The butchers shop selling both chicken and mutton/chevon had 2-3 workers. The average salary per worker ranged from 3-5 thousand per month. The average slaughter of 50 birds and 50 birds with goat or sheep was observed in 40.68 per cent and 42.37 per cent shops, respectively. Kumar et al., (2020) reported that average 18.4 birds were slaughtered in retail meat shops daily. As per the Foods Safety Act 2006, Schedule IV of FSSAI, retail meat shops slaughtering birds below 50 per day need to be registered with FSSAI. Majority of respondents (72.03%) reported that average chicken and mutton sale price were Rs. 180 and Rs. 680 per kg, respectively. Regarding sales of meat in post COVID 19 scenario mixed reports were received from the respondents. 50.85% respondents informed that the business decreased during post COVID-19 phase.

The COVID-19 pandemic was not major constraints for their business as compared to religious festivals (25.42%). The study contradicts with Kumar et al., (2020), who reported that COVID-19 had a visible impact on livelihoods, especially butchers/ retailors involved in unorganised slaughter sector with significant reduction in income up to 55.6 per cent. International meat prices declined in 2020 due to the impact of COVID-19 (OECD-FAO, 2021). The demands for meat and meat products increased during COVID-19 period as community thought that meat is healthy diet for COVID-19 patient, as well as physicians prescribed chicken soup (Rennard et al., 2020).

The study has shown that 98.31 per cent butchers' workers had habits of washing their hands with water by using hand wash

Table 3. Selling potential, sanitary measures, modernization of meat shops

Information	Options	Frequency (Percentage)
Workers and their salary	0-1 worker 3-5 thousand / Month	61 (51.69%)
	2-3 worker 3-5 thousand / Month	54 (45.76%)
	No Workers	3 (2.54%)
Per day slaughter & Sale of Bird/ Goat	1-5 Goat / day	15(12.00%)
	Up to 50 birds /day	48 (40.68%)
	Up to 150 Birds / day	3 (2.54%)
	Up to 50 birds +1- 5 Goat / day	50 (42.37%)
	Up to 150 Birds + 5 Goat / day	2 (1.69%)
Per kg selling price of meat during COVID 19 period	Chicken Rs 180 /kg Mutton Rs. 680 /kg	85 (72.03%)
	Chicken Rs 160 /kg Mutton Rs. 670 /kg	15 (12.71%)
	Chicken Rs 170 /kg Mutton Rs. 600 /kg	18 (15.25%)
Post COVID-19 Business	Increased	24 (20.34%)
	Decreased	60 (50.85%)
	Same	34 (28.81%)
Constraints	Festival	30 (25.42%)
	No modern technology	14 (11.86%)
	COVID Pandemic	4 (3.39%)
	Bird Flu	4 (3.39%)
	No Constrains	66 (55.93%)
Hands washing during sale	Yes	116 (98.31%)
	No	2 (1.69%)
Disposal place of blood offal/s, feather & other wastes	Municipal Corporation / Grampanchyat	72 (61.02%)
	Self disposal	46 (38.98%)
Recycling waste	Yes	20 (16.95%)
	No	98 (83.05%)
Earning form wastes	Yes	22 (18.64 %)
	No	96 (81.36%)
Complete washing of Shop	Daily washing	99 (83.90 %)
	Weekly washing	17 (14.41%)
	Monthly washing	2(1.69%)
List of equipments available in a shop	Bleeding Cone, Scalder, Centriplucker	17 (14.41%)
	Carcass Wash basin	58 (48.15%)
	Bleeding Cone	32 (27.12%)
	No	11 (9.32%)
Plan for modernization of shop	Purchase New Machine	68 (57.63%)
	Tiles in shop	33 (27.97%)
	Other Methods	5 (4.24%)
	No modernization	12 (10.17%)

before and after sale of meat. The finding are in agreement with the reports of Yenealem (2020) who reported that 91.6 per cent butchers wash their hands after garbage disposal and before handling meat. Jyoti et al., (2019) observed that 13.89 per cent and 41.67 per cent workers do not have habits of washing their hands with water and soap before and after sale of meat, respectively. In current study, higher percentage of hand wash habit might be due to COVID 19 preventive norms which were continuously informed to people by various media. Handwashing is one of the first lines of defence in food safety; inadequate personal hygiene can put consumers' health at risk. It is necessary to cultivate a culture of food safety and handwash should be encouraged. Butcher shops must be equipped with adequate hand washing stations. Butcher's shops (61.02%) utilised local body facilities for disposal of slaughter waste, while majority of butchers (83.05%) were not aware recycling of slaughter waste. The waste disposal in meat processing industry may pose problem in the areas of environment protection and sustainability. Upadhayaya & Ghimire (2018) showed that non availability of waste disposal system might result in the pile up paunch contents, other solid wastes, faeces, near the meat shops which may serve as the habitation for rodents, cats, and dogs. Non utilization of slaughter waste not only leads to loss of probable revenue but also generate major appealing and health problems along with environmental pollution.

The study reported that 83.90 per cent respondents clean their shop daily. The findings are not in agreement with Jyoti et al., (2019) where it was reported that 61.1 per cent of shops do complete washing of shop once in week or month which could reflect the risk of higher microbial contamination. Failure to appropriately clean and sanitize equipment could lead to the harbourage of pathogenic microorganisms that may cause foodborne infection. Ali et al., (2010) showed that use of disinfecting and

Table 4: Results of multivariable logistic regression for the training & licensing aspects of retail meat shop butchers in relation to educational status

Information	Options	Result				
		Educational Status		Odds Ratio	95% CI	P value
		Primary & Secondary (N=73)	Intermediate & Graduate (N=45)			
Training undergone	Yes	9 (12.33%)	18 (40.0%)	0.29	0.110-0.741	0.0098
	No	64 (87.67%)	27 (60.0%)	4.74	1.89-11.87	0.0009
Willingness for training	Yes	43 (58.90%)	26 (57.78%)	1.96	0.923-4.160	0.07
	No	30 (41.10%)	19 (42.22%)	0.50	0.240-1.018	0.07
Registered with local bodies	Yes	60 (82.19%)	35(77.78%)	1.31	0.521-3.320	0.55
	No	13 (17.81%)	10 (22.22%)	0.75	0.300-1.910	0.55
Registration with FSSAI	Yes	19 (26.03%)	18(40.0%)	0.5 2	0.234-1.160	0.11
	No	54 (73.97%)	27 (60.0%)	1.89	0.850-4.181	0.11

sanitizing agents for daily cleaning of butcher shops could elevate the hygienic status. 14.41 per cent butchers were using modern basic slaughter equipments such as bleeding cone, scalder, centriplucker in their shop and most of butcher's shops were not having basic equipments for poultry indicate their unawareness about modern equipments. Majority (57.63%) said that purchase of new machines was a plan for modernization but their unawareness about equipments was major concern. It is recommended that butcher shop operating license should be issued to people undergoing basic training on meat handling hygiene and practices (Chepkemoi et al., 2015).

Multivariable logistic regression model for training and licensing

The odds to undergo training among butchers tripled when butchers did complete primary and secondary education compared with butchers who underwent intermediate and graduate education. Similarly, butchers' interest in training does not affect by level of education but butchers' interest to participate in trainings becomes shown higher (Odds 1.96) compare to non-interested participants (Odds 0.50). The positive and negative association regarding registration of shop with local bodies & FDA, shown non-significant association with educational status. No significant difference in the odds of butchers registered with local bodies (Odds 1.31) and non registered (Odds 0.75) was noticed. Similar results were reported for registration of shop with FDA for FSSAI licence (Table 4).

CONCLUSION

Meat has been identified as major source of food borne disease however butchers and meat handlers were unaware about various health hazards occurring due to inadequate infrastructure & sanitary practices. Unawareness about the waste disposal and modern equipments in meat processing business may pose problem in the areas of environment protection and sustainability and hygienic meat production. Strict vigilance from regulatory bodies is necessary to control unauthorised meat business. In view of upcoming market competition, marketing skills and sanitary status of retail meat shops should be elevated through the butcher's skill development on hygienic meat production.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (135-139)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Estimation of Farmers' Willingness-to-Pay for Quality Planting Material of Greater Yam (*Dioscorea alata* L.)

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ARTICLE INFO

Keywords: Choice-based conjoint, Greater yam, Quality planting material

http://doi.org/10.48165/IJEE.2022.58226

ABSTRACT

Greater yam being a commercial tuber crop in Odisha state occupying a prominent place in food basket, the importance of meeting the planting material demand of the farmers, was realized by the ICAR-Central Tuber Crops Research Institute and initiated mass efforts to multiply the high-yielding and disease-resistant varieties of yam to supply to farmers as quality planting materials.. As the farmers' willingness to pay for the planting material depends on their assessment of the utility of each attribute of it, a research investigation was carried out in Odisha to estimate the utility value of each yam planting material attribute from the farmers' perspective. The utility values for each planting material attribute were estimated through a choice-based conjoint analysis. Results indicated that yield had the highest utility level (30 t/ha = 5.20 and 25 t/ha = 2.60), followed by planting material price (Rs. 30/kg = 1.147) and culinary quality (excellent quality = 0.794). The marginal WTP for the yield 30 t/ha versus 25 t/ha was Rs 4.54/kg. It clearly shows that the farmers were willing to pay an additional amount of Rs 4.54/kg for a quality yam planting material that gave a higher yield than their variety.

INTRODUCTION

The Greater yam or yam (*Dioscorea alata* L.), is commercially grown in Odisha state and occupies an important role in the food basket. Traditional local landraces like *Hatikhoj* and *Odisha Elite* dominate the yam area, owing to local preference and high market price (Sivakumar et al., 2009). As the yam is propagated through tubers, farmers need a sizable quantity (2 t/ha) of planting materials. The yam planting materials are primarily obtained through informal system, where the farmers source their tubers from their last harvest, exchange with other farmers, or purchase from the local markets. However, the quality of planting material is poor due to the narrow choice of varieties, high level of damage in the tubers, and disease susceptibility of local landraces (Sivakumar et al., 2009). Past studies conducted on potato (Reema et al., 2020; Rajavardhan et al., 2020) and mustard (Layek et al., 2021) established that the seed or planting materials are procured at higher rates, thereby escalating the cost of production. In this context, there is a pressing need for the research and extension agencies to supply quality planting material of high-yielding yam varieties to the farmers at an affordable price during the planting season.

Quality planting material is considered an essential input for the commercial production systems. The farmers are likely to buy the materials that possess attributes desired by them. These farmers' varietal preferences are essentially their perceived "utilities'' attached to the specific varietal attribute. The consumer choice theory (Lancaster, 1966), states that the consumers' decision to buy a good or product is determined by its attributes rather than the product *per se*. The Choice-based Conjoint analysis (CA) employs an experimental approach for measuring consumers'

Received 17-01-2022; Accepted 28-02-2022

preferences for a specific product or service attribute (Raghavarao et al., 2010). The CA is widely used in agricultural studies to elicit varietal preferences of the farmers. Baidu-Forson et al., (1997) employed choice-based conjoint analysis for designing a hypothetical groundnut variety for the farmers of Niger in West Africa. Their work revealed that farmers preferred groundnut varieties resistant to diseases, short duration, and yielded more pods than the local landraces. An Indian study on sorghum and pearl millets (Basavaraj et al., 2015) has employed conjoint analysis to identify the drought tolerance and maturation time as key varietal attributes. Another consumer preference study on bell peppers (Frank et al., 2001) indicated that the consumers demanded green bell peppers enriched with Vitamin C with affordable price. Recent work on (Marenya et al., 2021) maize varieties demonstrated significant gender differences in the valuation of varietal attributes.

The objective of the present study is to design a series of hypothetical yam planting material profiles using a combination of farmer preferred attributes, and then estimate the farmers "willingness-to-pay" for each profile based on the estimated attribute utilities. This conjoint model will help the yam seed producers to fix the price for the "yam planting materials" from the farmers "willingness-to-pay" estimates.

METHODOLOGY

A random utility model on yam planting material was developed. This model assumes that the utility of planting material as a function of the farmer's preferred seed attributes, such as yield, variety, and culinary quality (Sivakumar et al., 2009) along with the planting material price (Fuglie et al., 2006). The utility model assumes that the overall utility gained by the farmer by using the yam planting material obtained from an individual or firm, is the function of the utilities derived from each attribute of the yam planting material. This relationship was specified as follows:

$U = U$ (planting material price, variety, yield, culinary quality)

Where, U = Overall profit utility derived from a combination of yam quality planting material attributes; planting material price is the cost of per kilogram of yam seed tuber; variety refers to anthracnose disease-resistant variety; yield is tuber yield per hectare expressed in tonnes and culinary quality refers to the taste of cooked tubers. In this model, the ideal effects of the attributes on the utilities are specified as (i) increase in planting material price decreases its utility (i.e., $\delta U/\delta$ planting material price < 0), (ii) level of anthracnose disease resistance of yam planting material increases its utility ($\delta U/\delta$ disease-resistant yam variety > 0), (iii) increase in tuber yield enhances its utility ($\delta U/\delta$ yield > 0), and (iv) the culinary quality of yam increases its utility ($\delta U/\delta$ culinary quality > 0).

Two hundred yam farmers, who had a minimum of 10 years experience in yam cultivation, were randomly selected from four villages from Ganjam and Nayagarh districts of Odisha through simple random sampling method. An interview schedule was prepared to collect yam production system and respondents' demographic characteristics information. During the data collection, the cards containing hypothetical yam quality planting material profiles were presented (Brusch et al., 2002) and each respondent was asked to rank them according to his/her preference. The data were analyzed to estimate part-worth /utilities using the CONJOINT procedure of statistics software SPSS Ver. 17. After calculating the utilities, the farmer's willingness to pay for each attribute was estimated using the following formula (Louviere et al., 2000).

$$WTP_j = \left| \frac{\beta_j}{\beta_l} \right|$$

Where, $WTPj$ represents the farmers' willingness to pay for the j^{th} planting material attribute, β_j is the estimated coefficient of the j^{th} attribute, and β_l is the estimated coefficient of planting material price holding all other potential influences constant (Louviere et al., 2000).

RESULTS AND DISCUSSION

Random utility model for yam planting material

Based on the random utility model, the attribute levels of quality yam planting materials were decided (Table 1). The planting material price levels were chosen based on the Govt. prices followed in Odisha. The lower yield level, i.e., 25 t/ha, represents the farmers' existing yield potential of local landraces cultivated. In comparison, 30 t/ha was the average yield potential of improved yam varieties released by ICAR-CTCRI. Since the local landraces are susceptible to anthracnose disease that causes a yield loss of up to 40%, this level was identified as disease susceptible. The culinary quality level of "Good" represents the taste of existing popular landraces.

Table 1. Quality yam planting material attributes selected for the conjoint experiment

Attributes	Attribute levels	
	1	2
Planting material price (Rs/kg)	20	30
Variety	Disease susceptible	Disease resistant
Yield (t/ha)	25	30
Culinary quality	Good	Excellent

The Choice-based conjoint analysis enabled the researcher to create several hypothetical combinations of planting material combinations using factorial design, on which the consumers' utility values were estimated. The Orthogonal Main-Effect Plans suggested by Addelman (1962) were used to develop the orthogonal factorial design with a minimum efficient set of combinations of yam planting material attributes. An orthogonal array was consisting of eight yam planting material profiles was created (Table 2). Each attribute profile indicated a hypothetical yam quality planting material profile, and a total of eight yam types were generated for the study.

The majority of the respondents were male (70.83%), belonging to the 18 to 40 years age group (46.67%), matriculate (49.17%), and had 15 to 20 years experience in yam cultivation (37.50%). Many respondents cultivated yam under commercial production system (72%), while the rest followed a subsistence system (28%). Under commercial production system, yam is cultivated in deep vertisols, under unstacked conditions following scientific input management practices recommended by ICAR-CTCRI. Under subsistence production, yam is grown in the Alfisols under staked conditions with minimal inputs.

Table 2. Yam quality planting material profiles generated through the orthogonal array

Profile	Planting material price (Rs/kg)	Variety	Tuber yield (t/ha)	Culinary quality
1	30	Disease Resistant	30	Excellent
2	20	Disease Resistant	30	Good
3	30	Disease Susceptible	30	Good
4	30	Disease Resistant	25	Good
5	20	Disease Resistant	25	Excellent
6	30	Disease Susceptible	25	Excellent
7	20	Disease Susceptible	25	Good
8	20	Disease Susceptible	30	Excellent

Utility or part-worth of yam quality planting material attributes

Initially, the data were checked to assess its suitability for conjoint analysis based on correlations between observed and expected preferences. The results exhibited significant correlations with the expected preferences (Pearson's R = 0.987, p= 0.001; Kendall's tau = 0.987, p = 0.001), confirming that ranked data collected from the respondents were appropriate for the selected respondents conjoint model (Topcu, 2009).

The part-worth or utility coefficients for each level of the factor estimated through the conjoint procedure are displayed in Table 3. Among all attributes, yield has the highest utility levels (30 t/ha = 5.20 and 25 t/ha = 2.60), followed by planting material price (Rs. 30/kg = 1.147) and culinary quality (Excellent quality = 0.794). The disease resistance in yam variety had lowest level utility values (Disease resistant = 0.007; Disease susceptible = -0.007).

Data displayed in Table 3 also indicate the relative importance of each planting material attribute in a farmer's purchase decision. The yield was higher rated among other attributes, which influenced about 50% of the farmers' purchase of quality planting material. As perceived by the farmers, the culinary quality had 26% influence while planting material price had 18% contributions to farmers' purchase decision. However, the disease resistance of a variety had a negligible impact (4.8%) on farmers' decisions.

As expected, the farmers preferred higher yield as the primary criteria for designing a quality yam planting material. Past studies conducted by Anantharaman & Ramanathan (2002) and Ramanathan et al., (2006) in Kerala as well as by Nedunchezhiyan et al., (2006) in Odisha showed that the farmers sought high yielding yam varieties suitable for mixed cropping systems or under unstacked conditions. The results are consistent with past studies and indicate the need for promoting high-yielding yam varieties. Since the commercial yam farmers predominantly grow the local landraces that are poor yielders (15–20 t/ha) and vulnerable to genetic erosion in repeated cultivation. In view of the massive demand for high-yielding varieties, there is a need to accelerate the technology transfer efforts to popularize improved yam varieties in Odisha.

Another significant result of this study was the farmers' choice of culinary quality of yam ahead of disease resistance. Anantharaman and Ramanathan (2002) reported the preference for good culinary quality in a study conducted among tribal farmers of Kerala. The tribal farmers preferred yam varieties with good culinary qualities, good tuber shape, and tuber size. Similarly, Vernier & Dansi (2000) also reported that the farmers of Benin, Africa chose improved white yam varieties with good sensory quality for cultivation. In general, the culinary quality of yam is largely determined by its optimal sweet taste in boiled form. This research study subjectively determined the culinary quality levels based on their local preferences. There is a need to optimize the sugar content of yam tubers to match farmers' needs. The improved yam varieties released by ICAR-CTCRI contain lower levels of sugars (0.8–1.5%) than popular local landraces (Sivakumar et al., 2009). It is high time for the yam breeders to screen high yielding varieties for optimal sugar content as preferred by the farmers.

According to consumer theory, consumers seek quality good which provides the highest utility at a lower price. However, the respondents of this work assigned higher utility for the planting material price of Rs 30/kg, which is contradictory to facts. However, the preference for high planting material prices indicates the desperation of farmers to pay a higher price of yam quality planting material. As the farmers of Odisha faced an acute shortage of quality yam planting material during planting season and procured the planting material of low-yielding local landraces at higher prices, they preferred to pay a higher price for quality planting material.

Total utilities of yam quality planting material profiles

The total utilities of yam quality planting material profiles were calculated to identify the preferred hypothetical quality yam planting material. For example, the total utility of a hypothetical quality yam planting material that is disease resistant, provide tuber yield of 30 t/ha, has excellent culinary quality, and is sold for Rs 30/kg is calculated as follows:

TU = α (Constant) + U (Planting material price) + U (Variety) + U (Yield) + U (Culinary quality);

TU = -0.882 + 1.147 + 0.007 + 5.20 + 0.794 = 6.266

Table 3. Results of conjoint analysis

Planting material attributes	Levels	Utility/part-worth	Relative importance (%)	Standard error
Planting material price	20	0.574	18.91	0.741
	30	1.147		0.971
Variety	Disease susceptible	-0.007	4.80	0.370
	Disease resistant	0.007		0.370
Yield	25	2.60	49.62	0.741
	30	5.20		0.971
Culinary quality	Good	0.397	26.67	0.741
	Excellent	0.794		0.971
Constant		-0.882		0.960

Table 4. Total utilities of quality yam planting material profiles under the orthogonal array.

Profile	Planting material price (Rs/kg)	Variety	Yield (t/ha)	Culinary quality	Total utilities	Rank
1	30	Disease Resistant	30	Excellent	6.266	1
2	20	Disease Resistant	30	Good	5.296	4
3	30	Disease Susceptible	30	Good	5.855	3
4	30	Disease Resistant	25	Good	3.269	6
5	20	Disease Resistant	25	Excellent	3.093	7
6	30	Disease Susceptible	25	Excellent	3.652	5
7	20	Disease Susceptible	25	Good	2.682	8
8	20	Disease Susceptible	30	Excellent	5.679	2

Total utilities for other profiles were also calculated in the same way and displayed in Table 4. The yam profile estimates displayed in Table 4 indicate that, the farmers preferred hypothetical yam quality planting material profile 1 i.e., a quality planting material that is disease resistant, provides a tuber yield of 30 t ha^{-1}, has excellent culinary quality, and is sold for Rs 30/kg. Profiles 8, 3, 2 were similarly weighed as their total utilizes ranged from around five to six (i.e., 5.29 – 5.84). Profiles 6, 4, 5, and 7 were least preferred. These hypothetical yam quality planting material profiles provide an optimal combination of preferred varietal attributes, which will help the yam breeders to understand the farmer preferred combinations and develop varieties with a specified level of attributes.

Developing hypothetical planting material or variety profiles are widely used in designing breeding programs. Banerjee et al., (2007) generated two hypothetical cotton planting materials packaged and evaluated among Mississippi farmers in the USA. They identified lint yield and fiber quality as significant determinants of planting material selection. Similarly, Baidu-Forson et al., (1997) employed a hypothetical profile approach for developing groundnut variety profiles in Niger. After identifying groundnut planting material profiles, they concluded that conjoint analysis provided accurate estimates for farmers' preferences and urged the breeders to incorporate the needs in a breeding program.

Marginal Willingness-to-Pay for planting material attributes

In general, individual preferences mostly determine willingness to pay, but importantly, willingness-to-pay also reflects their ability to pay. The marginal willingness to pay is the maximum level of the consumer's price for buying the next unit of the product. Using the Louviere method (Louviere et al., 2000) of using utility scores of each attribute, the MWTP was estimated. Since disease resistance was least preferred, it was omitted from analysis (Table 5). The planting material price was not included as it would provide repetitive estimates.

The marginal WTP for the yield 30t/ha versus 25 t/ha is Rs 4.54/kg. It clearly shows that the farmers are willing to pay an additional amount of Rs 4.54/kg for a quality yam planting material that gives a higher yield than their own planting material/variety.

Table 5. Estimated Marginal Willingness to Pay from conjoint model

Variable	Marginal Willingness-to-pay (Rs)
Yield (30 t/ha Vs 25 t/ha)	4.54
Culinary quality (Excellent Vs. Good)	1.69

The marginal WTP for excellent culinary quality versus good quality is Rs 1.69. This result indicates that the farmers were willing to pay an extra of Rs 1.69 per kg of planting material for a culinary quality that is better than their local landraces. These estimates provide a framework for deciding on the price of quality planting material yam tubers and help the planting material producers to identify a profitable price based on attributes. The conjoint analysis has revealed new insights into the pricing of yam quality planting materials. The yam farmers derive the maximum benefits when they use a planting material that will provide a yield level of 30 t/ha; and the yam famer looks for a planting material tuber that will produce a minimum of 25 t/ha while visits a planting material trader to buy quality yam planting material. Suppose if they find planting material tubers that will provide a 30 t/ha yield, they have a 50% probability of buying the planting material even if it is disease susceptible and has the same level of culinary quality as his planting material and the farmers were willing to pay an extra amount of Rs 4.54/kg for a planting material that yields 30 t/ha instead of 25 t/ ha, and the farmer will incur an additional cost of Rs 1.69/kg if its culinary quality is better than his/ her planting material.

CONCLUSION

The present study on quality yam planting material has brought new insights into the pricing strategy for marketing quality seeds and planting materials. Though several extension research studies identified farmers' preferences for varietal attributes in the past, the present research investigation provides a model, which will enable the extension agencies, agripreneurs, small businesses and Farmers Producers Organizations, who are engaged in quality seed production, to fix price of their produce based on utilities derived by the farmers and other stakeholders. This model will also help the breeders to decide on the breeding objectives, based on the utilities derived from the stakeholders from specific varietal attributes.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (140-143)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Constraints Faced by Pineapple Growers in Tripura

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ARTICLE INFO

Keywords: Pineapple cultivation, Constraints, Farmer's perception, Difficulty level

http://doi.org/10.48165/IJEE.2022.58227

ABSTRACT

Agriculture is the main occupation of the inhabitants in Tripura and 80 per cent of the rural people depend on agriculture and allied sectors for the economic, food and nutritional security. Tripura has got highly suitable agro-climatic conditions to grow pineapple fruit. Livelihoods of many farmers largely depend on pineapple cultivation. However, pineapple cultivation is not delivering the desired output as it is constrained by several factors. Present study was conducted in year 2021 to delineate various constraints of pineapple cultivation and to determine difficulty level of each constraint as perceived by a random sample of 80 farmers. Various constraints were categorized as situational, technological, economic, social, environmental, infrastructure, and market related constraints. The major constraints identified were low rainfall, scarcity of water, labour intensiveness, high labour wage, high cost of cultivation, low adoption of scientific practices by neighbouring farmers, lack of group approach in farming, lack of infrastructure like; soil testing laboratory, agro-service centre, storage facilities and low-quality packaging. Lack of organised marketing facilities was the major concern for respondents-farmers. Future policy advocacies and agro-advisories for development of pineapple cultivation need to focus on combating aforesaid constraints in pineapple cultivation.

INTRODUCTION

Pineapple (*Ananas comosus*) is one of the most important commercial crops in India, ranking sixth with share of produces more than seven per cent of total world production of pineapple with productivity more than 15 t/ha against average productivity of 21 t/ha in the world (http://apeda.in/agriexchange/Market%20 Profile/one/PINEAPPLE.aspx). India's position in terms of harvested area of pineapple (1,11,000 ha) is first among the Asian and BRICS countries (Roy & Bandyopadhyay, 2019). India export pineapple to Gulf countries as well as to European countries. North eastern region of India provides about half of the productions. Due to compatible agro-ecosystems it is grown as one of the major horticultural crops in north eastern states of India, out of which the state of Tripura's economy is highly influenced by pineapple cultivation that is a major source of livelihood and economic security. Tripura produces an estimated 1.28 lakh MT pineapple every year in orchards spanning 8,800 hectares (Deb, 2020) and the farmer shave carefully preserved a belief that "Pineapple would never betray them". That any crop may fail in an unfavourable circumstance, but pineapple is just a viable crop of survival, providing substantial income year after year (www.pineappleindia.com, 2008).

Pineapple is a natural fruit in the state of Tripura with favorable sub-tropical agro-climatic conditions, fertile slightly acidic soil, and abundant rainfall. The undulating tilla land with varying degrees of slope are highly susceptible to erosion so practices to check soil erosion through pineapple cultivation are vital. 'Queen' and 'Kew' ('Smooth Cayenne') are the main cultivars grown in different parts of Tripura. And also, spreading production into the off season plays a vital role in nutrition and livelihood opportunity for rural and tribal areas of the state for employment and income

Received 14-01-2022; Accepted 03-03-2022

generation (Das et al., 2014). Now-a-days Tripura pineapple industry is facing trouble. Nandannagar in the West Tripura district was a hotspot for pineapple cultivation; however, all but one of the orchards there are closed down. According to growers, business is at an all-time low and the fruit is selling at less than half of market rate. Pineapple farmers complained of huge losses due to absence of food storage and lack of procurement facilities by the government (Deb, 2020). The price variation of pineapple was low but pricing system of pineapple was not yet developed. The poor processing facilities restricts the expansion of acreage of pineapple. The lack of infrastructure facilities discourages the resource-poor farmers from expansion of area under this crop (Das et al., 2016). Even, inadequate transport facilities, non- availability of market in the locality, low marketable surplus, absence of market information, lack of organization among producers, problems of storage etc. are the major constraints in pineapple production (Sharma et al., 2016). Pineapple cultivation is not delivering the desired output as it is still highly unorganized, inefficient, and unprofitable in spite of having various policies and schemes by various government agencies (Pathak et al., 2015). Thus, pineapple cultivation is constrained by several factors. On this backdrop, present study was conducted in the state of Tripura to unravel the constraints with pineapple cultivation and associated difficulties experienced by the grower with each constraint.

METHODOLOGY

The study was conducted in purposively selected Sepahijala district of Tripura because of its popularity and production of pineapple. In the second stage of sampling, blocks having highest acreage and production of pineapple i.e. Boxonagar & Mohanbhog were selected purposively. The villages under these two blocks selected were: Kuluibari, Aralia and Kalapania, Diptali following random sampling technique. A probability proportionate simple random sampling was done for selection of 80 pineapple growers of these four villages as respondents of present study.

Perceived constraints were defined as factors perceived by individuals to inhibit or prohibit participation and enjoyment. Various constraints relating to pineapple cultivation were identified and categorized under situational, technological, economic, social, environmental, infrastructure, and market related constraints. Severity of each of the constraints based on the difficulties experienced by the pineapple growers were measured on five-point continuum: 'very high'-5, 'high'-4, 'modereate'-3, 'low'-2 and 'very low'-1. The responses of the sampled pineapple growers were taken in a structured interview schedule. Data were analysed to present mean perception score and standard deviation values for each constraint followed by deriving difficulty level of each constraint as well as of each above-mentioned category of constraints through index values.

RESULTS AND DISCUSSION

Evidently from Table 1, amongst the situational constraints, farmers perceived the scarcity of water with highest mean perception score (4.83) as well as difficulty level (96.50%); while other major constraints were undulated topography, shortage of irrigation water and drainage problem with mean perception score greater than 4.0 on a 5-point continuum scale and very high difficulty level (>80%). Overall perception of situation constraints and difficulty level experienced by the pineapple growers is found quite high. Similar to findings of present study, farmers in Kollam district of Kerala faced scarcity of water and shortage of irrigation water as major constraints which had to give immediate attention (Chandran & Pondikunju, 2021). Lack of irrigation is also reported as major constraint in Himachal Pradesh (Singh & Hansra, 2021). Contrastingly, in Darjeeling district of West Bengal, the farmers were

Table 1. Constraints perceived by the pineapple growers

S. No.	Constraints	Mean value (SD)	Difficulty Level (%)
A	Situational Constraints		
1	Scarcity of water	4.83(0.38)	96.50
2	Drainage problem	4.08(0.31)	81.50
3	Wastage of water through overflowing	1.59(0.59)	31.75
4	Shortage of irrigation water	4.34(0.48)	86.75
5	Undulated topography	4.41(0.50)	88.25
	Overall	3.85(0.63)	76.95
B	Technological constraints		
1	Infestation of weed	1.35(0.48)	27.00
2	Problem of insect	1.35(0.48)	27.00
3	Problem of disease	1.51(0.50)	30.25
4	Inadequate nutrient management	1.79(0.69)	35.75
5	Labour intensiveness	4.04(0.34)	80.75
6	Inadequate irrigation	4.25(0.44)	85.00
	Overall	2.38(1.48)	47.63
C	Economic constraints		
12	Financial problem(lack of fund)	4.96(0.19)	99.25
13	High cost of cultivation	4.76(0.43)	95.25
14	High labour wage	4.64(0.48)	92.75
15	Lack of credit facility	2.10(0.61)	42.00
16	Lack of ownership of land	2.01(0.54)	40.25
17	Poor yield	4.09(0.56)	81.75
	Overall	3.76(0.98)	75.21
D	Social constraints		
18	Low adoption of improved practices by neighbor	2.18(0.47)	43.50
19	Lack of group approach in farming	2.36(0.51)	47.25
	Overall	2.27(0.73)	45.38
E	Environmental Constraints		
20	Low rainfall	4.74(0.44)	94.75
21	Drought	1.25(0.44)	25.00
22	Occurrence of flood	1.35(0.48)	27.00
	Overall	2.44(0.64)	48.92
F	Infrastructure Constraints		
23	Lack of soil testing laboratory	4.03(0.62)	80.50
24	Inadequate supply of electricity for irrigation pumps	1.94(1.04)	38.75
25	Lack of agro service centre	4.26(0.47)	85.25
26	Lacking of storage facilities	3.66(0.78)	73.25
27	Low quality packaging	3.76(0.82)	75.25
	Overall	3.53(1.05)	70.60
G	Market Related Constraints		
28	Non availability of fertilizer in time	3.73(0.84)	74.50
29	Non availability of plant protection chemical	3.76(1.11)	75.25
30	Low price of farm produce	4.19(0.42)	83.75
31	Lack of market facility	4.39(0.67)	87.75
32	Lack of postharvest value addition	3.86(0.78)	77.25
	Overall	3.99(0.56)	79.70

aware about irrigation but they also had to pay extra for groundwater irrigation in pineapple cultivation (Roy & Bandyopadhyay, 2019).

Technological constraints used to hinder pineapple cultivation and cause difficulties to the pineapple growers. It is evident that overall difficulty level of the pineapple growers due to technological constraints is found relatively less (mean value 2.38) that may be attributed to the scientific cultivation technologies being advocated by ICAR Research Complex for NEH Region Tripura Centre (2005). The perceived difficulty level with respect to irrigation and labour problem is found to be 85 per cent and 80.75 per cent, respectively. However, other four constraints have not caused greater difficulties as evident from relatively lower values (27% to 36%). Chandran & Pondikunju (2021) reported that workforce in agriculture is declining day by day in Kerala. Shasani et al., (2020) observed that application of improper dose of micronutrient as third most serious constraints faced by farmers of Odisha. Sankaran et al., (2006) mentioned that in Tripura there is no proper collection, improvement and application of agro-techniques for Pineapple. According to Roy & Bandyopadhyay (2019), pineapple growers of Darjeeling district in West Bengal were facing highest technological gap in use of fertilizer and lack of awareness about the dose of the application; they were facing difficulty due to non-availability of plant protection chemical resulting in difficulties in pest management. Roy et al., (2013) stated that the problems faced by the majority of the pineapple farmers in West Bengal are lack of knowledge about updated technologies of pineapple cultivation that underline the importance of effective extension programme, which will improve knowledge, skills and attitude of pineapple growers facilitating adoption of latest package of practices of pineapple cultivation.

Evidently, farmers perceived the financial problem (lack of fund) with highest difficulty level (99.25%) followed by high cost of cultivation (95.25%) and high labour wage (92.75%). Overall, the economic constraints were found at a higher level with perceived mean value of 3.76 and difficulty index value 75.21 per cent. Similar findings were also reported by Shasani et al., (2020); Gupta et al., (2020); Chandran & Pondikunju (2021); Singh & Hansra (2021). Present study shows that lack of credit facility as well as lack of ownership of land were perceived lowly as financial support has been given to the farmers by the state government; however, contrastingly, Shasani et al., (2020) stated that lack of credit facility was considered as the major economic constraint faced by farmers of Odisha. To combat economic constraint of pineapple cultivation in Darjeeling district of West Bengal pineapple growers were supported by government or other organization financially (Roy & Bandyopadhyay, 2019).

Existence of social constraints that hamper pineapple cultivation and cause difficulties to the pineapple growers were also present. Overall social constraints exist at a lower level with mean perceived value of 2.27 on a 5-point continuum. Low adoption of improved practices by the neighbor caused difficulty level of 43.50 per cent in adoption by the respondents. However, for the lack of group approach in farming, the perceived difficulty level was 47.25 per cent. According to Kumar et al., (2021), lack of cooperation among the community considered as 7th major constraint faced by the farmers of Haryana. This growing concern to combat social constraints warrant institutional interventions like farmers producer organization (FPOs) for sustainable and profitable pineapple cultivation.

Environmental constraints have also hampered pineapple cultivation and caused difficulties to the pineapple growers. Overall environment constraints belong at a lower level with mean perceived value 2.44. The perceived difficulty level with respect to low rainfall was found to be 94.75 per cent. However, the perceived difficulty level with occurrence of drought and flood was very low (25-30%). Kumar et al., (2021) & Shasani et al., (2020) also mentioned the problem of low and erratic rainfall during the wet season in Haryana and Odisha, respectively. Similar to the findings of present study, Feroze et al., (2019) stated that the temperature is raising and rainfall is declining in Tripura. Also, water availability has decreased and pest and disease infestation has increased, so the pineapple farmers are facing a lot of problems for sustaining production.

Farmers perceived the constraints of lack of soil testing laboratory with difficulty level of 80.50%. Farmers were facing difficulty due to lack of agro-service centre, low-quality packaging and lack of storage facilities at high levels (70-85%). Contrastingly, inadequate supply of electricity for irrigation pumps perceived as a constraint of low difficulty level (38.75%). Kumar et al., (2021), found in their study that farmers had high awareness of soil testing laboratory located nearest to them along with least knowledge about the procedure, dose of fertilizer to be applied. Even infrastructural constraints in pineapple cultivation in West Bengal are reported with improper fertility management due to lack of soil testing facilities, poor pricing system of pineapple and poor processing facilities restricting the areas and production of pineapple (Das et al., 2016). The lack of infrastructure facilities discourages the resource-poor farmers from expansion of area under pineapple crop.

Various market related constraints faced by the farmers in pineapple cultivation are also presented in the study. Overall, marketing constraints prevail at a high level with perceived mean value of 3.99 as well as difficulty level (79.70%). Evidently, farmers perceived the constraints of non-availability of fertilizer in time with difficulty level 74.50 per cent. Farmers were facing difficulty due to low price of farm produce and lack of market facilities at high level (75-90%). Lack of post-harvest value addition perceived with difficulty level of 77.25 per cent. Thus, overall difficulty faced by the respondents due to the market related constraints was quite high. Similarly, according to Roy and Bandyopadhyay (2019) pineapple growers of Darjeeling district in West Bengal had a very little knowledge about post-harvesting. They mentioned the built up of one cold storage for pineapple but no functional; once it becomes operational and accessible, farmers opined that will help them in future to get maximum profit from their pineapple production. In another study, it is mentioned that 55 per cent of the farmers felt the shortage of the fertilizer in time, 56 per cent of the farmers faced storage loss due to marketing constraints, also consider fluctuation of farm produce as the biggest constraints (Reema et al., 2020). Sharma et al., (2016) highlighted the marketing constraints in Nagaland in terms of inadequate transport facilities, non-availability of market in the locality, low marketable surplus, absence of market information, lack of organization among producers,

and problems of storage, which are in conformity of the findings of present study. Hossain & Islam (2017) stated that every year in Bangladesh large amount of pineapple damaged for lack of storage and transportation facilities. The pineapple growers compelled to sell the pineapples at a low price in peak season due to lack of proper marketing facilities. Das et al., (2014) also reported fluctuating market price and finding appropriate market price of produces as marketing constraints.

It is worth mentioning from present study that farmers in Tripura perceived overall highest difficulty level in market related constraints (79.70%) followed by situational constraints (76.95%), economic constraints (75.21%), infrastructure constraints (70.60%). Also, farmers were facing overall difficulty level in environmental constraints (48.92%), technological constraints (47.63%) and social constraints (45.38%). Present study unraveled major constraints in pineapple cultivation which are lack of market facilities, scarcity of water, financial problems (lack of fund), high cost of cultivation and high labour wage, lack of infrastructures like soil testing laboratory, agro-service centre and storage facilities, and low-quality packaging. Besides other minor constraints identified labour intensiveness, low rainfall, inadequate irrigation, low adoption of improved practice by neighbor and lack of group approach in farming.

CONCLUSION

The marketing constraints followed by situational, economic and environmental constraints warrant attention to combat to bring about improvement in pineapple cultivation and pineapple growers' livelihoods. Small pineapple growers were facing marketing problems and were selling the pineapples at a low price with poor return. Post-harvest management including poor processing, packaging and marketing facilities restricted the expansion of pineapple cultivation. Pineapple farmers indicated their concerns towards changing climatic scenario resulting in fluctuating temperature, erratic rainfall, and water shortage during crop growth period. The existence of economic constraints of farmers like lack of fund, high labour wage, and cost of cultivation were restricting expansion of area and production of pineapple cultivation in Tripura. Lack of adequate agro-service and soil testing centres as well as storage facilities need to be given attention for required infrastructure development.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (144-148)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Impact Assessment of *Bidi* Tobacco in Gujarat

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ARTICLE INFO

Keywords: *Bidi* tobacco, Constraints, Economic impact, Farmers, Jowar, Wheat

http://doi.org/10.48165/IJEE.2022.58235

ABSTRACT

Tobacco, the golden leaf is one of the important high value commercial crops grown in over 15 states in India. It is a highly remunerative crop fetching more economic benefits to the farmers. Among different types of tobacco, *bidi* tobacco is an important non-FCV tobacco grown largely in Gujarat. The present study was conducted in the year 2019 with an objective to assess the impact of tobacco crop on socio-economic transformation of tobacco farmers in Gujarat state. The total sample size of the study was 160. The average net returns from *bidi* tobacco were Rs. 65000/ha. in Gujarat compared to wheat (Rs. 25,000/ ha) and jowar (Rs. 15000/ha). The socio-economic impact was high for tobacco growers in terms of land size, annual income, expenditure pattern, possession of assets, net returns, habitat &educational security and social empowerment than non-tobacco farmers. The major constraints identified from tobacco farmers wereprice fluctuation, non-availability of labour, suckers problem and storage facilities. The different factors for growing tobacco were high profit, availability of timely and sufficient credit, location suitability and timely availability of inputs. For non-tobacco crops, the major factors for cultivation were location suitability, adoption of improved technology, quick payment to the produce and government support.

INTRODUCTION

India has prominent place as second largest producer of tobacco (760 million kg) after China (FAOSTAT, 2020). Tobacco provides employment directly and indirectly to 45.7 million people and Rs. 5,969.59 crore in terms of foreign exchange to the National exchequer (Tobacco Board, 2020). Indian tobacco has great demand in the international market in view of its low production cost and offers the customers value for money because of the availability of varied tobacco leaf styles. In India, the major tobacco producing states are Gujarat, Andhra Pradesh, Karnataka, Uttar Pradesh, Tamil Nadu, Bihar and West Bengal. Andhra Pradesh, Gujarat, Karnataka and Uttar Pradesh together account for about 90 per cent of the total tobacco production in the country (Goyal et al., 2004). Among non-Flue Cured Virginia types, *bidi* tobacco is a highly remunerative crop providing immense benefits to farmers in the *bidi* tobacco growing regions. Tobacco is cultivated in around 1.59 lakh ha in Gujarat, the major type being bidi tobacco. The other types of tobacco grown in Gujarat are chewing (Lal and Kala chopadia), Hookah (Gadaku) and rustica, which are grown in about 40,000 ha (AAU, 2022). The main beneficiaries include small, marginal, tenant farmers, tribal farmers and farm women. According to Tobacco Institute of India (2021) reports, the total number of registered *bidi* workers in the country is 49.82 lakhs, among them the total number of women employed is 36.25 lakhs.

Although tobacco is fetching high returns to farmers, but the present international policies, anti-tobacco campaigns, tobacco control measures by the government, intense measures to crop diversification in tobacco growing areas by Ministry of Agriculture and Farmers Welfare through Crop Diversification programme leaving the future of tobacco sector gloomy. The per cent budget share for tobacco growing areas to shift from tobacco to other crops

Received 18-02-2022; Accepted 05-03-2022

in the total 'Crop Diversification Programme' budget was increased from 2015-16 (16.67%) to 2019-20 (33.35%) which shows the success in implementation of the programme (Hema et al., 2020). In case of *bidi* tobacco in particular, the number of *bidi* workers engaged in *bidi* rolling industry was reduced from 55.86 lakhs in 2019 to 49.82 lakhs in 2021 (Tobacco Institute of India, 2021). Besides, in order to encourage tobacco workers to shift to alternative vocations, the Ministry of Labour and Employment, Government of India in collaboration with the Ministry of Skill Development and Entrepreneurship, Government of India, has initiated 'Skill Development' programme for *bidi* rollers, to facilitate them to shift to alternative vocations.

In this background, keeping in view of the significance of livelihood security of the farmers and employment of millions of stakeholders of tobacco sector, there is a need to study the impact of tobacco cultivation on farmers livelihood. Reports of last five years also showed that the total number of *bidi* workers was gradually increased from 48.12 lakhs in 2017 to 49.82 lakhs in 2021 (Tobacco Institute of India, 2021). To improve the tobacco cultivation scenario of major tobacco growing areas of Gujarat, assessment of the socio-economic impact, created by tobacco cultivation and constraints faced by farmers are very important Therefore, the present research was undertaken with an objective to study the impact assessment of *bidi* tobacco cultivated in Gujarat.

METHODOLOGY

The study was both quantitative and descriptive in nature. The production of *bidi* tobacco in Gujarat is largely concentrated in Middle Gujarat Zone comprising Kheda, Anand, Mahisagar and Vadodara districts (90% of total production of Gujarat) besides a small area in Panchmahals district, hence Gujarat is purposively selected for the present study. From middle Gujarat Zone, Anand and Kheda districts were selected for the study since the production of tobacco is largely concentrated in these districts. Two talukas from each district were selected randomly from selected districts among which one is tobacco growing and the other is non-tobacco growing taluka. The non-tobacco crops selected for the study were wheat and jowar. Four villages were selected randomly for the study from each sampled taluka, making a total of 16 villages for the study. Ten respondents were selected randomly for the study from each village. Thus a total of 160 respondents were selected randomly for the study among which 80 tobacco farmers and 80 non-tobacco farmers.

The ex-post facto research design was used for the study. The study was conducted by using the primary data. A semi structured questionnaire measuring the socio-economic impact along with farmers profiles was developed and data was collected by personnel interview method. The indicators for the study were selected based on review of literature and consultation with various experts. In total, 11 indicators were used to assess the socio-economic impact of *bidi* tobacco. The economic indicators selected based on pilot study *viz*., land size, assets possession, net returns, source of credit, annual income, expenditure pattern and social impact variables *viz*., social security, habitat security, health security and social empowerment. The statistical tools for data analysis used were descriptive statistics and non-parametric tests.

RESULTS AND DISCUSSION

Economic impact

Five major economic impact indicators were studied and were compared by using independent sample 't' test and the results were presented in Table 1.

It was observed from Table 1 that the average land size of tobacco growers was 3.31 ha and for non-tobacco growers was 2.61 ha. Statistics showed that there was significant difference in the extent of average land size between tobacco and non-tobacco growers ($t = 2.50$, $p<0.05$). The possible reasons that could be attributed to this finding were those who had agriculture as the main occupation almost depend on their land for their livelihood. So they always try to possess large area. It could be their ancestral property or high income from particular crop. The similar findings were reported by Duppal et al., (2020) & Vivek et al., (2021) reported that farmers land holding size was the most important influencing factor for empowerment. Credit borrowing is an important factor that affect the agricultural productivity of the farmers. It was observed that tobacco is a crop financed adequately by the traders to an average extent of up to Rs. 40,000/ha, whereas, non-tobacco farmers borrow money from money lenders. In the study area, it was found that wheat, and jowar crops were financed to the maximum limit of 20,000/ha. Traders were found to be major sources of finance in case of tobacco farmers while majority of non-tobacco growers preferred credit from informal sources like money lenders. The data also showed that there was significant difference between the two groups with respect to source of credit. The annual income of *bidi* tobacco farmers and non-tobacco farmers was Rs. 1.7 lakhs and Rs. 1.05 lakhs per ha respectively. The findings were in line with the results of Pal and Kaur (2020) showed that there was significant difference in annual income between two comparison groups. It can be concluded that the higher income generating capacity of the tobacco farmers was due to high economic benefits from tobacco crop. It was also noted that there was no significant difference in the income from livestock and non-farm sources for both the groups. Adoption behavior of the farmers is affected by the attitude they possess for a particular crop. *Bidi* tobacco farmers had more favourable attitude towards tobacco cultivation as a result of their association with the crop since many years due to comparatively stable returns.

Absolute income level of household or its income trends is more significant in determining its consumption and investment expenditure in basic needs. The different sub-variables taken under expenditure pattern were food, clothing & wearing, children education *i.e.* size of school growing children, health and recreation expenses. The monthly expenditure of tobacco farmers towards food, clothing, children education and recreation was relatively higher than the other crops farmers. Although food expenditure is considered to be basic for the daily life of the farmers, but the quality of the expenditure varied. The same is the case with clothing and recreation, The reasons behind these results may be majority of the respondents were having sufficient income which help them to spend expenditure on some items. Results concluded that the expenditure towards basic standard of living was high for tobacco farmers than non-tobacco farmers due to stable income from the

Table 1. Comparison of economic impact indicators using independent samples 't' test (N=160)

Variables	Particulars		Mean	t-test for Equality of Means
	Category	Respondents	(Rs.)	(Eq. variances) t, DF(Prob. t)
Land size	Farmers	Tobacco	3.31(ha)	2.50*158 (0.012)
		Non-tobacco	2.61(ha)	
Source of credit	Traders	Tobacco	34500	11.86*158 (0.00)
		Non-tobacco	12000	
	Money lenders	Tobacco	14500	-2.182*158 (0.001)
		Non-tobacco	17400	
	Bank	Tobacco	17400	0.456158 (0.650)
		Non-tobacco	17100	
Annual Income(Gross)	Farming(per ha)	Tobacco	170000	21.6*158 (0.000)
		Non-tobacco	105000	
	Livestock	Tobacco	6394	1.45^{ns}158 (0.028)
		Non-tobacco	5470	
	Non-farm sources	Tobacco	18000	1.5^{ns}158 (0.12)
		Non-tobacco	16500	
	Total income	Tobacco	189000	19.45*158 (0.000)
		Non-tobacco	136000	
Expenditure pattern	Food	Tobacco	5843	7.2*158 (0.000)
		Non-tobacco	4968	
	Clothing	Tobacco	2753	31.47*158 (0.000)
		Non-tobacco	1503	
	Children education	Tobacco	4887	12.46*158 (0.000)
		Non-tobacco	3636	
	Health	Tobacco	1393	1.98158 (0.049)
		Non-tobacco	1288	
	Recreation	Tobacco	3367	32.38*158 (0.000)
		Non-tobacco	1708	
Assets owned	Household assets	Tobacco	84444	12.100*158 (0.001)
		Non-tobacco	65854	
	Farm assets	Tobacco	64224	1.986*158 (0.00)
		Non-tobacco	36334	
	Livestock possession	Tobacco	46764	1.372*158 (0.001)
		Non-tobacco	32654	
	Vehicles possession	Tobacco	29634	-.454158 (0.603)
		Non-tobacco	30804	

* $p<0.05$, t = value of the t statistic, df = degrees of freedom

tobacco crop. There was significant difference in assets owned by the *bidi* tobacco growers in respect to value of household, farm assets and livestock. It shows the priority of the farmers to have valuable assets. The similar results were reported by Saha et al., (2018) indicated that asset possession was significantly correlated with the empowerment. The net returns/acre and B:C ratio for tobacco crop (1.6) was high compared to wheat (1.43) and Jowar (1.36). These findings were in accordance with the results of Kumar et al., (2016). It is due to high market price for tobacco *i.e.* Rs. 90 per kg. Therefore the farmers in this area were cultivating tobacco crop since many years. The tobacco crop has advantages of easy access to inputs, timely finance from money lenders and traders and easy access to marketing.

Social impact

The social impact indicators were compared by using Wilcoxon Mann-Whitney test. Data from table 2indicated that tobacco farmers were comparatively better off than non-tobacco growers. This indicates that the social impact on tobacco farmers was high which is due to high net profits from *bidi* tobacco. There was significant difference with high mean rank for tobacco and non-tobacco growers in respect of habitat security, educational security to children and social empowerment. It was also observed that the tendency towards food security, health security is almost same for *bidi* tobacco and non-tobacco farmers. The similar results were reported by Kranthi (2012, 2015).

Information seeking behaviour

Data collected on availability of various sources of information to the tobacco and non-tobacco farmers indicated that there was major difference between the groups. Unlike Flue Cured Virginia, which is regulated by Tobacco Board of India, Ministry of Commerce, *Bidi* tobacco trade is dominated by private traders. Hence, traders are the major source of information for tobacco farmers in Gujarat. Small farmers seek information from progressive farmers. The findings were in agreement with Lal et al., (2012). Whereas in case of wheat and jowar crops, agriculture department officials and progressive farmers are the major sources of technical information.

Factors determining cultivation of tobacco and non-tobacco crops

The various factors for cultivating tobacco and non-tobacco crops were compared by using Friedman's two-way ANOVA

Table 2. Wilcoxon Mann-Whitney test for analysis of social impact (N=160)

Variables	Mean rank		Mann - Whitney U value	Z value	Asymp. Sig. (2-tailed)
	Tobacco (n_1=80)	Non-tobacco (n_2=80)			
Food security	89	72	2.52^{ns}	-2.359	.018
Habitat security	106	54	5.15	-7.155	.000*
Educational security	116	44	6.78	-8.963	.000*
Health security	82	78	7.20^{ns}	.-0.443	0.636
Social empowerment	100	60	107.5	-5.471	.000*

analysis. From Table 3, it can be concluded that, the reasons expressed by the farmers for growing tobacco crop were high profit, availability of timely and sufficient credit, location suitability and Timely availability of inputs. The major contributing factors for growing non-tobacco crops were location suitability, adoption of improved technology, quick payment to the produce and government support. The similar results were reported by Chapke et al., (2018) & Paasa et al., (2016).

Constraints of tobacco and non-tobacco growers

Major constraints faced by the respondents were identified and administered to the respondents to analyse the major problems faced by them. Friedman's two-way ANOVA test was used to compare tobacco and non-tobacco growers.

It was evident from Table 4 that among the constraints, price fluctuations (mean rank 8.81) was the major constraint for tobacco farmers followed by non-availability of labour (mean rank 8.65), suckers problem (mean rank 5.38) and storage facilities (mean rank 3.93) were the major constraints for tobacco growers. In case of non-tobacco crops price fluctuations (mean rank 8.7), non-availability of sufficient credit (mean rank 8.2), high labour cost (mean rank 7.4), lack of technical knowledge (mean rank 5.2) were the major constraints. Similar results were reported by Shanabhoga et al., (2021). Farmers expressed their concern that the vertical spread existed between the wholesale and retail prices of the selected crops *i.e.* tobacco, wheat and jowar. Such diverse variations in price spread between the wholesale and retail prices could be due to asymmetry in the transmission of price signals from wholesale to retail prices and vice versa. This asymmetry in the transmission of prices normally occurs due to the actions of intermediaries in the vertical chain. Majority of the farmers have no storage facilities. In order to clear farmers debts and due to the lack of storage facilities, a vast majority of the farmers in the study area sell their marketable surplus of the product immediately after harvest and get low prices. Farmers expressed various suggestions to overcome the above constraints. The most important recommendation is, proper review of government policy of MSP (Minimum Support price) to all the crops. This need to be enhanced after consensus with farmer organizations across India for all the crops. In view of non-availability of labour and also huge labour cost, custom hiring centers to be run by the government or it is to be given to farmer producer organizations/progressive farmers with limited hiring charges. Farmers need to be educated on recent techniques of cultivation and farm management in local languages by government extension department officials functioning at grass root level. Proper infrastructural facilities to be established by the government to reduce the losses.

Table 3. Factors contributing for cultivating tobacco and non-tobacco crops

S.No.	Factors	Mean Rank	Std. Deviation
a)	Tobacco crop favouring factors		
1	High profit	8.92	1.23
2	Availability of timely and sufficient credit	8.31	1.54
3	Location suitability	7.42	1.54
4	Timely availability of inputs	6.15	0.11
5	Knowledge on GAP	5.22	1.55
6	Access to market	4.84	1.19
7	Following fellow farmers	3.31	1.78
b)	Non-Tobacco crop favouring factors		
1	Location suitability	7.95	0.77
2	Adoption of improved technology	7.25	1.25
3	Quick payment to the produce	5.55	0.24
4	Government support	4.32	1.78
5	Contact with institutions/organizations	3.87	1.55
6	Access to credit facilities	3.54	1.85

CONCLUSION

The farmers were having high socio-economic impact indicators than non-tobacco farmers in Anand and Kheda districts of Gujarat. The net returns from tobacco crop was significantly higher compared to the other major crops like wheat and jowar.

Table 4. Mean ranks comparison of constraints by tobacco and non-tobacco farmers

Constraints	Tobacco growers		Constraints	Non-tobacco growers	
	Mean rank	Std. seviation		Mean rank	Std. deviation
Price fluctuations	8.81	1.15	Price fluctuations	8.7	0.95
Non-availability of labour	8.65	1.23	Non-availability of sufficient credit	8.2	0.85
Suckers problem	5.38	1.14	High labour cost	7.4	1.12
Storage facilities	3.93	0.56	Lack of technical knowledge	5.2	1.29
Damping off disease	3.47	0.96	Unorganized market	2.9	0.54
Unorganized market	2.25	1.58	Storage facilities	2.5	1.54

Tobacco crop facilitated the farmers for creation of wealth and enhanced care for health and education to their children. The tobacco crop played the major impact on community development and provided not only livelihood security but also good standard of living to tobacco farmers in *bidi* tobacco growing areas of Gujarat. But the present national policies in the recent past few years is against the cultivation of tobacco. This disregards the socio-economic importance who are dependent on Tobacco. Balanced tobacco regulation and rational taxation can safeguard livelihood of millions of tobacco farmers. It is therefor imperative to keep in mind the huge socio-economic significance of tobacco in India, particularly for supporting sustainable livelihood for millions of people, while framing tobacco control policies for the country. The farmers preferences towards shifting from tobacco to other crops need to be taken into consideration before implementing any anti-tobacco policies in tobacco growing areas.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (149-152)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Impact of Cotton Development Programme on Adoption of Recommended Bt-Cotton Cultivation Practices

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ARTICLE INFO

Keywords: Bt-cotton, Adoption, Impact, South-western Punjab

http://doi.org/10.48165/IJEE.2022.58236

ABSTRACT

The study assessed the impact of Cotton Development Programme (CDP) on the adoption of recommended management practices in Bt-cotton (*Gossypium hirsutum* L). The data was collected from 210 farmers over a period of six years to make quantitative comparison with baseline data collected during the initial three year period (2013-15) from Mansa district of Punjab. The adoption of crop management practices in Bt-cotton in terms of recommended Bt-cotton hybrids, seed rate, fertilizer dose, use pattern of potassium nitrate (KNO_3; 13:00:45) and reduction in insecticide use was investigated to quantify the impact of the CDP in the study region. These results revealed that area under recommended Bt-cotton hybrids increased from a meager 15.2 per cent to as high as 89 per cent; adoption of recommended use nitrogenous fertilizers increased by 15.1 per cent; and the productivity of Bt-cotton enhanced by 138 per cent during this period. Therefore, it could be concluded that implementation of CDP was successful in the revival of Bt-cotton cultivation which was severely affected due to severe attack of sucking pests particularly by whitefly (*Bemisia tabaci*) during *kharif*-2015.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is one of the important crops grown in India, USA, China and Pakistan, contributing 85 per cent to the total global cotton production (Singh & Kairon, 2013; Singh et al., 2021a). In India, cotton is grown on 9.2 million ha (mha) area, constituting 27 per cent of worlds' cotton area with the highest production in the world (Niranjan, 2017). Indeed, the social security and rural livelihood of vast majority of people are greatly dependent upon cotton crop through its production, picking, transportation, trade, processing and marketing etc. (Singh & Sharma, 2016). Therefore, it is important to increase the production and productivity of cotton, especially in traditionally cotton growing areas of arid and semi-arid regions (Singh et al., 2018a). Although after the introduction of Bt-cotton in India, the production levels were significantly increased and country became the leader amongst the top cotton producers (Singh et al., 2021a), but still productivity remained low compared with other cotton growing countries (Kranthi et al., 2011). Among different yield governing factors, the attack of bollworms and sucking pests decreased in Bt-cotton production resulting increase in productivity (Singh et al., 2021c), but the infestation of sucking pests increased after 2006-07, which has caused indiscriminate use of pesticides (Sabesh et al., 2014; Singh et al., 2021b).

Worldwide, various extension programmes have been launched to enhance adoption of recommended practices among farmers for yield improvement and poverty reduction (Godtland et al., 2003; Asfaw et al., 2012; Mariano et al., 2012; Singh et al., 2021b). The implementation of Integrated Cotton Development Programme (ICDP) launched during 1970s in India helped increasing cotton

Received 18-01-2022; Accepted 07-03-2022

production through increased area under cotton (Sabesh et al., 2014). Government of India (GOI) launched technology mission on cotton in 2000 with the objective of improving the cotton production through improved seeds and integrated nutrient and insect-pest management. In Punjab, 'Cotton Development Program (CDP)' was launched by the state Government during 2016 to reduce the cost of cultivation, while enhancing productivity of Bt-cotton crop in the state. The CDP was launched after the devastation of Bt-cotton in the state amid epidemics of cotton whitefly (*Bemisia tabaci*) during 2015. The CDP was initiated with the objective of promoting scientific cultivation practices among farmers to revive Bt-cotton. During the period between 2015-17, numerous training programmes and awareness programmes were organized and field trials/ demonstrations were conducted to make the cotton growers aware regarding recommended Bt-cotton hybrids, optimum seed rate, fertilizer doses and application of recommended insecticides based on economic threshold level (ETL). The farmers were made aware for different site-specific component technologies to be followed for the management of whitefly and yield maximization.

It is perceived that the success of any extension programmes is judged by the adoption of improved practices and the productivity enhancement; therefore, institutions all over the world are giving importance to evaluation of the extension programmes. Therefore, the present study was conducted to assess the impact of CDP in terms of adoption of recommended Bt-cotton growing practices for productivity enhancement in Mansa district of south-western Indian Punjab.

METHODOLOGY

The present study used the quasi-experimental design. For the purpose of impact assessment primary source of data was used during the study. Firstly, three major cotton growing blocks viz; Jhunir, Sardulgarh and Budhlada blocks were purposively selected. From the each selected block seven major cotton growing villages were randomly selected, thus total 21 villages were selected. From each village 10 cotton growing farmers were randomly selected making total sample size of 210 farmers. The baseline survey was conducted during 2013-15 by including data from 210 randomly selected Bt-cotton growers in the study region. A data were again collected from same set of sampled farmers post implementation of CDP during 2016-18. For the purpose of data collection, a structured interview schedule was developed and implemented after pre-testing on 20 non-respondents farmers. Data were entered in Microsoft Excel spreadsheets (MS Office-2010) and were analysed using mean and percentage distribution of respondents among different categories. Impact was assessed in terms of increase in area under Bt-cotton, increase in adoption of recommended sowing time, seed rate, fertilizer use and decrease in insecticide use along with increase in seed cotton yield.

RESULTS AND DISCUSSION

Area under Bt-cotton in the study region decreased continuously from 2013 to 2015. The decrease in area under Bt-cotton was 13.1, 10.4, and 4.2 per cent during 2013,2014 and 2015, respectively. The decrease in area under cotton crop was ascribed to high incidence of sucking pests, low market prices and high picking costs of Bt-cotton. Area under Bt-cotton further decreased drastically by 37.9 per cent during 2016 (Table 1), due to epidemic of whitefly infestation that has led to almost complete failure of crop in cotton belt of Punjab during 2015 (Kranthi et al., 2015; Singh & Sharma, 2016; Singh et al., 2018a). However, after implementation of CDP, area under Bt-cotton among sampled farmers increased by 15.9 per cent during 2017 and further 20.6 per cent during 2018 (Table 1). Area under Bt-cotton increased during 2018 due to enhanced yield and improved produce quality owing to increase in knowledge level of farmers and adoption of recommended practices by farmers.

Impact of CDP on adoption of recommended Bt-cotton hybrids and management practices

During 2013-15, only ~15 per cent farmers were cultivating recommended Bt-cotton hybrids, while 89 per cent were cultivating Bt-cotton hybrids without adopting recommended package of practice. It exhibited a dramatic shift with reverse trend during 2016-18 showing that 78-100 per cent of farmers shifted towards adoption of recommended Bt-cotton hybrids. Severe infestation of cotton whitefly (*Bemisia tabaci*) and leaf curl virus (CLCuD) on non-recommended Bt-cotton hybrids during 2015 and the concentrated efforts by the extension workers, thereafter contributed towards increased adoption of recommended Bt-cotton hybrids in the study region.

To escape the crucial growth phase of cotton which is more conducive for the infestation of sucking pests, the farmers were advised to complete sowing of Bt-cotton well before 15th of May. The sowing on only 8.6 per cent of the total area under Bt-cotton was delayed during 2013-15, which was almost same (8.1%) after the implementation of CDP. Thus, number of farmers adopting timely sowing of cotton crop was 91.4 per cent after the implementation of CDP. Pulakkatu-Thodi et al., (2014) has reported lesser attack of insect pests, better boll quality and higher yield in early sown cotton crop. Results showed that after implementation of CDP, number of farmers using recommended seed rate increased by ~14 per cent (Table 2). Number of farmers using higher seed rate also increased due to problem of soil salinity and/ or sodicity, poor quality irrigation water and unfavorable climatic conditions. Gurjar et al., (2018) has reported unfavorable climatic conditions as major constraints in crop production. However, the number of farmers using lower seed rate than the recommended decreased from

Table 1. Change (Δ) in area under Bt-cotton before and after the implementation of CDP in south-western, Punjab

Particulars	Before implementation of CDP*			After implementation of CDP		
	2013	2014	2015	2016	2017	2018
Area (ha)	148.9	106.2	147.0	127.6	154.8	185.7
Δ in area (ha)	-13.1	-10.4	-4.2	-37.9	15.9	+20.6

*Field survey 2013-2018

Table 2. Impact of CDP on adoption of recommended Bt-cotton cultivation practices in south-western, Punjab (*N*=210)

Particular	Number of farmers		Difference (%)
	Before implementation of CDP	After the implementation of CDP	
Recommended Bt-cotton hybrids	32 (15.2%)†	187 (89.0)	73.8
Timely sowing (Between 15th April - 15th May)	192 (91.4%)	191 (90.9)	-0.5
Seed rate (g ha^{-1})			
< recommended	11 (5.2)	4 (1.9)	-63.6
Recommended (2850±450 g ha^{-1})	176 (83.8)	201 (95.7)	14.2
> recommended	5 (2.4)	23 (11.0)	-78.3
Fertilizer-N (kg N ha^{-1})			
< recommended	58 (27.6)	49 (23.3)	-15.5
Recommended (112.5-187.5 kg N ha^{-1})	139 (66.2)	160 (76.2)	15.1
> than recommended	13 (6.2)	1 (0.5)	-92.3
Fertilizer-P (kg P_2O_5 ha^{-1})			
Recommended (Nil)	70 (33.3)	91 (43.3)	30.0
Un-recommended (12.5-25)	140 (66.7)	119 (56.7)	-15.0
Fertilizer-K (kg K_2O ha^{-1})			
Recommended (Nil)	120 (57.1)	142 (64.5)	18.3
Un-recommended (0-25)	90 (42.9)	78 (35.5)	-24.4
Fertilizer-Zn ($ZnSO_4.7H_2O$)			
25 kg ha^{-1}	82 (39.0)	94 (44.8)	14.6
KNO_3 (13-00-45) sprays (kg ha^{-1})			
0-1 sprays (0-5 kg ha^{-1})	94 (44.8)	73 (34.8)	-22.3
2-3 sprays (10-15 kg ha^{-1})	100 (47.6)	117 (55.7)	17.0
4 sprays (20 kg ha^{-1})	16 (7.6)	20 (9.5)	25.0

†Figures in parenthesis are percentages

~5.0 to 1.9 per cent, a decrease of 63.6 per cent. The proportion of farmers applying recommended dose of fertilizer-N (112.5-187.5 kg ha^{-1}) increased from 66.2 to 76.2 per cent after implementation of CDP an increase of 15.1 per cent, so there was a significant impact of CDP on use of recommended fertilizer-N use (Table 2). The proportion of Bt-cotton farmers applying fertilizer-N less than the recommended dose decreased from 27.6 to 23.3 per cent a decrease of 15.5 per cent. Similarly, the proportion of farmers applying fertilizer-N more than recommended dose also decreased post implementation of CDP.

Farmers were advised to skip application of fertilizer-P in Bt-cotton, if recommended dose of fertilizer-P has been applied to previous winter (*rabi)* season crop. The number of farmers skipping application of fertilizer-P to Bt-cotton increased from 33.3 to 43.3 per cent (Table 2). Farmers were also advised to apply fertilizer-K to Bt-cotton based on the soil test report. The soils with available-K of 137.5 kg ha^{-1} are considered deficient. In K deficient soils, farmers were advised to apply K @ 30 kg ha^{-1}. Number of farmers skipping fertilizer-K to Bt-cotton increased from 57.1 to 64.5 per cent an increase of 18.3 per cent, after implementation of CDP in the study region. Farmers were also advised to apply $ZnSO_4.7\ H_2O$ @ 25 kg ha^{-1} to Bt-cotton. The data revealed that there was an increase in number of farmers applying zinc fertilizer after implementation of CDP (Table 2). However, still large number of farmers needs guidance regarding importance of balanced fertilizer use. Farmers were advised for four foliar application of potassium nitrate (KNO_3: 13-00-45) to Bt-cotton for yield gain and quality improvement. Over the years, farmers perceived the importance of foliar application of KNO_3 in terms of yield enhancement and economic gains. The proportion of farmers applying 2-3 foliar sprays of KNO_3 increased from 47.6 to 55.7 per cent. However, the proportion of farmers applying the recommended four foliar applications of KNO_3 was increased from 7.6 to 9.5 per cent. Although, the farmers realized the significance of KNO_3 on crop performance, yet shortage of labor and spray costs were the major constraint for this marginal increase in the proportion of farmers and in adoption of recommendation of 4 sprays.

Impact of CDP on insecticide use

The most important component of CDP was the promotion of integrated pest management (IPM) strategies among the cotton growers and this was realized by the drastic reduction in insecticide use after the implementation of CDP (Table 3). It was found that average number of sprays decreased from 5.9 to 4.9 after the implementation of CDP due to application of insecticides based at ETL. The number of farmers applying lesser number of sprays increased, while those applying higher number of sprays decreased. Data showed that 15.2 per cent of the farmers applied seven insecticidal sprays before CDP, while only 10 per cent of the farmers applied same number of sprays after implementation of CDP. Similarly, the proportion of farmers applying eight insecticide sprays decreased from 8.1 to 4.3 per cent (Table 3).

The use of recommended insecticide formulations also increased from 50.5 to 78.6 per cent, while proportion of farmers using mixture (cocktail) of insecticides decreased from 41.0 to 29.5 per cent (Table 4). After 2017 onwards, the use of *neem* based insecticides was recommended to the farmers as a preventive measure for the management of sucking pests. The proportion of farmers using *neem* based insecticides were 30.4 per cent after implementation of CDP.

Table 3. Decrease in use of insecticides after implementation of CDP in south-western Punjab (*N*=210)

Number of pesticide sprays	Number of farmers		Difference (%)
	Before the implementation of CDP	After the implementation of CDP	
1 spray	0 (0.0)†	3 (1.4)	-
2 sprays	3 (1.4)	7 (3.3)	1.3
3 sprays	15 (7.1)	31 (14.7)	106.7
4 sprays	37 (17.6)	39 (18.6)	5.4
5 sprays	44 (21.0)	58 (27.6)	31.8
6 sprays	29 (13.8)	37 (17.6)	27.6
7 sprays	32 (15.2)	22 (10.5)	-31.2
8 sprays	17 (8.1)	9 (4.3)	-1.4
>8 sprays	33 (15.7)	4 (1.9)	-87.9
Average no. of sprays per farmer	5.9	4.9	-1.0

†Figures in parenthesis are percentages

Table 4. Use of recommended insecticides by Bt-cotton growers after implementation of CDP in south-western Punjab (India) (*N*=210)

Insecticide use	Number of farmers		Difference (%)
	Before the implementation of CDP	After the implementation of CDP	
Un-recommended	94 (44.8)†	55 (26.2)	-41.5
Recommended	106 (50.5)	165 (78.6)	55.7
Mixture of insecticides	86 (41.0)	62 (29.5)	-14.8
Neem based spray	0 (0.0)	64 (30.4)	-

†Figures in parenthesis are percentages

Impact of CDP on productivity of Bt-cotton

Mean seed cotton yield increased from 17.7 to 24.4 q ha^{-1} (an increase of 138%) after the implementation of CDP. The lowest seed cotton yield in 2015 was due to severe infestation of cotton whitefly and resulted in almost complete failure of Bt-cotton in some fields. The increase in yield was ascribed to the adoption of recommended Bt-cotton hybrids, appropriate fertilizer management practices and IPM technologies. Kumar et al., (2012) reported productivity of Bt-cotton crop improved as result of implementation of IRM program in Haryana state of India.

CONCLUSION

These results showed that there was significant increase in number of farmers adopting recommended Bt-cotton cultivation practices after the implementation of CDP. The results of long term study (2013-18) showed that CDP was successful in convincing farmers to reduce insecticide use, adopt balanced fertilizer use and increased seed cotton yield despite of several site-specific and general constraints. The pesticide load for the management of sucking pests in Bt-Cotton was significantly reduced after the implementation of CDP. The CDP was also successful as farmers were able to manage incidence of whitefly and Bt cotton yield also increased in the study area. The CDP was also successful in gaining the much needed confidence among farmers for increasing the area under Bt-cotton.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (153-157)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Development of Scale to Measure Agripreneurs Attitude towards Entrepreneurial Climate

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ARTICLE INFO

Keywords: Attitude, Entrepreneurial climate, Agrienterprise development, Reliability, Validity and Standardized scale

http://doi.org/10.48165/IJEE.2022.58237

ABSTRACT

Attitude plays a crucial role in influencing one's behaviour with respect to a particular psychological object. To measure the attitude of farmers towards entrepreneurial climate for agrienterprise development, need was realized to devise a scale and a Likert's Summated Rating scale was constructed by following the standard methodology suggested. Attitude towards entrepreneurial climate was categorized in six specific dimensions *viz.* Institutional factors, psychological factors, cognitive factors, managerial factors, sociological factors and economic factors. A total of 141 items were constructed and was sent to 124 experts through email, Google docs form and handed over personally by visiting to the experts. Based on the 43 experts' responses 72 items were screened out for item analysis. The scale was administered to 80 agripreneurs of Uttar Pradesh. The odd-even method was followed for testing reliability of the scale and reliability co-efficient was 0.66. The validity of the scale was examined with the help of face and content validity. The scale developed finally consisted of 44 items (36 positive and 8 negative).

INTRODUCTION

Due to the lack of accessibility and availability of food anywhere/anytime across the globe, there is a need of focusing on the promotion of secondary agriculture. Secondary agriculture is the biggest private enterprise where majority of rural people can engaged in agripreneurial activity having certain degree of experiences and affiliations. In the recent time, the government is emphasizing on promotion and establishment of agrienterprise in agricultural sectors to increase the income of farmers. Also, the processing industry for value addition is the need of the hour to expand the market globally for the purpose of enhancing accessibility and availability of food everywhere. But it requires shaping of attitude of potential agripreneurs to shape new enterprises. Agripreneurs attitude can be operationally defined as the attitude that entails different processes undertaken by him in the creation of new firms and is result of the continuous interaction of personal factors and entrepreneurial climate (Bird, 1992). One notable manifestation of agripreneurs attitude is agripreneurship and the agripreneurs do not act in a vacuum, but react to entrepreneurial climate surrounding them (Peters & Waterman, 1982). Entrepreneurial climate consists of the factors which are critical in developing agripreneurship in certain regions (Gyanwali & Fogel, 1994). Thus, entrepreneurial climate liable in promoting agriculture development conceptualized to be comprised of various factors like institutional, sociological, economic, psychological, cultural, cognitive and managerial aspects within the boundaries of the agrienterprise and is of direct interest to an individual decision-making behaviour in the system. However, due to the complication of the attitude phenomenon, the researchers, as well as the psychologists, often find it intricacy to clearly define and measure the attitude construct (Allport, 1954; Dillard, 1993). A lot of attitude-based research avoids long-term development techniques. In many cases, researchers modify an existing standardized scale for their current research (Meena & Singh, 2013; Nikam et al., 2014) or collect a pool of statements from the literature review and

Received 15-02-2022; Accepted 07-03-2022

administer them to the respondents in Likert form for their level of agreement (Siebert et al., 2010; Badola et al., 2012; Ward et al., 2016; Singh et al., 2021; Kumar et al., 2021).). While the researches on farmers' attitudes towards entrepreneurial climate for agrienterprise development the scale's reliability and validity in modified versions is a drawback of such research methodologies. The majority of previous research in this area has lacked accurate data on agripreneurs attitudes regarding how entrepreneurial climate (EC) have effect on agripreneurial activity, necessitating the need to bridge the research gap by constructing a standardized tool to investigate agripreneurs attitudes toward entrepreneurial climate. Based on the definitions of attitude by Thurstone and Chave's (1946), literature review and expert consultation, the dimension of the attitude scale was derived from multiple components of entrepreneurial climate.

METHODOLOGY

The standardised attitude scale was taken up by using a step-by-step approach of Likert's summated rating scale method (Likert, 1932). A pool of statements was gathered during the item collection process from the literature, interaction with agricultural scientists, extension professionals, agripreneurs, and personal experience, a total of 202 items were gathered. Perspectives observed for the collecting of statements from the six EC dimensions namely Institutional factors, Psychological factors, Cognitive factors, Managerial factors, Sociological factors, and Economical factors. The 141 items were obtained after screening using the 14 criteria for attitude scale construction proposed by Edwards (1969); Thurston & Chave (1929); Edward & Kilpatrick (1948).

The relevancy test was conducted in which the selected items were sent to specialists in the field of EC for their professional opinion on the statement's relevancy (Kumar et al., 2021). The 141 items were delivered to 124 judges for testing the relevancy and difficulty on a five-point scale. On the expert opinion of 43 judges who responded completely 72 items were judged as relevant with the t-value estimation. The items with t value greater than or equal to 1.75 were selected.

According to Anastasi (1968), the consistency is the scores produced by the same persons when tested on multiple occasions. The odd-even method of reliability testing was used. For testing the reliability, 30 experts were asked to rate their level of agreement on a five-point scale. The items were coded on an excel sheet, separated into two equal halves (odd-even), and then exported into SPSS for scale reliability analysis.

The accuracy with which a test measures what it is designed to measure is defined by Lindquist (1951). Content validity test approach was used. This was accomplished by giving the established dependable attitude scale to 30 judges in the field of agricultural extension for feedback and suggestions. Content validity, according to Anastasi (1968), entails a systematic analysis of the test content to see if it covers a representative sample of the behaviour area to be assessed.

RESULTS AND DISCUSSION

Selection of relevant items was done after relevancy testing, the statement providing result >60, relevancy weightage >0.60 and mean relevancy score > 2.5 were considered for final selection. Also repetition and duplication type statements opined by judges were relooked. By this process out of total 141 statements, 69 items were discarded and finally 72 items remained for further item analysis which is depicted in Table 1.

Table 1. Mean Relevancy Score (MRS), Relevancy Weightage (RW), Relevancy Percentage (RP) and estimation of t-value of the selected items

		MRS	RW	RP	t-value
Institutional factors					
A.	Governmental factors				
1.	Provision of information about agro-processing is not adequate for me	2.59	62.53	0.65	2.25
2.	Resources and facilities at subsidized rate for agrienterprise are not adequate for me.	2.63	63.76	0.66	2.61
3.	Institutions provide help to me in expansion of agrienterprise	2.51	75.90	0.78	2.20
B.	Administrative policy related factors				
4.	Telecom services provided by govt. are not adequate for me	2.21	59.23	0.56	3.71
5	Incentives from government are adequate for me	2.91	78.37	0.73	0.10*
6.	I think government policies are supporting regional agrienterprises	3.05	80.98	0.77	0.61*
C.	Transport				
7	Facilities of road transportation are not adequate for me	2.94	76.93	0.74	1.12*
8.	Availability of scientific packaging/packing facility is not adequate in my area	2.68	70.23	0.67	0.50*
9.	"Kuccha" road damages the product during transportation	3.49	81.53	0.88	0.13*
D.	Infrastructure				
10.	Interrupted power supply reduces efficiency of my processing unit	3.52	81.97	0.88	1.77
11.	Availability of innovative storage facility for agro processed product helped me to enhance profit	3.35	76.41	0.84	0.31*
E.	Regulatory legal/Bureaucratic factor				
12.	Excess bureaucratic procedure while registration of agrienterprises disturbed me	3.35	79.70	0.84	2.30
13.	My agrienterprise follow safety standard ensured by regulating authority	3.19	81.12	0.80	1.23*
14.	GST and its payment is not easy for me	3.12	62.10	0.78	2.21
15.	The length of time involves in the legal procedure demotivates me to go for agrienterprise	3.13	52.07	0.40	2.30
Psychological factors					
A.	Psycho-behaviour Factors				
16.	Stress bearing ability helped me in handling the day to day problem related to agrienterprise	3.56	90.68	0.89	0.12*
17.	Agrienterprise functioning in the planned direction brought satisfaction to me	3.26	74.87	0.82	1.30

Table 1 contd...

		MRS	RW	RP	t-value
B.	Intention for entrepreneurship				
18.	I intent to develop agribusiness for specialized commodity based on local needs	3.49	90.06	0.88	0.14*
19.	Enthusiasm to have monopoly for an agroproduct helps me to get higher income.	1.82	51.74	0.46	1.83
20.	Intension to for increased in my networking agrienterprise helped me for expansion of geographical spheres	3.14	74.02	0.79	3.10
C.	Strategic orientation				
21.	Long term strategies can help me for sustainability of my enterprise	3.59	72.89	0.90	1.90
22.	I feel there is always chance for improvement in performance of agripreneurs	3.31	76.54	0.83	1.77
D.	Perception of desirability				
23.	I prefer to be an agripreneurs rather than in any other profession	3.10	67.21	0.78	2.89
24.	Villagers perceive that being agripreneurs, I will take advantage of customer	2.77	62.90	0.70	0.24*
E.	Perception of viability				
25.	Worker ideas in the agrienterprise helped me for survival of my agrienterprise	2.96	67.66	0.74	1.79
26.	Policy related to tax waiving for agrienterprise help me in survival of agrienterprise	3.12	78.07	0.78	2.08
F.	Entrepreneurial orientation				
27.	I take calculated risk for agrienterprise to get expected outcome	3.21	77.23	0.81	3.09
28.	I have ability to turn problem & barriers into opportunities	3.42	81.77	0.86	2.21
29.	I adopt novel technology for enhancing efficiency of my agrienterprise	3.40	79.55	0.85	1.94
Cognitive factors					
A.	Level of knowledge				
30.	I figure out the local need of the agroproduct based on society demand	3.45	89.06	0.87	2.22
31.	I used my entrepreneurial knowledge for establishment of agrienterprise instead of becoming a manager	3.26	78.98	0.82	2.30
B.	Human Resource Development				
32.	I am dependent on consultant for feasibility analysis for establishment of agrienterprise	2.91	76.43	0.73	0.50*
33.	I recruit worker with task matching qualification for the development of my agrienterprise	3.45	66.90	0.87	2.30
34.	I utilize my worker for efficiency not for drudgery	3.10	69.68	0.78	2.61
C.	Educational Factors				
35.	I used to attend workshop/conference/seminars organised on agripreneurship which help to be on the current scenario of agrienterprise development	3.52	81.11	0.88	1.90
36.	I feel affiliated research laboratories in educational institutions give opportunities to student to convert their theoretical idea into physical product	3.12	71.93	0.78	0.10*
3.	Socio-logical factors				
A.	Social factors				
37.	I used to get social recognition and influences due to my agrienterprise	3.10	69.11	0.78	2.19
38.	Starting an agrienterprise bring prestige/social status for me in society	3.26	84.55	0.82	0.66*
39.	Being agripreneurs, I am preferred to be involved in decision making process in the society	3.35	77.11	0.84	2.21
B.	Political factors				
40.	I am being preferred for participation in the process of policy formulation for agrienterprise development	2.89	81.6	0.73	0.63*
41.	I feel few person holding position and power can raise voice of agripreneurs for policy making	2.91	69.89	0.73	1.67*
C.	Family, relative and friends				
42.	I am continuing with the agrienterprise set by ancestor which required less effort for further development	2.87	74.44	0.72	1.77
43.	My family values agripreneurial activity rather than any other activities	3.14	80.30	0.79	0*
44.	For me family and friends opinion in relation to agrienterprise development is important	2.96	79.75	0.74	2.10
D.	Religious Factors				
45.	I use to develop innovative agroproduct as per the religious festival needs	2.84	67.43	0.71	2.87
E.	Cultural				
46.	My culture emphasizes to attain self-sufficiency in agrienterprise	3.31	78.81	0.83	1.60*
47.	My learning from cultural differences helped to establish agrienterprises	2.96	75.83	0.74	2.18
F.	Social acceptance				
48.	My tolerance level for notorious people is the hallmark for growth and development of my enterprise	2.84	68.43	0.71	0.74*
49.	I can nurture the associated “social capital” to become potential entrepreneur	3.21	79.23	0.81	2.70
Economical factors					
A.	Marketability factors				
50.	I implement different marketing strategies for successful penetration in the market	3.63	85.89	0.91	3.35
51.	I use to maintain quality of agroproduct for good price of the products	3.59	83.49	0.90	0.35*
52.	I access the marketing information for selling product to cover large area	3.40	79.01	0.85	1.53*
53.	I add value in agroproduct to utilize better opportunity in the market	3.49	89.93	0.88	2.26
54.	Timely supply of product to market ensure my credibility and profit	3.33	87.61	0.84	2.78
55.	Innovative ideas in agrienterprise help me for popularity of agroproduct	3.31	76.81	0.83	0.75*

Table 1 contd...

		MRS	RW	RP	t-value
B.	Financial Factors				
56.	Timely availability of credits to me save the agrienterprise from shutting down	3.45	0.87	79.30	2.96
57.	I prefer to choose the input where subsidy is available to save money	3.31	0.83	84.54	3.58
58.	I avail insurance for the agrienterprise to lower down the risk	3.35	0.84	90.10	3.2
59.	I assess investment capacity before investing in the agrienterprise	3.35	0.84	75.09	1.31*
60.	Non-institutional resources are not helpful to me for investment in my agrienterprise	2.66	0.67	69.91	1.45*
61.	I feel institutional resources need more paper work for sanctioning the credit	3.14	0.79	80.84	1.46*
C.	Socio-economic Factors				
62.	The profit making through my agrienterprise help me to fulfill the socio-economic need of my family	3.19	0.80	71.12	1.35*
D.	Ease of Doing business				
63.	Getting license for an agrienterprise is a difficult task for me	3.17	0.80	91.98	2.11
64.	I have skill for convincing others on various issues which helped me in solving conflict within agrienterprise	3.24	0.81	73.14	0.52*
65.	Trading across borders is not easy for me, its required numbers of paper work	3.05	0.77	81.28	2.34
66.	Enforcing contracts is not easy for me as an agripreneurs	2.98	0.75	67.86	1.13*
Managerial factors					
A.	Agripreneurs basic managerial skills				
67.	I feel autocratic situation in agrienterprise is beneficial	2.63	71.29	0.66	0.99*
68.	I do not like unethical practices to get the work done from workers	2.96	79.72	0.74	1.81
69.	I feel it is not necessary to be scientific and rational in labor-management for an agrienterprise	2.91	65.44	0.73	1.82
B.	Business network				
70.	Quality product built up strong global business network for me	3.45	73.65	0.87	3.38
71.	Good relation with the international agripreneurs helped me in enhancement business networking	3.40	72.21	0.85	3.28
C.	Competitiveness				
72.	My strong organizing skill boost up the competitiveness level for agripreneurship	3.45	81.76	0.87	2.91

Table 1 depicts that selection of item for final scale was done after calculating the t value for all items, the items with t-values equal to or greater than 1.75 were finally selected and included in the attitude scale. It was observed that 44 statements were found to be having values more than 1.75 and the 28 item were discarded from the list due to their lower value on item analysis which is marked with star (*). The range of the t value were ranging between 0 (lowest) and 3.5 (highest). According to Edwards, the t-value above 1.75 of any item has high discriminating power which could be placed in the final attitude scale. Therefore, the attitude scale consisted of 44 (36 positive and 8 negative items) which were finally included in the scale. Items not classified by the majority of judges as either positive or negative with regard to the attitudinal object were eliminated from consideration for use in the final scale.

Table 2. Reliability of scale

Cronbach alpha	Set 1	Value	0.767
		N of items	22[a]
	Set 2	Value	0.875
		N of items	22[b]
		Total N of items	44
Correlation between sets			0.665
Spearman brown coefficient		Equal length	0.761
		Unequal length	0.761

Reliability, according to Ray & Mondal (1999), relates to the precision or accuracy with which a measurement or score is taken. According to Kumar (2016), a test is said to be dependable when it consistently produces the same results when applied to the same sample. The split half model reliability coefficient was 0.761, according to the reliability data for the developed attitude scale (Spearman brown coefficient). The reliability coefficient revealed that the attitude scale devised had a high internal consistency which is the most important aspect of attitude scale creation because it demonstrates the scale's robustness.

According to American Psychological Association (1966), the representativeness or sampling adequacy of the content substance, matter, and themes of a measuring instrument is known as content validity. As the scale was developed with the help of 30 judges who reviewed all of the revised statements and the experts' recommendations were implemented into the scale. As a result, the content validity of the current scale was met. Finally, 44 items under six broad heads are considered to assess farmers' attitudes toward the entrepreneurial climate for agribusiness development, and they were structured in such a way that positive and negative words appeared at random to avoid bias answer. Against each of 44 item there are five columns representing a five point continuum of agreement or disagreement to the item as followed by Likert (1932). The points on continuum are strongly agree, agree, undecided, disagree and strongly disagree with respective weight of 4, 3, 2, 1 and 0 respectively for favorable (positive) item and with weight of 0, 1, 2, 3, and 4 respectively for unfavorable (negative) item.

CONCLUSION

The concept of Entrepreneurial climate is gaining attraction and the attitude of agripreneurs in shaping/influencing the entrepreneurial climate is critical to the success of agribusiness. The measurement tool created to assist researchers, policymakers, and anyone interested in determining agripreneurs' attitudes toward the EC in a given location. The scale may aid them in conducting baseline surveys in order to make policy decisions on agribusiness growth or a behavioural change awareness programme. The created tool has a reliability of reliability coefficient was 0.761 which may be termed as highly consistent, hence usable in varied conditions.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (158-162)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Technological Gap in Recommended Practices of Apple Cultivation in Kashmir Valley

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ARTICLE INFO

Keywords: Apple, Gap, Growers, Practices, Technology

http://doi.org/10.48165/IJEE.2022.58238

ABSTRACT

Apple is mainly cultivated in Kashmir valley, due to its well suited climatic conditions. The area under apple fruit has been increasing constantly, but the production as well as productivity has not improved to a satisfactory level. To notch up the goal of higher production and productivity of this important fruit in different regions of Kashmir valley, adoption of improved technologies plays an important role. A wide gap exists between the accessible technologies and its actual adoption by the apple growers, as reflected through the poor yield at the grower's field. The study was conducted during 2019-20, with a view to determine the extent of technological gap between the recommended and actually adopted technologies by the apple growers in three districts of the Kashmir valley, selected purposively having maximum area under apple cultivation. A multistage sampling procedure was adopted for the study. It was found that the highest mean technological gap was found in district Budgam, followed by district Baramulla and the least gap existed in district Shopian. The overall mean technological gap index from all the three districts was found to be 63.08 per cent indicating need for scaling up extension efforts.

INTRODUCTION

Apple is one of the important horticultural fruit grown in different regions of the world and ranks third among the fresh fruits traded worldwide (Iriarte et al., 2021). It is commercially the most significant temperate fruit and ranks fourth in terms of economic importance after, citrus, grapes and bananas (Mbovora et al., 2021). In India apple is cultivated in different areas, particularly in temperate regions of Jammu and Kashmir. Kashmir valley is endowed with congenial agro-climatic conditions for a wide range of horticultural crops, including apple (Shah et al., 2020). It is one of the ideal locations for apple cultivation and the fruit has been cultivated since ages. The valley produces almost 75 per cent of the country's apples (Tantry, 2020) and employs half a million households, besides dominates the horticultural sector and has an important role in the economic scenario of the state (Malik & Choure, 2014). It plays an important role in improving the standard of living, per capta income and employment generation in the state (Rather and Shrivastava, 2017).

The area and production of this important fruit was increasing constantly in the state with 164854 hectares and 2026472 MT respectively during the year 2019-2020, while in Kashmir valley (hotbed for apple cultivation), the area and production was estimated to be 147130 hectares and 1995101 MT respectively during the year 2019-2020 (DoHK, 2022). Obviously there was a quantum jump in the area and production of this important fruit in the country (India), but the productivity is still far behind the potential, which is nearly 06-08 tons/ha, lower than countries like Belgium (46.22 tons/ha), Denmark (41.87 tons/ha), and the Netherlands (40.40 tons/ha) (Wani et al., 2021a). Similarly, the average yield of different apple varieties in the union territory was only 11-13 tons/ha (Wani, et al., 2021b) as compared to the yield

Received 31-01-2022; Accepted 14-03-2022

of other countries viz. China (17.96 tons/ha), the United States (27.85 tons/ha), Germany (25.40 tons/ha), Italy (40.11 tons/ha), France (43.98 tons/ha) and world average 15.49 tons/ha (Na, 2016), and in certain countries yield of 70-80 tons/ha was also registered (Bhat, 2019). However, the potential yield can be increased to 40-70 tons/ha, which is the indication of enormous gap between actual production and production capacity of apple crop in the state.

The possible reason for low productivity in the state was due to low maintenance of orchards, mis-management of cultural practices (Rehman et al., 2020), variability in use of technologies, in-efficient and out-dated techniques that contribute to the lack of commercial success in apple production. Certain factors viz. alternate bearing, defective pruning/training, lack of proper nutrient/water management, the deficiency of pollinizers in the orchards are responsible for low productivity and quality (Shah et al., 2017a). Such lapses need to be minimised to enhance production/productivity of this important crop by disseminating improved and low cost technologies through intensive extension system with proper training programmes (Roy & Bandyopadhyay, 2019). In order to address the problem of non adoption and low adoption of scientific package in agri-horti system, the need for enhancement of knowledge through appropriate methods in easy with supportive verbal understanding of scientific principles with description and explanation of processes and causal relationships was stressed (Nain & Chandel, 2013).

METHODOLOGY

The study was conducted in the union territory of Jammu and Kashmir, the northern most region of India. Three districts (Shopian, Budgam and Baramulla) were purposively (maximum area under apple fruit) selected. A multistage sampling procedure was adopted for the selection of districts, horticultural zones, villages and apple growers. A list of apple growers (orchardists) of selected villages was obtained from concerned horticultural development offices and a sample of different apple growers having marginal, small, medium and large land holdings, were selected proportionately. Thus, a total of 300 apple growers were selected purposively from nine (9) selected villages by using the following formula.

$$n_i = \frac{N_i}{N} n$$

Where, n_i= *Number of sampled apple growers in each village.*
n=Total number of apple growers selected for the present study (300).
N= Total number of apple growers in sampled villages.
N_1=*Total number of apple growers in it*^{h} *village.*

The structured interview schedule was prepared for working out the technological gap and was pretested on 30 apple growers in the non-sampled area for its practicability and relevancy. The apple growers were interviewed (individually with face to face contact) that enabled to get first-hand information and additional qualitative data. The qualitative data was converted into quantitative data by giving different scores. Different formulae of indexes and statistical tools were employed in order to obtain different results.

RESULTS AND DISCUSSION

Practice-wise technological gap in recommended apple production technology

From Table 1, the highest gap among the apple growers from all the three districts was found in overcoming different nutritional deficiencies in apple fruit. Among the districts, the highest gap (77.33%) was found in overcoming nutritional deficiencies in Budgam, Baramulla (73.94%) and Shopian (72.79%). The apple growers in all the three districts perceived managing nutritional deficiency of their fruits more complex and difficult as it involved sophisticated techniques of spraying with varied concentrations of different chemicals, besides the operations of managing such deficiencies were felt difficult by less educated growers. Extension agencies need to organise method demonstrations in such areas in order to minimise this gap. Similarly, the recommended fertilizer application methods were having the 2nd highest technological gap in district Budgam (75.30%) and district Shopian (69.35%), however, in district Baramulla, the 2nd highest gap (70.93%) was found in rejuvenating unproductive orchards. The lowest gap (63.95%) was found in "Harvesting and Picking" aspect of apple cultivation in district Budgam, while the lowest gap among the apple growers of district Shopian (40.27%) and district Baramulla (44.55%) was found in managing different types of pests and disease prevalent in the study area.

The low technological gap was found in pest and disease management aspect of apple cultivation in district Shopian and Baramulla, whereas in district Budgam low gap was found in harvesting and picking aspect of apple cultivation. The lower technological gap in district Shopian and Baramulla was due to higher knowledge and adoption level of this practice by the apple growers as the technology needs regular and constant spraying of different pesticides throughout the year. The application of pesticides repeatedly (10-12 sprays/year) makes the apple growers confident enough to remember different specifications besides overtime observe (perceived characteristic of adoption) the possible results of such pesticides in their orchards (decreased infections) thereby leading to more adoption in these regions. It was also predicted that different extension agencies focus more on this practice and make apple growers aware through different media channels, resulting in more adoption. However, in district Budgam low gap (63.95%) was found in harvesting and picking of apple fruits, as the practice do not require complicated procedures (complex skills and competencies), so the apple growers easily adopt this practice with zeal and zest, hence lowest technological gap.

Further perusal of data presented in Table 1, the highest mean technological gap (70.78%) was found in district Budgam, followed by district Baramulla (64.05%) and Shopian (54.40%). The overall mean technological gap index of apple growers from entire three districts were found to be 63.08 percent. This high gap was due to lack of knowledge (awareness) about improved cultivation practices. Apple cultivation usually involve complex and numerous operations throughout the year resulted in less dissemination of improved technologies, which in turn affected the adoption of these technologies by the apple growers. Further the higher technological

Table 1. Practice-wise technological gap index in recommended apple production technology

S.No.	Recommended Practice	Technological Gap Index (Percentage)		
		Shopian	Budgam	Baramulla
A.	Preparation of land and planting	48.07	67.09	63.61
B.	Training and pruning			
1.	Pruning of young non-bearing trees	53.51	72.42	68.58
2.	Pruning of bearing trees	53.86	69.88	65.56
3.	Training and pruning of dwarf trees	64.24	74.89	70.21
C.	Orchard Management			
1.	Cultivation and Mulching	59.04	68.92	68.13
2.	Thinning and rejuvenation of unproductive orchards	55.42	73.60	70.93
3.	Irrigation and drainage	60.09	69.48	63.93
4.	Pollination and pre-harvest fruit drop	56.32	71.86	66.07
D.	Nutrient Management			
1.	Organic manure's (Fully decomposed FYM)	46.91	65.99	62.52
2.	Inorganic fertilizers	47.33	73.10	64.61
3.	Methods of fertilizer application	69.35	75.30	70.86
4.	Methods to overcome nutritional deficiencies	72.79	77.33	73.94
E.	Pest and disease management	40.27	66.51	44.55
F.	Harvesting and picking	41.32	63.95	48.01
G.	Packaging and storage	47.49	71.32	59.25

Mean Technological Gap Index in Percentage

Budgam	=	70.78
Baramulla	=	64.05
Shopian	=	54.40
Overall Mean Technological Gap Index of all the three districts	=	63.08

Source: Primary data

Table 2. Distribution of apple growers according to technological gap index in recommended apple production technology

Category	District			Overall
	Shopian (n_1=101)	Budgam (n_2=86)	Baramulla (n_3=113)	(N=300)
Low	25 (24.75)	12 (13.95)	17 (15.04)	54 (18.00)
Medium	53 (52.47)	35 (40.70)	61 (53.98)	149 (49.67)
High	23 (22.77)	39 (45.35)	35 (30.97)	97 (32.33)
Mean ± S.D.	49.91±10.47	69.91±14.80	65.36 ± 19.46	61.73±14.91
Observed range	30-78	10-88	17-100	10-100

Figures within parenthesis indicate the respective percentage.
Source: Primary data

gap in all the practices among the apple growers of district Budgam was due to lower knowledge and adoption index of improved technologies, low educational status, lower scientific orientation, less innovative proneness, and low contact of apple growers with different extension agencies(Shah et al., 2021), Besides the reason for the lower technological gap index among the apple growers of district Shopian was due to high adoption index, high scientific orientation and apple growers in this area mostly rely on innovative and scientific cultivation.

Categories of apple growers, according to technological gap index

From Table 2 it is revealed that majority of the apple growers were having the medium level of the technological gap in Shopian (52.47%) and Baramulla (53.98%). In Budgam, majority of the apple growers were following traditional cultivation practices and mostly rely on local input dealers, resulted in high technological gap (45.35%) in the region, thereby low production as well as productivity. For comparative analysis, the lowest technological gap was found among the apple growers of district Shopian (24.75%), which is explicit that the apple growers in the region were innovative, having good exposure of media channels and have contacts with different extension agencies, scientists (Shah et al., 2017b), who are not merely providing them different innovative/ improved techniques and technologies, but ensure practical application of such improved technologies in their fields.

The data presented in Table 3 revealed the pearson correlation of different socio-personal characteristics of apple growers with that of the technological gap and it was revealed, that in district Shopian and district Baramulla, the relationship between the independent variables and the technological gap of the apple growers was negative and significant, except in land holding where it was negative but non-significant. In district Shopian, the correlation coefficient (r) for innovative proneness (-.346), risk orientation (-.276), scientific orientation (-.265) and knowledge level (-1.000) with the technological gap was negative but significant at 0.01 level. Similarly, in district Baramulla, the correlation coefficient (r) for education (-.318), innovative proneness (-.313), risk orientation (-.248) and knowledge level (-.994) with technological gap was negative but significant at 0.01 level. However, in district Budgam,

Table 3. Correlation between selected socio-personal characteristics and technological gap

Variable	Shopian (n_1=101)		Budgam (n_2=86)		Baramulla (n_3=113)		Overall (N=300)	
	C.C (r)	P-Value	C.C (r)	P-Value	C.C (r)	P-Value	C.C (r)	P-Value
Age	-.242*	.015	-.212	.050	-.200*	.034	-.335**	.000
Education	-.250*	.012	-.159	.145	-.318**	.001	-.119*	.040
Annual Income	-.251*	.011	-.085	.434	-.234*	.013	-.277**	.000
Land Holding	-.067	.507	.163	.134	-.097	.309	-.112	.053
InnovativeProneness	-.346**	.000	-.158	.146	-.314**	.001	-.124*	.032
Media Exposure	-.242*	.015	-.078	.477	-.190*	.044	-.199**	.001
Extension Contact	-.252*	.011	-.014	.898	-.230*	.014	-.121*	.036
Experience	-.229*	.021	.140	.200	-.206*	.028	-.391**	.000
Economic Motivation	-.245*	.013	.018	.871	-.236*	.012	-.159**	.006
Risk Orientation	-.273**	.006	.070	.524	-.248**	.008	-.242**	.000
Scientific Orientation	-.265**	.007	.046	.672	-.229*	.015	-.236**	.000
Knowledge Level	-1.000**	.000	-1.000**	.000	-.994**	.000	-.998**	.000

**. Correlation is significant at the 0.01 level (2 tailed); *. Correlation is significant at the 0.05 level

the correlation coefficient (r) for knowledge level and the technological gap was negative and significant while the relation for the rest of independent variables with the technological gap was non-significant. It is worth to mention that in district Budgam the correlation coefficient (r) for land holding, experience, economic motivation, risk orientation and scientific orientation with the technological gap was positive but non-significant. It must be noted that from the entire three districts land holding were having negative but non-significant relation indicating least role to play in technological gap in apple cultivation.

CONCLUSION

Apple is one of the important fruit crops grown in different parts of the world. There is tremendous scope for apple cultivation in almost all the regions of the Kashmir valley due to its congenial climatic conditions. The area and production of apple fruit was increasing constantly, but productivity is still far behind the potential. Different innovative techniques and technologies have been developed at different experimental stations, farm science centers and research institutes to enhance the productivity of apple fruit. However such technologies/practices were not fully adopted by the growers. A wide technological gap existed in almost all the practices recommended by concerned agencies, so it warrants the attention of extension officials and scientists to intensify their efforts to minimise such gaps through different extension programmes like training's, demonstrations, and exhibitions etc. in order to create horizons of hope among the apple growers that a better future can be ahead.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (163-166)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Factors Affecting Livelihood Security of the Tribal Women in Crop Based Livelihood Activities

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ARTICLE INFO

Keywords: Factors, Association, Tribal women, Livelihood security, Chi-square values

http://doi.org/10.48165/IJEE.2022.58239

ABSTRACT

The study was aimed to find out the factors affecting by tribal women and association of different factors with livelihood security of the tribal women in crop based livelihood activities conducted in three districts of Rajasthan namely Dungarpur, Udaipur and Banswara 180 respondents data were collected through a well- structured interview schedule. Majority of the respondents had occasional access to extension agency, mass media sources, technological information as well print media. More than half of the respondents never had access to regular income, less than half of the respondents sometimes only produced new products, used improved methods and practices and took loan for carrying out livelihood. The livelihood security of the respondents was associated with access to resources, access to technological information, market and regular income, risk factors, risk taking ability and decision making ability. It can be inferred that all these factors affected to livelihood security of the tribal families with crop based livelihood.

INTRODUCTION

As per the 2011 Census, the Scheduled Tribe population of Rajasthan state is 9,238,534. Out of twelve tribes scheduled for the State, Meena is the most populous tribes, having a population of 3,799,971, constituting 53.05 per cent of the total ST population followed by Bhil (2805948). Meena and Bhil together constitute 93 per cent whereas Garasia, Damor, Dhanka and Saharia combine to form 6.6 per cent of the total ST population. The highest concentration of this population is mainly in districts viz. Udaipur, Bhilwara, Dungarpur, Banswara, Chittorgarh, Pratapgarh, and Rajsamand. The tribal women, constitute as in any other social group, about half of the total population. They are the backbone of the agricultural workforce. They do the most tedious and backbreaking tasks in agriculture, animal husbandry and homes (Sahu, 2014). Besides routine household work, the tribal women work in the agricultural fields, forests for long hours. Their schedule of long working hours continues even during pregnancy, natal and postnatal stages. They have a negative energy balance, high morbidity rate and low child survival rate. There are various circumstances which may restrict the performance of tribal women such as access to resources, technological information, information sources, market facility, regular income, risk factors, risk taking ability and decision making ability. An attempt was made to study the factor which may affect the livelihood security of the family through different livelihood activities.

METHODOLOGY

The investigation was conducted in three districts of Rajasthan state namely Banswara, Dungarpur and Udaipur were selected. Two panchayat samities from each district and two villages from each panchayat samiti were selected randomly. Total 180 tribal women were selected from the three districts. Interview schedule was developed which was used for data collection. The responses were recorded on three point continuum of complete, partial and not at

Received 02-01-2022; Accepted 15-03-2022

all for the factor viz. access to resources (capital, input, labour, cash earned from sale of produce, credit and loan, storage facility and transportation facility) assigning 2, 1 and 0 score respectively. The response regarding access to technological information and information sources like extension contact, mass media exposure and electronic media response was recorded on three point continuum of regular, occasional and never assigning 2, 1 and 0 scores respectively. Similarly, the response regarding the access to regular income, market, risk factor and risk taking ability, was recorded on three point continuum of always, sometime and never assigning 2, 1 and 0 scores respectively. On the basis of scores obtained by the respondents mean per cent score were calculated to have uniformity of the data.

RESULTS AND DISCUSSION

Factors affecting crop based livelihood

Data in Table 1 show that half of the respondents (50%) had partial access to land and 33.33 per cent respondents reported they were not having ownership of land which may be due to the reason that the tribal don't have land on their name because most of tribal live in forest and land is owned by the government. The findings are in conformity with Kumar (2010) who mentioned that tribal, have poor access to land and forests. Some of the respondents got access to the land because there were only daughters in the family and they got it as gift from their parents with the relatively low MPS of 41.66. It was found that more than half of the respondents (52.77%) had complete access as indicated by mean per cent score of 69.44. Table further reveals that half of the respondents (50%) had partial access to loan and saving with mean per cent score 41.66 and 49.16. Regarding farm assets it can be seen that respondents had low access to tractor (13.88 MPS), tool and implements (34.72 MPS) as very few of the respondents (0 to 15.55%) had complete access to these assets. This may be due to the reason that they did not have proper knowledge about tool and implements and they could not afford to purchase these assets. Regarding inputs like planting material, more than one third of the respondents (36.66%) had complete access whereas 31.11 per cent and 32.22 per cent

Table 1. Respondents' access of resources, technology, market and income

S.No.	Factors	Regular	Occasional	Not at all	MPS
1.	Access to resources				
I	Ownership of land	16.66	50.00	33.33	41.66
II	Irrigation water	52.77	33.33	13.88	69.44
III	Capital				
	Loan	16.66	50.00	33.33	41.66
	Saving	25.00	48.33	26.66	49.16
IV	Farm assets				
	Tractor	0.00	27.77	72.22	13.88
	Tools and implements	15.55	38.33	46.11	34.72
V	Input				
	Planting material	36.66	31.11	32.22	52.22
	Improved seed/ varieties	28.88	47.22	23.88	52.50
	Fertilizers	23.33	41.11	35.55	43.88
	Machinery	6.66	43.33	50.00	28.33
VI	Pest management				
	Chemical application	12.77	37.22	50.00	31.38
	Indigenous method	54.44	42.22	3.33	75.55
VII	Labour				
	Family labourer	43.33	48.88	7.77	67.77
	Hired labourer	36.11	42.22	21.66	57.22
VIII	Cash earned from sale of produce	23.33	22.22	54.44	34.44
IX	Storage facility	38.88	38.33	22.77	58.05
X	Transportation facility	37.77	46.11	16.11	60.83
2.	Access to technological information and information sources				
I	Scientific farming methods	25.00	13.88	56.00	31.11
II	Extension contact				
A	State department of agriculture	26.00	14.44	96.00	53.33
b	KVK personnel	19.00	10.55	131.00	72.77
c	NGOs personnel	35.00	19.44	120.00	66.66
III	Mass media exposure (Print media)				
a	Newspaper	10.00	5.55	57.00	31.66
b	Magazine	0.00	0.00	50.00	27.77
IV	Electronic media				
a	Television	95.00	52.77	55.00	30.55
b	Radio	93.00	51.66	60.00	33.33
c	Telephone	96.00	53.33	50.00	27.77
3.	Access to market and regular income				
I	Access to market				
A	Constant demand	11.11	25.00	63.88	23.61
b	Stable price	16.66	27.77	61.11	30.55
II	Access to regular income	15.55	32.22	52.22	31.66

partial and no access respectively. Regarding access to improved seed/ varieties and fertilizers about one fourth of the respondents (23.33 to 28.88%) had complete access whereas very few of them (6.66%) had complete access to machinery with MPS 28.33. Data in table also reveals that 54.44 per cent of the respondents had complete access to indigenous method of insecticides/pesticides. This may be due to the reason most of these substance are safe, low cost, biodegradable, less persistent, non-toxic, more dependable method of crop protection/technically feasible and easily available in and around their house tenements and land. Few of the respondents (12.77%) had complete access to chemical application with MPS 31.38 because most of tribal farmers did not have proper knowledge about chemical pesticides and it puts extra burden of costly on farmer.

Further an in-depth analysis of the data show that 43.33 per cent of the respondents had complete access of family labourer and 42.22 per cent respondents had only partial access to hired labourer. Regarding cash earned from sale of produce, more than half of the respondents (54.44%) did not have access this may be due to the reason that they totally depend on husband and other family member. Their most of decision related to money where taken by family male member. In case of storage facility (38.88%) and transportation facility (46.11%) the respondents had partial access with MPS ranging between 58.05-60.83. The tribal farmers are forced to dispose part of the food grain produced immediately after harvesting due to lack of storage facilities at lower prices. Later on they need to buy the food grain from the market at higher prices. There is the wide variation in food grain price, price are typically the lowest in the harvest season and the strongest before the harvest period. Without storage, these farmers eventually spend double the value of their food grain and often face a shortage of food. Regarding cash earned from sale of produce it can be seen that more than half of the respondents (54.44%) had no access which may be due to the reason that most of the economic activities in tribal families were male dominated. The results are in conformity with findings of Chauhan & Thakor (2010) and Chauhan & Nikulsinh (2011); Kaur et al., (2018): Paine et al., (2021).

Data highlight that few of the respondents (13.88%) had regular access to technological information regarding scientific farming methods which was due to the reason that most of tribal farmers are illiterate and have poor information regarding scientific farming and they were using traditional farming practices. Data in the table related to source of information reveals that majority of the respondents (72.77%) had occasional access to KVK personnel; while more than half of the respondents (66.66%) had access to NGOs personnel and State Department of Agriculture Personnel (53.33%) occasionally with MPS 46.94, 52.77 and 41.11 respectively. The findings get support from study by Dhakade (2020) who reported the agricultural extension contact and communicational activities are not that good because of lack of transportation facilities and communication networks, due to which most of the farmers have no access to technologies and current market information, especially in tribal area. Further it can be seen from the table regarding mass media exposure that majority of the respondents had no access to magazine (72.22%) and newspaper (62.77%) This is mainly due to the high incidence of illiteracy and very low level of education among the tribal people whereas electronic media had greater access whereas more than half of the respondents had regular access to telephone (53.33%), television (52.77%) and radio (51.66%) with MPS ranging between 67.22 to 68.05. The probable reason is that the respondents were quite aware about the prevalent electronic media in the study area.

More than half of the respondents (63.88 and 61.11%) never had stable price and constant demand with mean per cent score of 23.61 to 30.55 respectively. It can be seen that more than half of the respondents (52.22%) never had access to regular income with 31.66 MPS. They were able sell their products in the regulated markets thereby earning less profit. Risk taking ability is the quality of an individual that tells about the degree of taking shots in grabbing new opportunity. Data in table regarding risk factors affecting the respondents depict that more than half of the respondents had financial risk (51.66%) followed by production risk (51.11%) and marketing risk (50.55%) with mean per cent score ranging between 49.16-66.66. Regarding risk taking ability, less than half of the respondents sometimes only produced new products (49.44%), used improved methods and practices (48.88%) and took loan for carrying out livelihood (48.33%) with MPS 46.94, 51.94 and 58.33.

A decision can be defined as a course of action purposely chosen from a set of alternatives to achieve day to day objectives or goals. Data furnished in Table 3 highlight that more than half of the respondents sometimes took decision regarding marketing of the produce (55.55%) followed by purchasing of raw material (52.22%) and selection of products (51.11%) with mean per cent score ranging between 53.88-68.88. Findings are in conformity with Awasthi et al., (2020) and Kobba et al., (2020) who revealed that important

Table 2. Risk factors and risk taking ability

S.No.	Factors	Always		Sometimes		Never		MPS
		f	%	f	%	f	%	
I	Risk factors							
1.	Production risk	74	41.11	92	51.11	14	7.777	66.66
2.	Marketing risk	43	23.88	91	50.55	46	25.55	49.16
3.	Financial risk	46	25.55	93	51.66	41	22.77	51.38
II	Risk taking ability							
1.	Use improve methods and practices	61	33.88	88	48.88	31	17.22	58.33
2.	Take loan for livelihood activities	50	27.77	87	48.33	43	23.88	51.94
3.	Produce new products	40	22.22	89	49.44	51	28.33	46.94

Table 3. Decision making ability of the respondents

S.No.	Factors	Always		Sometimes		Never		MPS
		f	%	f	%	f	%	
1.	Selection of products	78	43.33	92	51.11	10	5.55	68.88
2.	Purchas of raw material	50	27.77	94	52.22	36	20	53.88
3.	Marketing of the produce	55	30.55	100	55.55	25	13.88	58.33

Table 4. Association of different factors with livelihood security of the respondents in crop based livelihood

S.No.	Factors	χ^2 value
1.	Access to resources	11.84**
2.	Access to technological information & sources	45.47**
3.	Access to market	29.24**
4.	Access to regular income	11.42**
5.	Risk factors	11.28**
6.	Risk taking ability	20.64**
7.	Decision making ability	18.72**

****** Significant at 1 per cent level of significance

decision related to farm and livestock were taken by male members whereas women respondents were involved jointly in some decisions although final say was of men only.

To study the association of livelihood security of family with different factors chi square was employed. Data presented in Table 4 point out that there was highly significant association between all the factors and livelihood security of the respondents as the calculated chi-square values were greater than the tabulated values. This indicates that the livelihood security of the respondents was associated with all the factors i.e. access to resources, access to technological information, market and regular income, risk factors, risk taking ability and decision making ability. It can inferred that all these factors affected to livelihood security of the tribal families with crop based livelihood. The present finding is conformity with the finding of Mahadik & Sawant (2012); Sunanda et al., (2014); Umunnakwe (2014); Ramya et al., (2017); Mishra et al., (2020) & Pradhan et al., (2021).

CONCLUSION

From the findings it can be concluded that poor access to land and low land holdings could be an important factor behind their poor economic status. Poor access to technological information and sources may be due to shy nature of respondents as they do not like to have contact with outsiders, wish to remain in isolation from the outsiders and are neglected by other community. Also due to less contact of KVK and NGO personnel, illiteracy and less exposure to training programmes and low social participation they have less access to inputs and other specialized tools. In order to increase income and contribution of tribal women in development of tribal area, it is imperative that they are trained in scientific practices and improved technologies by keeping them abreast with the latest innovations. Access to resources, technological information and institutional support can enable, strengthen and empower the long deprived tribal community and enhance tribal livelihood.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (167-172)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Determinant of Access to Credit and Availing Subsidies for Protected Cultivation in Maharashtra

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ARTICLE INFO

Keywords: Credit, Heckman selection model, Multiple linear regression model, Protected cultivation, Subsidy, Repayment pattern

http://doi.org/10.48165/IJEE.2022.58240

ABSTRACT

Protected cultivation requires high initial investment and intensive use of inputs for crop production but offers better yield which in turn increases the profitability of the farm. The study attempts to explore the economics of protected cultivation with different interest rates regime and subsidy in Pune and Nasik districts of Maharashtra conducted during 2018-19. About 95 to 97 per cent of the farmers availed subsidy from the government and the rest of the farmers constructed their polyhouse and shade net house without subsidy. About 47 to 50 per cent of the total cost was given as subsidy. Heckman selection model showed that the factors such as years of education, farm size, farm income, membership and occupation were the major determinants of access to credit. The study also indicated that household age, farm size, farm income, distance from the market and access to subsidies were important drivers of technology adoption. Among all, the access to subsidy reflected the availability of external capital support as one of the determining factors for adoption of technology. The factors responsible for non-repayment of loans were increase in farm income, family size and years of schooling.

INTRODUCTION

Government of India has taken several steps to enhance the flow of credit for the development of agriculture sector. The steps taken are creation of priority sector lending, formation of self-help groups, kisan credit card scheme and institutional innovations for better management of existing financial institutions. Despite all these effort about 36 per cent of the people in India do not have access to credit from formal financial institutions (Kumar et al., 2017). One of the main reasons is the lack of viable businesses for which financial institutions should lend. Horticulture sector has very strong backward and forward linkages and provides numerous viable enterprise combinations which are worthy of lending by financial institutions. Poor repayment is one of the major hindrances in financing agriculture sector. This has an implication on the viability of financial institutions. The repayment capacity of the farmers could be strengthened by enabling them to adopt profitable horticulture enterprises like protected cultivation through suitable farm finance. Protected cultivation involves high initial investment (Nordey et al., 2017; Harisha et al., 2019) and intensive use of inputs for crop production, but offers higher yield and returns as compared to open cultivation (Gruda & Tanny, 2014; Gruda & Tanny, 2015). To attract farmers towards protected cultivation, the Government has initiated a number of programmes and schemes namely Mission for Integrated Development of Horticulture (MIDH) by subsuming various schemes viz, National Horticulture Mission (NHM), National Horticulture Board (NHB), Horticulture Mission for North East Himalayan States (HMNEH) etc. The NABARD has launched

Received 05-03-2022; Accepted 16-03-2022

pilot projects to fund the protected cultivation in Maharashtra, Haryana and West Bengal. Besides, financial institutions are providing long term loan for establishing protected cultivation structures and short term loan through Kisan credit card for meeting the working capital. Thus, the availability of credit would be deciding factor about the adoption of the protected cultivation technology. Also, subsidy scheme needs to be continued to encourage maximum farmers to adopt protected cultivation and farmers need to be encouraged to form farmers producers organizations (FPOs), which would help them in seeking better quality of inputs and enhancing negotiating power in the market to realize maximum returns for their farm produce (Kumar et al., 2021). It is also imminent that it is a capital intensive crop is driven by a subsidy offered by the government. It is therefore important to assess the impact of credit on the adoption of technology. The overdue behaviour of the farmers also needs to be measured to understand the underlying factors turning them to be a defaulter. In this backdrop, this study was conducted in Pune and Nasik districts of Maharashtra with the objective to study the factors affecting access to credit and how it influences the extent of adoption of technology. The repayment position of the loans borrowed by protected cultivation farmers and the factors responsible for non-repayment of loans was also studied.

METHODOLOGY

The study was based on primary data collected from farmers practicing protected cultivation in Pune and Nasik districts of Maharashtra having large area under protected cultivation during 2018-19. The random sampling procedure was used to select the 116 farmers and data were collected through personal interview method with the help of schedule. In sampled farm household, 96 farmers adopted polyhouse and 20 farmers adopted shade net house. The selected farmers were interviewed to gather the information on polyhouse establishment cost, shade net house establishment cost, amount of subsidy, source of credit, amount borrowed, rate of interest, factors determining access to credit and its effects on the extent of adoption of technology, repayment pattern and the reasons for non-repayments of loan.

The Heckman model has been used to correct bias from samples not randomly selected (Abbeam et al., 2019; Aditya et al., 2018; Subash & Ali, 2018; Olawuyi, 2019). First, the probit regression model was used to identify the factors determining access to credit. Second, the estimated inverse mills ratio (IMR) from a probit model was used to account for the selection bias and was included as explanatory variables in estimating OLS to see how it influences adoption of technology.

The selection equation is

$$M = \gamma z_j + \mu_{1j} > 0 \quad \ldots (1)$$

Where, M denotes access to credit (M=1 if accessed and M=0 otherwise), z is the vector of explanatory variables, ã is a vector of unknown parameters.

The outcome equation is

$$y_j = \alpha + \beta X_j + \beta_\lambda \lambda_j + \mu_{2j} \quad \ldots (2)$$

Where y_j is the composite technology adoption index; X_j is the vector of independent variables; λ_j is the IMR; α and β are parameters to be estimated.

$\mu_1 \sim N(0, 1)$

$\mu_2 \sim N(0, \sigma)$

Corr $(\mu_1, \mu_2) = \rho$

When $\rho \neq 0$, the standard regression methods applied to the second equation produce biased results. Heckman provides consistent and asymptotically efficient estimates for all the parameters in these models.

The factors responsible for non-repayment of loans were estimated through multiple linear regression using OLS method and the equation is specified as.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 \quad \ldots (3)$$

Where, Y = Loan amount overdue (Rs.), X_1 = Age of the farmer (years), X_2 = Farm income (Rs.), X_3 = family size (numbers), X_4 = Education (years), X_5 = Access to kisan credit card loan ('1' if yes, else '0'), X_6 = Access to non-institutional credit ('1' if yes, else '0'), X_7 = Duration of loan (years), X_8 = Agriculture is the main occupation ('1' if yes, else '0').

RESULTS AND DISCUSSION

The interest rate charged by banks to the Kisan Credit Card (KCC) beneficiaries for a loan up to Rs. 3.0 lakh was governed by government policy of interest subvention and incentives for prompt repayment. The Indian government provided an interest subsidy of 2 per cent to banks to enable them to lend at 7 per cent. In addition to government interest subvention, the Government of Maharashtra also provided interest subvention to banks at 1 per cent to enable them to lend at 6 per cent. Further, interest rebate of 3 per cent was given to farmers for prompt repayment of the crop loan under the Government of India interest subvention scheme. The state government also provided interest subvention of 3 per cent up to Rs. 1 lakh. Thus, farmers in the state of Maharashtra got crop loan up to Rs. 1 lakh at 0 per cent and above Rs. one lakh to Rs. 3 lakh at 1 per cent. Further, it was observed that there was not much difference in the interest rate charged by financial institutions on the KCC loan (above Rs. 3.0 lakh) and agriculture term loan.

Table 1 describes the volume of investment, subsidy and credit availed by the farmers for the construction of different sizes of the polyhouse. Out of the total respondents (n=96), 97 per cent received subsidy that was provided by the government and 3 per cent of the farmers constructed their polyhouse without subsidy. About 47 per cent of the total cost was given as subsidy to construct a polyhouse of different sizes. Among the total respondents, 29 per cent had taken loans from financial institutions. About 79 per cent of the total amount was obtained from financial institutions and the remaining 21 per cent was contributed by farmers.

Table 2 depicts the investment, subsidy and credit availed for various sizes of shade net house farmers. Out of total farmers (n=20), 95 per cent were beneficiaries of subsidy provided by the government and 5 per cent of the farmers constructed shade net house without availing subsidy. About 50 per cent of the total cost was given as subsidy to construct different sizes of shade net houses. Among the total farmers, 30 per cent had taken the loan from financial institutions. About 80 per cent of the total amount

Table 1. Investment, subsidy and credit availed for various size of poly house

Size (ha)	Total No. of farmers	Total Cost# (Rs.)	No. of farmers availed subsidy	Subsidy amount (Rs.)	No. of farmers availed loan	Beneficiary contribution (Rs.)	Bank loan (Rs.)
0.1	50	963507	48	467500	10	216789	746718
	(52.08)	(100.00)	(96.00)	(48.52)	(20.00)	(22.50)	(77.50)
0.2	32	1887643	31	890000	10	437403	1423888
	(33.33)	(100)	(96.87)	(47.15)	(31.25)	(23.17)	(75.43)
0.3	1	2704546	1	1266000	1	540909	2163637
	(1.04)	(100.00)	(100.00)	(46.81)	(100.00)	(20.00)	(80.00)
0.4	13	3599221	13	1688000	7	745553	2853668
	(13.54)	(100.00)	(100)	(46.90)	(53.84)	(20.71)	(79.29)
Over all	96	2288729	93	1077875	28	485163	1796977
	(100)	(100.00)	(96.87)	(47.09)	(29.16)	(21.19)	(78.51)

Note: Figures in the parenthesis indicate respective percentage. # indicates the cost incurred for establishing polyhouse structure.

Table 2. Investment, subsidy and credit availed for various size of shade net house

Size (ha)	Total No. of farmers	Total Cost# (Rs.)	No. of farmers availed subsidy	Subsidy amount (Rs.)	No. of farmers availed loan	Beneficiary contribution (Rs.)	Bank loan (Rs.)
0.1	14	548611	13	274500	3	109722	472222
	(70.00)	(100.00)	(92.85)	(50.03)	(21.42)	(20.00)	(80.00)
0.2	2	796139	2	398000	2	159228	636912
	(10.00)	(100.00)	(100.00)	(49.99)	(100.00)	(20.00)	(80.00)
0.4	4	1421978	4	710989	1	284396	1137582
	(20.00)	(100.00)	(100.00)	(50.00)	(25.00)	(20.00)	(80.00)
Overall	20	922243	19	461163	6	184449	748905
	(100.00)	(100.00)	(95.00)	(50.00)	(30.00)	(20.00)	(80.00)

Note: Figures in the parenthesis indicate respective percentage. # indicates the cost incurred for setting up shade net house structures.

Table 3. Source of borrowing

Size of polyhouse	Institutional sources		Non-institutional sources		Total loan borrowed	
	Polyhouse (Rs.)	Shade net house (Rs.)	Polyhouse (Rs.)	Shade net house (Rs.)	Polyhouse (Rs.)	Shade net house (Rs.)
0.1 ha	279218	197722	89000	50000	368218	247722
	(75.80)	(79.81)	(24.17)	(20.18)	(100.00)	(100.00)
0.2 ha	533888	238912	175000	59000	708888	297912
	(75.30)	(80.19)	(24.68)	(19.80)	(100)	(100.00)
0.3 ha	897637	-	-	-	897637	-
	(100.00)				(100.00)	
0.4 ha	1165668	426593	73000	-	1238668	426593
	(94.10)	(100.00)	(5.89)		(100.00)	(100.00)
Overall	719103	287742	84250	54500	803353	243057
	(89.50)	(88.78)	(10.48)	(11.21)	(100.00)	(100.00)

Note: Figures in the parenthesis indicate percentage to the total loan borrowed

was obtained from financial institutions and the remaining 20 per cent of the total amount was contributed by farmers.

Table 3 depicts the proportion of respondents availing credit from institutional and non-institutional sources. Overall, about 90 per cent and 89 per cent of the total amount for polyhouse and shade net house was obtained from the institutional sources and remaining nearly 11 per cent of the total loan was borrowed from non-institutional sources. The small size polyhouse and shade net house farmers (0.1 and 0.2 ha) borrowed 75 to 80 per cent of the total amount of the loan from institutional sources and the remaining 20 to 25 per cent of the amount was obtained from non-institutional sources. The large size polyhouse farmers borrowed 94 per cent of the total amount from institutional sources and the remaining 6 per cent from non-institutional sources. Thus, it is revealed that the share of the amount borrowed from institutional sources increased with the increase in the size of polyhouse/shade net house. Kumari (2005) & Kumar et al., (2015) reported that the non-institutional share in the total amount decreased with increasing farm size.

The variables viz., years of education, farm size, farm income, membership and main occupation positively and significantly influenced access to credit (Table 4). However, the estimated inverse mills ratio was found to be insignificant which indicates no selection bias. This findings are also consistent with that of Ngwira et al., (2014); Abeam et al., (2019). The coefficients of age, land size, farm income, distance from market and access to subsidy were significant and hence influenced the extent of adoption of protected cultivation technology. With one year increase in farmer's age, the extent of adoption of technology will increase by 0.002 per cent. Similarly, increasing farm size and farm income by one unit will increase the extent of adoption of technology by 0.006 and 0.033 per cent

Table 4. Determinants of access to credit and their effects on technology adoption

Particulars	Access to credit (selection equation)		Extent of adoption of technology (outcome equation)	
	Coefficient	P>|z|	Coefficient	P>|z|
Age	0.006	0.751	0.002**	0.036
Education	0.258***	0.000	0.004	0.309
Household size	-0.048	0.629	0.003	0.600
Land	0.312*	0.074	0.016*	0.086
Experience	-0.024	0.490	-0.002	0.222
Income	0.411*	0.097	0.033**	0.031
Distance	0.001	0.918	-0.001*	0.088
Members	0.281*	0.061	0.007	0.402
Extension contact	-	-	0.058	0.132
Subsidy	-0.206	0.674	0.050*	0.086
Occupation	1.166*	0.073	-0.020	0.821
Credit	-	-	0.001	0.953
Inverse mills	-	-	-0.013	0.598
Constant	-10.289***	0.005	-0.021	0.924

Notes: In case of selection equation, the log likelihood = -65.589522, Number of observation = 116, Pseudo R^2 = 0.1779 and LR chi^2 (10) = 28.39; while in case of outcome equation, Number of observation = 116, R-squared = 0.2206 and Probability > F = 0.0080; ***p<0.01, **p<0.05, *p<0.1

respectively. Harisha et al., (2019) and Kumari et al., (2022) also confirmed that farmers age, education and landholding size were positively related to the adoption of technologies. Further, one km decrease in distance from the market the extent of adoption of technology will increase by 0.001 per cent. In all, access to subsidy was found to be an important determinant in the adoption of technology as it indicated with the provision of subsidy, the extent of adoption of technology will increase by 0.05 per cent. Yadav et al., (2019) found that subsidy, motivation, demonstration and training were the main prioritized strategies for adoption of technology.

Most of the respondents (60%) receiving short term credit were found to be regularly repaying the loan amounts, and about 24 per cent of the farmers paid their loan amount partly. Whereas, 16 per cent of the farmers failed to repay the loan due to various reasons. Similar results was observed in Northern Telangana Zone in Andhra Pradesh by Kumari (2005). The repayment position of medium-term credit by protected cultivation farmers showed that at the overall level, the average per farm amount borrowed was Rs. 2.93 lakh. Out of this amount Rs. 2.04 lakh (69.63%) amount was repaid, leaving 30.37 per cent of the amount as an outstanding. The proportion of repayment was the highest for the size of 0.2 ha (70.63% of the amount borrowed) followed by 0.1 ha. The average amount of outstanding per family was the highest (31.63%) for the size of 0.1 ha followed by 0.2 ha (29.37%). The average per family amount of outstanding loan with the interest was Rs. 9859 and Rs. 12277 for the size of 0.1 ha and 0.2 ha respectively. Out of the total outstanding loan amount the proportion of overdues was the tune of 32.85 per cent. The average per family amount of overdues was Rs. 20768 and Rs. 46642 for the size of 0.1 and 0.2 ha. The percentage of overdues to total outstanding loans was 22.52 and 43.19 for size of 0.1 and 0.2 ha.

The repayment position of long term credit by protected cultivation farmers revealed at the overall level, the average per farm amount borrowed was Rs. 8.45 lakh. Out of this amount Rs. 5.33 lakh (63.19%) amount was repaid, leaving 36.81 per cent of the amount as an outstanding. The proportion of repayment was the highest for the size of 0.3 ha (71.78% of the amount borrowed) followed by 0.2 ha (62.30%) and 0.3 ha (51.47%) respectively. The average amount of outstanding per family was the highest (48.53%) for the size of 0.4 ha followed by 0.2 ha (37.70%) and 0.3 ha (22.22%). The average amount of outstanding per family was increased with an increase in the size of structure. The average per family amount of outstanding loan with the interest was Rs. 39549, Rs. 29921 and Rs. 193892 for the size of 0.2, 0.3 and 0.4 ha respectively. Out of the total outstanding loan amount the proportion of overdue was 32.23 per cent. The average per family amount of overdues was increased with the increase in the size of structure, similar to that of outstanding amount. The average per family amount of overdues was Rs. 92592 (36.71% of the total outstanding amount), Rs. 91758 (40% of the outstanding amount) and Rs. 142894 (19.99% of the outstanding amount) for the size of 0.2, 0.3 and 0.4 ha respectively.

Multiple linear regression model were employed to identify the factors determining the loan defaulters (Table 5). The coefficient of multiple determinations (R^2) was 0.64 indicating that 64 per cent of the total variation in the loan overdue was explained by the regression analysis. The regression coefficients of farm income, household size and years of schooling were positive and significantly influenced the loan overdue. Whereas, the regression coefficients of the duration of the loan was found to be negative and significantly influenced the loan overdue. The regression results revealed that the effect of income on loan overdue was found to be positive and significant which indicated that as household income increases by one rupee, the loan overdue amount increase by 0.031 rupees. Similarly, the effect of education on loan overdue was positive and significant showed that one year increase in education, there was Rs. 12489 increase in loan overdue amount. This may be attributed to the high level of awareness about government loan waiver policy which induces them to delay the loan repayment. Gandhimathi & Ambigadevi (2013) & Singh et al., (2014) reported that an increase in farm income and education, then higher will be

Table 5. Regression estimates of factors determining loan overdue

Particulars	Coefficient	Std. error	P>|t|
Age of the farmer (years)	-76.801	1673.05	0.964
Farm income (rupees)	0.031*	0.0179	0.093
Household size (numbers)	52175.86***	18755.28	0.010
Education (years of schooling)	12489.77**	6025.97	0.049
Access to kisan credit card loan (yes=1, 0=otherwise)	-12664.1	36202.05	0.729
Access to non-institutional credit (yes=1, 0=otherwise)	-14836.9	43596.72	0.736
Duration of loan (years)	-18133.35***	4825.99	0.001
Occupation (yes=1, 0=otherwise)	109139	84510.01	0.208
Constant	-409834.5**	180703.4	0.032
R^2	0.6405		
F value	5.57		
Number of observation	34		

Note: ***p<0.01, **p<0.05, *p<0.1

wilful defaulting. A significant and positive coefficient of household size suggested that with the increase of one member in the family tend to increase the loan overdue amount by Rs. 52175. Finally, a significant and negative coefficient of the duration of loan suggested that with one year decrease in the loan period, farmers would tend to repay their loans it was Rs. 18133 decrease the loan overdue amount.

CONCLUSION

Protected cultivation is a capital and inputs intensive crop production, and rammed by a subsidy provided by the government. It was observed that the rate of interest prevailing in different institutions for short term loans is the cheapest among all kinds of loans. It is suggested that the banks need to be sensitized to offer loans to the farmers through KCC scheme for investment in protected cultivation.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (173-176)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Seed Production of Selected Crops in Telangana State, India: Assessment of Demand, Supply and Constraints

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ARTICLE INFO

Keywords: Certified seed, Demand-supply gap, Groundnut, Paddy, Soybean, Truthfully labelled seed

http://doi.org/10.48165/IJEE.2022.58241

ABSTRACT

The study estimated the gap in demand and supply of seed production in paddy, groundnut and soybean in Telangana state from 2012-13 to 2016-17. There was a surplus in paddy seed production (95 to 216%), which was exported to other states; inconsistency in groundnut seed production and deficit in few years was met through seed imported from Gujarat state; and deficit in soybean (13 to 80%) was met by imports from Madhya Pradesh. The constraints in seed production were assessed through primary data collected during 2017-18, using the multistage random sampling technique. Farmers reported that procurement price of seed (similar to crop prices) was not remunerative. Labour (human and machine) alone accounted for 30-38 per cent of the cost of seed production in soybean and groundnut. Coordination among public and private sector in seed production and distribution is required for addressing the demand and supply gaps.

INTRODUCTION

The seed production in India has quadrupled from 1991 to 2011 with a CAGR of 8 per cent per annum. The growth drivers were the rapid growth of innovations and seed markets, strengthening of IPRs and liberalized seed policies (Manjunatha et al., 2013). Indian seed industry with market size worth USD 2 billion is the fifth largest seed market in the world, accounting for 4.4 per cent of the global seed market after US (27%), China (20%), France (8%) and Brazil (6%) (Kumar et al., 2018). The Indian seeds market is further expected to grow at a CAGR of 14.3 per cent during 2018-2023, reaching a value of more than US$ 8 Billion by 2023. Telangana state is endowed with favorable climatic conditions suitable for seed production of paddy varieties, pulses, oilseeds, hybrids of cotton, sorghum, maize, bajra, sunflower, fodder sorghum and vegetable crops. The farmers have become expert in seed production of different crops over a period of four decades in the state. Telangana state is involved in production and supply of good quality seed to farmers all over India and also to other countries (Radha & Chowdary, 2002). Around 40 per cent of the hybrid seed marketed in the country is produced in Telangana and therefore can be developed as the 'Seed Bowl' of the country (DoA, 2018). Approximately 400 seed companies engaged in seed production are located in Telangana and is widely known as the seed capital of India. Both the public and private sectors have a huge network of certified seed production through contractual arrangements with progressive seed farmers (Janaiah & Debdutt, 2017). In this context, the present study was aimed at estimating the demand and supply gap in certified/ quality seed production of selected crops in Telangana state and to assess the constraints faced by the seed producing farmers.

Received 17-02-2022; Accepted 15-03-2022

METHODOLOGY

The primary data was collected from 300 seed producing farm households from January 2017 to December 2018 through personal interview method assisted by the well-designed pretested interview schedule. Multistage sampling technique was adopted for selection of the sample with Divisions (cluster of districts) at the first stage, Mandals (sub division/ block) at the second stage, villages at the third stage and respondents at the final stage. Paddy seed growers were selected from Karimnagar and Warangal districts; groundnut seed producers from Mahabubnagar district; and soybean seed producers from Adilabad and Nizamabad districts. Henry Garrett Ranking technique was used to prioritize and rank the constraints faced by the seed producing farmers.

The reference period for estimation of demand and supply was from 2012-13 to 2016-17. The demand of quality seed requirement was estimated by using area multiplied by seed rate and Seed Replacement Ratio (Kumar et al., 2018). The data on seed replacement ratio, seed rate, acreage, seed multiplication ratio, certified seed production was collected personally by the researchers from various agencies like Telangana State Seed & Organic Certification Authority (TSSOCA), Telangana State Seeds Development Corporation Ltd. (TSSDC) and Department of Agriculture, Government of Telangana. Secondary data was also collected from reports of various organizations (DoA, 2022; Professor Jayashankar Telangana State Agricultural University (Annual Reports, 2010-16), National Seeds Corporation Ltd. (NSC), All India Coordinated Research Projects (AICRPs) and Private companies. The demand of certified seed was calculated and compared with the actual/available quantities.

RESULTS AND DISCUSSION

The results are discussed under two sections: demand and supply gap in seed production in Telangana state and constraints faced by the farmers in seed production.

Demand and supply gap

The demand and supply of quality/ certified seed of paddy, groundnut and soybean in Telangana state is as in Table 1. The supply of paddy seed in the state increased from 1,48,773.7 tons in 2012-13 to 1,96,363.8 tons in 2016-17. There was a decline in seed supply during 2014-15 and 2015-16 because of decline in area under the crop and consequent decline in demand. The demand for certified seed increased from 70,900 tons during 2012-13 to 1,00,450 tons during 2013-14. There was wide variation in the demand of paddy seed over the years but the supply was always higher than demand. The surplus seed production ranged from 94.7 per cent during 2013-14 to 215.8 per cent in 2015-16.

In Telangana state, total area registered under seed production during 2017-18 was 179.18 thousand acres with certified seed production of 1,69,073.2 tons. Paddy seed production was undertaken in 109.1 thousand acres (47.75% of the registered area under seed production) with production of 1,71,107 tons during 2016-2017 (TSSOCA, 2017-18). The paddy seed production was undertaken in Karimnagar and Warangal districts and the major varieties were RNR-15048, MTU-1010, MTU-1061, KNM-118, JGL-18047 and BPT-5204. The surplus paddy seed production was exported to Andhra Pradesh, Tamil Nadu, Uttar Pradesh, Rajasthan, Karnataka, Chhattisgarh and Odisha. Two-thirds of India's total certified seed production of modern rice varieties were undertaken in Telangana and Andhra Pradesh. The most popular modern varieties of rice such as Swarna, BPT 5204, Vijetha, Cotton Dora, etc., which were developed and released by the local SAUs, are widely grown in different states of India (Janaiah & Debdutt, 2017).

The supply of groundnut seed from 2012-13 to 2016-17 has declined except during 2015-16. The demand for groundnut seed did not indicate any particular pattern. During 2012-13 and 2015-16, there was surplus in seed supply to the extent of 21 per cent and 96 per cent respectively. For the rest of the years, there was a deficit to the tune of 19 per cent to 66 per cent. Area under groundnut seed production was 18.77 thousand acres (8.21% of the registered area under seed production) with production of 8606.4 tons certified seed during 2016-17 (TSSOCA, 2017-18). The groundnut seed production was undertaken in Mahabubnagar district. The major growing varieties i.e., Kadiri-6 and Kadiri Lepakshi-1812 were imported from Andhra Pradesh (TSSOCA, 2018). The decline in supply was the result of changing cropping pattern and inconsistent rainfall during the last few years of the study period. The deficit in seed requirement in the state was met through imports from Gujarat state. The continuous fall in the prices of groundnut is also resulting in decrease in the area under the crop and decreased demand for the seed when compared to previous years (TSSOCA, 2018). The seed supply in the state increased from 7975.3 tons in 2012-13 to 15,789.9 tons in 2015-16 with wide fluctuations over the years. The demand increased consistently from 2012-13 to 2016-17. There was deficit in seed supply to the extent of 13 per cent to 80 per cent throughout the period.

The area under soybean seed production was 64.73 thousand acres (28.33% of the registered area under seed production) with certified seed production of 7493.8 tons during 2016-17 (TSSOCA, 2018). The soybean seed production was undertaken in Adilabad and Nizamabad districts. The major varieties were JS-335 and ADB-

Table 1. Demand and supply gap in quality seed production in Telangana State (in tons)

Year	Paddy			Groundnut			Soybean		
	Supply	Demand	Surplus/ Deficit	Supply	Demand	Surplus/ Deficit	Supply	Demand	Surplus/ Deficit
2012-13	148773.7	70900	77873.7 (109.8)	33958.4	28050	5908.4 (21.1)	7975.3	11850	-3874.7 (-32.7)
2013-14	195622.5	100450	95172.5 (94.7)	23113.0	31500	-8387.0 (-26.6)	3550.6	18150	-1,4599.4 (-80.4)
2014-15	165768.1	70750	95018.1 (134.3)	18737.2	23250	-4512.8 (-19.4)	5693.1	18225	-12531.9 (-68.8)
2015-16	158081.8	50050	108031.8 (215.8)	35193.8	18000	17193.8 (95.5)	15789.9	18225	-2435.1 (-13.4)
2016-17	196363.8	91400	104963.8 (114.8)	8606.4	25050	-16443.6 (-65.6)	7200.0	20775	-13575.0 (-65.3)

Note: (1) Figures in the parentheses are percentage to the total. (2) Quality seed includes "Certified seed" and Truthfully Labelled Seed".

22. The area under soybean has been consistently increasing and the supply was not able to match with the increased demand leading to the deficit. The seeds were imported from Madhya Pradesh state since enough seed was not produced due to unfavourable weather and lack of sufficient breeder/foundation seed in the state. Therefore, there is a good scope to expand the area under soybean seed production in the state. The area under soybean crop cultivation is witnessing a steady growth and newer districts are also looking at the area expansion.

Constraints faced by the farmers in seed production

The experiences of seed producing farmers with special reference to these three crops were explored (Table 2). The major issue among all seed producing farmers was the lack of remunerative prices for seed. Seed production involves higher cost over crop production and is also prone to higher risks (possibility of rejection of seed lots in case of not confirming to standards). Therefore, farmers demanded a remunerative procurement prices for seed from public and private sector seed agencies. The payment made by the private and public agencies to the seed growers is unduly delayed and released in installments. Further, whenever there is a crop loss, there is undue delay in releasing compensation to the farmers. Though the procurement price of seed is more than normal grain production, the delay in payment will negate the additional profits. Study conducted in Terai Zone of West Bengal reported that pest and diseases management and low price of output were the major constraints of mustard seed production (Layek et al., 2021).

It was reported that soybean seed production in Nizamabad and Adilabad districts in Telangana state during 2016-17 yielded average return of Rs. 98,760/ha with returns of 2.32 per rupee spent. Machine labour and human labour accounted for 16 per cent and 15 per cent of the total cost of cultivation, respectively. The groundnut seed production in Mahabubnagar district yielded average returns of Rs. 1,26,720/ha with returns of 1.46 per rupee spent. Human and machine labour accounted for 22 per cent and 16 per cent, respectively (Reddy et al., 2019a; Reddy et al., 2019b). The major costs in mustard seed production in Terai Zone of West Bengal were human labour charges, organic manure and machinery charges accounting 37 per cent, 16 per cent and 14 per cent of the total variable cost, respectively (Layek et al., 2021). Since agricultural labourers are migrating to cities in search of alternate and regular employment, farmers are finding it difficult to get skilled labour at affordable prices. The social interdependence among and between the farmers and farm labourers has declined in rural areas over a period of time. The soybean is a relatively new crop to the region and seed producers from Nizamabad division felt that a more detailed technical knowledge is needed to bring in quality seed production.

Seed certification in India is undertaken only for notified varieties and is optional. Private seed companies generally undertake production of Truthfully Labeled Seed to avoid time consuming and costly certification procedure (Manjunatha et al., 2016). Government agencies like TSSDCL organize seed production through registered contract farmers with certification from TSSOCA. Limited staff with TSSOCA has affected regular visits to seed plots and delayed seed certification.

Discussion with officers of TSSDCL, TSSOCA and department of agriculture revealed that some private companies procure the breeder seed in large quantities and multiply directly as certified seed instead of channelizing it through foundation seed. This has created the situation of short supply of foundation seed to the seed growers. The shortage of foundation seed will consequently lead to shortages in certified seed. The poor maintenance of purity of breeder and foundation seed was reported by some farmers especially in paddy. Some farmers undertook seed production of paddy on their own every year. They reported that the portion of their seed stock was unsold every year even though the quality of their seeds was best and preferred among the fellow farmers. Seed is a perishable commodity and lack of proper storage facilities with farmers resulted in reduction in quality of seed.

Study conducted in undivided Andhra Pradesh and Bihar states reported that protecting and upholding farmers' rights over seed without any legal hindrances was the most important issue for farmers. Farmers' rights over seed were implicit for all the farmers, irrespective of their awareness and knowledge on laws that protect and uphold these rights, such as PPVFRA, 2001 (Manjunatha et al., 2016). The increase in seed replacement ratio in itself is not an indicator of use of quality seed and high crop productivity. There are risks associated with purchasing new seeds every year from market under weak quality control regime such as crop failure on account of spurious seeds (Manjunatha et al., 2015a). The farmers' practice of using higher seed rate than recommended, resowing for 2-3 times in rainfed conditions and complete dependence on market has led to increased expenditure on seed (Manjunatha et al., 2018). The regulation of retail price and trait/royalty fee of seed is scientific under monopoly market conditions for proprietary technologies involving royalty component (Manjunatha et al., 2015b). Study undertaken in western Rajasthan reported that Quality Seed

Table 2. Constraints in seed production in Telangana state

S.No.	Item	Mean Score	Rank
1	Less remunerative procurement price for seed	82.00	I
2	Non-availability of skilled labour	76.93	II
3	Lack of seed production skills in case of new crops	65.67	III
4	Delayed payment and compensation in case of crop loss	57.33	IV
5	Lengthy seed certification procedure	56.47	V
6	Non-availability of foundation seed of required variety	51.33	VI
7	Poor quality of foundation seed	48.60	VII
8	Lack of systematic and scientific demand assessment	42.20	VIII
9	Unsold seed stock	35.13	IX
10	Lack of scientific storage facilities with farmers	31.40	X

Accessibility Index was highest for farm saved seeds (carrot, onion and garlic) indicating that the seeds/planting material in these crops were easily and timely available, affordable, credible and performed as expected without any cases of spurious seeds. In case of seeds purchased from market, timely availability was not an issue but the seeds of desired variety were not always available (Manjunatha et al., 2018). The farmers were found to have excellent seed production skills in carrot, onion and garlic as evident from high quality of seed/planting material in these crops though the seed replacement ratio was very low (Hajong et al., 2019). Participatory plant breeding (PPB) helps in developing varieties suitable to local environments. Study in Punjab reported that all the farmers and only 40 per cent of the breeders showed willingness to participate in a PPB programme (Faisal et al., 2020).

CONCLUSION

Due to huge market, and high revenues both the formal (public and private) and informal (farmers and civil society organizations) sector were involved in seed production of paddy. Therefore the seed supply in paddy was always higher than the demand. Groundnut and soybean seed production is not preferred by the private seed companies since these are "high-volume and low-value" crops. Therefore, government agencies may focus on fulfilling the seed requirement of these crops. Seed production, like agriculture as a whole, has become less remunerative due to increase in cost of cultivation and impact of climate change. Therefore, it is recommended that procurement price of seed must be at least 150 per cent of the cost of cultivation.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (177-180)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Arrival and Price Behaviour of Major Mustard Markets in Haryana

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ARTICLE INFO

Keywords: Co-integration, e-NAM, Granger causality, Mustard, Seasonality, Haryana

http://doi.org/10.48165/IJEE.2022.58242

ABSTRACT

The market arrival and price behaviour of major mustard markets in Haryana during the pre-e-NAM (2010-2016) and post-e-NAM (2017-2021) periods was studied. In Haryana, e-NAM was implemented in 2016 but after adoption, its impact was shown in 2017. Results revealed that arrivals of mustard increased during pre e-NAM period in two selected markets, whereas, prices of mustard were found to be increased in Sirsa market while it decreased in Rewari market. In post e-NAM period, arrival and prices of mustard found to be decreased in both the markets. It was found that adoption and awareness about e-NAM was found higher in case of Sirsa market as compared to the Rewari market. Both Sirsa and Rewari markets were found spatially integrated in both pre as well as post e-NAM period. The Granger causality test in the post-e-NAM period demonstrated that mustard prices in Sirsa market were having a unidirectional causation on the prices in Rewari market, however there was no causality link between mustard prices in both markets in the pre-e-NAM time.

INTRODUCTION

To ensure the availability of critical inputs in order to increase the productivity to achieve self-sufficiency in oilseed sector is stressed. One of the most commercially significant agricultural crops is the *Oleiferous brassica* species, sometimes known as rapeseed-mustard made up of eight different varieties, including toria, yellow sarson, brown sarson, gobhi sarson, karan rai, black-mustard, and taramira. It is a collection of oilseed crops that ranks second in importance in the Indian economy after groundnut. In the year 2020, the world's estimated rapeseed-mustard area, output, and yield were 35.98 million hectares, 72.77 million tonnes, and 2039 kg/ha, respectively. India accounts for 21.13 per cent of total acreage and 12.61 per cent of total output globally (FAO, 2020). Rapeseed and Mustard are grown as a Rabi crop in Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana, West Bengal, and Punjab in India. Haryana ranks fourth in area and second in production (Agricultural Statistics at a Glance, 2020). The area of mustard in the state increased from 0.51 million hectares to 0.61 million hectares and production from 0.95 million tonnes to 1.29 million tonnes during the period from 2010-11 to 2018-19 (Statistical Abstract of Haryana, 2019-20). Although productivity is increasing but to ensure the availability of critical inputs in order to increase the productivity to achieve self-sufficiency in oilseed sector is stressed (Kumar et al., 2018). Socio economic factors and knowledge level about different production recommendations significantly affected the attitude of respondent farmers towards cultivation of rapeseed mustard crop (Kumar et al., 2020). With the increase in demand of mustard oil and mustard cakes in the country as well at international level, it became highly remunerative crop for the farmers. National Agriculture Market (e-NAM) is an electronic trading portal started by the central government on 14th April, 2016 on pilot basis in 21 mandis at national level in which 4 mandis were covered from Haryana state. After that 1st phase, another 50 and 20 markets were included in e-NAM during the years 2018 and 2021, respectively. At present, there are total 81 APMC are integrated with e-NAM. The adoption of e-NAM in farmers, commission agents, trader and other stakeholders is increasing with

Received 08-03-2022; Accepted 16-02-2022

time. In Haryana more than 27 lakh farmers, nearly 25 thousand commission agents, nearly 13 thousand traders and other stakeholders joined with e-NAM till 28th, Feb. 2022 (e-NAM). This level of adoption and awareness will definitely fulfil the objectives of e-NAM in the state. As such the study was conducted to understand market behaviour, patterns and linkages between commodity arrivals and prices.

METHODOLOGY

The whole study was divided into two group *i.e.* Pre e-NAM (2010-2016) and Post e-NAM (2017-2021). Agriculture Produce Market Committees (APMCs) of Sirsa and Rewari markets, Haryana State Agricultural Marketing Board (HSAMB), Panchkula, and Agricultural Marketing Information Network (AGMARKNET) provided the required monthly data on wholesale prices and market arrivals of mustard. Seasonal indices were created using the twelve-month ratio to moving average approach to quantify seasonal fluctuations in pricing and arrivals. Intra-year price increase (IPR) and coefficient of average seasonal price variation (ASPV) were used to calculate the magnitude of seasonal price fluctuation (Mahalle et al., 2015).

Rapsomanikis et al., (2006) provided a thorough assessment of methodologies for analysing market integration and price transmission, which aided in the refinement of the methodology utilised in this study. The unit root in a time series sample is tested using the Augmented Dickey-Fuller test (ADF). The ADF test's autoregressive version with a drift component is provided by:

$$\Delta p_{it} = a_0 + \gamma p_{it-1} + \sum_{i=2}^{n} \beta_i \Delta p_{it-j+1} + \varepsilon_t$$

Where, p_{it} is the price in market i at the time t, $\Delta p_{it} = (p_{it} - p_{it-1})$ and α_0 is the intercept or drift term.

The joint hypothesis to check the presence of unit root is: H_0: $\gamma = \alpha_0 = 0$ using φ_0 statistic. Failure of the rejection of null hypothesis means that the series is non-stationary.

The Johansen (1988) maximum likelihood estimator was chosen over the Engle and Granger (1987) two-step technique for co-integration analysis. The Johansen technique is a multivariate version of the Dickey-Fuller test, and it has the following formulation:

$p_{it} = A_1 p_{it} + \varepsilon_t$
so that
$\Delta p_{it} = A_1 p_{it} - p_{it-1} + \varepsilon_t$
$\Delta p_{it} = (A_1 - 1) p_{it-1} + \varepsilon_t$
$\Delta p_{it} = \Pi p_{it-1} + \varepsilon_t$

Where, p_{it} and ε_t are (n×1) vectors; A_1 is an (n×n) matrix of parameters; I is an (n×n) identity matrix; and Π is the (A_1-1) matrix.

The number of co-integrating vectors is equal to the rank of the (A_1-1) matrix. The most important thing to look for is whether (A_1-1) contains all zeros or not. If it does, all of the $\{p_{it}\}$ in the preceding VAR are unit root processes, and one linear combination of them is stationary, implying that the variables are not co-integrated. The number of independent co-integrating vectors equals the rank of the matrix Π.

The presence of a co-integrating connection between the price series was determined using the trace test. The following statistics were used to test for the number of characteristic roots that are insignificantly different from unity using the estimations of the characteristic roots:

$$\lambda_{trace}\ (r) = -T \sum_{j=r+1}^{n} ln\ (1 - \grave{\lambda_j})$$

Where, λ_j is the estimated values of the characteristic roots (eigen values) derived from the estimated Π matrix.; and T is the number of valid observations.

After determining that two markets were co-integrated using the Johansen approach, we used Granger (1969) causality tests to determine the order and direction of short-term and long-term equilibrium linkages. The following tests were used to see if market p 1 Granger caused market p 2 or vice versa:

$$p_{it} = c \sum_{j=1}^{n} (\emptyset\, p_{1t-j} + \delta_j p_{2t-j}) + \varepsilon_t$$

The Granger causality was tested using a simple test of the joint significance of δ_j. i.e.

$$H_{0:}\ \delta_1 = \delta_2 = \ldots \delta_n = 0.$$

RESULTS AND DISCUSSION

Adoption of e-NAM in major mustard markets

Stakeholders are very important for successful implementation of the e-NAM in APMC's. In Sirsa and Rewari APMC's stakeholder status is presented in Table 1. In the Sirsa market, the number of farmers registered with e-NAM were 6 times higher as compared to the Rewari market which shows higher adoption of e-NAM by farmers in the Sirsa market. In case of traders and commission agents, higher adoption was found in Sirsa market as compared to Rewari market.

Table 1. Stakeholders status of major mustard markets

Markets	Farmers	Traders	Commission Agent
Sirsa	179726	413	791
Rewari	28379	214	259

Trends in arrivals and prices of mustard

Table 2 shows the trends of arrival and prices of mustard during the pre e-NAM and post e-NAM period in Sirsa and Rewari market. Arrivals of mustard have increased during pre e-NAM period in both the market. Whereas, prices of mustard were found to be increased in Sirsa market while it was decreased in Rewari market. In post e-NAM period, arrival and prices of mustard were observed decreasing trend in both the markets.

Prices and arrivals seasonality of mustard

Table 3 shows the seasonal changes in mustard prices in the pre e-NAM and post e-NAM periods. The data demonstrated that during the pre-e-NAM period, indices of seasonal price fluctuation in Sirsa Market were greatest in August and October to December, whereas it was highest in Rewari Market from June to December. In post e-NAM period, in Sirsa market, indices of seasonal prices were observed highest in January, April to June and August while

Table 2. Trends in prices and arrivals of mustard in major wholesale markets of Haryana

Markets	Pre e-NAM		Post e-NAM	
	Coefficient of linear trend		Coefficient of linear trend	
	Change in price (Rs/q/year)	Change in arrival (q/year)	Change in price (Rs/q/year)	Change in arrival (q/year)
Sirsa	y = 281.17x + 2038.9	y = 0.2859x + 401.11	y = -615.83x + 4914.2	y = -79.867x + 939.45
Rewari	y = 247.94x + 2251.9	y = -214.5x + 2281.6	y = -1076x + 5441.8	y = -328.81x + 1361.7

Table 3. Monthly prices and arrivals seasonal indices of selected mustard markets in Haryana

Month	Seasonal Index – Price (%)							
	Pre e-NAM				Post e-NAM			
	Sirsa		Rewari		Sirsa		Rewari	
	Prices	Arrivals	Prices	Arrivals	Prices	Arrivals	Prices	Arrivals
January	94.86	5.00	98.33	16.29	102.26	4.47	107.37	10.83
February	96.78	12.04	90.60	17.73	96.28	2.17	102.05	2.05
March	94.01	154.45	88.12	127.45	96.39	79.50	106.11	124.90
April	87.85	696.34	90.56	676.01	105.72	652.01	107.76	423.73
May	90.99	222.94	99.38	170.87	104.48	375.89	100.41	146.95
June	93.05	48.49	102.13	42.77	104.67	26.59	96.32	25.26
July	98.91	17.97	100.36	67.16	94.91	12.76	96.69	66.05
August	110.44	12.03	107.09	10.14	100.12	10.62	97.24	47.02
September	99.15	13.96	102.29	20.01	98.99	7.41	97.49	52.37
October	100.91	8.00	103.67	25.55	89.81	14.52	95.48	28.92
November	116.94	5.98	110.76	8.96	101.77	10.21	97.86	22.92
December	116.11	2.80	106.72	17.04	104.59	3.85	95.23	248.98

in Rewari market, seasonal prices were higher from January to May month. Table 3 further shows the seasonal fluctuation in mustard arrivals in Haryana's designated marketplaces. During the pre e-NAM period, arrivals were greater in the months of March and May, but remained lower in the months of October and January in the Sirsa and Rewari markets. Whereas, in post e-NAM period, arrival of mustard was found to be highest in the months of April and May in Sirsa market and during the March and May in Rewari market. Similar results were observed by Wadke (2013) in their study.

Seasonal movement in prices of mustard

The intra-year price rise (IPR) of mustard has had significant consequences for producers, merchandisers, and consumers over the years. The intra-year variations in mustard prices ranged between 25.69 to 33.11 and 13.16 to 17.72 per cent per cent during the pre e-NAM as well as post e-NAM period in Sirsa and Rewari markets of Haryana, respectively (Table 4).

The pre-e-NAM period's average seasonal price variation (ASPV) varied from 22.77 to 28.41 per cent, whereas the post-e-NAM period's ASPV was between 12.35 and 16.27 per cent. Intra-year changes in mustard prices, as well as average seasonal price variations, may have significant ramifications for pricing and yearly mustard production decisions.

Market integration

The Augmented Dickey Fuller (ADF) test was used to investigate market integration, and the findings are shown in Table 5. The ADF values in the pre-e-NAM period were lower than the crucial values at the 1 per cent level, indicating that the price series were free of unit root effects. This meant that at the ADF levels, the price series were stationary. The ADF values were greater than the critical values at the 1 per cent level after e-NAM, showing the presence of a unit root in the series and non-stationary nature of the data. The ADF values in the Rewari market were smaller than the crucial values at the 1 per cent level of significance, indicating

Table 4. Descending order of mustard markets according to IPR and ASPV

Market	IPR (%)		Market	ASPV (%)	
	Pre e-NAM	Post e-NAM		Pre e-NAM	Post e-NAM
Sirsa	33.11	17.72	Sirsa	28.41	16.27
Rewari	25.69	13.16	Rewari	22.77	12.35

Table 5. Market integration of mustard prices in different markets of Haryana

Market	Pre e-NAM			Post e-NAM		
	Level series	First Difference	Critical value	Level series	First Difference	Critical value
Sirsa	-5.7830	-10.4406	-3.5133	-3.0740	3.20	-3.5503
Rewari	-4.8341	-7.1788		-3.3122	-6.4127	

Table 6. Results of multiple co-integration analysis

Hypothesized	Pre e-NAM			Post e-NAM		
No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Eigenvalue	Trace Statistic	0.05 Critical Value
None*	0.2239	26.2509	15.4947	0.1725	15.6548	15.4947
At most 1*	0.0836	6.7283	3.8414	0.1532	7.32017	3.8414

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level

that the price series were free of the effects of unit root, but not in the Sirsa market. Except for Sirsa, this meant that the price series were stagnant at the first difference level.

Johansen's multiple co-integration test was used to establish the long-run connection between the price series of both markets in the pre-e-NAM and post-e-NAM periods, with the findings reported in Table 6. The findings demonstrated that both markets, Sirsa and Rewari, were co-integrated at a 1 per cent level of significance, meaning that the selected mustard markets had a long-run equilibrium connection and that co-integration occurred between them. The findings of the pair-wise Granger causality test in the pre-e-NAM and post-e-NAM periods revealed that there was a unidirectional causation in the pricing of Rewari in the post-e-NAM era, but there was no causality in both markets in the pre-e-NAM time.

CONCLUSION

In Haryana, the empirical investigation discovered an unbalanced trend in pricing for distinct marketplaces. According to the study's findings, mustard arrivals in both Sirsa and Rewari marketplaces rose during the pre-e-NAM timeframe. Whereas, prices of mustard were found to be increased in Sirsa market while it was decreased in Rewari market. In post e-NAM period, arrival and prices of mustard found to be decreasing trend in both the markets. The ASPV and IPR of prices have been delivered similar ranks to the different markets. Both Sirsa & Rewari markets have been found spatially integrated in both pre e-NAM and post e-NAM period. Granger causality test in in post e-NAM period shows Sirsa market price has a unidirectional causality on the prices of Rewari while in pre-e-NAM period there is no causality in both markets. Further strengthening of a single, uniform economic market in the area, and the country as a whole, necessitates the development of physical infrastructure, market information and communication technologies, and well-defined, transparent agricultural policies and market measures in the state.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (181-185)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Diffusion of Agricultural Innovations: The Case of Organic Farming in Uttarakhand State of India

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ARTICLE INFO

Keywords: Diffusion, Organic farming, Innovation-decision process, Adoption, Registered farmers, UOCB

http://doi.org/10.48165/IJEE.2022.58243

ABSTRACT

Organic agriculture is an innovation among the agricultural production systems having its own unique characteristics thus making it distinct from traditional as well as conventional agricultural production systems. From India, organic food products exports grew by 51 per cent to US$1040 million in 2020-21. The rapid spread of organic agriculture makes an interesting case for analysis particularly in the context of developing countries. This paper has attempted to discuss the diffusion of organic farming in Uttarakhand state of India where promotion of organic farming is taking place systematically through Uttarakhand Organic Commodity Board (UOCB). The various stages of innovation-decision in the process of adoption of organic farming i.e. from knowledge to confirmation by the registered organic farmers have been traced including the factors that played role at every stage. Characteristics like social participation, information access, training received, and experience in organic farming were found having significant association with adoption of organic farming.

INTRODUCTION

Growing awareness, increasing market demand, increasing inclination of farmers to go organic and growing institutional support have resulted in more than 200 per cent growth in the certified area during the recent years (Ramesh et al., 2010). Unlike Europe and USA, very few long-term organic farming experiments are available in India, however, there were farmers who have been cultivating land under organic farming conditions for the last two decades. India holds 5th position in terms of area (2.3 million hectare) under certified organic production (Willer et al., 2021) and currently exports across the globe a range of certified organic edibles and fiber to 58 countries. Organic food products exports grew by 51 per cent to US$1040 million in 2020-21 compared to US $689 Million in 2019-20, beating COVID-19 induced hiccups in the supply chain. The level of exports of organic agricultural produce gained momentum gradually and steep rise was seen which reveals that time is a very important factor in diffusion and adoption of any innovation. Early adopters are different from late adopters, and a longer time period is required for an innovation to spread amongst all potential adopters (Rogers, 1995) as the individual decision to adopt any innovation takes time. It was also reported by Singh et al., (2021) that from awareness to adoption average forty months were taken by the farmers to complete the five stages of adoption process.

Technology adoption is largely a function of communication between different groups, where knowledge and information play a large pivotal role. However, adoption issues reflect a variety of factors apart from socio-psychological values and beliefs of farmers in case of any innovation. Methodologies and approaches to support farmers' experiential learning to improve their technical and managerial capacities, is always advocated (Nain et al., 2020).

Received 02-03-2022; Accepted 17-03-2022

Efforts to promote agricultural technologies must be adapted to suit local agricultural and cultural contexts as also stated by Ruzzante et al., (2021) in their study on the adoption of agriculture technology in the developing world. Hence a study on the factors that contributed towards adoption was organised through innovation-decision process model of Rogers (1995), which was also justified in a review study done by Padel (2001) that the model can be used to gain understanding of the diffusion processes of organic farming and the individual adoption or conversion decision.

METHODOLOGY

Uttarakhand (77° 34' and 81° 02'E longitude and 28° 43' to 31° 27' latitude), one of the Northern states of India was selected purposively where organic farming was being promoted systematically. Multistage sampling took place at the district, block and village levels and a total of 180 registered organic farmers were studied which consisted of 110 registered organic farmers from hill region and 70 farmers from *bhavar* (plain) parts. Details of information regarding farmers were collected from the official records as well as through interaction with the officials of UOCB. Data was collected personally from the respondents through structured interviews. 'Exploratory research design' was used. Analysis of the adoption of organic farming was carried out through innovation-decision process (Rogers, 1983) which comprises the following stages.

- Knowledge: Exposure to a technology and understanding its usage and benefits.
- Persuasion: Once the person is with needy information, then motivating him to think of its usage practically.
- Decision: Taking the final decision after proper perception.
- Implementation: Carrying out practically the technology on small-scale.
- Confirmation: Accepting or rejecting the technology basing on the outcome of the technology adoption.

RESULTS AND DISCUSSION

Profile of organic farmers

The respondents comprised of both the gender (62% male and 38% female) and were in the range of 21 to 66 years age group. Majority belong to higher castes and around 75.56 per cent of respondents have primary education and above. The average land holding of farmers was found to be 0.98 hectares, whereas, the land converted to organic farming on an average was 0.343 hectares accounting to 35 per cent of land under conversion. All the farmers received training on the importance of organic farming and around 61.67 per cent of farmers had medium level of innovativeness.

Factors leading to adoption of organic farming with roger's method of innovation-decision process

Farmers' basic level of knowledge plays a role in successful adoption and continuation of any innovation and hence, organic farmers were enquired about knowledge in different aspects of organic farming standards. Farmers were knowledgeable about different aspects of organic agriculture including the role and essentiality of animals in organic agriculture (Table 1). At the persuasion stage of the innovation-decision process, the individuals form a favorable or unfavorable attitude which play role in influencing the acceptance or rejection of any innovative idea.

Table 1. Farmers' awareness and knowledge about organic agriculture standards

Area	Frequency (%) of organic farmers		
	Hill (110)	Plain (70)	Total (180)
1. Organic Agriculture			
Organic agriculture is mixed farming	110 (100.00)	70 (100.00)	180 (100.00)
2. Compost making			
Aware	110 (100.00)	70 (100.00)	180 (100.00)
Types of compost	110 (100.00)	70 (100.00)	180 (100.00)
Preparation /*procedure*	110 (100.00)	70 (100.00)	180 (100.00)
Economic than direct *gober*	110 (100.00)	70 (100.00)	180 (100.00)
Enriches soil fertility	110 (100.00)	70 (100.00)	180 (100.00)
3. Crop rotation/Multiple cropping			
Aware	110 (100.00)	70 (100.00)	180 (100.00)
Protects soil fertility	73 (66.36)	51 (72.86)	124 (68.89)
Diversified production	55 (50.00)	34 (48.57)	89 (49.44)
Reduces risk & economic	43 (39.09)	32 (45.71)	75 (41.67)
Enhances local food security	00	08 (11.43)	08 (04.44)
4. Nature of organic farming			
Aware	110 (100.00)	70 (100.00)	180 (100.00)
Low external input intensive system	74 (67.27)	54 (77.12)	128 (71.11)
Conventional systems in organic production not allowed	110 (100.00)	70 (100.00)	180 (100.00)
Environmental pollution is less	61 (55.45)	53 (75.71)**	114 (63.33)
5. Animals in organic agriculture			
Aware	110 (100.00)	70 (100.00)	180 (100.00)
Essential	110 (100.00)	70 (100.00)	180 (100.00)
Recycling of nutrients	85 (77.27)	55 (78.57)	140(77.78)
Maintain bio-diversity	55 (50.00)	32 (45.71)	87 (48.33)
Duration of livestock conversion period - No idea	110 (100.00)	70 (100.00)	180 (100.00)
Less capital intensive	13 (11.82)	09 (12.86)	22 (12.22)

* Significant at 5% level; **Significant at 1% level

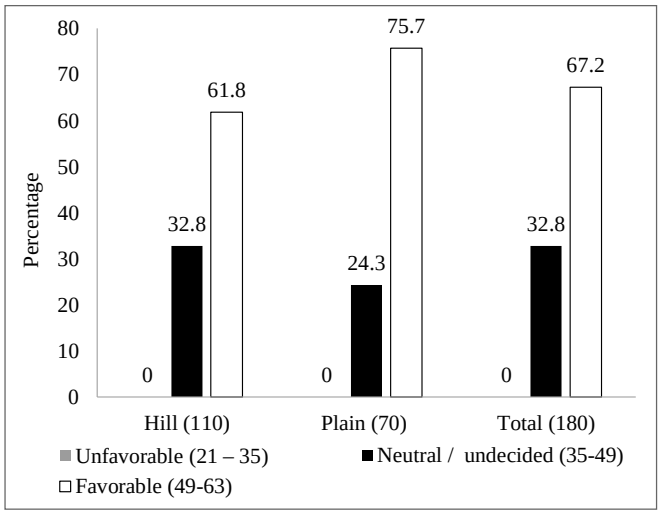

Figure 1. Attitude of farmers towards organic farming

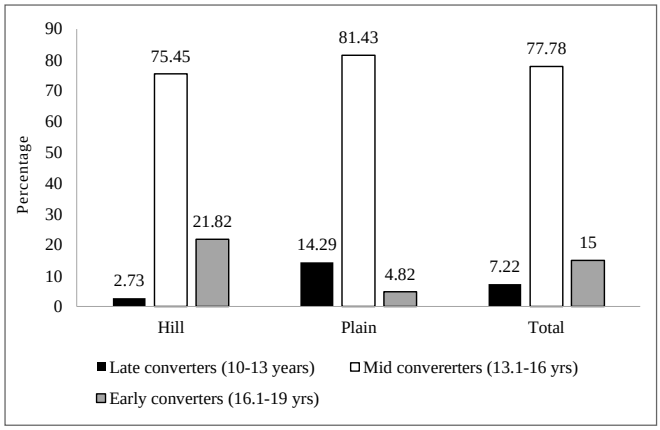

Figure 2. Categorization of organic farmers as per stage of conversion

It is quite clear (Figure 1), that no single farmer was with unfavorable attitude, an indication of farmers' affinity towards organic farming. The respondents being registered organic farmers of UOCB and moreover, their farming practices, values and beliefs might be in line with the principles of organic farming and hence the favorable attitude by majority. A study by Waghmode et al., (2018) also mentioned that more than three fifth of the mango growers were found to have favorable attitude towards global gap certification an innovative idea which is designed to maintain consumer confidence in food quality and safety as mentioned. Gills et al., (2021) mentioned that along with the ecological sustainability of the organic cultivation practices, farmers were more oriented to the economic and social sustainability of the organic way of cardamom production due to the social and cultural linkage which the crop possessed. Selective perception is important about the attributes of an innovation like its relative advantage, compatibility and complexity (Rogers, 2003) and here in case of organic farming, attributes like due recognition of age old practices of farmers, suitability to own agro-ecological situation, increasing demand and price premium for organic produce, philosophical views and the compatibility with the principles of organic farming might lead to favorable attitude among farmers towards organic farming. Though standards like certification process of farm and farm produce and raising of on-farm inputs necessary for farming appeared as complex to the farmers, the extension workers i.e. master trainers of UOCB could successfully pursue them by reducing the uncertainty of innovation through better orientation. All innovations carry some degree of uncertainty for an individual who is untypically sure of the innovation's functioning and thus seeks social reinforcement from others especially the *localite* personnel. The Master trainers and service providers of UOCB, who are the *localite* could successfully pursue the farmers towards better understanding of the concept of organic farming. Mass media, the *impersonal cosmopolite* channel further provided the specific kind of reinforcement and played greater role in making the farmers accessible to various developments.

In the study area organic farmers were being persuaded by the extension workers, could try the innovation on small-scale, and hence, out of the total land holding of 176.72 acres, about 61.67 acres of land is converted to organic i.e. 34.97 per cent of the total land. Farmers were very cautious in taking decisions about the innovation and the scattered land holdings of the respondents might further facilitated the farmers to try on small-scale. In adoption research it was discovered that farmers often experiment on small scale before they introduce a new technology on the whole farm (Ryan & Gross, 1943).

Organic farmers as innovators or early adopters

Farmers were categorized into early, mid and late converters basing on their entry into organic farming i.e. the period of time, since they started converting their farms. There was significant difference ($p<0.01$) between hill and plain area farmers with respect to number of farmers' experience in organic agriculture in the two categories i.e. late and early converters (Figure 2). The promoting agency might started motivating and registering the farmers in a phased way with a special focus on the opinion leaders of the farming community initially who act as key informants to the other members of the social system and leads to the effective diffusion of information.

Motivational factors and goals of organic farmers

Values of farming, sustainability of farm resources, reliable and stable income in organic farming were the major motivational factors as revealed by more than three fourth of the respondents. The decision to take up organic farming depends on the values and beliefs of farmers. Well planned awareness and educational programmes of organic agriculture promoting agencies could succeed in getting the farmers convinced to take up organic farming. Organic farming is offering a good prospect for securing their income as also found by Vaidya and Pratap (2007) that income security was a key motivating factor behind adoption of organic farming by small farmers in India.

Attributes of the technology viz. relative advantages, trialability, observability and compatibility have positive effects on the rate of adoption as also mentioned by Singh et al., (2021) in their study on adoption of happy seeder technology. Seth et al., (2014) in their study also revealed that due to desired innovation attributes like relative advantage, observability, cultural compatibility and trialability, there was faster rate of adoption of 'T&D pig'.

Table 2. Motivational factors and goals of organic farmers

S.No.	Motivating factor	Hill (110) F (%)	Plain (70) F (%)	Total (180) F (%)
1.	Role of organic agriculture promoting agencies	100 (90.90)	61 (87.14)	161 (89.44)
2.	Farmers personally convinced with the values of organic farming	95 (86.36)	62 (88.57)	157 (87.22)
3.	Sustainability of farm resources	86 (78.18)	61 (87.14)	147 (81.66)
4.	For stable and reliable income	84 (76.36)	55 (78.57)	139 (77.22)
Goal of taking up organic farming				
1.	To continue successfully traditional livestock farming practices which are given importance in organic production	101 (91.81)	58 (82.85)	159 (88.33)
2.	To have reliable and stable income	98 (89.09)	61 (87.14)	159 (88.33)
3.	To protect soil fertility through recycling of nutrients	80 (77.27)	63 (90.00)	148 (82.22)

Certain degree of uncertainty about the expected consequences of the innovation may exist at the implementation stage, wherein, technical assistance may help out in implementation of the innovation. In the present study, trainings and demonstrations by the *localite personnel* i.e. the co-operative net work of UOCB through its master trainers of the organic promoting agency could strengthen the farmers towards practical application and hence resulting in adoption of most of the practices as recommended (Table 3). The farmers selected for the study were at different stages of conversion and exposed to training at different phases in the various aspects of organic farming and hence adoption of practices were in different proportions (Table 3). Whereas, in case of organic livestock farming standards, very small number of farmers from both plain (2.86%) and hill area (1.82%) were following them indications about the need of technical expertise in organic livestock farming. Significant difference ($p<0.01$ and $p<0.05$) was found between the hill and plain area farmers. Through studies, it was assumed that when adoption has reached upto 15-20 per cent of the community, the process will continue on its own (Rogers, 1995), whereas, in the present study, the adoption rates were more than 15 to 20 per cent, thus, the successful continuation of the innovative farming. Naberia et al., (2015) mentioned in their report that psychological attributes of farmers significantly associate with the adoption of low cost technologies and organic practices being low cost production technologies and hence successful adoption and continuation of practices.

Table 3. Adoption of organic farming practices

S.No.	Area	Number (%) of organic farmers practicing	
		Hill F %	Plain F %
1.	Concept of organic farming	-	-
2.	Principles of organic farming	110 (100.00)	70 (100.00)
3.	Compost making	110 (100.00)	70 (100.00)
4.	Bio-pesticide making	40 (36.36)	35 (50.00)
5.	IPM	21 (19.09)	27***** (38.57)
6.	Crop rotation	110 (100.00)	70 (100.00)
7.	Record maintenance	110 (100.00)	70 (100.00)
8.	ICS	51 (46.36)	36 (51.43)
9.	Packaging and processing of products	25 (22.72)	43****** (61.43)
10.	Marketing channels		
	1. Export	00	45****** (64.29)
	2. Local/Domestic	60 (54.54)	70** (100.00)
11.	Organic livestock farming standards	02 (01.82)	02 (02.86)

Generally individuals seek reinforcement for an individual-decision already made, but may reverse the decision if exposed to conflicting messages. In the present study the systematic motivation of farmers through orientation and training in a phased way, the farmers could face no conflicting messages and hence resulted in successful carrying out of the practices. Moreover, the perceived usefulness of technology coupled with the ease in use of technology might encouraged farmers to continue the organic agriculture practices. Prajapathi & Shabyasachi (2019) also found that self efficacy, cooperative network and perceived usefulness of technology significantly associated with the adoption behaviour of farmers.

Relation of socio-personal characteristics with adoption of organic farmers

A relationship between socio-economic status, such as education, income level, farm size and commercial orientation and innovativeness was generalized from many adoption studies in the adoption model (Rogers, 1995). Several studies of conversion to organic farming have also looked at some aspects of the socio-economic status of organic farmers, such as caste, education farm size, farming background, social relationships and motivation to convert. And in the present study characteristics like social participation, information access, training received, experience in organic farming showed significant association with adoption of organic farming (Table 4). Extension activities, easy availability of technology and large operational land holding had a positive effect on the rate of adoption of Happy Seeder Technology as mentioned by Singh et al., (2021) in their study. Naberia et al., (2011) also reported that socio-personal attributes like social participation of

Table 4. Relation of socio-personal variables with adoption of organic farming

S.No.	Variable	Hill	Plain	Total
1.	Age	0.163	0.040	0.080
2.	Education	0.179	0.012	0.099
3.	Social participation	0.271**	0.186	0.079
4.	Information access	0.594**	0.707**	0.665*
5.	Training received	0.738**	0.832**	0.775**
6.	Land holding	0.059	0.075	0.053
7.	Organic land holding	0.030	0.276*	0.153*
8.	Organic farming experience	0.442**	0.158	0.147*
9.	Family education	0.290**	0.132	0.096

* Significant at 5 %; ** Significant at 1%

farmers significantly associate with the adoption of low cost technologies.

CONCLUSION

All types of innovations cannot be diffused successfully in a social system unless the innovation fits well into the multitude characteristics of society's psychological beliefs and values of individuals, wherein the adoption of organic farming in Uttarakhand state of India sets as an example. This study could analyze the factors to take up an innovation which can be taken as key factors to promote organic agriculture in the similar agro-ecological regions not only in India, but also elsewhere in the world. This study further supports the research on adoption of innovations, that innovations are more easily adopted if the practice is highly divisible, i.e. can be tried on a small-scale**,** so that the farmer gains some experience and confidence with the new techniques to adopt it on large scale successfully. A meta-analysis on the empirical literature, which has been further explained by this study that suitability of the organic farming to agro-ecological and cultural situation of farmers of Uttarakhand further facilitated the diffusion

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (186-190)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Effectiveness of Agricultural Information Disseminated through Social Media

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ARTICLE INFO

Keywords: Social media, Dissemination, Agricultural information, Effectiveness and EAII Index

http://doi.org/10.48165/IJEE.2022.58244

ABSTRACT

The study conducted to understand the effectiveness of agricultural information disseminated through social media as perceived by the farmers in three erstwhile districts of the Southern Telangana zone of Telangana state, with a sample size of 120 in year 2020. Effectiveness of Agricultural Information Index (EAII) was developed for the study by selecting eight indicators. It was found that (39.17%) of the respondents perceived effectiveness of agriculture information disseminated through social media as a medium level. Age and farming experience were found to be negative and significant with the effectiveness of agricultural information perceived by respondents. Digital literacy, farm size, social media network, social media usage, mode of access and preference, readiness to accept information, social media participation was positive and significant in relation to perceived effectiveness, and the variable information processing was found non-significant. The results shown that more than half of the respondents perceived information received on social media is effective. Social media platforms can be utilised effectively by developing better interface and information content to pictures and video format.

INTRODUCTION

Sustainable development depends on attitude towards information, adjustment for sharing information, and proper consumption of information by the people (Sinha, 2018). The way of information dissemination is also changing along with technological changes. Recent innovations in information technology can deliver agricultural information with high speed to a large number of people and with more accuracy (Goyal, 2011). In 21st century, social media occupied major space in communication and there is no field untouched by social media. ICT utilization among the livestock and poultry farmers was maximum followed by mass media exposure and extension agency (Panda et al., 2022), indicating the importance of ICT tools. The tribal farmers of Rajasthan ranked Mobile, TV and Radio in higher positions for getting agricultural information (Jat et al., 2021). The availability of numerous online information resources from computer files, library catalogues, databases, organizations, newsgroups, industrial, and commercial sources as well as from individuals, makes the internet an indispensable tool for academia and research (Buabeng et al., 2016). Mobile based delivery ensures timeliness and is of great use to the farmers (Sandhu et al., 2012). Google for searching information ranked 1st, followed by Facebook, Others (Malik et al., 2020). Social networking was found effective in creating knowledge (Nain et al., 2019).

Since the last decade the Social Media platforms have predominantly dominated the way of communication. They are an interactive network in which ICTs bequeath to modern society through the instrumentality of the internet and the telecommunication gadgets (Eke et al., 2014). The social media has become a preferred media for receiving and further sharing information among all the stake holders (Sharma et al., 2020). Social media are tools of electronic communication that allow users to interact with others

Received 19-01-2022; Accepted 21-03-2022

individually or in groups for the purposes of sharing thoughts, information and opinions (Bhattacharjee & Raj, 2016). The unique experience of openness, conversation, community and connectedness makes social media an important tool of communication (Mayfield, 2008). Educating the patients by using modern digital media content formats like text, voice messages, and animated modules in local language enhanced the knowledge, skill, and attitude of the respondents towards the disease for effective self-management among the diabetic patients (Devi, 2020). Farmers exposed to paddy expert system had high level of symbolic adoption behaviour (Monikha et al., 2021). WhatsApp, Facebook, and YouTube were more familiar at field level among all social media platforms and extension personnel should develop content accordingly in such a way that reach farmers more effectively through these social media platforms (Sandeep et al., 2020). The advantages of using social media are beyond cost effective ways of communication to empowerment (Neill et al., 2011). Social media can be easily included for sharing information related to agriculture along with different other media. In recent years, however, technology awareness and digital literacy are increasing among farming community in all demographics and various forms of social media are being used more and more by farmers searching for news, education, and other information in day to day life for agricultural development. Thus, the present investigation was conducted to study the perceived effectiveness of agricultural information received on the Social Media platforms with help of Effectiveness of Agriculture Information Index (EAII).

METHODOLOGY

Southern Telangana Zone of Telangana State was purposively selected for the study in 2020. All three erstwhile districts of the Southern Telangana Zone were selected. Two Mandals from each district and two villages from each Mandal were selected using a simple random sampling technique. Thus, a total of twelve villages were selected and from each village 10 respondents were selected making 120 respondents for the study. In total, ten profile characteristics i.e., age, digital literacy, farming experience, farm size, social media network, social media usage, information processing, mode of access and preference, readiness to accept information and social media participation were selected for the study to find out the relationship with the effectiveness of agricultural information disseminated through social media perceived by respondents after reviewing the literature available. The Effectiveness of Agricultural Information Index (EAII) was developed. In total 15 indicators were identified based on literature and shortlisted after judges rating having relevancy score more 0.80. Only eight indicators satisfied this condition, and they were information content, retrievability of information, relevancy of information, information practicability, ease of understanding, the utility of information, information satisfaction, and timeliness of the information. The reliability of index was measured by using test- retest method and the correlation value (r = 0.83) found satisfied. The content validity method used to know the validity of the index. As index value differs for almost all statements included had a very high discriminating value, it seemed reasonable to accept the index as a valid measure of the effectiveness of agriculture information. Each indicator to study the effectiveness of agriculture information consisted of unequal number of statements and hence their rage was different. Therefore, the scores of all the eight indicators were normalized by using the formula given below:

$$U_{ij} = \frac{Y_{ij} - Min_{yj}}{Max_{yj} - Min_{yj}}$$

Where, U_{ij} = Unit score of the i^{th} respondents on j^{th} component, Y_{ij} = Value of i^{th} respondent on the j^{th} component, Max_{yj}= Maximum score on the j^{th} component, Min_{yj}= Minimum score on the j^{th} component, The score of each component ranged from 0 to 1 *i.e.* when Y^{ij} is minimum the score is 0 and when Y^{ij} is maximum the score is 1.

$$\text{Effectiveness of agriculture information} = \frac{SI_1 + SI_2 + SI_3 + SI_4 + SI_5 + SI_6 + SI_7 + SI_8}{8}$$

Where, SI_1 = Normalized indicator value of information content, SI_2 = Normalized indicator value of information retrievability of information, SI_3 = Normalized indicator value of relevancy of information, SI_4 = Normalized indicator value of information practicability, SI_5 = Normalized indicator value of utility of information, SI_6 = Normalized indicator value of ease of understanding, SI_7 = Normalized indicator value of information satisfaction and SI_8 = Normalized indicator value of timeliness of the information.

The primary data was collected from the farmers using social media as source of agricultural information and appropriate statistical methods like data classification, frequency, and correlation used for data analysis.

RESULTS AND DISCUSSION

Perceived effectiveness of agricultural information disseminated through social media

Data presented in Table 1 shows that majority (50.00%) of the respondents perceived that agricultural information on social media was good. In total 64.10 per cent of the respondents perceived that information content available on social media is good and above. Regarding the retrievability of information from social media (35.00% perceived that retrievability of information in social media was poor followed by average (31.17%), good (20.00%), very good (9.17%), and excellent (4.16%). Further regarding the indicator relevancy of information available on social media platforms, 45.83 per cent perceived that the relevancy of agriculture information on social media was very good. Practicality of the information perceived by the 44.17 per cent of respondents as good and the results are supported by the finding of Khan et al., (2017). The indicator utility of information was found by the majority (50.00%) as average and similar results were observed by (Kumar et al., 2017 & Soumya et al., 2018). 43.30 per cent of the respondents perceived that ease of understanding of agriculture information on social media was good and results are on par with the findings of Khan et al., (2017). The majority (65.00%) of the respondents perceived information satisfaction as good and the findings were in line with the (Kumar et al., 2017). Further that majority (52.50%) perceived timeliness of information was good and results are on par with the (Sowjanya et al., 2018).

Table 1. Distribution of respondents on dimension of EAII Index

S.No.	Indicator	Category	Class Interval	Percentage
1.	Information Content (SI_1)	Poor	15-18	4.20
		Average	19-22	31.70
		Good	23-26	50.00
		Very good	27-30	5.80
		Excellent	31-34	8.30
2.	Retrievability of information (SI_2)	Poor	24-27	35.00
		Average	28-31	31.17
		Good	32-35	20.00
		Very good	36-39	9.17
		Excellent	40-43	4.16
3.	Relevancy of information (SI_3)	Poor	12-13	1.17
		Average	14-15	10.00
		Good	16-17	28.33
		Very good	18-19	45.83
		Excellent	20-21	14.16
4.	Information practicability (SI_4)	Poor	12-14	0.83
		Average	15-17	10.83
		Good	18-20	44.17
		Very good	21-23	36.67
		Excellent	24-26	7.50
5.	Utility of information (SI_5)	Poor	19-22	4.20
		Average	23-26	50.00
		Good	27-30	33.30
		Very good	31-34	7.50
		Excellent	35-38	5.00
6.	Ease of understanding (SI_6)	Poor	13-17	2.50
		Average	18-22	20.80
		Good	23-27	43.30
		Very good	28-32	29.20
		Excellent	33-37	4.20
7.	Information satisfaction (SI_7)	Poor	14-17	0.80
		Average	18-21	13.30
		Good	22-25	65.00
		Very good	26-29	14.20
		Excellent	30-33	6.70
8.	Timeliness of the information (SI_8)	Poor	10-12	2.50
		Average	13-15	26.67
		Good	16-18	52.50
		Very good	19-21	14.17
		Excellent	22-24	4.16

Overall effectiveness of agricultural information perceived by respondents

Data presented in Table 2 shows that 39.17 per cent of the respondents perceived effectiveness of agriculture information medium level of effectiveness followed by less level of effectiveness (38.33 %), very high level of effectiveness (8.33%), high level of effectiveness (7.50%) and very less (6.67%). It can be depicted that 55 per cent of respondents perceived that agriculture information received through social media as effective and above. The results are in line with Satyapriya et al., (2017) & Khan et al., (2017). The probable reason for these results might be due to the fact that social media platforms providing local agricultural information and access to information is available round the clock, the advantage of sharing information in text, photo and video format in easy way and the reach of information is also rapid. It also might be due to fact that these social media platforms helping the farmers to share information to experts, in the same way receive information from them at cheaper cost and it is providing platform to discuss

Table 2. Effectiveness of agricultural information

S.No.	Category	Class interval	Frequency	Percentage
1.	Very less effective	0.14 – 0.29	08	6.67
2.	Less effective	0.30 – 0.45	46	38.33
3.	Effective	0.46 – 0.61	47	39.17
4.	Highly effective	0.62 – 0.77	09	7.50
5.	Very highly effective	0.78 - 0.93	10	8.33
	Total		120	100.00

agricultural related topics. It can also be depicted that 45 per cent of respondents perceived the effectiveness of agricultural information disseminated through social media as less and very less effective and it could be due to the low digital literacy and difficulty in retrieving the agricultural information from social media platforms.

Relationship between profile characteristics of farmers and perceived effectiveness

It is revealed from the Table 3 that 'r' calculated values between the digital literacy, farm size, social media network, social media usage, mode of access and preference, social media participation and effectiveness of agriculture information were greater than the 'r' table value at 0.01 level of significance. The calculated 'r' value between readiness to accept information and effectiveness were greater than the 'r' table value at 0.05 level of significance. In case of age and farming experience, negatively significant correlation was observed with perceived effectiveness of agriculture information; the calculated 'r' value is greater than the table value at 0.01 level of significance. On the other hand, 'r' value of variable information processing and effectiveness of agriculture information were found less than 'r' table value. Therefore, it can be concluded that there was positive and no significant relationship between information processing and effectiveness of agriculture information.

It was observed from the results that there was a significant negative relationship between the variables age, farming experience and effectiveness of agricultural information. The possible reason for the above trend might be attributed to the fact that the farmers with middle, young age and low farming experience respondents and might be enthusiastic to use and to know new technologies through digital platforms and it is also based on the fact that old

Table 3. Relationship between profile characteristics and perceived effectiveness of agriculture information

S.No.	Profile characters	Correlation Coefficient
1.	Age	-0.548^{**}
2.	Digital Literacy	0.413^{**}
3.	Farming Experience	-0.489^{**}
4.	Farm Size	0.359^{**}
5.	Social Media Network	0.240^{**}
6.	Social Media Usage	0.452^{**}
7.	Information Processing	0.092^{NS}
8.	Mode of Access and Preference	0.399^{**}
9.	Readiness to Accept Information	0.215^{*}
10.	Social Media Participation	0.472^{**}

**Significant at 0.0l level; *Significant at 0.05 level NS = non-significant

aged and high farming experienced farmers have poor skills to revive information on social media and to choose direct contact with experts than connecting digitally. Digital literacy was found to be positive and to have significant relationship with the effectiveness. This might be due to the fact that high digital literacy will enhance the ability to get information from different social media and digital platforms. The farm size variable was observed to be positive and significant related, the probable reason for which might be due to larger holding would have generated more income and it will provide more opportunities to try and purchase latest communication technologies. The variable social media network was found to be positive and significant and may be due to the better social media network that would have influenced better satisfaction level of individuals. Social media usage was found to be positive and significant, due to more usage of social media for agriculture information that would help individual to have more exposure to agriculture information. Information processing was found to be positive and non-significant, which indicates that these variables have low effect on effectiveness of information perceived by farmers. An individual having more chance of access and preference to use will have positive effect on anything. Similar kind of results were found with variable mode of access and preference and effectiveness of agriculture information. Readiness to accept information and social media participation was observed to be positive and had significant relation, which might be due to the fact that individual acceptance and participation have direct bearing on effect of phenomenon.

CONCLUSION

The farmers perceived the information available or received through social media platforms as effective and useful to them in practicing and helping them to adopt best agricultural practices. The content in social media needs to be developed based on user's need and interface in social media platforms and simpler for easy identification of information from these platforms. Relevancy of information available or disseminated in social media was good and optimum to adapt to their situation. It is suggested to provide alternate solutions along with recommended practice in social media platforms as they take up best among alternate solutions based on resource availability. For better utilisation of information, avoid too much information and not to publish irrelevant information. It was found that ease of understanding of information on social media was good and image and video-based information along with the textual information helped in a better understanding of information. To give more importance in disseminating weather and market information is suggested to assist in decision making for adopting agricultural technologies.

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Research Article

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (191-194)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Knowledge Test for Extension Personnel on National Food Security Mission

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ARTICLE INFO

Keywords: National food security mission, Knowledge test, Extension personnel, Difficulty index, Discrimination index

http://doi.org/10.48165/IJEE.2022.58246

ABSTRACT

National Food Security Mission is one of the pertinent programmes of Indian Government. Developing a knowledge test to measure knowledge level of Extension Personnel on National Food Security Mission was required to study the programme in details. The locale of the study was Uttar Pradesh and Karnataka, hence the knowledge test items were selected keeping the locale under consideration. A Knowledge test comprising 33 items was subjected to relevancy test sought from extension specialists eventually selecting 29 items for the test. The 29 items were pretested on 30 extension personnel from other than the study area. Based on the scores obtained from the pretesting, item analysis eliciting difficulty index, discrimation index and point biserial correlation were done. The items with difficulty index ranging from 0.2 to 0.8, discrimination index above 0.1 and point biserial correlation significant at 5 per cent level of significance were selected. The reliability of the test was measured by using split half method and found to be 0.8. Eventually 24 items were selected for the final knowledge test for extension personnel on National Food Security Mission. This knowledge test can address the knowledge gap existing among the extension personnel by equipping them with right kind of information on NFSM through trainings.

INTRODUCTION

According to the FAO definition agreed at the World Food Summit-1996 and thereafter expanded upon at the 2001 Summit, “food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. It suggests people will be food secure only if sufficient food is available accessible, and utilized by all. The National Development Council (NDC) in its 53rd meeting held on 29th May, 2007 adopted a resolution to launch a Food Security Mission comprising rice, wheat and pulses to increase the production of rice by 10 million tons, wheat by 8 million tons and pulses by 2 million tons by the end of the Eleventh Five Year Plan (Parmar & Bhaveshkumar, 2020). Thereafter, a centrally sponsored scheme, ‘National Food Security Mission’ (NFSM), was launched in October 2007. The flag bearers of this scheme are extension personnel of line departments, who are the connecting link between farmers and government.

The Training & Visit (T&V) system introduced in the 1970s with World Bank assistance was key to the science society interface as it established a cadre of agriculture extension specialists at the local level (The Hindu, 2018). The role of extension personnel became significant during green revolution period and henceforth. The focus then was food security and now it is nutritional security. National Food Security Mission has been replacing the soiled facet of agriculture for food security to sustainability of food systems and nutritional security (Vijayan & Nain, 2020). Nutrition indicators have marginally improved over the years. However, macro and micronutrient malnutrition is widespread, with 18.7 per cent of women and 16.2 per cent of men unable to access enough food to meet basic nutritional needs, and over 32 per cent of children below five years still underweight as per the recently released fifth National Family Health Survey (2019-2021), (Sivagnanam et al., 2019). India

Received 02-03-2022; Accepted 22-03-2022

is ranked 101 out of 116 countries in the Global Hunger Index, 2021 (The Hindu, 2021). To ensure proper implementation of NFSM, there should be efficient and laudable execution of the programme by the officials.

The extension personnel can function foolproof only if they have enough grasp on the nitty gritties of the programme. Not having access to right information at right time, at right place often stymie the progress of the programme. There can be a plethora of reasons for the knowledge gap in the extension personnel such as cognitive, attitudinal, perceptional, institutional etc. These problems may eventually result in hampering of the implementation of the programme. Hence it is an imperative to assess their knowledge on the programme. Knowledge is a body of understood information possessed by an individual (Bhatt & Patel, 2009). The knowledge here is operationalized as the level of information possessed *vis-à-vis* NFSM, the program's drafting, selection of beneficiaries, planning and implementation aspects by the extension personnel. The knowledge test on NFSM was developed for the use on the extension personnel/line department officials of Uttar Pradesh and Karnataka.

METHODOLOGY

The knowledge test on National Food Security Mission was developed by employing the standard methodology. The knowledge test comprised questions (items) on National Food Security Mission. By reviewing literature, referring to textbooks, visiting NFSM and related websites as well as by conducting discussions with subject matter specialists and field extension personnel, a question (items) bank was created culminating into a thorough scrutiny of the items were done with the aid of subject matter specialists. The questions were designed to test the knowledge level of extension personnel on National Food Security Mission. A total of 33 knowledge items were constructed for relevancy test as followed by Kumar et al., (2016). The item statements were subjected to scrutiny by an expert panel of judges to determine the relevancy and screening for inclusion in the final test (Kline, 1986). For this, the 33 items were sent to panel of 30 judges experts in the field of extension education with a request to critically evaluate each item for its relevancy to measure knowledge level of extension personnel on National Food Security Mission. The judges were requested to give their response on a five point continuum *viz*., highly relevant, relevant, undecided, less relevant and not relevant with scores 5, 4, 3, 2 and 1 respectively. The relevancy score of each item was established by adding the scores on the rating scale for all the judges' responses. From the data three types of tests *viz*., relevancy percentage, relevancy weightage and mean relevancy scores was worked out for all the items. The items satisfying the standard criterion (Relevancy % >70, Relevancy weightage >0.70 and Mean relevancy score > 3.0) were selected. A total of 29 items were selected.

The items collected for the construction of the knowledge test were in objective form. The items were of multiple choice as well as a few yes or no questions also. The 29 items selected were subjected to thirty respondents who were from outside the locale of data collection. The respondents were asked to indicate their responses to each item in the knowledge test, and the correct answers were assigned a score of '1' and incorrect answers a score of '0. The total knowledge score for each item was calculated by summing up the scores given by all the respondents to the item (Kaur et al., 2020). Based on this, the difficulty index and discrimination index were calculated.

The item difficulty index P, was worked out in this study as the percentage of respondents giving correct response to an item.

$$P = \frac{NC}{N} \times 100$$

It was calculated using the formula Where, P = Difficulty index, NC = Number of respondents who answered correctly and N is total number of respondents. In the present study, the items having P values between 20 and 80 were considered and included in the final knowledge test. The discrimination power of all the 29 items were worked out using E1/3 method to find out the item discrimination. In this method, those 30 respondents were divided into six equal groups, each having five respondents and they were arranged in descending order of their magnitude of their knowledge scores as obtained from them. The middle two groups were eliminated. Only four extremes groups i.e. the groups with highest and lowest scores were considered in order to calculate the 'Discrimination Index'. It was calculated by the following formula:

$$E1/3 = \frac{(S1 + S2) - (S5 + S6)}{N/3}$$

Where, N = Total number of respondents to whom the items were administered.

S1 and S2 are the frequencies of correct answers of highest and higher scores, respectively.

S5 and S6 are the frequencies of correct answers of lower and lowest scores, respectively.

Items with discrimination index above 0.1 are selected in the final knowledge test.

A correlation between a continuous and a dichotomous variable is known as the point-biserial correlation **(Rp bis)** (Demirtas & Hedeker, 2016). To check the internal consistency of an item, its relationship with the total score when it was found to a dichotomised answer to a given item, point biserial correlation was computed.

$$Rp\ bis = \frac{Mp - Mq}{Sigma} \times \sqrt{pq}$$

Where, Rp bis is the point biserial correlation

Mp is the mean of the total score of the respondents who answered an item correctly

Mq is the mean of the total score of the respondents who answered an item incorrectly

Sigma is the standard deviation of the entire sample

p is the proportion of the respondents giving correct answer to an item

q is the proportion of the respondents giving incorrect answer to an item

The calculated point biserial correlation values were statistically tested with n-2 degrees of freedom. 24 items having point bi serial correlation value which was significant at 5 per cent

Table 1. Difficulty and Discrimination Index of the Knowledge Items on National Food Security Mission (Final items)

S. No.	Items	Difficulty Index	Discrimi-nation Index	Point Biserial Correlation (Rpbis)
1	National Food Security Mission's (NFSM) major objective is Food Security- T/F	60.00	0.2	0.16*
2	NFSM cereals include only rice – T/F	80.00	0.5	0.64*
3	NFSM is centrally sponsored programme -T/F	66.67	0.2	0.27*
4	The components of NFSM are NFSM-Cereals, NFSM-Pulses, NFSM- Commercial Crops – T/F	50.00	0.5	0.38*
5	30 percent of the budgetary allocation was earmarked for women beneficiary farmers- T/F	56.67	0.6	0.49*
6	Panchayat Raj Institutions were actively involved in selection of beneficiaries- T/F	66.67	0.4	0.40*
7	NFSM incorporates Integrated Nutrient Management Integrated Pest Management and Cropping System based training - T/F	36.67	0.2	0.27*
8	NFSM line personnel are given exposure visit to related State Universities, ICAR institutes, as well as CGIAR institutes in India -T/F	56.67	0.6	0.39*
9	NGO's can be entrusted to carry out cluster demonstrations in inaccessible areas if they have at least 3 years' experience of successful execution of agriculture/rural development projects in remote/backward areas of the specific state- T/F	56.67	0.6	0.60*
10	A farmer can avail benefits under NFSM limited to 10 hectare per season –T/F	53.33	0.2	0.06*
11	NFSM pulse component include Cluster demonstrations, Seed hub programme, Seed Kit – T/F	63.33	0.4	0.49*
12	NFSM Wheat comprises Cluster demonstration, Distribution of HYV seeds and assistance for irrigation equipments - T/F	53.33	0.5	0.36*
13	NFSM Oil seed major components include Area Expansion Inputs component, Production Inputs component, Transfer of Technologies component – T/F	80.00	0.5	0.62*
14	NFSM enshrines food security by focusing on Enhancing Crop Productivity, Incorporating Pulse component, Including nutri-cereals/millets - T/F	36.67	0.2	0.17*
15	NFSM and fund allocation is in the form (Centre: State, 60:40 (normal states), 90:10 (North eastern and hill states)- T/F	73.33	0.3	0.19*
16	NFSM Coarse cereals include, Cotton Jute, Sugarcane - T/F	70.00	0.4	0.30*
17	Nutri-cereals in NFSM means Millets - T/F	70.00	0.2	0.25*
18	As per mandates of NFSM in terms with fund allocation no specific accounts are maintained by State through Public Financial Management System (PFMS) - T/F	50.00	0.5	0.48*
19	Nutri-cereal programme incorporates the following crops Jowar/Sorghum, Bajra and Ragi - T/F	60.00	0.6	0.47*
20	Strengthening of credit facilities is also an objective of NFSM – T/F	43.33	0.2	0.25*
21	Package of Practice of NFSM crops are given in the NFSM portal : T/F	63.33	0.2	0.15*
22	Geo–tagging is done for NFSM components – T/F	53.33	0.3	0.13*
23	Nutritional security is intended through NFSM-Pulses and NFSM-Nutri-cereals – T/F	73.33	0.5	0.48*
24	The fixation of price of seed minikits of oil seeds/pulses is done by State Agricultural Dept.- T/F	53.33	0.3	0.24*

level of significance were selected as final items of the knowledge test.

RESULTS AND DISCUSSION

The content validity of the knowledge test was ensured by purposively selecting items in consultation with various subject matter specialists The domains from which the items were selected include, food security, nutritional security, crops specific to NFSM and transfer of technology components of NFSM, which in line with the study of Kumar et al., (2020). The reliability of the knowledge test was determined using split half method (Kerlinger, 2004). Reliability was found to be 0.8, which indicates high reliability of the test. Then the test items were subjected to difficulty index, discrimination index and point biserial correlation. The knowledge items, having difficulty index value within 0.2 to 0.80 and discrimination index value above 0.1 and point bi serial correlation value which was significant at 5 per cent level of significance were selected as final items of the knowledge test. Eventually 24 items (Table 1) were selected for the knowledge test on National Food Security Mission, which would distinguish the well informed personnel from the less informed ones.

CONCLUSION

This knowledge test could be used for assessing the knowledge level of line department officials involved in the execution of NFSM. A knowledge test is quintessential to identify the lacunae existing in the programme implementation. This test can pave way for planning need based training of line department officials and also in addressing the knowledge gap. The test can be used for assessing the knowledge level of line department officials/extension personnel on National Food Security Mission implementing regions of India with suitable modifications.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (195-197)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Impact of Cluster Front Line Demonstrations on Field Pea (*Pisum sativum* L.) in valley areas of Manipur

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ARTICLE INFO

Keywords: Cluster front line demonstrations (CFLD), Yield, Extension gap index, Technology gap index

http://doi.org/10.48165/IJEE.2022.58228

ABSTRACT

In Imphal district of Manipur, the field pea (*Pisum sativum* L.) is a prominent rabi season pulse crop. In comparison to other sections of the country, however, its output is quite poor. The productivity and economics of cluster front line demonstrations, as well as the adoption of newest production technologies including technology and extension gap by 50 Cluster Front Line Demonstrations (CFLD) farmers and 50 non-CFLD farmers were investigated during 2018-19 to 2020-21. The results revealed that average yield of the demonstration were 15.33 q/ha against the potential yield of 22 q/ha. The yield gap of 6.67 q/ha indicates that there still a technology gap and still there is big scope for increasing the yield. The percentage of increase in yield in CFLD ranged from 38.43 to 40.17 per cent with an average increase of 39.57 per cent over the farmers practice in local check plots. The extension yield gap fluctuated between 27.97 and 28.64 per cent. Overall it is concluded that cluster frontline demonstrations (CFLD) proved an effective tool for increasing the productivity of field pea.

INTRODUCTION

India has long been the world's leading pulse producer, consumer, and importer. Pulses are responsible for 11 per cent of India's entire protein consumption (Reddy, 2010) and are taken considerably more frequently than any other form of protein in India, showing their importance in people's daily diets (Raj et al., 2013). In India, the pea is a common legume and the Indian Council of Agricultural Research (ICAR), New Delhi, held a field demonstration on field peas in the mid-1980s as part of a pulse and oilseed technology mission. Pulses also provide green pods for vegetables and healthy fodder for cattle, as well as increasing soil fertility and physical structure, being compatible with mixed/ intercropping systems, crop rotations, and dry farming (Naik and Nethrayini, 2019). Bridging the yield gap by increasing pulses in new positions, soil test-based INM, high-quality inputs, precision farming and mechanised pulse cultivation, all of which are complemented by generous government policies and funding support for implementing states/stakeholders, can result in targeted production and productivity (Tiwari and Shivhare, 2017). According to the ICAR-Indian Institute of Pulses Research (IIPR), Kanpur's Vision-2030 document, a 4.2 per cent growth rate is needed to fulfil the proposed demand for 32 million tonnes of pulses by 2030, but this will necessitate a paradigm change in research, technology invention and diffusion, popularisation of improved crop management practises and commercialization, as well as capacity building. The Department of Agriculture and Farmers Welfare, Govt. of India, has taken steps to address this critical issue since 2015-16, as part of the National Food Security Mission-Pulses (NFSM-Pulses), India has been implementing a countrywide Cluster Frontline Demonstration Program (CFLD) on pulses. Peas are a significant source of income for many valley farmers of Imphal West

Received 17-12-2021; Accepted 10-02-2022

District, Manipur, although profit margins are still challenging. An extensive fast investigation of the rural area and several group meetings of pea growers were organised to examine the causes of the poor output. A number of gaps in technology introduction surfaced as a consequence of the sessions. With the aid of farmers, the production limitations were ranked in a matrix. In the years 2018-19, 50 pea producers were enrolled in the CFLD programme, which included a comprehensive practice package. Individual demonstration areas varied in size from 0.25 to 1 hectare, with a total area of 20 hectares. The foremost goal of these demonstrations was to improve field pea productivity, which would augment farmer revenue, as well as to disseminate the most up-to-date production technologies to farmers in the region.

METHODOLOGY

The research was carried out in Manipur's Imphal West area in north-east India During the three years (2018-19 to 2020-21), only one selected variety of field pea was evaluated for the study, which was of crucial importance in terms of production potential and wide acceptability by farmers in their local agricultural systems. All the technological interventions were taken as per prescribed packages of practices for field pea. The farmer practice was considered as control plot/local check. The KVK provided critical inputs to the farmers for demonstration plots with technical support.

During the years 2018-2021, ICAR-Krishi Vigyan Kendra (KVK) Imphal West conducted training and demonstration to different villages of Haorang Sabal and Wangoi blocks of Imphal West valley district of Manipur. The percent increase in yield, technology gap and extension gap were evaluated following norms given by Samui et al., (2000).

RESULTS AND DISCUSSION

The average yield of cluster front line demonstration (CFLD) field pea (var. Prakash) was documented at 15.31 q/ha, 15.25 q/ha and 15.44 q/ha during the year 2018-19, 2019-20 and 2020-21, respectively (Table 1). The year 2019-20 had lowest yield and this was due to the erratic rainfall during the period. The better soil moisture conservation acquired during the year 2020-21 had performed better in production among the three study years. Similarly, farmers' practice also performed at 11.06 q/ha, 10.88 q/ha and 11.02 q/h during the year 2018-19, 2019-20 and 2020-21, respectively. The percent of standard deviation (SD) of yield ranged from 1.4 to 2.74, while SD of farmers' practice ranges from 0.21 to 0.42. The average percentage increased in the yield over farmers' practices was 38, 40 and 40 for the year 2018-19, 2019-2020 and 2020-21, respectively. The performances of CFLD yields were much higher as compared to average yield of farmers' practices. The percent of coefficient of variation (CV) of yield ranged from 1.4 to 2.74, while CV of farmers' practice ranged from 5.04 to 5.87. Although there was decline in yield during the year 2019-20 for CFLD and farmers' practice the increased yield was similar to the year 2020-21. The results indicated that the CFLD have given a good impact over the farming community of valley areas of Manipur as they were motivated by the new agricultural technologies applied in the CFLD plots. This finding demonstrated that the better average grain yield in demonstration plots over time relative to farmer practices was attained due to knowledge and implementation of the entire package of methods. The findings are comparable to those of a previous study of Poonia & Pithia (2011); Kumbhare et al., (2014); Nain et al., (2014); Dhaka et al., (2015); Nain et al., (2015); Kalita et al., (2019); Singh et al., (2019) & Sangwan et al., (2021).

The maximum technological gap was in the year 2019-20 and 2020-21 at 33.95 per cent, followed by the year 2018-19 at 31.64 per cent. The minimum technological gap was obtained in the year 2018-19 at 27.86 per cent and followed by the year 2020-21 and 2019-20 at 28.55 per cent and 27.86 per cent, respectively. It may be stated that there was a technological yield gap in crops due to variations in soil fertility and meteorological conditions (Mukherjee, 2003; Raj et al., 2013). The percent of standard deviation (SD) of technological gap ranged from 0.98 to 1.90, while coefficient of variation (CV) ranged from 3.21 to 6.19. It is clear from the findings that using various inputs, such as better variety, excellent seed, and seed treatment with fungicides and bio fertilizers resulted in a considerable improvement in field pea growth and production (Table 2). Similar findings were reported by Kirar et al., (2006) & Singh et al., (2014).

The minimum extension gap was obtained in the year 2018-19 at 16.86 per cent and followed by 22.48 per cent and 23.22 per cent in the year 2020-21 and 2019-20, respectively. While the

Table 1. The year-wise average yield, standard deviation, coefficient of variation and increased yield of field pea

S.No.	Year	CFLD			Farmers' Practice			Increased yield (%)
		Average yield (q/ha)	SD (q/ha)	CV (%)	Average yield (q/ha)	SD (q/ha)	CV (%)	
1	2018-19	15.31	0.21	1.40	11.06	0.58	5.27	38.43
2	2019-20	15.25	0.42	2.74	10.88	0.55	5.04	40.17
3	2020-21	15.44	0.26	1.70	11.02	0.65	5.87	40.11

Table 2. The detail statistical analysis of extension gap for the field pea

S.No.	Year	Range* (%)	n	Min (%)	Max (%)	SD (%)	CV (%)	Overall Technological Gap Index (%)
1	2018-19	27.86-31.64	57	27.86	31.64	0.98	3.21	30.41
2	2019-20	28.18-33.95	40	28.18	33.95	1.90	6.19	30.67
3	2020-21	28.55-33.95	36	28.55	33.95	1.19	3.99	29.84

*Ranges at 5 and 95 percentiles of the entire data; n number of data used in the analysis

Table 3. Statistical analysis of extension gap for the field pea

S.No.	Year	Range* (%)	n	Min (%)	Max (%)	SD (%)	CV (%)	Overall Technological Gap Index (%)
1	2018-19	21.95-34.25	57	16.86	34.71	4.51	16.11	27.97
2	2019-20	24.16-34.16	40	23.22	35.95	3.24	11.32	28.64
3	2020-21	23.22-33.87	36	22.48	35.38	3.85	13.59	28.35

*Ranges at 5 and 95 percentiles of the entire data; n number of data used in the analysis

maximum extension gap was obtained in the year 2019-20 at 35.95 per cent and followed by 35.38 per cent and 34.71 per cent in the year 2020-21 and 2018-19, respectively. The percent of standard deviation (SD) of extension gap ranges from 3.24 to 4.51, while coefficient of variation (CV) ranged from 11.32 to 16.11. The overall extension gap was highest in the in the year 2019-20 at 28.64 per cent, followed by the year 2020-21 at 20.35 per cent and lowest at 27.97 per cent for the year 2018-19 (Table 3). Kumar et al., (2010) & Singh et al., (2017) agreed that there exist extension gap in frontline demonstration. This highlights the necessity for field agricultural extension personnel to be technologically upgraded in their understanding of field pea production technology, either through specialised field training or brief in-service training and visits to research stations.

CONCLUSION

Prakash variety of field pea is developed for fertile and irrigated regions of north India while the demonstrations were conducted in north eastern India, Manipur agro-climatic region. Therefore, the yield gap should not surprise to the farmers and agriculturist. However, there should be an effort to increase the yield near to the potential yield or reduce the present technology gap. This further necessitate field agricultural extension personnel to be technologically upgraded in their understanding of field pea production technology, either through skills based field training or short-term field training. Field agricultural extension personnel must also be trained in technology transfer abilities in order to effectively translate information into crop production potential. It is concluded that cluster frontline demonstrations (CFLD) was an effective tool for increasing the productivity of field pea, building the relationship and confidence between farmers and scientists of KVK.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (198-201)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Assessment of Water Use Efficiency in Dairy Production Systems

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ARTICLE INFO

Keywords: Water use, Dairy production system, Dairy Farmers, Water use efficiency, Water footprint

http://doi.org/10.48165/IJEE.2022.58229

ABSTRACT

Increasing water scarcity and simultaneously growing demands for food and feed challenge agricultural production. Globally livestock feed sourcing is one of the major causes for water depletion, therefore increasing livestock water use efficiency (LWUE) is necessary. In this direction, primary data was collected from 240 small and medium sized dairy farms in Karnataka, India during the period 2018-2021. Water inputs (by animals) considered were drinking water, water contained in forages, water for on-farm servicing, water for crop irrigation and water for all upstream inputs other than feeds and milk was considered as output. The water inputs through forage and other feed ingredients were more as compared to water inputs through drinking water and that used for on farm servicing operations such as cleaning etc. Average direct consumptive water use by smallholder system was found to be 130 litres per day per animal and 205 litres per day for commercial dairies. Water use efficiency for the smallholder system was 0.85 and for the commercial dairying it was 1.62

INTRODUCTION

Milk production is challenged by increasing water scarcity and simultaneously growing demand for food and feed. Globally livestock feed sourcing is a major cause for water depletion, and optimum livestock water use is essential. Feed sources in smallholder production system consist of grazing, crop residue, concentrates etc. Extensive smallholder systems in dry-land eco-regions face water depletion for feed production. This demands understanding of livestock-water interactions, and designing strategies to improve Water Use Efficiency (WUE). Livestock Water Productivity is the ratio of livestock products and services to the amount of water depleted and degraded in producing these products and services, usually expressed at L m^{-3} (Peden et al., 2007). Since 2002 livestock water use has been analysed across scales: regions, systems, farm-herd and animal. Generally with increasing intensification and integration of crop-and livestock systems livestock water use value tends to increase (Descheemaeker et al., 2011). But this may not always guarantee system sustainability. Comparison between these values might not be relevant as the studies were based on different data sources and addressing different scales. What is more appealing is the enormous gap between minimum and maximum values of LWP, illustrating potential for improvement.

About sixty four per cent of irrigated area in arid and semi-arid regions of India relies on groundwater resources as reported by Sirohi *et al.*, (2013) & Mahin et al., (2013). Declining water table aggravates overexploitation of groundwater and threatens livelihood security of small and marginal farmers (Mahin & Ashok, 2011). The majority of farmers have high knowledge levels of agro-ecological principles and hydrological cycle and high consensus with high importance points the need for synergy between surface and aquifer storage to attain sustainable water policy and practices in sustainable manner (Gupta et al., 2021). About 93 per cent of farmers try to ensure the sufficient supply of clean and fresh water to the animal, as water is one of the major critical component of dairy farming. (Sudhanshu, 2019) and 95 per cent of respondents reported that meeting out the water requirement of animals was

Received 04-09-2021; Accepted 10-02-2022

challenge during drought periods (Letha Devi et al., 2021). Generally, reproductive /productive performance of indigenous breeds are inferior compared with the cross-breeds (Haileslassie et al., 2011a). Haileslassie et al., (2011b) also emphasized strong intra and interbreed variability. Livestock mortality and morbidity are the major causes of economic loss and low productivity, mainly in grazing, and in mixed-rainfed systems.

In north Gujarat the farmers produced 0.31 litre of buffalo milk and 0.49 litres of crossbred cow milk by using a m^3 of groundwater (IWMI, 2004). Similar studies carried out in different parts of Gujarat state showed that water productivity of buffaloes was 0.31 l/m^3 in south and central Gujarat and for crossbred cows it was 0.53 l/m^3 (Singh et al., 2009). The water use efficiencies in crossbred were higher than the buffaloes and local cows. Interestingly farmers in the water scarce areas (overexploited and critical) were more efficient than the farmers of water sufficient areas (safe and semi-critical) in utilization of groundwater (Mahin & Dixit, 2015). An effort was made to assess and analyse LWUE in smallholder and commercial production and to analyse the factors affecting water use efficiency and their relation with performance in dairy animals and to formulate for strategies for improving LWUE.

METHODOLOGY

The study was a primary field study using survey method. Primary data was collected from small and medium sized 240 dairy farms from Kolar and Shimoga district, Karnataka, India. The consumptive use of blue water (direct and indirect) was assessed using primary data through personal interview and observation in particular farms. Water use efficiency (kg/animal) was estimated and compared for small holder as well as commercial dairy production systems using the following formula.

$$WUE = (Y/U) \times 100$$

Where, Y = Marketable yield (kg/ animal), and U = Seasonal consumptive use of water (m^3)

Water use efficiency for crop biomass used as fodder = Total Biomass / water applied at different level of requirement and Mekonnen & Hoekstra (2011) method was used for calculation of LWP of feed (recommended by IWMI). Different water wastage points in different operations were identified and strategies to reduce water wastage were formulated using participatory focus group discussions. The major challenges associated with LWU as perceived by farmers was analyzed and ranked based on rank coefficients. Scarcity of water for livestock drinking, other livestock operations and feed quality due to low water quality used for crop production were the major challenges across all the seasons.

RESULTS AND DISCUSSION

The data indicated that the average agricultural land owned were 2.1 acres by small holders. Only in 3 per cent land is being practiced for fodder production. The animals were fed with average 4 kg of concentrate, 15 kg of green fodder and 2.5 kg of dry fodder daily by the small holder system. The animals under the commercial dairy farms were fed with average 6.5 kg of concentrate, 21 kg of green fodder and 1.5 kg of dry fodder daily. Average milk yield (litres/ animal/ day) was 7.15 litres; the corresponding figures for small holder system was 7.4 litres and for commercial system it was 15.4 litres; and 4 per cent of total produce was retained for home consumption. KMF feed, Wheat bran, flakes, rice bran, mineral mixture, salt, horse gram husk, ragi straw etc., were used in general for feeding. The major water sources are Bore well and panchayat supply.

Table 1. Direct and Indirect Water use (litre/day/animal) in different dairy production systems

Operations	Small holder system (n=200)	Commercial dairying (n=40)
Drinking	57	52
Washing shed	74	90
Washing animals	71	58
Cleaning cans and other equipments	66	41
Direct Consumptive Use	268	241
Water contained in feed and fodder	605	740
Total	873	945

The water intake by animals through forage and other feed ingredients were more as compared to water intake through drinking water and that used for on farm servicing operations such as cleaning etc (Table 1). Average direct consumptive water use by smallholder system was found to be 268 litres per day per animal and 241 litres per day for commercial dairies. The water use efficiency was calculated as 0.85 for small holder system and 1.62 for commercial dairying. This indicates that the commercial system was more efficient in water use. This may be because there was a lot of water reuse and recycling in case of commercial dairy farms covered under the study and most of them were growing fodder on their own thereby reducing the water footprint involved in transporting fodder and feed from far away locations.

The major challenges connected with Livestock Water Use (LWU) as perceived by farmers were analyzed and ranked based on rank coefficients (Table 2). Scarcity of water for livestock drinking, other livestock operations and feed quality due to low water quality used for crop production were the major challenges across all the seasons

There were various factors affecting water use by livestock. The major factors are seasons, different weather parameters, fodder, feed and other inputs etc. The source of water, animal conditions like lactation stage, age, body and health conditions also play a role in water use efficiency (Table 3). Availability and quantity of green fodder was the major concern during summer months. Quality of green fodder was also a concern during summer season, which causes a drop in total milk yield. There was a price variation in milk due to variation in milk fat across different seasons. The water wastage points mainly in summer season were identified. Water wastage while growing fodder and washing sheds constituted the maximum, as perceived by the respondents.

Prediction model for water use

A prediction model for optimum water use was developed with the variables such as milk yield, ambient atmospheric temperature, body weight of the animal, daily dry matter intake by the animal and sodium intake by the animal.

Table 2. Problem matrix showing the scale of importance of Livestock Water Use related problems across seasons

Key LWP related problems	Seasonal variations Dairy Production Systems								
	Summer			Winter			Rainy		
	1	2	3	1	2	3	1	2	3
Scarcity of water for livestock drinking	√				√				√
Scarcity of water for livestock operations	√				√				√
Scarcity of water for feed production	√				√				√
Inefficient use of available water			√			√	√		
Soil/nutrient loss	√					√		√	
Poor feed/fodder quality	√					√			√
High feed scarcity	√				√				√
Use of common property resources	√			√			√		
Post-harvest feed quality & quantity	√				√				√

Table 3. Water use and perceived effect on livestock production

S.No.		Rank
Factors affecting water use		
1	Seasonal variation	I
2	Weather parameters (Temp, Rainfall, humidity)	II
3	Fodder, Feed and other inputs	III
4	Source of water (Borewell, Canals, Ponds etc.)	IV
5	Animal conditions	V
6	Animal output	VI
Seasonal impact of water use		
1	Availability/Quantity of fodder (Green/Dry)	64
2	Quality of fodder (Green/Dry)	59
3	Drop in milk yield (l)	55
4	Milk Fat (%)	59
5	Major Diseases	49
6	Reproductive issues	47
7	Animal growth	36
Perceived water wastage points in summer season		
1	Washing sheds	40
2	Washing animals	30
3	Cleaning cans and other equipment	20
4	Water used for growing green/dry fodder	49

Daily water intake (litres/day) = 16.12+ 1.516t + 1.299 y + 0.058w + *0.71i* + 0.406s

Whereas, y = Milk yield (kg/day), t = Ambient Temperature (°C), w= Body weight (kg), *i*= daily dry matter intake (kg/day), *s* =sodium intake (g/day)

This prediction model was evaluated in a non study village and the optimum water use for a milk yield level of 7.5 litres and 10 litres were calculated in a population of 35 lactating animals. The same was repeated for summer and rainy seasons in the same animal samples.

CONCLUSION

The study indicated that water inputs through forage and other feed ingredients are more as compared to water inputs through drinking water and on farm servicing operations. Water inputs considered were drinking water, water contained in forages, on-farm servicing, crop irrigation and output considered was milk. The water inputs through forage and other feed ingredients are more as compared to water inputs through drinking water and that used for on farm servicing operations such as cleaning etc. Average direct consumptive water use by smallholder system was found to be 130 litres per day per animal and 205 litres per day for commercial dairies. Water use efficiency for the smallholder system was 0.85 and for the commercial dairying it was 1.62. Proper management strategies are highly essential for sustaining the livestock production and meet demands of growing population with available water resources.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (202-204)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Client's Satisfaction towards Indian Veterinary Research Institute- Referral Veterinary Polyclinic Services: A Case Study

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ARTICLE INFO

Keywords: IVRI-RVP, Clients satisfaction, Animal health, Veterinary services, Polyclinic

http://doi.org/10.48165/IJEE.2022.58230

ABSTRACT

The study was conducted at Indian Veterinary Research Institute- Referral Veterinary Polyclinic (RVP), Izatnagar, to assess the client's satisfaction on the overall veterinary service provided by the polyclinic from 2019-2020. A total of 60 clients visiting the RVP were at random selected irrespective of the animal they brought and place they belong too. 95 per cent of the clients prefer IVRI-RVP over other private or government-run clinics because of nominal consultation fees and 93.33 per cent due to their belief in the Institutes' reliability of treatment of the diseases diagnosed on their animals. All the clients agreed that the IVRI-RVP cleanliness was very satisfactory, 98.33 per cent of them felt that the veterinarians were courteous and genuinely concerned for their animals and clearly explained their problems upon diagnosis. 56.67 per cent of the clients rated the overall quality of veterinary services as very good and were more than happy to recommend the polyclinic to their families and friends.

INTRODUCTION

Effective and efficient delivery of animal health and production services is considered as vital to effectively prevent and protect any animal from injury. Many national and international organizations, notably the Food and Agricultural Organization (FAO), are increasingly concerned about the prompt delivery of veterinary services. Animal health-care (AHC) services are provided by the public sector in many underdeveloped countries. The availability and quality of these services can have an impact on the survival and production of animals, particularly in the livestock sector (Umali et al., 1994). Any animals' production potential is essentially determined by the quality of nutrition, genetic up-gradation and upliftment of animal health status. Apart from livestock, various companion animals like dogs and cats are found in communities all over the world, with their life varying according to geography, local human-animal connections, economy, access to culturally sensitive veterinary care, and simple circumstances (Brook et al., 2010; Guttilla & Stapp, 2010; Villa et al., 2010; Beck, 2013; Barnard et al., 2015; Rock & Degeling, 2016). Keeping in mind the need for one step veterinary services, the World Health Organization (WHO) and the World Organization for Animal Health (OIE) both recognize the importance of veterinary services in controlling zoonotic diseases, preventing human injury, and protecting the welfare of non-human animals. Furthermore, both organizations propose that veterinarian programmes and services be evaluated on a regular basis (Baker et al., 2018). In India, with an acute shortage of manpower delivering animal health service, a concern for efficient delivery of minor veterinary services have gained popularity among stakeholders (Kumar & Meena, 2021).

Client-satisfaction surveys are more common in human health-care than in animal health. According to Dutta et al., (2021), satisfaction refers to the contentment or fulfillment of wishes, expectations, and needs of a person according to the requirement. Surveys provide a feedback mechanism to managers to uncover the client's perceptions of strengths and weaknesses (Lin & Brian,

Received 18-01-2022; Accepted 14-02-2022

1996). Williams et al., (1998) identified three factors that determined the outcome of a patient's evaluation of services: a positive or negative experience, the perceived function of the service and the culpability of the service for their experience. Veterinarians must understand what their clients expect from their veterinary service in order to provide the best possible service. For the clients, it is the satisfaction, which drives, dictates, or dedicates the next course of action as it is important to develop an understanding of the preferences of clients when they select a veterinarian to provide animal care (Talukdar et al., 2015). Understanding client satisfaction is one area that has been gaining significant attention within organizations. With this in mind, the study was set out with the following objectives to assess the client satisfaction on the quality of veterinary services provided by Indian Veterinary Research Institute- Referral Veterinary Polyclinic (IVRI- RVP) and to identify suggestions that would allow for recommendations and improvements in service quality.

METHODOLOGY

The study was conducted in IVRI-RVP at Izatnagar, Bareilly in the state of Uttar Pradesh. To assess client satisfaction, an interview schedule consisting of structured, semi-structured and open-ended questions was used for the survey. Using random sampling method, a total of 60 clients were surveyed. Clients visiting the RVP were randomly selected irrespective of the animal they brought and place they belong too. To assess client's satisfaction towards the veterinary services provided various indicators were selected such as the client's reasons for visiting the IVRI-RVP over other private or government-run clinics, veterinarians' attitude towards clients and animals, degree of clarity of the veterinarians' explanation about the diagnosis, cleanliness of the polyclinic and finally client's willingness to recommend the polyclinic to friends and families. Finally, based on these indicators and experience of the clients at the polyclinic they were finally instructed to give their final assessment of the overall quality of veterinary services provided at the RVP on four degrees of continuum viz. poor, good, very good and excellent.

RESULTS AND DISCUSSIONS

Client's reasons for visiting IVRI-RVP over other private or government-run clinics clinic and expectations before visiting the RVP

As humans, our choices and decisions are governed by various factors. Therefore, each is different in his or her choices and for this reason too there could be umpteen reasons that could decide why the respondents we interacted with chose to visit IVRI-RVP and have their animals diagnosed and treated. A perusal of Table 1 reveals that 95.00 per cent of the clients prefer IVRI-RVP over other private or government-run clinics because of it nominal consultation fees, followed by 93.33 per cent due to their faith in the institutes' reliability of treatment of the diseases. IVRI as an institute that caters to the development of livestock sector has created a niche for itself in this aspect; as a result, 81.67 per cent of the clients prefer IVRI-RVP over any other private or government-run clinics because of the credibility of the institute.

Table 1. Clients reasons for visiting IVRI-RVP over other private or government-run clinics and expectations before visiting the RVP

Particulars	Percentage
Reasons for visiting IVRI-RVP over other private or government-run clinics	
Close proximity with residential area	76.67
Nominal consultation fees	95.00
Reliability of treatment of the disease	93.33
Credibility of the institute	81.67
Reference from friend/family/ other veterinarians	31.67
Clients expectations before visiting the RVP	
Quality treatment	90.00
Animal should recover or be cured	78.33
Cow/Buffalo should reproduce after AI	23.33
Nominal consultation and medicine fees	26.67
Know about IVRI as they are residents of Bareilly so no expectations	13.33
No complications in the treatment should arise	10.00
To experience first-hand about the quality of services	20.00
Expected rush and commotion as it was a government-run polyclinic	8.33
Medical store outlet within the polyclinic with subsidised rates	66.67

The majority of the clients were known to the place and lived within few kilometres from the polyclinic hence they had no second thoughts on coming to IVRI for their animal health and welfare. The findings are in consonance with Kumar and Meena 2021. A majority (90.00%) of the clients who visited the polyclinic first and foremost expected quality treatment with 63.33 per cent expecting their animals to recover or be cured after their visits or treatment. IVRI-RVP has been serving its clients since 1996 and is continuing to do so till date. Over the years since its inceptions, it has developed name and fame and is now one of the premier institutes of animal husbandry development; therefore expectations from clientele are bound to arise before they first visit the institute or its RVP.

Client's satisfaction towards veterinary services at IVRI-RVP and their overall satisfaction of the quality of veterinary services at IVRI-RVP

To assess client's satisfaction towards the veterinary services provided certain indicators were selected (Table 2). All the clients (100%) agreed that the RVP cleanliness was satisfactory, rather they were very much impressed because being public sector run facilities which usually are not as clean as they would be elsewhere. Similarly, 98.33 per cent of them felt that the doctors/veterinarians was courteous and genuinely concerned for their animals and clearly explained their problems upon diagnosis. Further perusal reveals that 96.67 per cent of the clients agreed that their animals had received professional healthcare. In all, they were all very much satisfied to the extent that almost all (96.67%) of the clients were of the opinion that they would recommend the polyclinic to their friends and families and some have even already started recommending.

Based on the indicators provided to assess satisfaction and experience of the clients at the polyclinic they were finally instructed to give their final assessment of the overall quality of

Table 2. Clients satisfaction towards veterinary services at IVRI RVP

Indicators	Percentage	
	Yes	No
Doctors courteous and genuinely concerned for your animal	98.33	1.67
Animals/pets problem clearly explained	98.33	1.67
Received professional healthcare	96.67	3.33
Facility cleanliness satisfactory	100.00	-
Conduct follow up after treatment	96.67	3.33
Recommend the polyclinic to friends/families	96.67	3.33

Table 3. Clients overall satisfaction of the quality of veterinary services at IVRI-RVP

Rating	Percentage
Poor	1.67
Good	10.00
Very Good	56.67
Excellent	31.67

veterinary services provided at the RVP (Table 3). More than half (56.67%) of the clients rated the overall quality of veterinary services as very good, followed by 31.67 per cent excellent, 10.00 per cent good and a mere 1.67 per cent was not satisfied and rated the overall quality as poor. Similar findings were reported by Kumar & Meena (2021). Satisha et al., (2018) is of the opinion that the delivery of livestock services is emerging as an important priority area for enhancing and optimizing livestock production and management of the livestock, therefore it is imperative that the organization assigned with the task veterinary services delivering out timely animal health services to various categories of animals.

CONCLUSION

It is evident from the findings that a majority of the clients rated the overall quality of veterinary services at IVRI RVP as very good, inferring that the clients were satisfied with the services with a majority of them implying that they would recommend their friends and families to opt for IVRI in case of any animal health problems. Veterinary services delivery at the clients' door or footstep is not possible but the IVRI-RVP being a model Teaching Veterinary Clinical Complex for undergraduate and postgraduate students has immensely strived to cater the needs of its clients under the supervision and guidance of senior faculties. But despite that, more could be done if necessary suggestions as recommended by the clients, if incorporated could go a long way in helping the polyclinic to better serve its clients with every visit they make to the polyclinic.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (205-208)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Modelling and Forecasting of Area, Production and Productivity of Tomatoes in Haryana and India

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ARTICLE INFO

Keywords: AIC, ARIMA, Linear Model, Nonlinear model and SBIC

http://doi.org/10.48165/IJEE.2022.58231

ABSTRACT

An effort was made to investigate the behaviour of the area, production and productivity of tomato crop in the Haryana and India. For the purpose modelling and forecasting, linear trend, exponential trend, quadratic trend, S-curve trend, ARIMA modelling techniques were used and analysed the available information from 1991 to 2018. The results show that there will not be a significant increase in tomato productivity in Haryana, but it will raise yield in India. The total production of tomatoes in Haryana will be 1029 thousand tons by 2024 and the current production (2018-19) is 643.55 thousand tons and an increase of 4043 tons can be achieved in 2024 in India. It is noteworthy that although the area under tomatoes will increase in the near future in Haryana, but productivity remains the same. Productivity in India may increase in the coming years, although the area under cultivation remains the same.

INTRODUCTION

Vegetables are one of the most important parts of the horticulture sector in both Haryana and India. Vegetables productivity in Haryana and India has increased over the last several years. Various factors have led to an increase in the area and production of vegetables such as an increase in per capita income, a rise in health awareness, a shift in farmers' growth of higher-value vegetables due to higher returns etc. Favourable income-elasticity of demand has also contributed in increasing trend in vegetable production worldwide. Vegetables are an essential aspect of Indian agriculture because of its short growing season, better yield, nutrient diversity, and economic viability. India is the world's second-largest producer of horticulture crops. Among vegetables, tomato (*Solanum lycopersicum*) is the important vegetable crops in India with 2nd rank in the production and area worldwide. Globally, China is largest producer accounts for 27.8 per cent followed by India (11.2%), respectively (Kumar et al., 2016; Harisha et al., 2019; Gupta et al., 2021). Haryana ranks 12th in tomato production with 753.72 thousand tonnes (Horticulture at a glance, 2018). In Haryana, tomato cultivated in open and protected cultivation both. Tomato production is higher in protected as compared to open cultivation (Kumar et al., 2017; Nimbrayan et al., 2018). The objective of this study is that of understanding the trend in production and productivity in the Haryana area compared to India, this analysis allows better policy decisions in terms of food security and allocation of land use too.

The ARIMA model is most used for forecasting time series used following the literature. The auto regressing integrated moving average (ARIMA) model is used to forecast using a univariate time series model. The Box and Jenkin model is another name for it (Box et al., 1976). The ARIMA model is one of the most prominent stochastic time series models for forecasting using observed data with little forecast error. In the literature, several statistical and economic forecasting models have been created that may be used to forecast a variety of topics, including agricultural output, marketing, demand, trade, and so on (Hanke & Wichern, 2008). Just to mention a few works; Verma et al., (2015); Kumar et al., (2019);

Received 09-02-2022; Accepted 15-02-2022

Naidu et al., (2018) etc. are working on several forecasting facets in agriculture in India. Forecasters should explore a variety of approaches and compare their performance across a random sample of series, according to Fildes & Lusk (1984). In agriculture, which is full of uncertainty, reliable and timely predictions give valuable and practical recommendations for successful, foresighted, and perceptive planning. Forecasting crop area, production, and productivity are critical parameters in our model for establishing a support policy choice on food security, optimal land use allocation, technical issues, and environmental challenges, among other things.

METHODOLOGY

The time series data of Haryana and India, period from 1990-91 to 2018-19 of tomato have been used to study the growth trends. The time series data have been taken from Department of Horticulture, Haryana, Department of Agriculture, Cooperation & Farmers Welfare, Government of India, Indian Institute of Vegetable Research, ICAR.

The study tried to fit univariate forecasting models such as linear trend, nonlinear trend and ARIMA models to predict vegetable production. Model diagnostic checking were doing through minimum of root mean squared error (RMSE), Akaike Information Criteria (AIC) and Schwarz Bayesian Information Criteria (SBIC) etc. Linear model and nonlinear model are presented in the next sub-section.

Linear trend is a basic function that is defined as a straight line that runs across multiple points on a time series graph and has a consistent pattern.

$$Y_n = c + bT_n$$

Where, c is the constant of production at base period and b is the coefficient of trend line direction. Method least squares can be applied to find these coefficients.

$$b = \frac{N\sum Y_n T_n - \sum Y_n \sum T_n}{N\sum T_n^2 - \sum (T_n)^2} \text{ and } c = \bar{T}_n - b\bar{Y}_n$$

There are several nonlinear trends, and this study uses three different trends:

Quadratic trend $Y_n = c + bT_n + rT^2_n$
Exponential trend $Y_n = cb^n$
S-curve or Logistic trend $Y_n = 1 / 1+e^{c+bTn}$

Non-linear equations can be solved using linearization, Newton Raphson methods etc. see Weisberg (2005).

The basic goal of fitting an Autoregressive Integrated Moving Average (ARIMA) model is to identify the time series' stochastic process and properly forecast future values. There are two types of stochastic processes: stationary and non-stationary. The first point to keep in mind is that most time series are non-stationary, while ARIMA models only consider stationary time series (Chatfield & Yar, 1988). Because ARIMA models only consider stationary time series, the first stage of the Box-Jenkins model involves extracting first order differences to convert non-stationary time series to stationary time series.

To measure the adequacy of the fitted model RMSE and AIC value are utilized and it can be computed as follows:

$$RMSE = \sqrt{\frac{1}{N}\sum e_n^2}$$

AIC = 2 ln (RMSE) + 2k / N

SBIC = ln (N) k-2 ln ($\hat{L}$)

Where, k is the number of estimated model parameters and $\hat{L}$ is the maximized value of the likelihood function of the model.

RESULTS AND DISCUSSION

The mean, maximum (Max.) and minimum (Min.) values, as well as other statistical features, are displayed in descriptive statistics. Table 1 shows that during the research period, there was a substantial variation in the minimum and maximum value of area, production, and productivity of tomato in Haryana and India (Kalia et al., 2021). The standard deviation value (Stdev.) for all variables is too high for tomato production, resulting in a volatile pattern. Even if the means are substantially different, the coefficient of variation (CV) is a helpful statistic for comparing the degree of variation from one data series to another. The standard deviation to mean ratio is used to compute it. In terms of area, production, and productivity, Haryana has a higher CV than India. Skewness is a metric for symmetry, or more specifically, the lack of it. If a distribution, or data collection, looks the same to the left and right of the centre point, it is said to be symmetric (Skewness value around zero). Kurtosis is a measure of how heavy-tailed or light-tailed the data are in comparison to a normal distribution.

The area data set in case of Haryana and India, production data set in case of Haryana and productivity data set in case of India found to be following platykurtic distribution. All the data set are more or less symmetrically distributed around the central value. The results of fitting different models to the data are compared in Table 2. The first model shows results for Haryana area; while the second model reports results for India. The model with based on RMSE, AIC and SBIC was selected and used to generate the forecast values.

Table 1. Descriptive statistics for tomato in Haryana and India from 1990-91 to 2018-19

	Min.	Max.	Mean	Stdev.	CV (%)	Skewness	Kurtosis
Haryana							
Area	5	35	16.93	9.772	57.729	.255	-1.514
Production	93	746	307.57	206.720	67.212	.952	-.490
Productivity	11	25	18.31	3.865	21.113	-.426	-.957
India							
Area	289	882	571.65	199.272	34.859	.269	-1.345
Production	4243	20708	11125.70	5569.049	50.056	.501	-1.358
Productivity	14	26	18.55	3.343	18.027	.925	-.058

Table 2. Comparison of different time series models based on selection criteria

Model	Area			Production			Productivity		
	RMSE	AIC	SBIC	RMSE	AIC	SBIC	RMSE	AIC	SBIC
Haryana									
Linear Trend	2375	15.684	15.779	84936	22.837	22.932	3.935	2.878	2.972
Quadratic trend	2325	15.623	15.764	53956	21.999	22.140	3.309	2.600	2.742
Exponential trend	3244	16.307	16.401	57505	22.057	22.152	3.962	2.891	2.986
S-curve trend	8086	18.134	18.228	186617	24.412	24.506	3.928	2.874	2.969
ARIMA	2297	15.618	15.712	59460	22.124	22.218	3.344	2.414	2.414
India									
Linear trend	67	8.568	8.663	1609	14.910	15.006	1.474	0.919	1.015
Quadratic trend	68	8.676	8.819	1269	14.506	14.649	0.959	0.132	0.274
Exponential trend	76	8.827	8.922	1332	14.533	14.628	1.331	0.714	0.810
S-curve trend	156	10.243	10.338	4664	17.038	17.134	2.975	2.323	2.418
ARIMA	54	7.985	7.985	1152	14.170	14.218	1.208	0.450	0.497

Table 3. Forecasted value of area, production, and productivity of tomato in Haryana and India

Year	Area (000'ha)	Lower limit@95%	Upper limit@95%	Production (tonnes/ha)	Lower limit@95%	Upper limit@95%	Productivity (Tonnes/ha)	Lower limit@95%	Upper limit@95%
Haryana									
2019-20	34.64	29.91	39.38	800	670491	928928	21.37	14.52	28.22
2020-21	34.58	29.20	39.96	854	719422	987997	21.37	11.68	31.06
2021-22	36.92	30.29	43.55	910	769459	1050060	21.37	9.51	33.23
2022-23	38.16	30.68	45.63	968	820572	1115150	21.37	7.67	35.07
2023-24	40.06	31.63	48.49	1029	872746	1183280	21.37	6.06	36.68
India									
2019-20	778	666.82	889.19	20145.70	17777.80	22513.50	26.58	24.27	28.90
2020-21	778	620.76	935.24	20923.20	17509.30	24337.10	27.51	25.10	29.92
2021-22	778	585.42	970.58	21730.80	17467.20	25994.40	28.48	25.95	31.01
2022-23	778	555.63	1000.37	22569.50	17548.00	27591.00	29.48	26.82	32.15
2023-24	778	529.38	1026.62	23440.60	17713.00	29168.30	30.53	27.71	33.34

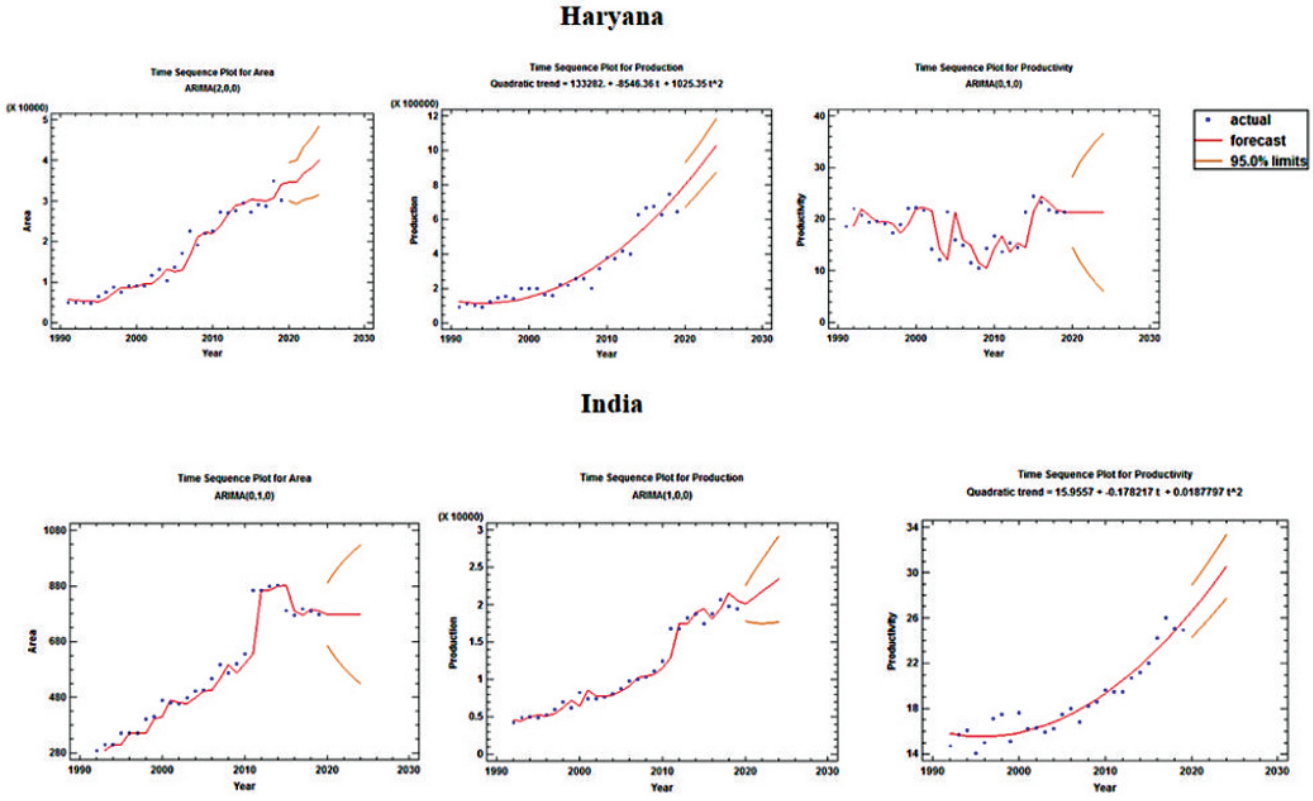

Figure 1. Time series forecast plots for tomato in Haryana and India

ARIMA model was shown to be better suited for forecasting Area [ARIMA (2, 0, 0)] and Productivity [ARIMA (0, 1, 0)] in Haryana. This approach posits that a parametric model linking the most current data value to prior data values and historical noise provides the best forecast for future data. In Haryana, however, tomato output follows a quadratic pattern (133282- 8546.36 t + 1025.35 t^2). This model assumes that the quadratic regression curve fitted to all prior data provides the best forecast for future data. In India, ARIMA model found more suitable to forecast Area [ARIMA (0, 1, 0)] and Production [ARIMA (1, 0, 0)] while Quadratic trend (15.9557 + -0.178217 t + 0.0187797 t^2) is best fit for time series data on tomato productivity in India. Table 3 displays the anticipated values from the different fitted models, as well as the predictions' 95.0 per cent prediction limitations. If the fitted model is acceptable for the data, these limits reveal where the real data value at a given future time is expected to be with 95.0 per cent confidence. Figure 1 shows several projected values and their patterns. It is interesting to note that in the case of in the case of tomato productivity in Haryana and Area under cultivation in India, the selected models provided a same forecast value for all the forecast years that means the forecast value depends solely on the recent available data. The rest of variables indicates increasing trends, although nonlinear in many cases.

CONCLUSION

As results shows, it is observed from results that the CV (%) found high in Haryana as compared to India with respect to Area, Production and productivity. In Haryana, ARIMA model found more suitable to forecast Area [ARIMA (2, 0, 0)] & Productivity [ARIMA (0, 1, 0)]. In India, ARIMA model found more suitable to forecast Area [ARIMA (0, 1, 0)] and Production [ARIMA (1, 0, 0)] while Quadratic trend (15.9557 + -0.178217 t+0.0187797 t^2) is best fit for time series data on tomato productivity in India. The results of the study also show that there will not be a significant increase in tomato crop productivity in Haryana, while a yield in India may upsurge significantly. There is more scope of increasing yield in Haryana using modern agricultural practices, high yielding varieties etc.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (209-212)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Perception of Farmers towards Custom Hiring Service Centres in Tumakuru District of Karnataka

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ARTICLE INFO

Keywords: Custom hiring service centre, Farm machinery, Perception, Private vendors, Quality service, Small and marginal farmer

http://doi.org/10.48165/IJEE.2022.58232

ABSTRACT

The study was carried out in Tumakuru district of Karnataka state during the year 2019-20. Eight taluks and 130 farmers were selected where the Custom Hiring Service Centres were working effectively. The majority of the farmers strongly agreed with helps in overcoming the problem of labour through custom hiring service centre, for visiting farmers field after completion of the work, farmers pays only for the number of acres or number of hours used. The overall perception of farmers indicated that 43.8 % were categorized under favourable level of perception towards CHSC. The small and medium-sized farmers could not possess the modern machinery, due to high hiring charges with private vendors they were unable to take the farm machinery for the rent and some of the large farmers also were in great need of the modern machinery thus they require modern machinery through custom hiring. Hence, extension efforts need to be more strengthened to create awareness among the farming community about the services available in CHSCs.

INTRODUCTION

Agricultural labour scarcity is one of the main problems faced by the farmers in rural India. Farm mechanization, therefore, plays an important role in timely taking up of agricultural operations. The cost of cultivation data shows that labour accounts for more than 40 per cent of the total variable cost of production for most of the crops (Anonymous, 2011 & Laxmi et al., 2014). Proper utilization of farm machinery saves 20-30 per cent time, 15-20 per cent seeds, 20-25 per cent fertilizers, 10-20 per cent labour, and an increase in cropping intensity to about 10 per cent (Singh, 2005). Small and marginal farmers can use the heavy machinery by developing a rental market of farm implements, so large numbers of farmers can be benefited without investment in farm machinery and implements. As Indian farming community is dominated by small and marginal farmers, they may not afford all the equipments and implements necessary for various agricultural operations. Mechanization in agricultural operation is found to be less in rural areas, and the need for farm mechanization is more important for getting higher yield and productivity. Hence farmers in the rural areas require modern machinery and equipment which are capital intensive and difficult in procurement and maintenance for the small and marginal farmers. Hence availing the equipments on hire basis is the best option. The government is also promoting the concept.

Custom hiring of farm machinery was first introduced in Indian agriculture in the 19th century (Srinivasarao et al., 2013). Agro Industries Corporation (AIC) began an organized custom hiring unit to promote farm mechanization. With the launching of a scheme to set up agro-service centers across the country in 1971 by Government of India, custom hiring services gained further

Received 23-09-2021; Accepted 10-03-2022

momentum. In 2014, the Department of Agriculture, Government of Karnataka proposed the establishment of 186 Custom Hiring Service Centers (CHSCs). Government of Karnataka identified two private entities to operate 178 custom hiring service centres in the state. Shri Kshetra Dharmasthala Rural Development Project (SKDRDP 161 CHCs), a charitable trust established by the Dharmasthala temple administrator in Dakshina Kannada and the Indian Society of Agri-business Professionals (17 CHCs) New Delhi. Government of Karnataka initiated the programme called "Krishi Yantradhare" to solve problems through custom hiring service centres to provide access to small and marginal farmers to use costly farm machinery for farm operations and also facilitate timeliness in farm operations and efficient use of resources. It helped to reduce the cost of cultivation and also provide work opportunities for skilled labour and small artisans. Hence studying their perceptions is a matter of research interest.

METHODOLOGY

Tumakuru district of Karnataka comprises of ten taluks viz., Kunigal, Tumkur, Koratagere, Turuvekere, Gubbi, Tiptur, Madhugiri, Sira among which eight taluks were purposively selected where the CHSC was effectively functioning. From each CHSC ten respondents were selected by using a simple random sampling method without replacement. A total of 13CHSCsfrom eight taluks of Tumakuru district were selected to form a sample of 130 respondents. A semi-structured interview schedule was used to collect the data from the respondents by personal interview method. The Semi-structured Schedule consisting of items related to Custom Hiring Service Centres (CHSC) was prepared with the help of available literature and in consultation with the officials/scientists of the concerned departments. A total of 23 items indicating the perception of farmers on customs hiring centres were designed. These 23 items were administered to 130 respondents to assess their perception about the custom hiring service centre. The responses of each respondent against each item were recorded on a five-point continuum *viz.*, strongly agree, agree, undecided, disagree, and strongly disagree with the scores 5, 4, 3, 2, 1, respectively. Based on the response obtained, the Respondents were divided into three categories using mean (X) and standard deviation (SD).

RESULTS AND DISCUSSION

Perception of farmers on the usefulness of custom hiring service centres

The results in Table 1 pertaining to perception towards the objective of custom hiring service centres showed that the majority of the farmers 'strongly agree' with custom hiring service centre help to overcome the problem of labour in carrying out an agricultural operation (agreement score 611) followed by custom hiring service centre help to maintain timeliness in agricultural operation (agreement score 591), helps to carry out sowing on time with minimum labour (agreement score 560), helps to carry out the intercultural operations on time (agreement score 558), farm machinery are available at a reasonable cost for small and marginal farmers (agreement score 534) and some of the farmers 'strongly agree' with harvesting with machines will help to reduce the wastage in production (agreement score 505), timely use of sprayers for IPM practice will help in the control of pest and diseases (agreement score 453). Some of the farmers 'agree' with farm machinery at custom hiring service centre attracts rural youth towards agriculture (agreement score 424). The findings indicate the relevance of agreement between extension service providers and extension educators (Singh et al., 2019; Kirti et al., 2015). Such agreement can bring in changes in the domains of stakeholders. The Custom Hiring Service Centre allows a farmer to gain control over farm machinery on a short-term basis without spending much money. Mechanization of agriculture helps to perform farm operations, to solve labour problems, to increase production, quality, and profitability by reducing unit production costs. Because these farm machinery and equipment are costly and not affordable to farmers and maintenance costs are higher and even private vendor hiring charges are high, most of the farmers need farm machinery and equipment by custom hiring. This could be the reason why most of the farmers agree with all objectives of CHSC. Findings were in line with the study of Chandrashekar (2016) & Sindhu (2017).

Further perception towards service delivery in custom hiring service centre clearly shows that majority of the farmers 'strongly disagree' for visiting farmers field after completion of the work (agreement score 157) and the majority of the farmers 'strongly agree' for repairs of the machinery are done in custom hiring service centre (agreement score 614), followed by modern machinery were available at custom hiring service centre (agreement score 579), pre-booking service facility was available (agreement score 565). The interventions reveal the role of visionary managers in ensuring the essential services (Singh et al., 2014). Nearly half (agreement score 503) of the farmers 'agree' for quality service was available and some (agreement score 504) of the farmers 'strongly agree' for expert drivers and operators were available. The findings indicate towards the importance of participation of stakeholders in delivery as well as adoption of services offered by the extension agencies (Jirli & Kumar, 2010). Small farmers and medium-sized farmers lack innovative and advanced machinery and they couldn't afford such machinery because of the higher rates and some of the modern machinery wasn't available with private vendors. Hence they availed the needed farm machinery and equipment through custom hiring service centres. Even the large farmers who lack the modern and advanced equipment which are needed for the farm operation also depend on custom hiring centres. As per the findings of the study majority of the farmers strongly disagreed that the functionaries of CHC visit farmers field after completion of the work. The reason might be lack of technical staff available in the custom hiring service centres and the unavailability of field supervisors in majority of the CHSCs. The study of Singh et al., (2017) indicated the quality of service delivered by private sector is better than public sector agencies. The study also reveals that services like pre-booking facility, modern machinery, quality service, expert drivers, and repairs of machinery are available in CHSC. The results were supported by the findings of Srinivasasa et al., (2013) & Chandrashekar (2016).

Perception towards benefits of custom hiring service centre shows that the majority of farmers 'strongly agree' with the fact that farmers pays only for the number of acres or number of hours

used (agreement score 619). The reason behind satisfaction lies in the fact that small and marginal farmers have access to the desired machinery without any involvement and on payment of nominal fees. There is no need for the long term capital investment in the machine (agreement score 581), provision of using machines as per the requirement of (less or more time) booking based on payment (agreement score 584) also add to the value of service and future implications on production. The contrasting findings were observed by Jiyawan et al., (2010) where majority of the respondents (90%) had expressed that inadequate credit facility was the main constraint for purchasing improved agricultural implements. More than half of farmers (agreement score 533) 'agreed' with improvement in the quality of work, as the machinery was being hired in good working condition (agreement score 528), whereas nearly fifty per cent of farmers 'strongly agreed' that farmers had no responsibility for operating the machine (agreement score 575) and maintenance of timeliness of agricultural operation (agreement score 514). Farmers strongly agreed with the timely availability of farm machinery and implements (agreement score 529). Farmers were happy with custom hiring of farm machinery and implements because it reduced the cost of cultivation (agreement score 527). The results are supported by the findings of Srinivasrao et al., (2013) & Chandrashekar (2016).

Overall perception of farmers about the custom hiring service centre

A perusal of Table 2 indicates that about 44 per cent of the farmers were categorized under elevated perception category regarding the services of CHSC, followed by 31 per cent of the farmers belonged to squat perception category, and 25 per cent of the farmers belonged to standard perception category. If the target community face constraints it becomes a hindering factor in acceptance of extension advisory (Srisailam et al., 2021). The CHSC is a step towards minimizing the constraints of end users. The study is supported by the findings of Manjunath (2014); Chandrashekar (2016) & Sindhu (2017). About 70 per cent respondents are classified under medium to elevated category towards the services of CHSC. The efforts of CHSC are helping farmers to overcome shortage of labour and ensuring the timely operations in the field. The section of farming community wherein the operation of machine in the field is difficult intervention due to small size of land are unable to harness the benefits of CHSC. Hence the implications of study lead towards designing the customized machinery which are suitable for operation in small holdings. Such intervention can easily satisfy needs of remaining 30 per cent of respondents.

Table 2. Overall perception of farmers towards custom hiring service centre

Category	Frequency	Percentage
Squat perception (score less than 87.62)	40	31
Standard perception (Score between 87.62-99.24)	33	25
Elevated perception (Score more than 99.24)	57	44

Mean score = 93.43, SD = 5.817

CONCLUSION

Higher levels of education, the wages, living standards of individuals, and other factors have compelled or motivated

Table 1. Perception of the usefulness of custom hiring service centres by farmers

S.No.	Items of Perception	Agreement Score
a.	Perception towards objectives of CHSC	
1	Overcome the problem of labour in agricultural operations	611
2	Helps to maintain timeliness in an agricultural operation	591
3	Farm machinery is available at a reasonable cost for small and marginal farmers	534
4	Farm machinery at CHSC attracts rural youth towards agriculture	424
5	Helps to carry out sowing on time with minimum labour	560
6	Helps to carry out the intercultural operations on time	558
7	Harvesting with machines will help to reduce the wastage in production	505
8	Timely use of sprayers for IPM practice will help in the control of pest and disease	453
b.	Perception towards service delivery in CHSC	
1	Modern machinery is available in CHSC	579
2	The pre-booking service facility is available	565
3	Expert drivers and operators are available	504
4	Quality service is available	503
5	Visiting farmers field after completion of the work	157
6	Repairs of the machinery are done in CHSC	614
c.	Perception towards benefits of CHSC	
1	There is no need for the farmers for long term capital investment in the machine.	581
2	Hiring farmer has no responsibility for operating the machine.	575
3	The farmer pays only for the number of acres or the number of hours used.	619
4	Machinery which is given for hiring is mostly in good condition.	528
5	Improves the quality of work.	533
6	Maintain timeliness of agricultural operation.	514
7	Custom hiring of farm machinery and implements will reduce the cost of cultivation.	527
8	Custom hiring makes timely availability of farm machinery and implements.	529
9	There is a provision of using machines as per the requirement of booking	584

Maximum obtainable score: 650 and Minimum obtainable score: 130

individuals to migrate from rural areas to urban centres leading to shortage of labour in the agricultural production cycle, which has necessitated the agricultural mechanization. Overall perception of farmers about the CHSC was found high indicating need for investment in agricultural machinery and equipment would increase the cost of agricultural production. Hence, extension efforts need to be more strengthened to create awareness among the farming community about the services available in CHSCs. Strengthening the public-private partnership/co-operation in operating CHSCs to bring about socio-economic development among the farming community is very much important for customized farm mechanization.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (213-216)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Response of Green Gram Demonstrated Technology under Cluster Front Line Demonstration in Samastipur, Bihar, India

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ARTICLE INFO

Keywords: CFLD, Economics, Green gram, Growth and yield attributes, Technology index

http://doi.org/10.48165/IJEE.2022.58233

ABSTRACT

Cluster Front Line Demonstration on green gram was conducted during 2016-17 to 2017-18 in Samastipur district of Bihar to evaluate the performance of improved management techniques in green gram during each year. Performance of demonstrated technology revealed the highest number of nodules/plant at 20 DAS (12.78 & 11.92) & 40 DAS (26.83 & 25.14) and dry weight of nodules/plant at 20 DAS (29.14 & 78.57) & at 40 DAS (26.87 & 73.26) was observed in CFLD. Highest grain yield of (14.20 & 11.20 q/ha) were recorded in demonstrated plot over farmers' practice during both the years. Lowest technology index was observed in demonstrated technology, 29.0 per cent and 43.8 per cent, respectively. The extension gap varied from 3.62 to 4.855 q/ha. Maximum net returns (Rs. 44,630/ha during 2016-17 and Rs. 40,740/ha in 2017-18) was obtained with higher benefit-cost ratio 2.69 and 2.53, respectively compared to 1.99 in case of local check. The results clearly indicate that use of improved package of practice with scientific intervention under cluster frontline demonstration programme led to increase the productivity and profitability of green gram.

INTRODUCTION

Pulses are a good and cheap source of protein for a majority of our population. India lonely accounts for 33 per cent of world area and 22 per cent of the world production of pulses (Sandhu & Dhaliwal, 2016). Pulses consumption is much higher than any other source of protein, which indicates the great importance of pulses in their daily food habits. Greengram is one of the most important and hardiest crops among all the pulses. It contains 25-26 per cent protein, 3 per cent vitamins and 51 per cent carbohydrates (Mondal et al., 2012). The pulses cultivation has been drastically reduced in back year resulting in shortage of pulses in the market although the demand was high. Pulses has ability to fix the atmospheric nitrogen and addition of organic matter to soil, which are important factors to maintaining soil fertility (Kumar et al., 2017). In order to address this short coming, the Government of India has devised a programme to promote the pulse cultivation in cluster mode under National Food Security Mission through KVKs. Green gram is primarily a *summer* season pulse crop of Samastipur, Bihar. Nutrient management plays a pivotal role that greatly affects the growth and yield of green gram. To maintain reasonable health of the Indian soils, each and every field to be manured with at least 7 to 10 tons of organic fertilizer. With this assumption, there is a need for about 850 to 1200 million tons of organic fertilizer (Singh & Singh, 2014.). The main objective of CFLD was to explore new production technology and its management practices on farmer's field under different farming situations. These demonstrations were carried out under the supervision of agricultural scientists and feedback from the different farmers was generated on the demonstrated technology.

METHODOLOGY

The study was carried out during summer season from 2016-17 to 2017-18 by KVK Birauli, Samastipur. Area were selected for cluster formation (0.2 to 0.4 ha, each) in ten villages of the district. Farmers were trained to follow the package and practices for

Received 08-09-2021; Accepted 03-03-2022

greengram cultivation and critical inputs like seeds, fungicides, insecticide, were supplied to the farmers. In case of local check, the traditional practices were followed. In demonstration plots, use of quality seeds of improved varieties SML-668 and Pusa Vishal with line sowing at 30 x 10 cm row spacing, and need based pesticide as well as balanced fertilizer were emphasized. The crop was harvested at its optimum maturity stage. Five plants were randomly selected from demonstrated plot and check plot from each cluster area at 20 and 40 DAS and uprooted carefully. After washing the roots, total number of nodules from the roots were detached and counted and then averaged. The nodules so detached were freshly weighed after that sun-dried for 2 days and then oven dried at 70°C. After complete drying, dry weight of nodules was taken at 20 and 40 DAS. Length of pods in sampled plants were recorded and averaged. Number of pods per plant in sampled plants were also counted expressed as average number of pods per plant. The yield data were collected both from the demonstration and farmers' practice by crop cutting method and analyzed with using simple statistical techniques. Gross return was calculated by multiplying yield into prevailing local market price of the grains obtained by the farmers. Further, net return and benefit cost ratio were calculated. The technology gap and technological index (Yadav et al., 2004) along with the benefit cost ratio (Samui et al., 2000) were calculated by using following formula as given below.

Technology gap = Potential yield - Demonstration yield
Extension gap = Demonstration yield – Farmers' yield
Technology index = Technology gap/Potential yield x 100

RESULTS AND DISCUSSION

Results revealed that the technological interventions of CFLDs had positive influence on grain yield over farmers' practice during two years of demonstrations (Table 1). Results indicated that due to use of high yielding varieties, balanced use of fertilizers and micronutrients and control of insect and disease during both the years, maximum number of farmers were motivated to take up greengram as a summer crop under strict supervision of scientists from KVK, Samastipur. The data revealed that number of nodules/plant at 20 days after sowing (12.78 & 11.92) and at 40 days after sowing (26.83 & 25.14) were produced higher in demonstrated plots during both the years over farmers' practice. Similarly, dry weight of nodules/plant at 20 days after sowing (29.14 & 26.87) and at 40 days after sowing (78.57 & 73.26) were higher in demonstrated plots during both the years than check plots. Increase in nodules number might be due to increased rhizobial colonization in the rhizosphere because of increased availability of micronutrients in the root zone (Meena et al., 2012). During 2016-17, SML-668 in demonstrated plots recorded 7.12 grains/pod, 8.02 cm pod length, 18.28 number of pods/plant and 36.75 g test weight. Similarly, during 2017-18, Pusa Vishal in demo plots recorded 6.45 grains/pod, 6.98 cm pod length, 16.67 number of pods/plant and 35.47 g test weight. Results obtained by Saravanakumar et al., (2021) showed that number of pods per plant was increased by 7.66 per cent over farmer's practice. The beneficial effects of foliar nutrition of micronutrients on green gram were also reported by previous researchers like Kumawat et al., (2005). The micronutrients might have enhancing role in seed setting that resulted in improvement in number of seeds per pod. Greater mobilization of photosynthates to the developing grains by application of micronutrients might be the reason for increase in grain weight. Application of the micronutrients along with the inoculations might have a synergistic effect, which enhanced the activity of nitrogenase, in turn supplied more nitrogen by fixation for better growth and yield attributes. Similar results were also corroborated by the findings of Singh et al., (2010) & Choudhary et al., (2011).

The grain yield of green gram during both the years under demonstration recorded as 14.20 and 11.24 q/ha as compared to grain obtained from farmers' field as 9.35 and 7.62 q/ha (Table 1). Demonstration plot resulted in 51.87 per cent and 47.50 per cent higher grain yield from local check during both the years. Similar findings were recorded by Nain et al., (2014); Sandhu & Dhaliwal (2016); Jain (2016) & Kumar et al., (2018). The major differences observed between demonstration practices and farmers' practices might be due to introduction of seed treatment, method and time of sowing, fertilizer doses and method of its application and plant protection measures. It is evident from the results that the yield of demonstration was found better than the local check (farmer's practice) under the similar environmental conditions. Jakhar & Kumar (2022) also reported significant increase in the average yield of demonstrated plot (23.1%) over the farmer's plot in green gram cultivation.

The technology gap observed as 5.80 and 8.76 q/ha in 2016-17 and 2017-18, respectively. The observed technology gap resulted may be due to various constraints such as soil fertility, availability of low moisture content, sowing time and climatic hazards etc. Hence, to reduce the yield gap location specific recommendations for varieties, soil testing and timely sowing appears to be necessary. The 4.85 q/ha extension gap found in 2016-17 whereas 3.62 q/ha was in 2017-18. There is a need to decrease this wider extension gap through latest technologies. The findings are similar to the findings of Raj et al., (2013); Jain (2016) & Kushwah et al., (2016). The technology index showed the suitability of varieties at farmers' field. The technology index was 29.0 per cent and 43.8 per cent, respectively in 2016-17 and 2017-18. This finding is in corroboration with the findings of Kumbhare et al., (2014); Bar & Das (2015); Sandhu et al., (2016) & Anuratha et al., (2019).

Table 1. Yield, technology gap, extension gap and technology index of green gram cultivation

Year	No. of farmers	Variety	No. of demo	Potential yield (q/ha)	Yield (q/ha)						Yield increase (%)	Tech-nology gap (q/ha)	Exten-sion gap (q/ha)	Tech-nology index (%)
					Demonstration			Check						
					Max	Min	Av.	Max	Min	Av.				
2016-17	35	SML-668	35	20	16.27	12.13	14.20	10.89	7.81	9.35	34.15	5.80	4.85	29.0
2017-18	26	Pusa Vishal	26	20	13.67	8.81	11.24	8.92	6.32	7.62	32.20	8.76	3.62	43.8

Table 2: Gross return, cost of cultivation, net return and B:C ratio of green gram cultivation

Year	Expenditure and return (Rs/ha)								Net return increase (%)
	Check				Demonstration				
	Gross cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio	Gross (Rs/ha)	Gross (Rs/ha)	Net (Rs/ha)	B:C ratio	
2016-17	23470	46750	23280	1.99	26370	71000	44630	2.69	91.71
2017-18	23970	45720	21750	1.90	26700	67440	40740	2.53	87.31

* Rs. 50 per kg rate in 2016-17 & Rs 60 per kg rate in 2017-18

The economics of green gram production under CFLD have been presented in Table 2. Economics analysis of the yield performance revealed that CFLD recorded higher gross return (Rs. 71,000/ha during 2016-17 and Rs. 67,440/ha in 2017-18) and net return (Rs. 44,630/ha during 2016-17 and Rs. 40,740/ha in 2017-18) with higher benefit-cost ratio 2.69 and 2.53 compared to 1.99 in case of local check. The net return increase was 91.71 per cent and 87.31 per cent during 2016-17 and 2017-18, respectively. Nain et al., (2015); Patil et al., (2015); Kumar et al., (2018) & Gireesh et al., (2019) also find the similar results in which demonstration plot gave higher net return over the check farmers' practice.

CONCLUSION

The cluster frontline line demonstrations conducted by KVK, Birauli, Samastipur had enhanced the yield of green gram and ensured rapid spread of recommended technologies of green gram production by implementation of various extension activities like training programmes, field days, exposure visits etc. organized in farmer's field. The farmers included under CFLD programme also played an important role for wider dissemination of the improved technologies for the nearby farmers. Therefore, it is suggested that policy maker may provide adequate financial support to frontline extension system for organizing CFLD under the close supervision of agricultural scientists and extension functionaries.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (217-220)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Impact of Tribal Sub Plan (TSP) Intervention on Yield and Economics of Chickpea Cultivation in Kurnool District of Andhra Pradesh

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ARTICLE INFO

Keywords: Tribal Sub Plan (TSP), Chickpea, Kurnool, Impact, Nandyal Gram 49, Nandyal Gram 119

http://doi.org/10.48165/IJEE.2022.58234

ABSTRACT

To promote improved chickpea varieties along with profitable crop management technologies, Regional Agricultural Research Station (RARS), Nandyal organized demonstrations on chickpea improved varieties along with crop package of practices in 210 tribal farmer's fields (84 ha) under Tribal Sub Plan during 2018-2021 in Kurnool district of Andhra Pradesh. The technology interventions included improved varieties (Nandyal Gram 49 and Nandyal Gram 119), seed treatment with vitavax power (1.5 g/kg seed), basal application of zinc sulphate, erection of pheromone traps @ 10/ha, prophylactic spray of neem oil and use of need based plant protection chemicals. The average yield of demonstration field with improved desi variety Nandyal Gram 49 (14.36 q/ha) was 19 per cent higher than the existing farmers practice (12.05 q/ha) and the average yield of 13.16 q/ha was recorded with improved kabuli variety Nandyal Gram 119 which resulted in 7.78 per cent yield increase over farmers practice (JG11/Vihar) (12.21 q/ha). These demonstrations resulted not only in higher yield, but the higher net returns and cost benefits indicated the worth of improved varieties and scope for further spread of other technological interventions in farmers' holdings.

INTRODUCTION

Andhra Pradesh's Scheduled Tribes (STs) represent 6.75 per cent of India's tribal population and 6.59 per cent of the state's population and predominant tribes in Kurnool district of Andhra Pradesh are Sugali and chenchu (Reddy & Kumar, 2010). The Kurnool district is categorized under scare rainfall zone of Andhra Pradesh due its scanty and uneven rainfall during crop season. In these conditions, the tribal farmers are totally dependent on agriculture and are facing problem with fluctuating yields. Hence, there is a need to improve/stabilize the crop yields by introducing crop specific interventions which can be achieved by implementation of Tribal Sub Plan (TSP) area approach.

Chickpea is the major rabi pulse crop cultivated in an area of 1.5 to 2 lakh ha in Kurnool district alone and the average yield obtained by the tribal chickpea farmers was 800-900 kg/ha which was 30-40 per cent lower than potential yield of the state (1211 kg/ha) (Directorate of Economics and Statistics, Planning Department, Andhra Pradesh, 2019-20). To maximize economic returns of tribal farmers, Regional Agricultural Research Station, Nandyal, a lead research station in scarce rainfall zone of Andhra Pradesh implemented Tribal Sub Plan (TSP) under All India Co-ordinated Research Project (AICRP) on Chickpea in 18 villages in different mandals of Kurnool district in a systematic manner to demonstrate the importance of newly released varieties and proven crop management technologies.

METHODOLOGY

Demonstrations under Tribal Sub Plan (TSP) were implemented in 210 farmers' fields during 2018-2021. Eighty five demonstrations were organized with Nandyal Gram 49 during the

Received 25-11-2021; Accepted 16-03-2022

year 2018-19 and 2020-21 covering 12 villages; where one twenty five demonstrations were conducted with Nandyal Gram 119 variety during the year 2019-20 and 2020-21 covering 16 villages in Kurnool district. The technology interventions of these demonstrations under TSP were cultivation of improved varieties, seed treatment with vitavax power (1.5 g/kg of seed) and *Trichoderma viridi* (8-10 g/kg of seed) as a prophylactic measure against soil borne diseases, basal application of $ZnSO_4$ along with recommended application of N and P fertilizers, erection of pheromone traps (10 traps /ha) for managing *Helicoverpa armigera* and *Spodoptera exigua*, prophylactic application of neem oil and ETL based application of chlorantriniliprole to keep the pest level below the economic threshold level. The critical inputs supplied to the beneficiary farmers under TSP were high yielding chickpea varieties *i.e.* Nandyal Gram 49 (*desi*), Nandyal Gram 119 (*kabuli*), power sprayers, $ZnSo_4$, seed treatment and plant protection chemicals.

The extension gap, technology gap and technology index (Samui et al., 2000) were calculated using the standard methodology. Total 209 chickpea growing tribal farmers from different villages of Kurnool district were selected to measure the extent of adoption of recommended practices in chickpea cultivation. The data was collected by conducting personal interview with selected 209 respondents. The data was analyzed and interpreted.

RESULTS AND DISCUSSION

Yield and economic analysis

During 2018-19, an average yield of 1032.7 kg ha^{-1} was recorded with Nandyal Gram 49 and it was 35.2 per cent higher than farmer's practice-JG11 (763.4 kg ha^{-1}). In the year 2020-21, an average yield of 1839 kg ha^{-1} was recorded which was 11.73 per cent higher than farmers practice. The improved chickpea varieties released from RARS, Nandyal established the yield advantage of more than 10 per cent over popular varieties of the tract (Jayalakshmi *et al.,* 2017). In this study also, Nandyal Gram 49 variety has clearly showed its superior performance in both the years owing to intrinsic high yield potential of the variety compared with better wilt resistance (Table 1). Nandyal Gram 49 variety performed well under rainfed conditions and recorded higher yield (Deva *et al.,* 2019). The yield advantage of 9-10 per cent with Nandyal Gram 49 and 13-18 per cent with Nandyal Gram 119 varieties was demonstrated in selected districts of Andhra Pradesh during 2018 to 2020 (Palakurthi *et al.,* 2021).

The production and productivity of chickpea was improved with the introduction of improved chickpea varieties (Kassa *et al.,* 2021). Differences in yield of different varieties across sites were possible due to variation in weather conditions, soil fertility status and location specific management practices (Dudhade *et al.,* 2009 & Singh *et al.,* 2017). The average gross income of Rs. 81498/ha and net income of Rs. 67558/ha was recorded in demonstrated fields under TSP with cost benefit ratio of 1:2.62. Adoption of integrated pest management practices resulted in less cost of cultivation in demonstration plot compared to farmers practice which resulted in high C:B ratio. Maximization of chickpea productivity with improved crop management was also reported by Tomar (2010).

The farmers obtained an average yield of 1316 kg ha^{-1} with Nandyal Gram 119 and it was 7.79 per cent higher than farmer's practice Vihar (1221 kg ha^{-1}) during the years 2019-20 and 2020-21. The average gross income of Rs. 74898/ha and net income of Rs. 69597/ha was recorded in demonstrated fields with cost benefit ratio of 1:2.48. Increased returns due to demonstrations in farmers' holdings were reported by Kumbhare et al., (2014); Nain et al., (2014); Singh et al., 2019; Singh et al., (2019); Gireesh et al., (2019) & Singh et al., (2020).

An average technology gap under two years of demonstration was 5.64 q/ha with Nandyal Gram 49 (Table 2) and it was 6.85 q/ha with Nandyal Gram 119 (Table 2). The technology gap observed among various demonstrations may be attributed to dissimilarity in the soil fertility status, agricultural practices adopted by tribal farmers coupled with variation in local climatic situations of farm holdings. Extension gap of 2.31 and 0.95 q/ha was observed during 2018-19 and 2020-21 respectively with Nandyal Gram 49. This indicates the need to educate the tribal farmers for better adoption of improved technology. The extension gap of 1.07 and 0.83 q/ha was observed during 2019-20 and 2020-21 respectively with Nandyal Gram 119 kabuli variety. On an average extension gap of 1.63 and 0.95 q/ha was observed with Nandyal Gram 49 and Nandyal Gram 119 respectively.

An average of 28.21 per cent of technology index was observed with Nandyal Gram 49 variety and 33.23 per cent was observed with Nandyal Gram 119 variety during the two years of FLD programmes. The value of technology index shows the feasibility of spreading of improved technology at the farmer's field and the lower the value of technology index indicates the feasibility of technology is more (Nain et al., 2015; Kothyari et al., 2018; Singh et al., 2018).

Adoption of recommended package of practices by tribal farmers

Among the beneficiary farmers, majority of tribal farmers (60.29%) fully adopted the need based application of insecticides followed by recommended seed rate (55.02%), recommended improved varieties (51.20%) and seed treatment (49.28%).

Table 1. Economics of improved varieties along with full package demonstrations in chickpea

Year	No. of Demos	Variety	Yield		Gross Returns		Cost of Cultivation		Net Returns		B:C ratio	
			Demo	FP	Demo	FP	Demo	FP	Demo	FP	Demo	FP
2018-19	50	Nandyal Gram 49	1032.7	763.4	69191	51148	25970	26550	43221	24598	2.66	1.93
2020-21	35		1839	1646	93804	83968	36271	41357	57533	42611	2.6	2.03
Total	85		1435.85	1204.7	81497.5	67558	31120.5	33953.5	50377	33604.5	2.62	1.99
2019-20	100	Nandyal Gram 119	1306	1199	63670	58463	24437	26755	39233	31708	2.6	2.2
2020-21	25		1325	1242	86125	80730	35920	41050	50205	36980	2.4	1.97
Total	125		1315.5	1220.5	74897.5	69596.5	30178.5	33902.5	44719	34344	2.48	2.05

Table 2. Technology gap, Extension gap and Technological index of demonstration on chickpea

Year	Variety	No of demos	Area	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
2018-19	Nandyal Gram 49	50	20	9.67	2.31	48.37
2020-21		35	14	1.61	0.95	8.05
Total/Average		85	34	5.64	1.63	28.21
2019-20	Nandyal Gram 119	100	40	6.94	1.07	34.70
2020-21		25	10	6.75	0.83	33.75
Total/Average		125	50	6.85	0.95	33.23

Table 3. Practice wise adoption percentage of recommended practices chickpea cultivation by selected respondents

S.No.	Details of the Practice	Extent of Adoption		
		Non Adoption (%)	Partial Adoption (%)	Full Adoption (%)
1.	Recommended improved varieties	22.49	26.32	51.20
2.	Seed treatment	5.74	44.98	49.28
3.	Recommended seed rate	10.53	34.45	55.02
4.	Recommended Fertilizer application	26.79	37.80	35.41
5.	Basal application of zinc sulphate	64.59	23.92	11.48
6.	Integrated pest management Practices			
A)	Pheromone traps	55.50	30.62	13.88
B)	Neem oil	38.76	27.75	33.49
C)	Need based application of insecticides	8.61	31.10	60.29
D)	Need based application of fungicides	44.02	25.84	30.14

Comparatively lesser adoption was observed with respect to recommended fertilizer application (35.41%), usage of neem oil (33.49%) and need based application of fungicides (30.14%). The least adoption was for usage of pheromone traps (13.88%) and basal application of zinc sulphate (11.48%) (Table 3). Though low level of adoption (less than 15%) was found in practices like usage of pheromone traps and basal application of zinc sulphate, they have definite role in reducing cost of cultivation and in increasing seed yield. Similar findings were also reported by Nain et al., (2015); Kumar et al., (2016); Kumar & Kumawat (2019). The implementation of various extension activities should require for better adoption of these practices to get higher production in chickpea cultivation.

CONCLUSION

The demonstrations conducted with new improved varieties of chickpea were successful in changing farmer's perception and improving knowledge on recommended chickpea farming practices which resulted in higher yields. The beneficiary farmers also gained knowledge on quality seed production and obtained additional income from the quality seed of Nandyal Gram 49 and Nandyal Gram 119 supplied to the neighbouring farmers. Over all the interventions in selected villages improved net returns on account of adoption of new varieties with reduced cost of cultivation.

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Research Note

Indian Journal of Extension Education
Vol. 58, No. 2 (April–June), 2022, (221-223)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Knowledge and Adoption Levels of Buckwheat (*Fagopyrum esculentum*) Cultivation by Farmers in Ladakh

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ARTICLE INFO

Keywords: Buckwheat, Knowledge, Adoption, Ladakh

http://doi.org/10.48165/IJEE.2022.58245

ABSTRACT

Buckwheat belongs to the family polygonaceous is a high-value crop of Ladakh where it is grown either as the main season crop or after barley as short duration second crop. In the present investigation, four villages were selected from Leh and Kargil, districts. A random sample of 200 farmers was selected that included 50 farmers from each village. Collective interpolation of surveyed data indicated that the maximum number of farmers had a medium level of knowledge and adoption about the cultivation of buckwheat. The main constraints revealed by the respondents about the cultivation of buckwheat crops included non-availability of improved seeds, lack of knowledge about varieties, lack of knowledge about the market rate, etc. However, the Ladakh administration is now facilitating the cultivation of buckwheat by giving training to the farmers through agriculture university experts and other allied departments in the cold desert aimed to enhance the knowledge base and the adoption of buckwheat cultivation, its popularization and commercialization.

INTRODUCTION

Buckwheat (*Fagopyrum esculentum*) also known as common buckwheat, Japanese buckwheat, and Silverhull buckwheat is a plant cultivated for its grain-like seeds and as a cover crop (Ahmad et al., 2018). The buckwheat is not closely related to wheat. It is not a cereal, nor is it even a member of the grass family (Ohnishi, 1998). It has triangular seeds and produces a flower that is usually white colour although can also be pink or yellow colour (Brennan, 2020). In the higher Himalayan region of India (4500 amsl), this is the only crop grown and occupies about 90 per cent of cultivated land as a pure crop. In India, buckwheat flour is known as *kuttu-ka-atta* and is culturally associated with the *Navratri* festival. On the day of this festival, food items are made only from buckwheat (Ahmad & Raj, 2012). Buckwheat is a versatile source of fiber, a good dietary food crop as it has high nutritional value and the protein content in buckwheat flour is higher than in commonly used cereals such as rice, wheat, millet, sorghum, and maize (Chrungoo & Cheltry, 2021). It can be sold roasted or unroasted or ground into flour. Being short duration, buckwheat fits well in the high-altitude area of Ladakh where the growing season of a crop is of a limited period because of the early onset of winters and snowfall. It is specific that buckwheat is usually grown traditionally in relatively warmer areas of both Leh and Kargil districts of Ladakh, where double-cropping is possible. It is generally grown as the second crop after harvesting the barley crop. Locally buckwheat is known by various names viz. *dyat*, *dro*, *bro*, *fafer*, etc. in different regional dialects of Ladakh (Ahmad & Raj, 2012).

Buckwheat was one of the staple foods of Ladakhi people a few years ago, however over the period of time cultivation of buckwheat has receded due to the easy availability of subsidized ration (rice). The present generation lacks the information about the importance of buckwheat consumption in the daily dietary food which possesses a tremendous functional and active food constituent. Ladakh Autonomous Hill Development Council (LAHDC) focuses on promoting buckwheat production in the

Received 14-03-2022; Accepted 21-03-2022

Ladakh region and it assured special funding in the Hill Council budget to promote its production and the agriculture university and other allied departments urged the farmers to grow buckwheat crop production on a large scale as cash crops (Anonymous, 2021). The present study was conducted to know the extent of knowledge and adoption by farmers about the cultivation of buckwheat and its constraints faced by respondent farmers in the region.

METHODOLOGY

The union territory of Ladakh lies in the Trans-Himalayas and comprises Leh and Kargil districts. Leh district is situated between 32°N to 36°N latitude and 75°E to 80°E longitude at an altitude ranging from 2900-5900 m above sea level. Kargil district is situated between 34°N to 27°N latitude and 76°E to 34°E longitude at an altitude ranging from 2686-7010m above mean sea level. Leh district comprises 119 total villages whereas in Kargil district there are 127 total villages. The study was conducted in purposively selected Leh and Kargil districts of the Union territory of Ladakh during 2021. Four villages were selected for this study from two districts of Ladakh viz. Saspol and Dha-Beema (from Leh) and Tambis and Mingi (from Kargil) respectively. A random sample of 200 farmers was selected for the study which included 50 farmers from each village. The knowledge and adoption level of farmers about the recommended package of practices of buckwheat crops was collected with the help of a pre-structured interview schedule. The knowledge of farmers about each major cultivation practice was assigned marks. One mark was assigned for each correct reply and zero to wrong reply or no reply. The percentage of respondents in each practice was also calculated. The extent of knowledge level was measured on the basis of the mean per cent score obtained for each statement and each practice was ranked accordingly. Besides, the buckwheat farmer respondents were divided into three categories (high, medium, and low) on the basis of mean knowledge scores. The Adoption level of recommended practices of buckwheat was analysed in a two-point continuum i.e., Adoption and Non-adoption with a score of 1 and 0. Similarly, the adoption level was measured on the basis of percentage and mean score obtained for each statement, and the adoption level of farmers of buckwheat was divided into three categories (high, medium, and low) on the basis of mean adoption scores. The farmer respondents were asked to point out the constraints in the process of improved production and management practices of the buck-wheat crops.

RESULTS AND DISCUSSION

The data presented in Table 1 show that extent of knowledge of respondents was highest in land preparation with a mean score of 0.95, followed by harvesting and threshing with a mean score of 0.92. The extent of knowledge of respondents about the date of sowing was 80 per cent followed by sowing methods (74%). The table further shows that respondents had fair knowledge about seed rate (71%), weeding (65%), recommended manures /fertilizers (60%), and irrigation schedule (58%). However, respondents had fair knowledge about spacing (45%), marketing (32%), and improved varieties (25%). Similarly, findings were imported by Sangeetha et al., (2009); Nain & Chandel (2013); Kumar et al., (2021).

In a similar way, the adoption level of farmers about irrigation scheduling, varieties of buckwheat and harvesting, and threshing were observed highest at (75%). The adoption level of farmers about the date of sowing and sowing method both were observed the second-highest (60%). The weeding (57.50%), seed rate (45%), spacing (40%), recommended manures/fertilizers (32.50%), and varieties of buckwheat (30.00%) followed. The results were in agreement with the findings of Shasani et al., (2020) who studied correlates of adoption of groundnut cultivation technology, and Angmo et al., (2021) in case of alfalfa scientific cultivation practices in eastern Ladakh (UT), India.

The majority of the respondents conceded to the level of knowledge regarding buckwheat cultivation in these four villages. The results were that the maximum number of respondents (50%) had a medium level of knowledge, 30 per cent had a low level, and 20 per cent had a high level of knowledge about recommended cultivation practices of buckwheat (Table 2). The findings were observed by Kumar et al., (2020) who studied knowledge of mango growers about management practices in western Uttar Pradesh. Rani and Hariharan (2021) also studied the knowledge level of farm women on the use of ICT through farm women knowledge groups

Table 2. Distribution of respondents conceding to the level of knowledge and adoption

S.	Knowledge		Adoption	
No.	Category	%tage	Category	%tage
1.	Low < 2.95	30.00	Low < 3.0	35.00
2.	Medium 2.95 to 7.95	50.00	Medium 3.0 to 7.5	45.00
3.	High > 7.95	20.00	High > 7.5	20.00

Table 1. Knowledge level and adoption of cultivation of Buck-wheat crop

S.No.	Practices of Buck-Wheat	Knowledge			Adoption		
		Knowledge (%)	Mean score	Rank	Adoption (%)	Mean score	Rank
1	Improved recommended varieties	25.00	0.25	XI	30.00	0.30	VII
2	Land preparation	95.00	0.95	I	75.00	0.75	I
3	Date of sowing	80.00	0.80	III	60.00	0.60	II
4	Sowing methods	74.50	0.74	IV	60.00	0.60	II
5	Seed rate	71.00	0.71	V	45.00	0.45	IV
6	Spacing	43.00	0.43	IX	40.00	0.40	V
7	Irrigation schedule	58.00	0.58	VIII	75.00	0.75	I
8	Recommendedmanures/fertilizers	60.00	0.60	VII	32.50	0.32	VI
9	Weeding	65.00	0.65	VI	57.50	0.57	III
10	Harvesting and threshing	92.00	0.92	II	75.00	0.75	I
11	Marketing	32.00	0.32	X	-	-	-

(FWKGS) in Madurai, Tamil Nadu, and observed similar results. Table 2 further revealed that the majority of respondents (45.00%) had medium level adoption followed by low (35.00%) and high (20.00%) levels adoption about scientific buckwheat cultivation practices, respectively. Similar findings were imported by Jeeva and Balasubramanian (2007).

Major constraints expressed by the respondents about the cultivation of buckwheat crops are presented in Table 3. The majority of farmers reported non-availability of improved seed (85%) as the major constraints followed by lack of knowledge about varieties with an observed frequency of 71 per cent. The other major constraints reported by the respondent farmers were lack of Govt. support, 70 per cent, and lack of knowledge about the rate of market 68 per cent. Lack of knowledge about marketing (57%) was observed as the constraint faced by the farmers, followed by a lack of knowledge about the medicinal benefits of this crop (50%). The other problems highlighted by the respondents reported that the commercial value of this crop is low as compared to other alternatives (48.50%) and drudgery faced by the farmers for buckwheat cultivation (43.50%). However, the farmers of Ladakh reported that the major constraint is the non-availability of labours (42.50%). The other constraints observed were the low yield of the crop with an observed frequency of 39.50 per cent from the cultivation of buckwheat as perceived by the respondent farmers. The findings were observed by Rana (2012) who studied analyzing problems and prospects of buckwheat cultivation in India. Shah (2013) studied the first report on buckwheat (Fagopyrum Esculentum) from the high-altitude temperate zone of the north-western Himalayan region of Kashmir.

Table 3. Constraints expressed by the farmers about the cultivation of buckwheat

S.No.	Constraints	Percentage
1	Lack of Govt. support	70.00
2	Non-availability of Improved Seed	85.00
3	Low Yield of the Crop	39.50
4	Lack of knowledge about Marketing	57.00
5	Lack of knowledge about varieties	71.00
6	Lack of knowledge about rate of market	68.00
7	Drudgery faced by the farmers for buckwheat cultivation	43.50
8	Non-availability of labours	42.50
9	The commercial value of this crop is low as compared to other alternatives	48.50
10	Lack of knowledge about the medicinal benefits of this crop	50.00

CONCLUSION

It is concluded from that the majority of respondent farmers had a medium level of knowledge and adoption about the recommended practices of buckwheat cultivation. The maximum number of respondent farmers expressed constraints during the investigation and reported non-availability of the improved seeds in the market followed by a lack of knowledge about varieties of buckwheat. However, the new administration is now facilitating the cultivation of buckwheat by imparting training and awareness to the farmers through agriculture university experts and other allied departments in the cold region of Ladakh.

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