



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

Indian Journal of Extension Education

Volume 59, No. 3
July-September 2023

THE INDIAN SOCIETY OF EXTENSION EDUCATION

Division of Agricultural Extension, ICAR-Indian Agricultural Research Institute
New Delhi 110 012, Website : www.iseeiari.org

INDIAN JOURNAL OF EXTENSION EDUCATION

(ISSN 0537-1996, eISSN 2454-552X)

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Indexing

Crossref, AGRIS, CABI, Index Copernicus International, BASE, Google Scholar, Scilit, Semantic Scholar, WorldCat, EBSCO, PlumX, Mendley etc.

EDITORIAL

Food system shocks risk increasing food insecurity, hunger, and malnutrition can disrupt livelihoods, increase poverty, and further diminish prospects for the world's most vulnerable populations. Addressing the "new normal" of more frequent and often overlapping crises requires rethinking national and global responses that build long-term resilience. Hundreds of thousands of locusts are destroying crops in Afghanistan, a country where nine in ten families already struggle to afford food. If left unchecked, the population of locusts could increase hundred fold in the next year. El Niño conditions are compounding the already dry season in Panama and raising concerns that prices for traded goods like food will increase. The proposal for enacting of the Children's Act for Responsible Employment (CARE), which would criminalize current agriculture labor practices that allow for children as young as 12 years old to work on farms, with no limits on labor time or farm type will threaten to long-held family practices and financial livelihood. The destruction of the Kakhovka Dam will directly affect food security, and global wheat supply concerns, increasing prices once again, also, some farmland will be completely destroyed even after the floodwaters recede. Two weeks of continuous rain in regions of China created oversaturated wheat crops and left fields too wet to harvest, causing kernels to sprout too early and consequently produce worse quality flower, the rains are significantly lowering national grain production, which may lead to higher imports and ultimately raise global food prices.

The Indian Society of Extension Education (ISEE), New Delhi celebrated its 60th inception on 22 June 2023 during its National Seminar 2023 on '*Evolving Extension Science towards Secondary Agriculture for Sustainable Development*' at the University of Agricultural Sciences, Bangalore during June 22-24, 2023. The seminar witnessed participation of over 550 scholars, 100 famers, 37 exhibitors across 25 states, 63 universities, and 17 ICAR institutes. Significant recommendations aroused for research, academia, extension professionals, policy planners, governmental and nongovernmental organizations interested in agricultural extension.

The current issue (July-September, 2023) contains 31 manuscripts including two research tools, four research notes, and twenty five full-length research papers from cross-sectional authors and content. The data is regularly being fed to indexing agencies and its indexing at Index Copernicus International Journal Master list, CAB International; ICI; BASE; Google scholar; Scilit; Semantic Scholar; WorldCat; Science gate; Agricultural Science and Technology Information database of FAO, PlumX, Mendley and Crossref. From January 2023, the Indian Journal of Extension Education has been inducted into the UGC CARE List enabling the authors and scholars to quote the publications in IJEE for their personal promotions as well as accreditations for NAAC and other rankings including NIRF.

I extend sincere thanks to all the expert members of the editorial board for their painstaking efforts. The reviewing contributions of not only the editorial team members but many willful contributors are sincerely acknowledged. 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

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Effect of Assured Transit Time for Perishable Farm Produce on Enhancing Farmers' Income: A Case Study of *Kisan Rail* in Context of *Mann Ki Baat*

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ARTICLE INFO

Keywords: *Mann Ki Baat*, *Kisan Rail*, Fruits, Distant marketing, Farmers' income

<http://doi.org/10.48165/IJEE.2023.59301>

Conflict of Interest: None

ABSTRACT

Transporting the farmers' produce from field to market in shortest possible time has great potential to curtail farmers' risk on net profit. Keeping this in view, the Government of India took initiative to operationalize *Kisan Rail* in August 2020 to fill this gap. The initiative got a fillip through its elaboration in a radio program named *Man Ki Baat*. The study aimed to answer the research question whether the *Mann Ki Baat* episode had effect on farmers' knowledge and decision to avail the rail services. Applying a case study approach, the study was carried out in four states of India growing prominent fruit crops including grapes, guava, pomegranate and mango and transporting the produce by *Kisan Rail* from the site of production to distant places. The respondents selected for the study comprised of 8 groups of 20-25 farmers each. Thus, the total sample size for all the four fruit crops included was 200 respondents. The data were collected using personal interviews and Focus Group Discussions and were analyzed using descriptive statistics. The results showed that an appreciable number of farmers got sensitized, and mobilized to avail the services of *Kisan Rail* after 77th episode of '*Mann Ki Baat*' (aired on 30th May, 2021). With increasing probability of getting benefits through access of '*Kisan Rail*', farmers perceived that the risk percentage of perishable agro-produce got minimized. Grape grower farmers from Nasik (Maharashtra) earned a net profit of Rs. 70.0 Lakh by supplying 22.2 thousand quintal by using *Kisan Rail*. Whereas, pomegranate farmers of Solapur (Maharashtra) supplied 2.0 thousand quintals of pomegranate and earned a net profit of Rs. 5.40 Lakh. From Raipur, farmers' group transported 0.54 thousand quintals of guava and earned the net profit of Rs. 0.54 Lakh. The highest net profit of Rs. 28000/q was secured by mango transportation (2.50 th.q) by a group of farmers from Chikkaballapur (Karnataka). The study suggests that *kisan rail* facilitated the transport of farmers' produce from one place to another, secured higher net profit, and minimized the losses, and reduced the involvement of middleman.

INTRODUCTION

India has achieved impressive growth since independence in terms of production of food grains (315 MMT during 2022), fruits and vegetables (342 MMT during 2022) and production of

milk (220 million tonnes in 2022) (<https://www.timesnownews.com/india/economic-survey-2022-23>). However, these indicators do not lead to similar growth in the income of the farmers. Taking away the effect of inflation, real farm income just doubled during past

22 years i.e., 1993-94 & 2015-16 (Chand, 2017). This probably happened as the focus of the government was mainly on raising agricultural output and improving food security rather on farmer's income and welfare. At the same time, India's contribution to wasted food, at 68.8 million tonnes annually, is 7 per cent of the global total and approximately 10 per cent of total food grains (16%) and fruits & vegetable production (15-30%) combined together at national, as estimated by United Nations Environment Programme (Anon, 2022; Food Waste Index Report 2021).

These situations have ignited the policy institutions for seeking the alternatives for increasing farmers' income by adopting the 7-steps model (including technological, market related and policy based measures) as suggested by NITI Ayog of India (<https://www.niti.gov.in/indian-agriculture-towards-2030>) and therefore, the government is having its focus on farmer's welfare and income enhancement. Resultantly, the Government of India has focused its attention on doubling the farmers' income during the seven-year period from 2015-16 to 2022-23, marking a significant departure from past policies of emphasis only on production rather than the marketability of the produce and there has been such successful cases documented by ICAR (<https://www.ncaer.org/project/doubling-farmers-income>).

'In the entire process of farmers' income enhancement, agricultural marketing is most significant one that starts with a decision to produce a saleable farm commodity, involving all the aspects of market structure or system, both financial and institutional, based on technical and economic considerations, and includes pre- and post-harvest operations, assembling, grading, storage, transportation and distribution (National Commission on Agriculture, 1976; Acharya & Agarwal, 2011; Singh et al., 2012; Das et al., 2015). Distance to markets is also important; as an increasing distance to the market increases the probability that the household sells their produce in the proximity. This is joined up with the existing means of transportation, infrastructure, and costs of logistic. With specific reference to Tanzania et al., (2013) categorically established that market access is an important aspect for farmers in raising incomes, reducing poverty, and improving their general welfare. Further, evidences suggest that the social and economic attributes of small farmers and their extent of market use indicate that farmers having access to market outside the region were those who had agriculture as the main occupation and they were having small landholdings (Rajabu et al., 2020). The scholars have also established that if farmers have group attributes and affiliation to any organization, the possibility of marketing their produce outside the region is magnified and ultimately the transactional costs (Raina et al., 2011; Parthiban et al., 2015; Kumari et al., 2022).

The case studies done in Asian countries further revealed that, markets and storage facilities were on an average closer to villages than in the African countries (Hine & Ellis, 2002). In addition, farmers were more able to sell their produce at those markets. In Ghana, the multitude of middlemen that were involved in the marketing process means that even if a farmer is able to get to a market; he may not have the facilities or contacts needed to sell his/her produce at reasonable prices. Thus, the lack of faster and timely transportation facilities implicated farmers to take

lower prices rather than risk not being able to sell their produce in distant places. Mechanized transport methods can improve the efficiency of on-farm agricultural transports by reducing the transport costs and time. The effects on agricultural production can be manifested manifold in the form of deploying larger area under cultivation, reduction of transport time, which could be partly used for income generation, reduced effort and drudgery involved in human portage; and spill-over effects in mechanization of farm operations and transporting the produces. Retail market shall be another important component in marketing of agri-produce. Retail market is estimated to reach USD 1.6 trillion by 2026, registering a CAGR of approximately 10 percent. Share of organised retail will likely increase to 22-25 per cent in 2022 from 12 percent in 2017 (Baskar & Salender, 2022).

Genesis and operationalization of Kisan Rail

The arguments discernibly reveal that farmers, especially small and marginal farmers, often find it difficult to sell their produce in markets beyond a certain distance, primarily due to factors such as non-availability of affordable transport (Das et al., 2014), delay in transit resulting in damage/decay to produce, and unwillingness of road transporters to carry small sized consignments. In order to overcome such hurdles, which have been preventing small and marginal farmers from reaching larger markets, an announcement was made in the Union Budget 2020-21 regarding Indian Railways to set up a *Kisan Rail* for transportation of perishables, inclusive of milk, meat and fish (https://indianrailways.gov.in/railwayboard/uploads/directorate/Secretary_branches/Reforms/Kisan%20Rail%20-%20A%20Boon%20for%20Farmers.pdf). The idea behind running *Kisan Rail* services is to move perishables agri-products from production/ surplus regions to consumption or deficient regions, and speedy movement to ensure minimum damage during transit. *Kisan Rail* is a step to enable farmers to utilize the vast railway network to gain access to distant, bigger and more lucrative markets. Access to such markets will enable farmers to sell their produce at a better price, which will go a long way in fulfilling Government's vision of 'doubling farmers' income. *Kisan Rail* is an enabling factor for improvement in farmers' trade and real returns received by the farmers for their produce. The first Kisan Rail Service was flagged off between Devlali (Maharashtra) and Danapur (Bihar) on August 7 during 2020 by Hon'ble Minister for Railways and Hon'ble Minister for Agriculture and Farmers Welfare. Since the launch of *Kisan Rail* service on 7 August 2020 and upto 31 January 2023, Railways have operated around 2,359 *Kisan Rail* services, transporting approximately 7.9 lakh tonnes of perishables (PIB 2023). The prominent states include Andhra Pradesh (116 onward service), Maharashtra (1868 onward services), Gujarat (62), Uttar Pradesh (76), Madhya Pradesh (74) and West Bengal (44). Up to 31.3.2022, 50 per cent subsidy in freight was granted by Ministry of Food Processing Industries (MoFPI) for transportation of fruits and vegetables by *Kisan Rail*, which was not continued further. Thereafter, Railways have been continuing with the subsidy, at a rate of 45 per cent. This subsidy is presently applicable till 31 March 2023. During 2020-21, Railways disbursed Rs. 27.79 crore as subsidy which was reimbursed by MoFPI. During 2021-22, Railways disbursed Rs. 121.86 crores as

subsidy, out of which only Rs. 50 crores was reimbursed by MoFPI. During the current year up to 31.01.2023, Railways have disbursed Rs. 4 crore as subsidy (Anon, 2022). Apart from direct benefits the farmers had a mental peace also while growing perishable agro-produce because of assured transportation facility and marketing.

Therefore, the operationalization of *Kisan Rail* for last two and half years covering the vast railway network/route across the major states of India raises certain research questions like as to how magnitude of the major fruits are being transported using it, how the *kisan rail* benefitting small scale fruit growers in amplifying their income with lesser investment and how the experiences of *Kisan Rail* operation shall be a running institutional interventions in the benefits of agricultural farmers of India? The present case study may enable us to understand the perspectives of smallholder farmers on *Kisan Rail* that was discussed in *Mann Ki Baat* (episode number 77).

METHODOLOGY

The study followed case study method of investigation. Case study as a technique for presenting data is one of the oldest and important methods (Jocher, 1928) although perceptual mapping have potential (Gupta et al., 2021). The earliest applications of the case method to social research were the historians' descriptive accounts of peoples and nations, followed later by detailed studies of smaller groups, factions, and individuals (Anonymous, 1922). Case studies of contemporary groups and individuals were a later development (Bernard, 1927).

In the common parlance, transport costs are taken as the only variable that varies per unit of distance covered often maximum for bulky and/or perishable items such as timber and dairy products. This has inferences on declining of the production unit if it is away from the market point according to the 'Distance Decay Model', but the rate of decline differs by commodity as hypothesized by von Thünen (1985).

As fruit crops are more perishable, analyzing the case of four major fruits like grapes, pomegranate, mango and guava covering the four major districts namely Nasik and Solapur from Maharashtra, Raipur and Chikkaballpura from Chhattisgarh and Karnataka, were opted respectively. The large proportion of small farmers (75% and more) in these three states were the major criterion for their purposive selection. The two types of data viz. primary data from the groups of farmers cultivating these crops; and secondary data (the monthly details of these selected four

fruit crops transported from the identified district railway station using *Kisan Rail*) were procured from railway official records for the period of August 2020 to March 2023. Researchers interacted with a set of key sampled farmers in a group (usually comprising 20-25 farmers per group). Thus, the sample size for all the four fruit crops included 200 farmers as respondents representing eight groups, who were interacted using the checklist devised for the purpose.

Mainly physical mapping, transportation related indicators and economic parameters were utilized for the study. Physical mapping included the names of farmers' led group or business organization, their membership strength and total area (acre) actually under cultivation of that crop by the given group members. Likewise, transportation related parameters included quantity of the produce transported (q), their total commercial value as per the standard norms adopted by the *Kisan Rail* (lakh Rs.), number of farmers groups availed this facility for the given crop and the subsidy given by the *Kisan Rail* (lakh Rs.). The major economic indicators included the net profit earned by the group as a whole (lakh Rs) as well as individual farmer (Rs/q). The collected data were subjected for descriptive statistics using mean and unit value to draw the meaningful inferences from this study.

RESULTS AND DISCUSSION

Major fruits transported through *Kisan Rail* during 2020-23 were grapes, pomegranate, guava and mango from Nashik, Solapur, Raipur and Chikkaballpura, respectively (Table 1).

Grapes

Nashik is the leading grape producer in the country and also known as grape capital of India producing about 10 lakh tonne grapes from 1.75 lakh ha with a productivity about 20 tonne/ha. It was learned that total 10 farmers group transported 35 q grapes valued Rs. 110 lakh and a subsidy of Rs. 70 lakh was provided by the government for transportation of 35 q grapes from Nasik (Maharashtra) (Table 1). The survey results revealed that 15,000 farmers covering 15000 acre of area under grapes cultivation associated with Shayadri Farm Supply Chain Limited group supplied 22.2 thousand quintal grapes. They have earned a net profit of Rs. 70.0 Lakh from this supply (Table 2 & 3). *Kisan Rail* levied charges of Rs. 400/q for transportation, subsidy was Rs 200/q and net profit of Rs 5000/- per quintal was attained by availing *Kisan Rail* facility from Nasik (Maharashtra) (Table 3).

Table 1. Details of different fruits transported through *Kisan Rail* in major states of India during 2020-23

State	District	Fruit crops	Transportation parameter			
			Quantity transported (q. th.)	Total value (Lakh Rs.)	Number of farmer groups availed this facility	Subsidy given by <i>Kisan Rail</i> (Lakh Rs.)
Maharashtra	Nasik	Grapes	35.00	110.00	10	70.00
	Solapur	Pomegranate	19.20	63.31	05	32.50
Chhattisgarh	Raipur	Guava	5.30	2.70	Aggregator	0.14
Karnataka	Chikkaballpur	Mango	2.50	0.40	04	0.20

Source: Secondary data collected from railway officials for *Kisan Rail* Service

Table 2. Physical mapping of promising horticultural produces being transported using *Kisan Rail* in India

State	District	Crops	Major operating Farmers Group	No. of farmer members associated	Area covered (Acre)
Maharashtra	Nasik	Grapes	Sahayadri Farm supply chain limited	15,000	15,000
	Solapur	Pomegranate	Maresh Annada Bandgar	100	96.00
Chhattisgarh	Raipur	Guava	By aggregator	10	10.00
Karnataka	Chikkaballapur	Mango (Alphonso)	Maavu Belagara Sangh	25	136.00

Source: Authors' survey based findings

Table 3. Economic analysis of promising horticultural produces being transported in the selected states of India

State	District	Crops	Total Quantity Transported (th. q)	Charges of Kisan Rail (Rs./q)	Subsidy (Rs./q)	Net profit earned (Lakh Rs.)	Net profit earned per farmer (Rs./q)
Maharashtra	Nasik	Grapes	22.2	400	200	70.00	5000(Rs. 50/kg)
	Solapur	Pomegranate	2.00	540	270	05.40	5625(Rs. 56/kg)
Chhattisgarh	Raipur	Guava	0.54	203	101	00.54	2727(Rs. 27.27/kg)
Karnataka	Chikkaballapur	Mango(Alphonso)	1.25	560	280	7.0	28000(Rs. 280/kg)

Source: Authors' survey based findings

Pomegranate

Nashik in Maharashtra is a major pomegranate growing district with an area of 0.5 lakh ha and production is 6.79 lakh MT, followed by Solapur district (area: 0.2 lakh ha; production: 1.69 lakh MT) with average productivity of 50 q/ha (Kharat et al., 2019). Total 5 farmers group transported a total of 19.2 q pomegranate valued Rs 63.31 lakh, and a subsidy of Rs 32.50 lakh was provided by the Govt. for transportation of 19.20 q pomegranate from Solapur (Table 1). The survey results revealed that 100 farmers covering 96 acre area under pomegranate cultivation associated with *Maresh Annada Bandgar* group. This group has supplied 2.0 thousand quintal pomegranate and could earn net profit of Rs. 5.40 Lakh (Table 2 &3). *Kisan Rail* levied charges of Rs. 540/q for transportation, subsidy was Rs. 270/q and net profit of Rs. 5625 per quintal was attained by pomegranate farmers by availing *Kisan Rail* facility from Solapur (Table 3).

Guava

Farmers of Chhattisgarh have been gaining increased income from guava cultivation that resulted in increasing the area (47%) and production (67%). Raipur district is one of the major guava producing districts in the state which produces 7403 metric tonnes of guava (<https://timesofindia.indiatimes.com/city/raipur/>). Aggregators from Raipur (Chhattisgarh) transported 5.30 thousand q guava valued Rs. 2.70 lakh, and a subsidy of Rs 0.14 lakh was provided by the Govt for transportation of guava from Raipur (Table 1). Data analysis exhibited that group of 10 farmers covering 10 acre area under guava cultivation associated with aggregators group supplied 0.54 thousand quintals of guava. They could earn a net profit of Rs. 0.54 Lakh (Table 2 &3). *Kisan Rail* levied charges of Rs. 203/q for transportation; subsidy was Rs. 101 per q and net profit of Rs. 2727 per quintal was attained by guava farmers from availing *Kisan Rail* facility from Raipur (Chhattisgarh) (Table 3). During conversation with farmers, one of them had

narrated the benefits of *Kisan Rail* facilitated with *Mann Ki Baat* was as:

“Pradhan Mantri jee ke bahut bahut dhanyavad. 2021 mein ham radio pe Mann ki Baat me sunae ke tarkaree (sabjee) aur doodh khatir ego train kisan ke khatir chalat bate, hum aaree kisan logun se baat kar ke aapna bihi (guava) kae kissan rail se bhejal suru kainee je se hamar bihi khrab hokhe se bache lagal, mandi ke bichouliyan se bhee chhut milal aur munaf a bhee badh gayeel (Expression of a farmer)”

This local perception of farmer indicated that how enabling environment being created through *Kisan Rail* and facilitated by mass media messages (*Mann Ki Baat* by Hon'ble PM) can make a significant change in curtailing the farmers' risks in terms of losses incurred on perishable items.

Mango

Chikkaballapur (Karnataka) is known for early harvest of mango in Karnataka and farmers are fetching good prices for growing different varieties of mango such as Alphonso, Banganapalle, Imam Pasand, Senthooora, Kesar, Mallika etc. (<https://www.thehindu.com/news/national/karnataka/>). Total area covered by Mango crop in Chikkaballapur is about 0.46 lakh ha producing 3.7 lakh MT mango with a productivity of 80 q/ha (Chandra et al., 2020). Total four farmers groups transported 1.25 thousand q mango valued Rs 0.40 lakh and a subsidy of Rs 0.20 lakh was provided by the government for transportation of mango from Chikkaballapur (Karnataka) (Table 1). Observation indicated that 25 farmers covering 136acre area under mango cultivation associated with Maavu Belagara Sangh group supplied 1.25 quintal mango, and were able to earn net profit of Rs. 7.0 lakh (Table 2 &3). *Kisan Rail* levied charges of Rs. 560 per q for transportation, and subsidy was received for Rs. 280 per q. There was net profit of Rs. 28000/q by the mango farmers by availing *Kisan Rail* facility from Chikkaballapur (Table 3). The value chain analysis of pulses also showed that transportation cost has the share

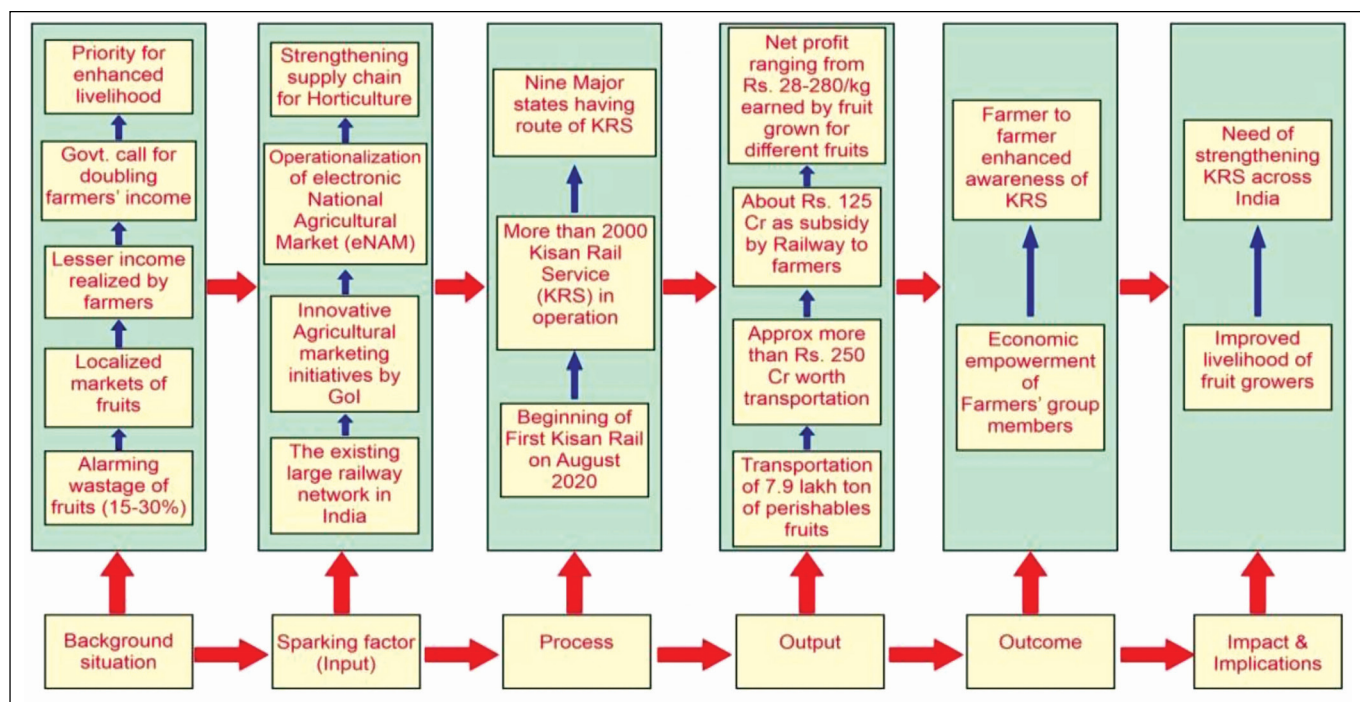


Figure 1. Result Framework of Kisan Rail for transporting the major fruit crops across India

of 15-18 per cent of the total cost (Sah et al., 2022) and also the scenarios analysis of pulses in Bundelkhand region aptly highlighted the issue of marketing of produce from the actual site to its desired destination (Sah et al., 2021), and if Government has support in transportation as being done by *Kisan Rail*, shall have far reaching implications. Based on such insights of success noted from four fruit crops, a result framework of *Kisan Rail* service for transportation of major fruit crops has been illustrated as in Figure 1.

CONCLUSION

Kisan Rail provide a seamless and cost-effective mode of transportation for farmers, enabling them to access larger markets for assured marketing of their produce and fetching better prices. It also helps in reducing wastage by ensuring the timely delivery of perishable goods. Findings of the study helped to understand how *Mann Ki Baat* sensitized the farmers that *Kisan Rail* service is instrumental for distant placement of perishable fruits timely and in safest mode to consumers as well as agribusiness processing industries. The fruit growers' net income has been also proved to be doubled (150-200%) using *Kisan Rail* service as compared to those who sold otherwise. The benefits of *Kisan Rail* are manifold including a reliable and efficient transportation system for farmers to transport their produce, which helps them in accessing new markets and earning higher profits. The refrigerated coaches ensure the quality and freshness of the produce, reducing wastage and increasing the value of the goods. In summary, *Kisan Rail* is a beneficial initiative that aims to help institutionalization of farmers group through assured transportation and marketing of perishable agri-produce reducing wastage and promoting economic growth and negate the hypothesis of distance decay model.

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Influence of ‘Mann Ki Baat’ on Farmers Producer Organizations (FPOs): Lessons from Successful Cases

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ARTICLE INFO

Keywords: Farmer Producer Organizations (FPOs), *Mann Ki Baat*, *Krishi Vigyan Kendras* (KVKs), Farmers, Schemes, Shareholders, Technologies, Inputs and Market

<http://doi.org/10.48165/IJEE.2023.59302>

Conflict of Interest: None

ABSTRACT

The Hon'ble Prime Minister of India has been addressing the nation every month since 2014 on the emerging issues of national and international importance through his *Mann Ki Baat* programme in radio. The issues related to agriculture and allied sectors covered in the programme have attracted the attention of farmers as well as the change agencies. The importance of Farmers Producer Company (FPOs) and its role in strengthening the farmers' income were highlighted in *Mann Ki Baat*. The present study was undertaken to assess the effect of the episodes on the farmers as well as the FPOs. An integrated approach of survey and case study method with *ex-post-facto* research design was followed. Using purposive sampling, 44 FPOs were selected from across the country covering 40 districts from 19 states for the study. The survey results showed that 98.50 per cent of the FPOs were formed during the PM's *Mann Ki Baat* programme (2014-2023), FPOs had the highest shareholders of 4409 and paid-up capital of Rs. 1.31 crore. The business of FPOs covered almost all major crops, seed production of important crops, sale of agricultural inputs especially fertilizers and pesticides, custom hiring and value-added products. Successful cases of entrepreneurship development in FPOs were observed e.g., Puthari Farmers Producer Co Ltd., Kodagu, Karnataka operating at 10000 ha land of plantation crops with a turnover of Rs. 2.20 crore. Due to collective action, there was a reduction in the cost of cultivation by 20-25 per cent. FPOs' feedback indicated that with *Mann Ki Baat* episodes most of them became aware about the different policies and schemes. The FPOs are ensuring several benefits to member farmers like acquainting with different government schemes, delivering inputs at doorsteps, reducing cost of cultivation and so on. However, there is a need to strengthen FPOs through further support of government and allied departments. With awareness and increasing access to institutional resources through the enabling environment, being made by *Mann Ki Baat*, the employment opportunities and livelihood resilience of farmers will be improved.

INTRODUCTION

“Unity is strength and the farmers will progress towards prosperity with collective approach”. The organised strength of the farmers will help to reduce the transaction cost on one hand (Parthiban et al., 2015; Gorai et al., 2022) and realize remunerative

prices to them on the other hand. In fact, over the years, the farm holding size has reduced to less than 1.10 hectare and nearly 86 per cent of farmers in the country are marginal farmers. These small holding farmers face tremendous challenges like access to technology, quality seed, fertilizers and pesticides including farmers credit and difficulty in accessing the market due to low marketable

surplus and hence fail to realise remunerative prices for their produce. Farmers, especially small and marginal, do not directly trade in India. Their small size, lack of trust and understanding of futures market and dependence on middlemen, are some of the main deterrents (Chatterjee et al., 2019).

The concern is to unite these small and marginal holders and link them to the markets. To link small holders to input and/output markets several attempts have been made in the form of cooperatives, Self Help Groups (SHGs), Farmers Interest Groups (FIGs), Commodity Interest Groups (CIGs) etc. However, the success achieved was limited and these institutions were dealing with only a part of the supply chain. In the recent past, several organizational prototypes are emerging to integrate small and marginal farmers in the form of Farmer Producer Organizations (FPOs) to provide benefits through collective action (Singh et al., 2021; Kumari et al., 2022). The main aim of the formation of FPO is to establish basic business principles among farming communities, to bring industry and agriculture closer together, and to boost rural development (Sharma, 2008) by organising of the farmers especially small and marginal farmers to address the challenges faced by farming community (Kyriakopoulos et al., 2004; Valentinov, 2007; Singh et al., 2014; EevaAlho, 2015; Singh et al., 2016; Singh et al., 2021; Rathour et al., 2022). This concept allowed farmers to improve their economic position within the production system and offered better scope for income enhancement through cost saving and efficient use of inputs by facilitating better crop planning, crop insurance and integrating them with knowledge sources.

Every month through *Mann Ki Baat* programme in All India Radio, Hon'ble Prime Minister of India has been addressing the citizens of India on various issues of national importance and pride calling for attention and collective action. The first *Mann Ki Baat* programme was broadcast on the occasion of Vijayadashami on 3 October 2014 followed by the second broadcast on 2 November 2014. So far (March 2023), 99 episodes were successfully completed and in the process our Honble Prime Minister has established personal reach to every common of the country. The *Mann Ki Baat* programme has been well received by the target audience across the country and created required impetus among audience towards the issues addressed and action called for.

Among various issues focused by the Hon'ble Prime Minister in his *Mann Ki Baat* address, the issues related to agriculture and allied sectors gained special attention from the audience. The importance of Farmers Producer Company (FPOs) and its role in strengthening the farmers' income were highlighted by him motivated the farmers to understand the functioning of FPOs and also gave them required confidence in the formation and running of FPOs. Several successful FPOs were lauded by the Hon'ble Prime Minister. In 97th episode of PM Mann Ki Baat, it was mentioned by him that *'The Aland Bhootai Millets Farmers Producer Company started working last year in Kalaburgi, Karnataka under the supervision of the Indian Institute of Millets Research. People are liking the khakra, biscuits and laddoos produced by the company. In Karnataka's Bidar district, women associated with the Hulsoor Millet Producer Company are cultivating millets as well as preparing their flour. Through this, their earnings have also increased considering. Farmers from 12 states have joined the*

FPO of Chhattisgarh's Sandeep Sharma, who is associated with natural farming. The FPO of Bilaspur is making eight types of millets flour and their dishes". Today, the mantra of collective strength yielded progress to members of Farmer Producer Organization started in Chitrakoot" (Prime Minister Narendra Modi, February 29, 2020). The study was conceptualized to know the status, lessons learnt, feedback and way forward from selected FPOs across the country that are under technical guidance of KVKs.

METHODOLOGY

The exploratory research design was used in the study. An integrated approach of using survey and case study method was followed. A total of 11 Zones (states and areas where Agriculture Technology Application Research Institutes operate and supervise the Krishi Vigyan Kendras) across the country were sampled purposively based on the concentrated efforts made on FPOs in those areas. The range of three to five FPOs were purposively and randomly selected from each Zone as sample making a total of 44 FPOs from 11 Zones including Zone-I (Ludhiana), Zone-II (Jodhpur), Zone-III (Kanpur), Zone-IV (Patna), Zone-V (Kolkata), Zone-VI (Guwahati), Zone-VII (Barapani), Zone-VIII (Pune), Zone-IX (Jabalpur), Zone-X (Hyderabad), and Zone- XI (Bengaluru). A total of 40 districts from 19 states were covered by these 44 FPOs. Zone, state and district wise selected FPOs for the study presented in Table 1.

Well-structured schedule with open ended questions was developed for the collection of primary data. The data on status and management structure of FPOs were collected in a prescribed schedule. Information related to influence of PM *Mann Ki Baat* programme, listing out the lessons learned and way forward for increasing the effectiveness of FPOs were collected through open-ended questions. Before collecting the data, Subject Matter Specialists (SMSs) from KVKs (those who collected the primary data), were trained about the skill and knowledge required in collecting data. Interviews with the FPO members were held in local language to have proper understanding of the context of PM *Mann Ki Baat* and for getting reliable information. Using descriptive statistics, including frequency and percentages, data were analysed to draw meaningful and logical inferences.

RESULTS AND DISCUSSION

State of art of FPOs guided by KVKs

Formation and business objectives: The state of art of FPOs guided by KVKs across the Zones in the country presented in Table 2 indicated that 98.50 per cent FPOs were formed during *PM Ma Ki Baat* Programme (2014–2023) and only two FPOs viz., Nachalur Farmers Producer Company Ltd. (2012) in Zone-X (Hyderabad) and Somnath Farmers' Producer Company Ltd. (2013) in Zone-VIII, Pune were formed before *PM Mann Ki Baat* Programme. The business of FPOs covered almost all major crops including cereal, millets, vegetable, fruits; seed production of important crops like paddy, wheat, vegetables of their local/regional demand; selling of agricultural inputs especially fertilizers and pesticides; agricultural machineries and implements (custom hiring); and value-added products.

Table 1. Zone, state and district wise list of selected FPOs for the study

Zone	Location	State	District	FPOs (No.)
I	Ludhiana	Himachal Pradesh	Mandi	1
		Punjab	Amritsar	1
		Punjab	Moga	1
Total		2	3	3
II	Jodhpur	Rajasthan	Ajmer	1
		Rajasthan	Barmer	1
		Rajasthan	Bundi	1
		Rajasthan	Bhilwar	1
Total		1	4	4
III	Kanpur	Uttar Pradesh	Agra	1
		Uttar Pradesh	Barabanki	1
		Uttar Pradesh	Kaushambi	1
		Uttar Pradesh	Pratapgarh	2
Total		1	4	5
IV	Patna	Bihar	Darbhanga	1
		Bihar	Nawada	1
		Jharkhand	Godda	1
		Jharkhand	Gulma	1
		Jharkhand	Ranchi	1
Total		2	5	5
V	Kolkata	Odisha	Balasore	1
		Odisha	Khordha	1
		Odisha	Nuapada	1
Total		1	3	3
VI	Guwahati	Assam	Kamrup	3
Total		1	1	3
VII	Umiam	Manipur	Chandel	1
		Manipur	Kakching	1
		Manipur	Thoubal	1
		Nagaland	Peren	1
		Tripura	North-Tripura	1
Total		3	5	5
VIII	Pune	Gujarath	Junagarh	1
		Gujarath	Patan	1
		Gujarath	Surath	1
		Maharashtra	Beed	1
Total		2	4	4
IX	Jabalpur	Madhya Pradesh	Chhatarpur	1
		Madhya Pradesh	Narmadapuram	2
Total		1	2	3
X	Hyderabad	Andhra Pradesh	Anakapalli	1
		Andhra Pradesh	Tirupati	1
		Tamil Nadu	Erode	1
		Tamil Nadu	Karur	1
		Telangana	Hanumakonda	1
Total		3	5	5
XI	Bengaluru	Karnataka	Bidar	1
		Karnataka	Kalaburagi	1
		Karnataka	Kodagu	1
		Kerala	Alappuzha	1
Total		2	4	4
Grand total		19	40	44

Shareholders and share capital

Distribution of FPOs based on their shareholders and share capital is presented in Table 3. Data regarding shareholders indicated that majority of FPOs (50.00%) had less than 500 shareholders followed by 34.09 per cent FPOs had in the range of 501-1000 shareholders and 15.91 per cent FPOs had more than 1001 shareholders. However, lowest shareholders (130) FPO is Chandel United Farmers Cooperative Society Ltd., in Zone-VII and the highest shareholders (4409) FPO is Krushidhan Producer Company Ltd., in Zone-VIII. Majority of FPOs (75.00%) had less than Rs. 10 lakh share capital followed by 6.82 per cent FPOs in the range of Rs. 10-20 lakh, 9.09 per cent FPOs in the range of Rs. 20-30 lakh, 2.27 per cent FPOs in the range of Rs. 30-40 lakh, and 6.82 per cent FPOs had more than Rs. 40 lakh share capital.

However, FPO wise analysis revealed that the Puthari Farmers Producer Co Ltd., in Zone-XI subscribed highest share capital of Rs. 1,31,15,416 (Rupees one crore thirty-one lakh fifteen thousand four hundred sixteen). On the contrary, Mandia Cooperative Farmer Producer Organisation Ltd., in Zone-VI subscribed a lowest share capital of Rs. 20000 (Rupees twenty thousand).

Successful cases of FPOs

Some FPOs clearly expressed their path of accomplishment of their entrepreneurship and in most cases, the extent of success is measurable in terms of growth of the business that led to enhancement of income benefits among the shareholders. Such cases of FPOs are many some of them as examples are narrated here. After PM *Mann Ki Baat* programme, the FPO named as Hulsoor Mahila Kisan Millets Producer Company Ltd guided by KVK in Bidar district of Karnataka had established Secondary Processing Unit and supplied of millet seeds and products through GeM to Navodaya Schools from Telangana and Andhra Pradesh. In view of its performance mention of it in the *Maan Ki Baat*, 27 Indian Technical and Economic Cooperation Programme (ITEC) of MANAGE participants from 17 countries visited to this FPO to study challenges involved in providing services to farmers through FPOs. Similarly, Aland Bhootai Millets Farmers Producer Company Ltd., guided by KVK in Kalaburagi district of Karnataka started supply of millet products to various states such as Gujarat, Rajasthan, Chhattisgarh, Orissa, Telangana and Maharashtra through GeM, ONDC-my store and FPO kisan Bazar. Both FPOs exhibited their products at Shree Anna Global Conference held on 19 March, 2023 at IARI, Pusa New Delhi.

Some of the case studies of FPOs encouraged by PM's Mann Ki Baat included 9 specific cases. The first one named Nachalur Farmers Producer Company Ltd., started on 12/06/2012, guided by KVK in Karur district of Tamil Nadu is carrying out business through input shop, seed processing unit, Value addition unit, providing weather advisory to farmers, insurance support, farm equipment hiring centre, start content measuring in tapioca etc and recorded positive balance sheets for nine years and reached more than Rs. 15 crore turnover since its formation. Second case was of Somnath Farmers Producer Company Ltd., started on 09/03/2013, guided by KVK in Gir Somnath district of Gujarat has established a cattle feed unit with making different six products

Table 2. State of art of FPOs guided by KVKs across the Zones in the country

Zone	FPOs (No.)	Period of formation	Business objectives/main crops/commodities
I	3	2016-2022	Jaggery, mustard oil, IFFCO cattle feed, pulses, wheat, paddy, basmati paddy, tomato, spices, oilseeds processed products and other agriculture-based products.
II	4	2015-2022	Rose, Pomegranate, seed production, milk and its products, animal feed, vegetables, fruits, and herbs.
III	5	2021-2022	Chilli, banana, mustard, millets, maize, bajara potato, paddy, wheat, vegetables, kinnow, mango, fish, animal husbandry and dairy products, green fodder, vermi compost, mushroom, seed production, organic and natural farming, organic fertilizers food grains, and value-added products.
IV	5	2019-2022	Vegetables, seed production, paddy, wheat, mustard, green gram, linseed, makhana, maize, chickpea, banana, mango, apiary, handicrafts, milk and value-added products.
V	3	2019-2022	Millets, pulses vegetables, vermicompost, cattle feed, agri-input, and forest honey.
VI	3	2017-2022	Mustard, maize, vegetables, potato, paddy, arecanut, banana, fruits, assam lemon and pickles.
VII	5	2021-2022	Chilli, jackfruit, turmeric, ginger, pineapple, lemon, seed production, mushroom, piggery, poultry, fisheries, mini feed and rural mart.
VIII	4	2013-2016	Groundnut, cotton, wheat, gram, soybean, sunflower, sesame, karadai edible oil, cumin (jeera), castor, coriander, carom (ajwain), fennel (saunf), fenugreek (methi), mustard, vaidikbilon ghee, panchgavya soap, gulab, mogra, kasturi, essence sticks, laldantmanjan and kala dantmanjan (tooth powder) and natural immunity boosters, pesticides, seeds, organic inputs and agricultural equipment.
IX	3	2021-2022	Greengram, seed production and chilli powder.
X	5	2012-2019	Paddy, millets, vegetables, pulses, oilseeds, mango, coconut, cashew, farm equipments, agri inputs and value-added products.
XI	4	2016-2021	Millets, paddy, pulses, spices, seed production, jaggery, black pepper grading, mini oil extraction unit, agricultural inputs, custom hiring, and rural mart.
	44	2012-2023	

Table 3. Distribution of FPOs based on their shareholders and share capital

Particulars	Distribution of FPOs (%)
Less than 500	50.00
501-1000	34.09
More than 1001	15.91
Total	100
Share capital	
Less than Rs. 10 lakh	75.00
Rs. 10 - 20 lakh	6.82
Rs. 20 - 30 lakh	9.09
Rs. 30 - 40 lakh	2.27
More than Rs. 40 lakh	6.82
Total	100

and gave 53 dealerships in the district and now turnover is approximately Rs. 1.60 crore. Third case refereed to Pushkar Rural Agricultural Youth and Employment Producer Company Ltd., started on 16/11/2015, guided by KVK in Ajmer district of Rajasthan is engaged in fruits and flowers production like Jamun, Phalsa, Amla, Lisoda, Chrysanthemum, Marigold, Pink Rose etc., and made business revenue transactions of Rs. 8648723 (audited) in 2020-21 and crossed turnover of Rs. 2.00 crore in 2022-23. Further, this FPO, not only gave financial benefits to farmers but also provided employment to rural people and there are 9 persons permanently and 15 persons casually works in FPO processing unit. Fourth case was Puthari Farmers Producer Co Ltd., started on 8/03/2017, guided by KVK in Kodagu district of Karnataka, probably the Largest farmer organization in plantation sector with about 10000 ha coverage, dealing with 430 products including manures, fertilizers, plant protection chemicals, irrigation pumps,

sprinkler and drip irrigations items, farm machinery etc., and achieved turnover of Rs. 2.20 crore per annum as well as reduced in cost of cultivation by 20-25 per cent through its collective efforts. Asandra Farmer Producer Company Ltd., started on 21/07/2021, guided by KVK in Barabanki district of Uttar Pradesh is a growing FPO in field of Vegetables, good quality inputs (Seed, Fertiliser and Pesticides) with its business turnover of Rs. 2.17 lakh in 2021-22 and Rs. 7.57 lakh in 2022-23. Aman Shree Farmer Producer Company Ltd., started on 14/12/2021, guided by KVK in Nawada district of Bihar had its business in value-added products like Moong dal, Masoor dal, Chana Dal, Arhar Dal, and Mustard oil etc., and achieved annual turnover of Rs.1.47 lakh. FPO named as Balh Valley Adarsh Kisan Sabji Utpadak Sahkari Samiti simit Balh Sthit Sayohli, started on 27/01/2022, guided by KVK in Mandi district of Himachal Pradesh had its business on sale of tomato and other vegetables, seeds, fertilisers, pesticides, implements etc and achieved turnover of Rs. 47.87 lakh till date. Ratnagarbha Krashak Utpadak Sahkari Samiti Ltd., started on 25/03/2022, guided by KVK in Hoshangabad district of Madhya Pradesh had its main activities on pulses seed production especially moong and agri-inputs and achieved business turnover of Rs. 4.50 lakh in 2022-23. It is worth to note that women formed as FPO named as Jayadev Pitha Women Farmers' Producer Company Ltd., started in 29/10/2022, guided by KVK in Khordha District of Odisha had its business activities on mainly in the production of vermicompost and cattle feed with which they earned a net profit of Rs. 3.00 lakh within a short span of time.

The turnover of selected 9 FPOs ranged from Rs. 3.00 lakh to Rs. 220.00 lakh. This may be due to the business activities adopted by the respective FPOs as well as year of establishment. Though, the turnover of some of the FPOs is low, but the growth

in post Mann Ki Baat scenario provides opportunities for increasing the scale in futures. The observations are almost in conformity of the study on Farmer Producing Organisations for Development of Farmers in India: An economic perspective by Darshan et al., (2017) wherein they stated that the analysis of cases of FPOs revealed a positive impact on the economic development of farmers. The FPOs have helped to organize the small and marginal farmers to improve their standards of living by providing assured income, employment, better technologies of production and post-harvest management activities. Since the collective action of farmers given positive results, it can be advisable to initiate and sustain the FPOs across the country to improve the agricultural contribution to GDP and to retain small and marginal farmers in agriculture. Further, Vendasri et al., (2021) revealed that the group members were able to earn higher incomes, small farmers performed the marketing activity and take all the benefits accrued from FPOs which improved the income of small farmers. FPOs were instrumental in reduction of transaction cost and number of intermediaries leading to the realization of a higher proportion of producer's share in consumers rupee.

Feedback on PM Maan Ki Baat Programme

The topics like soil health cards and soil fertility, natural farming, organic farming, zero budget farming, per drop more crops, importance of millets, use of drip irrigation, nutritional security by growing of legume, organic fuel and so forth were discussed to the farmers during different episodes of PM *Mann Ki Baat* Programme. The FPO-Hulsoor Mahila Kisan Millets Producer Company Ltd in Bidar district and Aland Bhootai millets FPO in Kalaburagi district of Karnataka and Tribal FPO in Sundargarh district of Odisha on millets have got wide publicity throughout the country due to their coverage live in 97th episode of PM Maan Ki Baat Programme. Similarly, in 99th episode, covered FPO in Dal Lake of Kashmir who started exporting Kamal Kakdi, locally called as Nadru to foreign countries. Hon'ble, Prime Minister's 10000 FPO policy by Government of India has motivated the farmers and farmwomen for formation of Farmer Producer Organizations/Companies. FPOs expressed that they came to know about different schemes like PM Kisan Saman Yojna, PM Krishi Sichai Yojna, PM Fasal Bima Yojna, PM Formalisation of Micro food processing Enterprises (PMFME) Scheme etc. Farmers are looking forward to work with Government institutes to get handholding support for providing good agricultural services, happy in terms of quality input procurement and lot of scope for need based output marketing at grass root level and problem of being exploited by middle men has been solved some extent after formation of FPOs. PM *Mann Ki Baat* Programme also motivated the farmers and FPOs in the way of increasing shareholders/memberships in FPOs. Farmers get united and formed FPO to become self-sufficient, mutual assistance, welfare measures, financial services along with insurance of producers of their primary produce, and enhanced bargaining power of the farmers and developed a sense of ownership among them, as a result input cost is reduced by 10-15 per cent due to the direct procurement of inputs like seeds, fertilizers chemicals etc. and getting almost 5-10 per cent more price than market price. However, few FPO Members are

still demanding for marketing security. Some FPO members if missed to see the live programme of PM Maan Ki Baat, they used to see later on in the YouTube and felt strengthen through the FPO activities.

Lessons learned and way forward

There is a need to work with SHGs or FPOs which helps in gaining various facilities through different schemes implemented by the Government and allied departments. Training and motivation changes skill and attitude of the farmers for enhancement of business in group mode at one platform. Therefore, an appropriate capacity building method should be adopted to train the people involved in the management of FPOs or prescribe some qualifications for the office bearers of the FPOs. This will help in effective management of FPOs and to make FPO members and office bearers capable of making appropriate and timely decisions.

FPOs face the major problem of lack of working capital and the tedious procedures involved in compliance of the company laws and statutes. There are significant barriers to access to credit and regulatory compliances which are difficult for budding FPOs to meet in lieu of the registration acts and most financial institutions require collaterals and at least three years of balance sheets for credit assessment. Lack of fund is a constraint for engaging professionals in the areas of value addition and marketing management to compete with corporate marketing and processing agencies. Hence, relief to FPOs from a penal provision in case of certain non-compliances and handholding support from government institutions (promoting departments) at least for the first five years to become self-sustainable would boost their growth. FPOs do have certain limitations related to negotiation, existing market intelligence, market infrastructure, supply and market chains for getting optimum price for the produce. Further, farmers themselves as managers of the company for taking up processing and marketing activities do not appear to be a viable proposition in some of the FPOs. Therefore, promoting institutes should involve themselves more and more with FPOs so that they can help them in extending maximum benefits from FPO schemes, establishment of agri-enterprises, creation of infrastructure and storage facilities, value addition and processing, efficient commodity pricing mechanism through business network etc. On the other hand, FPO's have to create their logos, own brand and trade mark for raw as well as processed commodities for improving marketing and price realization. For example, Banas Farmers Producer Company Limited in Patan district of Gujarat has launched its own brand – Chorad Jeera and Hulsoor Mahila Kisan Millets Producer Company Ltd has planned to expand the value-added products by up scaling millet processing plant under AIF (Agriculture Infrastructure Fund). A Policy should be developed to establish the FPOs as the grassroots organisation for delivering extension services effectively. Besides, FPOs can resort to retailing activities which will enhance members share in consumer rupee.

In fact, supply of quality inputs like seeds, fertilizers, compost and animal feed at the door step has helped the farmers to avoid purchase of spurious and low-quality inputs at high prices. This helped to reduce their cost of cultivation almost 20-30 per cent and also led to increased production as well as better price

realization for their produce and ensured 20 to 30 per cent more returns to the farmers. A conducive environment may be created by the Government for extension of business of FPOs. For example, the FPO-Jale Makhana Kisan Utpadak Sangathan Sahkari Samiti Limited in Darbhanga district of Bihar looking forward to extend the Makhana production area, processing sector and provide a recognition to makhana at national market. Measures to overcome social and cultural constraints by focussing on allied sectors as well as non-agri products and rural entrepreneurial activities are required. Most of the FPOs were not aware of export market to tap export market. Hence, strengthen the ways and means to export the crop produce with the help of FPOs to International markets for getting direct benefit to farmers. Banas Farmers Producer Company Limited in Patan district of Gujarat has aimed to venture into export of Cumin in another 5-7 years' time. The FPC has started its due diligence on the same.

Establishment of Food processing cluster as well as formalizing a consortium of FPCs and establishment of warehouse to ease farmers to store their produce at FPO level are need of the hour for effective operations and expanding market linkages as well to form a registered federation. Need to focus on commodities not perceived by the Government as 'sensitive' from food security point of view, identify production centres and build delivery centres around them, upgrade their knowledge and skills about trading, scaling the efforts and support of linking FPOs to the upcoming markets. Verma et al., (2019) learned from the functioning of FPOs that if FPOs are considered as a promising approach to ameliorate the condition of small and marginal farmers, there should be a proper mechanism for selecting members, selection based on cropping pattern or on region, idea of product differentiation. In our field survey, and incentive-based model.

CONCLUSION

The PM's *Man Ki Batt* programme has brought confidence among FPO members and created awareness about different schemes and policies of Government of India. The FPOs are ensuring several benefits to member farmers like acquainting with different government schemes; delivering inputs at door steps; reducing cost of cultivation; providing custom hiring services; dissemination of good agricultural practices; increasing bargaining power; accessing to digital platforms such as eNAM, ReMS and NCDEX services; more remuneration for produce; and such others. However, there is need to strengthen FPOs through the support of government and allied departments by creating policy approach to FPOs on capacity building; capital and credit; infrastructure and market linkages; inputs and agri-practices; shareholders and scale up of activities; and commodities and export market; making consortium of FPCs as federation; and incentive-based FPO model for effective functioning of FPOs. Further, leveraging from the new environment being created with *Mann Ki Baat*, the FPOs have potential to act as a catalyst of change in economic system of our country through scaling up of business and capacity-building activities to cover both member and non-member farmers. There is plentiful scope for FPOs to utilize the potential of women shareholders for promoting their branding and value-addition activities. There are many policies which can be converged at FPOs for supporting it initially and help the institutions take the next step

further. The long-term effects of FPOs on food production, natural resources (land and water) and linkages with poverty alleviation may be further explored. The new generation FPOs are designed in such a manner that they will be able to leverage economics of scale, increase in bargaining power and realization of remunerative price to the farmers.

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Linkage Network Structures of Farmers: Analysing FPOs of M.P. and Bihar in India

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ARTICLE INFO

Keywords: Agribusiness linkages, Network analysis, Linkage networks, Farmer Producer Organisation (FPO)

<http://doi.org/10.48165/IJEE.2023.59303>

Conflict of Interest: None

ABSTRACT

Effective linkages among farmers play a crucial role in fostering growth within the agriculture sector. This study conducted during 2020-23 utilizes social network analysis to examine the backward and forward agribusiness linkages of farmers in Dairy Farmer Producer Organizations (FPOs) in Madhya Pradesh and Bihar. Through focused group discussions, a comprehensive list of private and government institutions acting as linkage actors for each FPO were compiled. The findings highlight that farmers primarily rely on strong informal ties for accessing agricultural information and services. Furthermore, a disparity is observed between the FPOs in Bihar and Madhya Pradesh, with the former having a smaller number of linkage actors. The FPO in Bihar demonstrates stronger associations with government institutions and officials, while the FPO in Madhya Pradesh exhibits stronger connections with private entities, including the food processing industry, artificial insemination (AI) technicians, and veterinary doctors. The study provides valuable insights into the connectedness of network actors, underscores the importance of multi-actor alliances, and emphasizes the implications of centrality measures in determining network dynamics.

INTRODUCTION

The agriculture and allied sectors play a vital role in the Indian economy, serving as its backbone. Despite employing nearly 55 per cent of the total workforce, agriculture contributes only 18.8 percent to the country's Gross Value Added (GVA) in the year 2021-22 at current prices (Ministry of Agriculture & Farmers' Welfare, 2022). Moreover, the agricultural sector can support other sectors of the economy through backward and forward linkages, which are essential for any enterprise. To foster these linkages, it is crucial to promote new approaches to farming that encompass all aspects from production to consumption. Research by Anríquez (2007) has shown that a rapidly growing agriculture

sector can generate powerful forward and backward linkages, facilitated by network ties among stakeholders. Establishing agribusiness linkages faces a major obstacle: small land holdings among Indian farmers. To overcome this, collectivization of producers, especially small and marginal farmers, into producer organizations is an effective solution. Farmer collectivization reduces transaction costs, provides economies of scale, and enables knowledge sharing, cost efficiencies, marketing, and risk reduction (Parthiban et al., 2015; Kanitkar, 2016; NABARD, 2019; Kumar et al., 2021; Kumari et al., 2022). Farmer Producer Organizations (FPOs) mobilize farmers and enhance their collective production and marketing strength. Farmer Producer Companies disrupted middlemen chains, enabling direct selling to traders or end

consumers, improving farmers' financial conditions and lifestyles (Salokhe et al., 2017; Nain et al., 2019; Gorai et al., 2022).

To succeed and gain higher returns, agribusinesses must network effectively. In-depth studies on networking dynamics in rural areas are crucial to understand the role of efficient networking in forming successful linkages in agriculture. This research has emphasised on the significance of establishing strong networks for the development and growth of agribusinesses.

METHODOLOGY

In developing countries, it is rare for households to focus just on one single source of income (Reardon, 2007). Dairy FPOs practiced crop farming alongside animal husbandry to maximise and diversify their income. The dairy industry in India has been instrumental in driving socio-economic progress by creating employment and income-generating prospects in rural regions (Das et al., 2020). For the study FPOs were selected from two north Indian states, M.P. and Bihar. Despite being a significant state with ample natural resources, Bihar continues to encounter obstacles such as low productivity, insufficient institutional support, and inadequate governance (Joshi et al., 2012). M.P. has earned highest award 'Krishi Karman' for six consecutive years and tops in production of pulses and food grains. Both M.P. and Bihar have nearly same agricultural productivity of 2199 and 2302 kg/ha, respectively (Ministry of Agriculture and Farmers Welfare, Govt of India, 2019-20). In dairy sector, average yield per In-Milk animal for M.P. and Bihar are 4.46, 4.38 (Buffalo) and 2.84, 3.34 (Cow) kg/day respectively (Ministry of Agriculture and Farmers Welfare, Govt of India, 2017-18). But, in the 'Ease of Doing Business' ranking, over the years there has been large gap among the two states with Bihar always in the lower rungs. This depicts the difference in entrepreneurial environment and linkages among the actors of enterprises. So, studying both states gave an opportunity to assess the differences and similarities and comparison of linkages for a successful entrepreneurial environment. NABARD promoted Dairy FPOs (one from each state) were selected through simple random sampling. Selected 'Dairy' FPOs: *Magadh Agriculture Farmers Producer Company Limited* (Gaya, Bihar); *Parvati Milk Producer Company Limited* (Bhopal, M.P.)

Snowball sampling was followed to select 30 farmers from each FPO for studying the linkage network. Snowball sampling design preserves the information of the network structure (Kolaczyk, 2009). The key actors (organisations/institutions/officials/individuals) in the forward and backward linkages with whom farmers of a FPO had contact was documented through focussed group discussion. One-step modified reputational snowball sampling approach (Farquharson, 2005; Harris et al., 2008) was used to identify key actors in linkages for each FPO. Initially the Board of Directors of the FPO were contacted to compile a list of all the actors with whom they had contact for FPO functioning. Then that list was reviewed by the other selected farmer members and the other actors were added (if any) to the list. While this approach had the drawback of truncating the respondents' linkage network to only include strong connections (Maertens & Barrett, 2013), it had the advantage of capturing the most significant links as perceived by the respondents, thus saving time.

To know the characteristic of ties among farmers and linkage actors 'Tie Strength' and 'Tie Direction' variables were used. The strength of a tie (strong or weak) indicates the overall level of social interconnectedness and the potential for information or resource exchange among individuals (Granovetter, 2005). Strong ties form with family members, neighbours, relatives, friends or group members. Weak ties are characterized by infrequent interactions and little or no emotional investment between actors (Granovetter, 2005; Hampton, 2011). Weak ties include extension agents, formal institutions, agri-officials or researchers. Tie strength measured in frequency percentage basis for a time interval (Thou et al., 2013). The 'Tie Direction' (mutual or one way) reflected about the reciprocity of connections among farmers and actors.

The questions were asked to know 'Tie Strength' and 'Tie Direction'. If a farmer mentioned neighbours/relatives/friends or group members among the most influential links for agriculture named as strong Tie whereas if a farmer mentioned formal institutions/agri-officials/researchers/extension agent or private institutions among the most influential links for agriculture was regarded as weak tie. Regarding tie direction; whether a farmer perceived the contacts with the actors are mutual or a farmer perceived the contacts with the actors are one way.

Social Network Analysis (SNA) was used to delineate the linkage network for FPOs. To determine the links of farmers with the actors, participants were asked how often they had contact with each of the listed actor. The response categories were daily, weekly, monthly, quarterly, yearly or no contact. To aid in structural analysis, the contact measure was dichotomized with a cut-off of quarterly contact (Harris et al., 2008). Having contacts with actors once or more in the previous quarter (three months) was marked as having contact '1', while no contact in the previous quarter was marked '0'.

For the study, responses of only farmers were collected to know about the links/contacts with actors (Stork & Richards, 1992). If a farmer said having contact with the actor, then contact was considered, with no need to confirm from the actor. Thus, we could draw undirected, unweighted, 2- Mode networks for FPOs, with farmers and actors as the two set of entities. Software used were UCINET 6.747 (Borgatti et al., 2002) (trial version) and NetDraw 2.176 (open source) for network visualisation and computing centrality measures. For the centrality measure, Degree Centrality was calculated. Degree centrality refers to the quantity of connections a node possesses. The greater the number of linkages (ties), the higher the level of centrality, and vice versa. This metric highlights the significance of a specific actor within the network. It could be denoted as (Landherr et al., 2010).

$$\sigma D(x) = \sum_{i=1}^n a_{ix},$$

where, σD is the degree centrality score for node x using an adjacent matrix $A = (a_{ij})$.

RESULTS AND DISCUSSION

Characteristics of social ties for the farmers of FPOs

From Table 1, it was found that higher percentage of farmers in Parvati FPO (83%) had trust in strong ties for agricultural

Table 1. Characteristics of social ties for the farmers of FPOs

	Tie strength		Tie Direction	
	Strong	Weak	Mutual	One way
Magadh, Bihar (n=30)	23 (76.67%)	7 (23.33%)	18(60.00%)	12(40.00%)
Parvati, M.P. (n=30)	25 (83.33%)	5 (16.67%)	13(43.33%)	17(56.67%)

information and services, compared to a lower percentage (77%) of farmers in Magadh FPO. In terms of information flow within a network, both strong ties and weak ties plays equally important roles (Bandiera & Rasul, 2006). Weak ties are crucial for introducing innovations and acquiring new knowledge, while strong ties among farmers facilitate the adoption of these innovations by a larger group. Previous studies have also observed a similar trend, where a combination of weak ties with extension agents and strong ties with close associates emerged as the primary sources of information (Thu, 2012). Understanding and leveraging these social ties can have implications for effective information dissemination, technology adoption, and innovation diffusion in the agricultural sector.

For the “Tie Direction,” it was observed that farmers from Magadh FPO had a higher percentage (60%) of mutual or bi-directional ties compared to Parvati FPO. This finding suggests that there is a reciprocal flow of information among farmers and linkage actors in the network. Ties that involve reciprocal relationships tend to be stronger and have a higher likelihood of

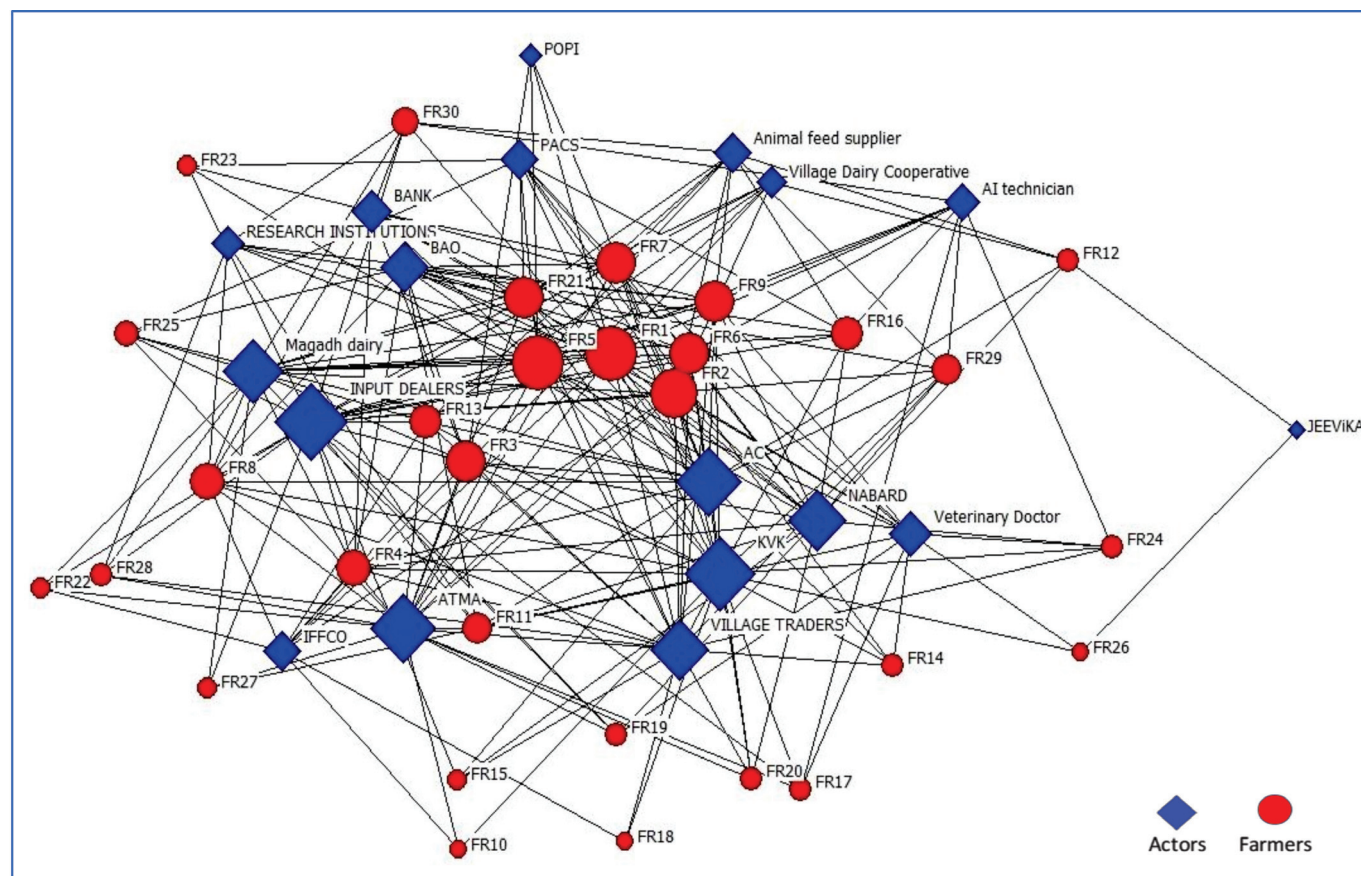
lasting over time (Carolan, 2014; Daly, 2010). Reciprocal relationships enable agribusinesses to establish trust, reliability, and mutual support, fostering sustained interactions and positive outcomes for all involved.

Social network Structures and measures for farmers of FPOs

Results of the social network analysis, displaying the 2-mode linkage networks between farmers and actors is presented in this section. Node size is proportional to the degree centrality for the node. Distance among nodes is proportional to geodesic distance (shortest straight path; an edge) among them.

Network structures/ maps

Figure 1 depicts the linkage network map for Magadh FPO, Bihar. Here it was found that farmers and actors equally distributed across the network, suggests that there is a balance of power and influence among actors in the network. Majority of farmers had equal links to the actors. With high centrality of farmers, farmers can depend on their collective power to take advantage of their

**Figure 1.** Linkage network for Magadh FPO

central position by influencing other actors in the network (Chindime et al., 2016). This is positive for agricultural development as it suggests that farmers are not dependent on a single source for their needs and are connected to a diverse set of actors. Actors with larger nodes, like Input Dealers, KVK, NABARD, AC, Magadh Dairy, and ATMA, are highly contacted by farmers, highlighting their crucial role in providing inputs, services, credit, and market links to improve farmers' livelihoods and incomes. Some peripheral actors, such as AI technician, Village Dairy Cooperative, Animal feed supplier, and PACS, may offer niche services valuable to specific farmers. Strengthening linkages with these actors could be beneficial. JEEVIKA, with limited connections, should increase interaction and collaboration with farmers, as it has a vital role in supporting the farmers in FPO and improving rural livelihoods in Bihar.

For Parvati FPO (Figure 2), findings show that there is a clear distinction between the bigger and smaller node size of farmers. The bigger node size farmers have more direct links with all the actors, whereas smaller node size farmers have limited connections with only the major actors. Those who are at the center of a network have the power to determine which new ideas or information are disseminated to others, while those on the outer edges are not as closely involved in the daily workings of the network, as pointed out by Cross et al., (2001). The research outcome highlights the importance of addressing the needs of smallholder farmers who are located at the periphery of the network map. Actors with biggest nodes include the Dairy Industry, Input Dealers, ATMA, APMC Mandi, RAE0, KVK, and Veterinary

Doctor. Strengthening linkages among actors in the agribusiness ecosystem is essential. Smaller node size actors like NCDEX, IFFCO, Bank, Agro Industry, POPI, Research Inst., MPSCDF, and NABARD should actively engage with smallholder farmers, providing necessary resources and services. This would benefit farmers and enhance integration and resilience in the agribusiness ecosystem.

Gaining a comprehensive understanding of the positioning of farmers within a broader institutional framework is essential. This understanding has significant implications (Chindime et al., 2016). It allows us to delve into specific details regarding the collaborative generation and adoption of new knowledge, practices, and technologies by farmers (Klerkx et al., 2009), which ultimately affects their capacity for innovation. Additionally, comprehending the network structure and the roles of key participants can assist in developing interventions that aim to improve connectivity and inclusivity for all farmers in the Farmer Producer Organization (FPO). A crucial objective is to ensure that all farmers have fair access to participate in the network and leverage the available resources and opportunities.

Network measures

Comparing the network measures of Parvati FPO and Magadh FPO (Table 2), we find differences in the number of actors, ties, and average degree. Parvati FPO has more linkage actors (21) than Magadh FPO (18). This suggests that Parvati FPO has a more extensive reach and more potential for knowledge sharing and resource mobilization. The size of the network indicates the degree

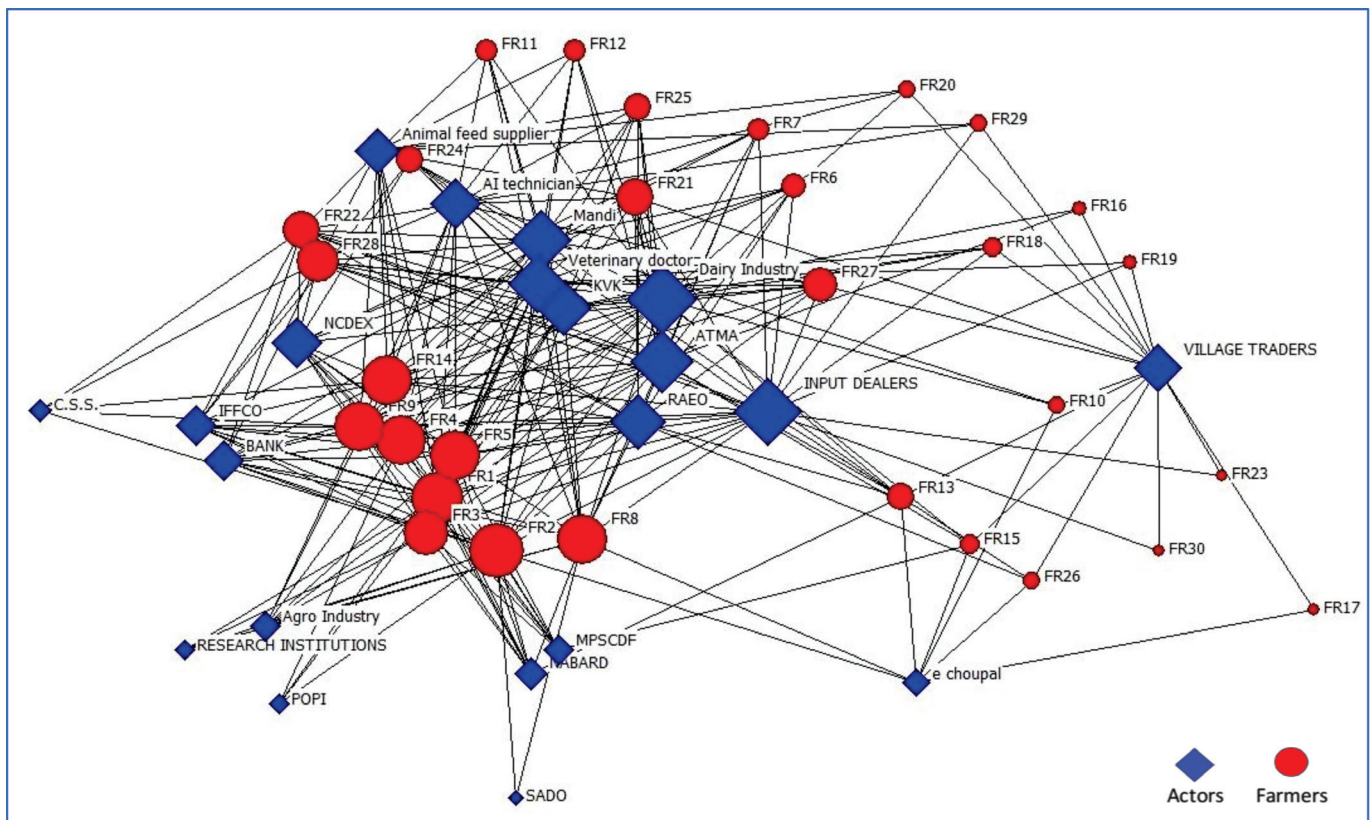


Figure 2. Linkage network for Parvati FPO

Table 2. Network Measures for linkage networks of Dairy FPOs

Variables	Magadh, Bihar	Parvati, M.P.
No. of nodes	48 (30+18)	51 (30+21)
No. of observations	540 (30×18)	630 (30×21)
No. of ties	233	264
Average degree (farmer)	7.767	8.8
Density	0.431	0.419
Diameter	5	4
Compactness	0.55	0.55
Average distance (among any two node)	2.128	2.125

of interconnectedness between farmers and other actors, as affirmed by Matuschke (2008). However, Magadh FPO has a higher network density (0.431), indicating tighter connections among farmers. A denser network has more social interactions and the learning alliance of the participants would be much more effective, as cited by Mashavave et al., (2013). Both FPOs show equal cohesion in terms of compactness and average distance. Magadh FPO's network diameter (5) is slightly larger than Parvati FPO (4), indicating greater distance between a few nodes. This could be an area for improvement in Magadh FPO's network, as it may require more effort to connect these distant nodes. A larger network size coupled with greater density indicates a higher level of interactivity and faster communication within the network (Helsley & Zenou, 2014), as well as a higher degree of innovativeness (Davis et al., 2008). Understanding these network structures helps in designing interventions for knowledge sharing, resource mobilization, and capacity building.

Comparing linkage actors in different settings of both FPOs

Degree centrality is the measure of direct ties the linkage actors have with the farmers, as also mentioned by Matous et al., (2015). Comparing degree centralities (DC) for linkage actors in the FPOs (Table 3), we found that ATMA had the same degree centrality in both FPOs. KVK has higher degree centrality in Magadh FPO, indicating a stronger presence and influence in their social network. Agri officials BAO and AC had higher degree centrality with Magadh farmers (0.43 and 0.67, respectively) compared to SADO and RAEO with Parvati farmers (0.07 and 0.57, respectively). Higher degree centrality with Magadh farmers suggests more guidance, resource allocation, and access to government schemes. NABARD had higher degree centrality with Magadh FPO (0.30), indicating access to funding, credit facilities, or development programs. Banks had similar degree centrality (0.37 and 0.40) for both FPOs, indicating a similar level of engagement. State dairy cooperatives, BSMCFL and MPSCDF, had similar degree centrality (0.23 and 0.27), suggesting similar engagement and support. Contrasting destinations for dairy produce indicate different market channels and supply chains. However, the contrasting destinations for dairy produce—Parvati farmers selling to a food processing company and Magadh farmers selling to a local cooperative—indicate different market channels and supply chains in operation. The links between the Central Semen Station in Bhopal and a small number of big dairy farmers in the Parvati FPO suggest targeted collaborations in the field of artificial insemination and breeding. Veterinary doctor services were more frequently utilized by Parvati farmers (0.60) compared to Magadh FPO (0.40) suggests a greater utilization of these specialized

Table 3. Centrality measures for Dairy FPO

Magadh, Bihar		Parvati, M.P.	
Actors	DC (nDC)*	Actors	DC (nDC)*
ATMA	20(0.67)	ATMA	20(0.67)
KVK	22(0.73)	KVK	17(0.57)
Research Institutions	8(0.27)	Research Institutions	4(0.13)
POPI	4(0.13)	POPI	4(0.13)
Bank	11(0.37)	Bank	12(0.40)
BAO	13(0.43)	SADO	2(0.07)
AC	20(0.67)	RAEO	17(0.57)
NABARD	17(0.57)	NABARD	9(0.30)
IFFCO	10(0.33)	IFFCO	12(0.40)
Input Dealers	23(0.77)	Input Dealers	22(0.73)
Village Traders	17(0.57)	Village Traders	14(0.47)
PACS	10(0.33)	Mandi	19(0.63)
Magadh dairy	18(0.60)	Dairy Industry	23(0.77)
Village Dairy Cooperative (BSMCFL)	7(0.23)	MPSCDF	8(0.27)
Animal feed supplier	10(0.33)	Animal feed supplier	13(0.43)
AI technician	9(0.30)	AI technician	15(0.50)
Veterinary Doctor	12(0.40)	Veterinary doctor	18(0.60)
JEEViKA	2(0.07)	C.S.S.	5(0.17)
		Agro Industry	8(0.27)
		NCDEX	15(0.50)
		e-Choupal	7(0.23)

*(DC- Degree Centrality, nDC-Normalised Degree Centrality)

services by farmers in that region indicating a higher demand for animal healthcare and reproductive services, potentially driven by factors such as greater income, dairy production systems and livestock size/number. Similarly, AI (Artificial Insemination) technicians had a higher degree centrality in the Parvati FPO (0.50) compared to the Magadh FPO (0.30). An actor's strategic position within a network can determine the different roles they play, such as central connectors, boundary spanners, information brokers, or peripheral specialists, as highlighted by Chan & Liebowitz (2006). The findings reveal variations in the degree centralities of different actors, pointing to differences in knowledge dissemination, government support, financial assistance, market channels, and specialized services, thus providing valuable insights into the structural and relational aspects of the FPOs. Social network analysis helps to identify critical stakeholders and barriers, as brought up by Wang et al., (2020). Understanding these network structures can inform targeted interventions and strategies to strengthen collaboration, resource allocation, and agricultural development in each FPO (Nain et al., 2015).

CONCLUSION

The study of linkage networks in agriculture has several important implications, including: improved understanding of market dynamics, better targeting of interventions, enhanced competitiveness, increased economic opportunities and improved policy making. The study provides insight into the relationships between actors in the agriculture and dairy sector, including farmers, traders, processors, and retailers. This can improve understanding of market dynamics, enhance competitiveness by improving the efficiency of supply chains, reducing transaction costs, and increasing the quality and reliability of products. By understanding the structure of linkage networks, valuable information is provided for policymakers to identify the key actors and bottlenecks in the agriculture sector. The information can be used to target interventions and investments in areas that will have the greatest impact on improving the agriculture sector and design policies that will support its development and growth.

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Influence of Study Stream on the Students' Information-Seeking Behaviour

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ARTICLE INFO

Keywords: Information seeking behaviour, Students, Stream of the study, University, Rajasthan

<http://doi.org/10.48165/IJEE.2023.59304>

Conflict of Interest: None

ABSTRACT

The study was conducted to find out the association between information-seeking behaviour and the stream of study (faculty) of postgraduate students. The study used a structured online questionnaire to collect the data during 2022. From a sample of 378 postgraduate students chosen at random from eight faculties (Arts, Science, Engineering & Technology, Law, Commerce, Education, Fine Arts and Social Science) at the University of Rajasthan, Jaipur. The findings revealed a significant association between the respondents' stream of study (faculty) and their purpose of seeking information, frequency of using the library, the purposes of use of the library, time spent in the library, purpose-wise usage of the internet, information sources used, browsing of different e-resources, and extent of use of e-resources. All selected aspects were found to be affected by the stream of study of the students. This research can be utilized to better understand the psychology of students seeking knowledge. This research may also aid in improving the university's information delivery system based on students' information-seeking behaviour.

INTRODUCTION

The new paradigm of the information age is emerging at a faster pace, where information is one of the assets required and used by human beings for their upliftment and prosperity. Seeking information is a natural phenomenon and every person requires information in order to complete a task or to fill a gap in their knowledge. Information seeking is the process of obtaining information from various information sources, like electronic, informal and formal sources etc. it is the method by which people search information and utilize it to fulfill their need of information. The manner in which people seek information varies. The emotional, personal, educational, and demographic variables of the person seeking information influence his or her information-seeking behaviour (Nain et al., 2015). Even for marketing of farm produce information sources including personal localite as well as cosmopolite sources act as the major information providers to followed by electronic media, print media and traditional media (Raina et al., 2011). Maamiry (2017) undertook a study on the

information-seeking behaviour of students of the University of Dubai. The study focused that students' pattern of information seeking depends mainly on the culture and information-searching skills of students. Khan & Nisa (2017) also reported that gender has significant association with the information seeking behavior of students. Students' information-seeking behaviour has also varied due to their unique characteristics and needs. Students are also varied in their information-seeking behaviour due to their different kinds of needs and attributes. Information seeking behaviour of students affected by the various factors like discipline/stream of study, mode of admission (regular or private), available resources, information need of students and personal characteristics etc. Ozowa & Aba (2017) carried out a study entitled "Perceived personality traits and information-seeking behaviour of postgraduate students in universities in Benue State, Nigeria". The study found that personality traits such as conscientiousness, extroversion, neuroticism, openness to experience, and agreeableness are significantly correlated positively with the information-seeking

behaviour of postgraduate students. Barret (2005) research shows that 80 per cent of social science students approach current issued journals. For academic assignments, search engines are often utilized. Students who are seeking information for jobs seem to approach library more. It shows that information seeking behavior is affected by the various factors. As well as stream of study impact a lot on students' future goals and life style, therefore this study was conducted to assess the effect of stream of study (faculty) on the information seeking behavior of post graduate students.

METHODOLOGY

The current study was undertaken at the University of Rajasthan, Jaipur. In Rajasthan, this university is the oldest and largest university in terms of students' strength and territory area. Post-graduate students enrolled in various faculties namely Arts, Science, Engineering and Technology, Law, Commerce, Education, Fine Arts and Social Science were participants of this study for the 2019-2020 academic year. Sample size was determined with help of Yamane (1967) formula ($n = N/1+N(e)^2$). Sampling (selection of sample) was done in 3 stages i.e. Selection of the university (1st stage), Selection of the faculties (2nd stage) and selection of sample (3rd stage). Lottery method was applied to take students in final sample. Among the 9 faculties of the university, eight faculties were selected through a purposive sampling method. And A simple random sampling (lottery) procedure was used to include students from all of the selected faculties in the final sample. To ensure equal involvement of both male and female students from each faculty in the sample, two separate lists were prepared (one for male students, the other for female students). Afterwards, the random sampling technique (lottery method) was applied to include the students in the sample. A self-developed questionnaire was used to collect data for the study. Validity and Reliability of the tool was also tested before the administration of tool. The reliability coefficient for the structured questionnaire was 0.85. Thus, the tool was found to be highly reliable. Out of total 478 questionnaires were sent by mail and what's-app to randomly selected 478 students. There were 378 questionnaires were returned with response (81.46%). Information seeking behaviour was taken as dependent variables and stream of study (Faculty) was taken as independent variables. Hypothesis were formulated in null form. Chi-square test was used for establishment of association between dependent and independent variables in the present study.

RESULTS AND DISCUSSION

Stream of study (faculty) and purpose-based information seeking

Table 1 shows the association between faculty and the purpose for which respondents seek information. According to Table 1, the majority of the 250 respondents seeking information for routine academic information needs are from the Sciences (35.6%) followed by Humanities (33.6%), and Social Science (30.8%) faculties. Humanities account for 39.0 percent of the 230 respondents looking for career advice and employment information and Science faculty account for 36.5% and Social Sciences (24.5%). The majority of respondents seeking library-related information and social security benefits were Social Science faculty members. Thus, the above table shows that there are differences in the faculties of the respondents in terms of their various purposes for seeking information. At 16 degrees of freedom, the p-value (.001605) is statistically justified to be less than the significance level (0.01). Therefore, the formulated null hypothesis must not be accepted. As per results it is concluded that there is a link between the respondents' faculties and the purpose of seeking information.

Stream of study-wise information sources

The humanities faculty (Figure 1) has the highest percentage of library users (38.8%), it is followed by science faculty (31.1%) and Social Science (30.1%) faculty. While faculty (teaching staff) and Informal resources (family and friends) are consulted more by science faculty as compare to humanities and Social Science faculty. Further research shows that students consulted with the administration, with a higher percentage of them coming from the humanities (33.9%), social sciences (46.1%), and sciences (27.7%). Nearly the same percentages of respondents from the Humanities (30.7%) and Science faculty (29.8%) indicated that the Internet was their primary information source (39.5% each). Findings show that the P-value (.0016297) is less than the significance threshold of 0.01 at 8 degrees of freedom. Furthermore, it has been demonstrated statistically that the students' choice of information sources was influenced by their course of study. The results are in line with those of Fasola & Olabode (2014); Marila's (2013); Tafti & Tarverdezade (2010), & Owolabi et al., (2010), who also found that students' information-seeking behaviour is influenced by their course of study and educational level.

Table 1. Influence of stream of study on purpose-wise seeking Information

Purpose of Information seeking	Stream of Study			Average percentage/ (Total respondents)
	Social Science (%)	Humanities (%)	Science (%)	
Career counseling and employment	24.5	39.0	36.5	60.8/ (230)
Library related	45.6	28.2	26.2	27.2 / (103)
Routine academic information needs	30.8	33.6	35.6	66.1/ (250)
Students' union election	24.9	31.1	44.0	51.1/ (193)
Associated curricular activities	28.4	34.7	36.9	50.2/ (190)
Co-curricular activities	44.6	32.7	22.7	29.1/ (110)
Research work	32.8	28.5	38.7	49.2/ (186)
Competency development	30.3	37.5	32.2	54.2/ (205)
Social security benefits	35.9	33.4	30.7	40.5/ (153)

$\chi^2 = 37.8199$; $df = 16$; P-value = $<.001605$; Significant at $p < .01$

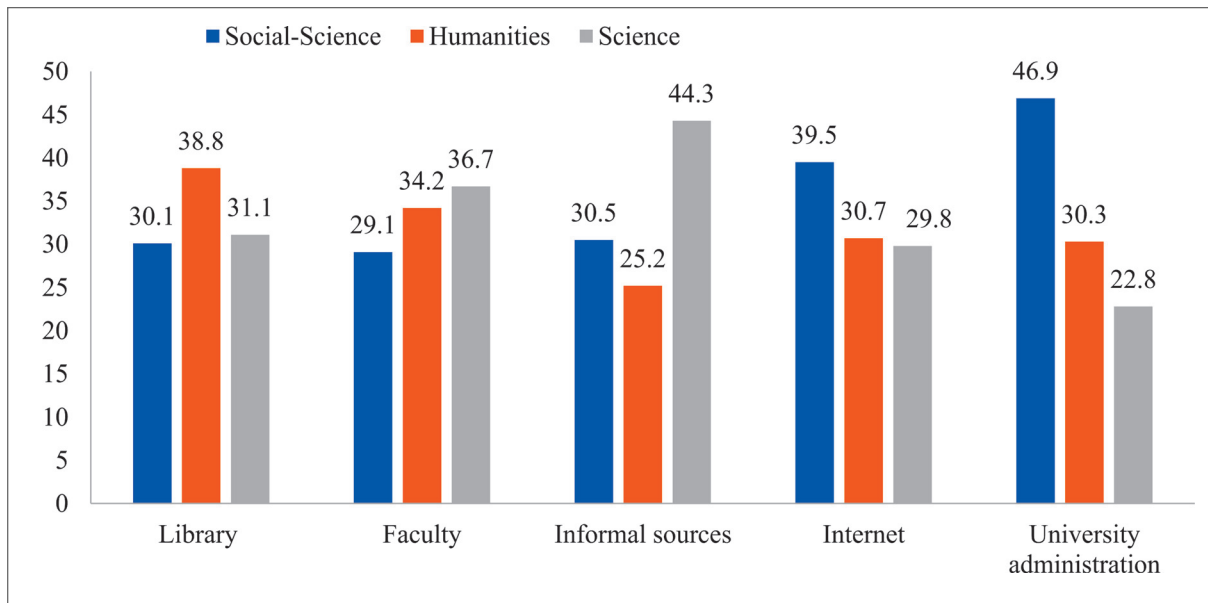


Figure 1. Influence of stream of study on information sources consulted
 $X^2 = 24.8788$; $df = 8$; $P\text{-value} = <.001629$; Significant at $p < .01$

Stream of study wise usage of library

Figure 2 shows the association of stream of study and usages of library by the respondents. The humanities (42.9%) are the most likely to use the library on a daily basis, followed by Science (32.3%). The majority of those who used the library every alternative day were from the Science faculty (40.74%). The library was used once a week by 45.78 per cent of Social Sciences students, 31.3 per cent of Humanities students, and 22.8 per cent of science students. Similarly, a good number of students (66.2%) in the Social Sciences faculty visited the library once every 15 days. In the monthly visit category, similar numbers of respondents from all three faculties were found, whereas the higher number of students (58.5%) belongs to the faculty of Social Science who visited the library occasionally. According to the data gathered, students of Humanities stream use the library more than students of Science and Social Science stream. Furthermore, results show that a vast number of students from the Humanities field use the library daily. It is statistically proved that the P-value (0.00029) at 10 degrees of freedom is less than 0.01 level of significance (Figure 2). Thus, findings show that null hypothesis must be rejected. The frequency of library use found to be influenced by

the respondents' academic field. According to Urquhart and Rowley's (2007) research, the students' behaviour has an impact on how frequently they utilise the library.

Stream of study wise purposes of use of the library

Higher number of students who use library for the purpose of borrowing books belongs to Humanities (39.9%). The students who used the libraries to see reference materials belonged to Humanities (44.6%). Maximum number of students were from Humanities (39.2%) faculty who visit the library to access periodicals (Table 2). Furthermore, results presented that Social Science students accessed online resources more than faculty of Science and Humanities. Humanities students account for 34.8 per cent of those who visit the library for study purposes, followed by Science students (33.2%), and Social Science students (32.1%). It also, demonstrates a strong correlation between the library's and the study stream intended usage.

Stream of study and the purpose-wise usage of internet

According to data showing in Table 3, the majority of 220 students were from Humanities (39.6%), who use the internet for

Table 2. Influence of Stream of study on purposes of use of the library

Purpose of information seeking	Stream of the study			Average percentage/ (Total respondents)
	Social Sciences (%)	Humanities (%)	Science (%)	
Access periodicals	31.3	39.2	29.5	60.0/ (227)
Access reference resource	24.7	44.6	30.7	70.6/ (267)
Borrowing books	29.5	39.9	30.6	76.2/ (288)
Reprography service	35.2	20.7	44.1	38.4/ (145)
Access thesis and project reports	31.9	25.9	42.2	52.1/ (197)
Study purpose only	33.2	34.7	32.1	68.5/ (259)
Access e-resource	39.0	25.8	35.2	27.8/ (105)

$X^2 = 46.3475$; $df = 14$; $P\text{-value} = .00024$; Significant at $p < .01$

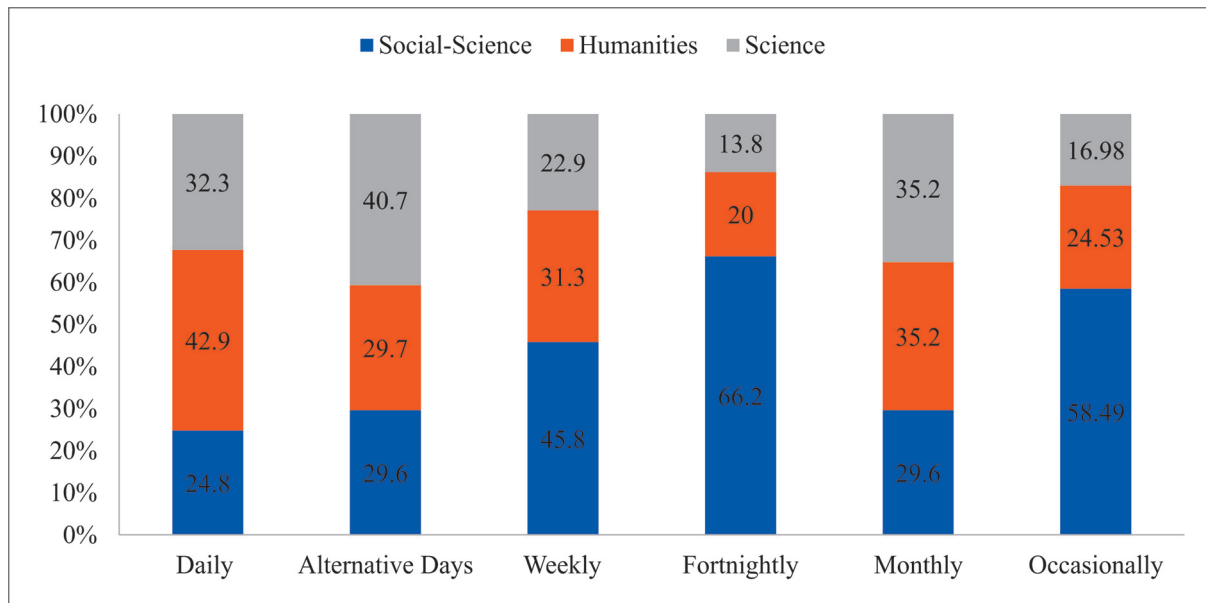


Figure 2. Influence of stream of study on usage of library
 $X^2 = 32.75$, $df = 10$; P -value = .0003; Significant at $p < .01$

Table 3. Influence of stream of study on the purpose-wise usage of internet

Purpose of Information seeking	Stream of the study			AveragePercentage/ (Total no. of respondents)
	Social Sciences (%)	Humanities (%)	Science (%)	
Literature search	33.2	41.1	25.7	74.0/ (280)
Reading	22.7	39.6	37.7	58.2/ (220)
Research purpose	36.8	28.6	34.6	62.0/ (234)
Database search	31.2	28.8	40.0	45.0/ (170)
To update knowledge	23.9	41.1	35.00	68.8/ (260)
Means of communication	39.4	32.4	28.2	45.0/ (170)

$X^2 = 39.325$; $df = 12$; P -value = .00009; Significant at $p < .01$

reading purpose and it is closely follow by Science (37.7%). Higher number of students are also from Humanities, who were using the internet for literature searches (41.1%) and to update their knowledge (41.2%). However, the percentage of respondents who use the internet for research purposes and uses as a means of communication is dominated by Social science faculty. Findings presents that at 12 degrees of freedom, the P -value (.00009) is less than 0.01 level of the significant. It can be concluded that faculty affects the respondents' various purposes for using the internet. According to Pinto et al., (2014), academic faculty of study has the greatest influence on students' internet information-seeking patterns. Dhanwal et al., (2022) highlighted that students keep themselves updated with latest know and how through the television, mobile phones and with internet connections. Study stated that internet use was positively correlated with the stream of study of the students.

Faculty-wise browsing of e-sources

Table 4 depicts that almost similar number of respondents from all selected streams browsed the internet for E-books. The majority of respondents who use e-journals are from Science stream (44.7%). The majority of students, however, are from the Social Science stream, use the Internet to assess various E-theses.

A good number of students were from the humanities faculty (41.2%), who use the internet for reading electronic newspapers. Data from postgraduate students assessing website resources show that the majority of students (38.1%) were from the Social Sciences stream. Findings depict that this stream of study affects the information seeking behavior (assessing electronic resources) of postgraduate students. According to statistics, the p -value at 14 degrees of freedom (.00227) is below the significance level (0.05). in order for the null hypothesis to be rejected. It demonstrates that there is a relationship between the variables under comparison. Consequently, it can be said that this area of research is related to the many online information sources that the respondents looked up. According to statistics, the level of significance is below the p -value (.00227) at 14 degrees of freedom (0.05). in order for the null hypothesis to be rejected. It demonstrates a relationship between the variables under comparison. As a result, that the respondents' internet for material related to their field of study. Nain et al., (2019) opined that WhatsApp is a possible means of socialization and internalization, facilitated the creation of social wealth in the form of discussion groups for innovative farmers for learning exchange. Singh et al., (2021) found that majority of the young farmers preferred internet based sources viz. social media, as a source of agricultural information. They are

Table 4. Influence of stream of study on browsing of different E-sources

E-information sources	Science (%)	Humanities (%)	Social-Science (%)	Average percentage/ (Total no. of respondents)
e-periodicals	44.7	35.9	19.4	45.0/ (170)
e-Books	33.7	34.6	31.7	54.2/ (205)
Digital library	36.0	33.6	30.4	33.0/ (125)
e-newspaper	35.9	41.2	22.9	45.0/ (170)
e-thesis	34.4	27.5	38.1	160/ (160)
Website resources	27.5	34.4	38.1	42.3/ (320)
Online database	35.5	34.1	30.4	36.5/ (138)
Other information sources	32.5	37.5	30.0	21.1/ (80)

Note: significance at $p < .01$.

using these sources to share and receive information on agriculture and allied fields. Mobile applications (e-source) are used by farmers to a great extent as a vital information resource regarding improved agricultural technologies (Jayalakshmi, 2022).

CONCLUSION

The study found that the students' stream of study influenced all selected factors such as the purpose of seeking information, frequency of using the library, time spent in the library, internet usage, browsing of different e-resources, and extent of use of e-resources etc. This study is helpful for policymakers and university administrators to gain insight into the behaviour and psychology of postgraduate students who seek information for study purposes as well as about their other activities and various tasks. Hence, Libraries and need to develop need-based accessible information delivery system for the students.

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Strengthening Millet Value Chain through Farmer Producer Organizations

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ARTICLE INFO

Keywords: Food security, Millet value-chain, Value addition, FPOs, Market linkages, Nutritional security

<http://doi.org/10.48165/IJEE.2023.59305>

Conflict of Interest: None

ABSTRACT

Millet is a group of small-seeded “Nutri-Cereals” that are grown as food crops in many parts of the world and is in need of hour for achieving nutritional security. In the traditional supply chain, millet farmers were not getting remunerative prices but being the members in Farmers’ Producer Organizations, the share in the consumer rupee was increased. The value chain approach was used for analyzing the supply chain aspects of millets to strengthen the linkages, increase efficiency, competitiveness, and profitability. The study was conducted during 2022-23 with ICAR-IIMR promoting FPOs. The establishment of a primary processing unit by ICAR-IIMR at the FPO farm gate through the FPO strengthened the millet value chain by engaging FPOs/SHGs/rural women/unemployed youth in preparing value-added products and delivering them through the GeM portal, ONDC, FPO Bazar, and e-commerce platforms. To meet the millet value chain challenges overall adoption of improved technologies, better market linkages, and increased investment in infrastructure were the key strategies. Primary processing, value-added technology adoption by FPOs and declaring minimum support price by the state government, and creating facilities to procure at MSP by establishing millet food parks, millet shakti cafes, and millet bazar were found key sources to generate better income.

INTRODUCTION

Majority of the Indian farmers are small and marginal that are involved in agriculture and allied activities for their livelihood (Bikkina, 2018). Because of the small patches of land, the production and productivity of the crops is low, due to which the farmers face challenges like, market identification, market connectivity, market outreach, fair price for produce, lack of storage, high transportation cost, existence of intermediaries and lack of credit availability (Raina et al., 2013; Bishnoi & Kumari, 2020). To support such small and marginal farmers, Farmers Producer Organizations (FPOs) is the collectivization of farmers that improve the bargaining power, access the financial and non-financial inputs and services, technologies, reduce transportation costs, tap high value market and enter into partnership with public and private entities (Parthiban et al., 2015; Baruah et al., 2022; Kumari et al.,

2022; Kumar et al., 2023). Millets are a group of small-seeded coarse cereals that are grown as food & fodder crops in many parts of the world, particularly in Africa and Asia.

Millets are considered as smart crops and “Harbingers of Ever Green Revolution”. Millets are nutritious, drought-resistant, environmentally friendly, high economic benefits and have the potential to address several global challenges such as climate change, food security, and rural livelihoods. Millet cultivation has been showing a trend of increased productivity, but the declining area under millets is a major concern that needs to be addressed. Policy support such as incentivizing millet cultivation, opening processing industries in millet clusters, FPOs, Krishi Vigyan Kendra (KVKs) and millet awareness through *Mann Ki Baat* have created demand and ensured a continuous supply of millets (Garg, 2019; Richa & Sharma, 2021; Garhwal, 2023). Hon. Prime Minister in *Mann Ki Baat* addressed the issues related to agri & allied areas created

awareness among farmers-customers-stakeholders of rural and urban areas. The International Year of Millets 2023 (IYOM, 2023) offers an opportunity to scale up interventions for increasing millet area and production, as well as diversifying processing machinery and technologies to cater to various segments in domestic and export markets. By doing so, we can help to promote the consumption of millets, which have various health benefits, and also provide a source of income for farmers. Millet value chain involves a series of activities, actors and processes in their production, processing and marketing of millet products to the end customer for consumption. In this connection, a study was conducted in strengthening the millet value chain through FPOs promoted by ICAR-IIMR, Hyderabad in the state of Andhra Pradesh, Telangana and Karnataka by establishing millet-processing unit at farm gate.

METHODOLOGY

Exploratory action research design was adopted for this study and problems faced by the FPOs in marketing the millet products were analysed. The proper plans to resolve the value chain of millets were formulated. The plans were executed in a phase wise for obtaining anticipated results. The proper network like input agency, financial institutions, traders, processors, value addition centres and other stakeholders required by the farmers/FPOs were identified, interactive meets were made, after analysing the pros and cons that were linked to the FPOs. Millet value chain involves a series of activities, actors and processes in their production, processing and marketing of millet products to the end customer for consumption. The value chain approach was used to identify and strengthen the linkages between the different actors and activities involved in the production and marketing of millet products, in order to increase efficiency, competitiveness, and

profitability (Zamora, 2016). For understanding the role of each player in millet value chain the value chain approach was used for drawing conclusions through set of statistical tools like averages, percentage analysis, cumulative frequencies, standard deviations etc. The millet value chain typically includes various stages like provision of inputs such as seeds, fertilizers, and pesticides to farmers (Input stage), cultivation of millets by using provided inputs (Production), harvesting and post-harvest handling, processing of millets as flour, flakes, rava and puffed grains, packaging and branding, distribution, marketing and consumption. At each stage of millet value chain, ICAR-IIMR with this technology adoption and experience boosted small and marginal farmer income by establishing farm gate processing units and increasing producer share in consumer rupee.

RESULTS AND DISCUSSION

ICAR-IIMR altered the traditional value chain by engaging FPOs in millet supply chain with timely guidance, support, trainings, capacity buildings and market awareness (Sanjeev et al., 2021). Establishment of millet processing unit at farm gate and experiences of ICAR-IIMR promoted are shown in these results and discussions.

Millet value chain

Millet value chain is facing many challenges, including poor infrastructure, inadequate financing, lack of market information, and low consumer awareness. However, there are many opportunities to improve the value chain, such as through the adoption of improved technologies, better market linkages, and increased investment in infrastructure (Sangappa et al., 2023). These efforts can help to enhance the competitiveness of the millet value chain, increase the

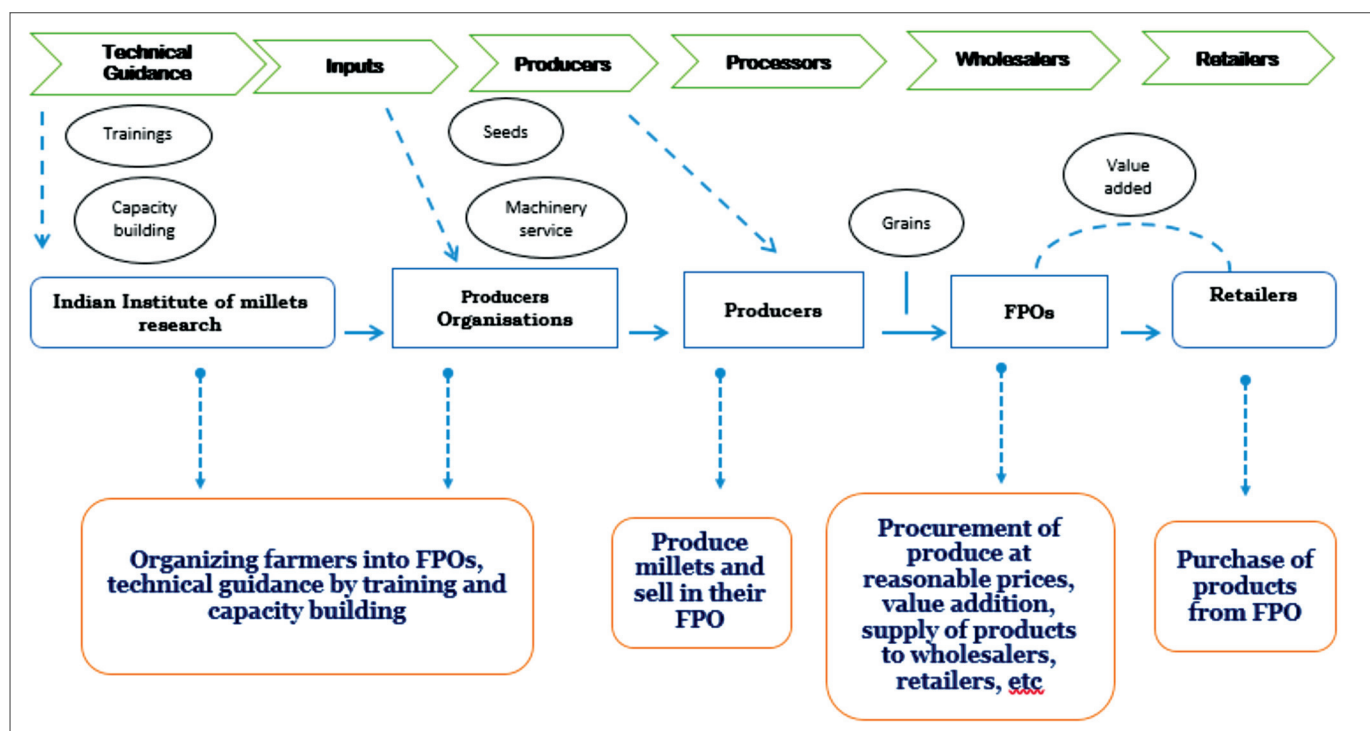


Figure 1. Millet value chain

income of farmers, other players and improve food security & nutrition (Figure 1). In traditional supply chain, millet farmers are not getting remunerative prices to their produce as there exist local aggregators, millers, wholesalers, retailers as middlemen (Kumar et al., 2023). Presence of excessive middlemen in traditional millet supply chain had lessened the primary producer share in consumer rupee as shown in Figure 2. Demand for millets is high but market lacks with continuous supply of millets and presence of excessive middlemen. In order to supply millets continuously millet farmers should get remunerative prices for the produce by linking them to better markets (Trebbin, 2014). Farmers as Producer Organizations (POs) or collectives can play a significant role in grain aggregation, processing at farm gate, wholesale, and retailing of products to consumers for increasing the farmers share in consumer rupee. Primary processing and value addition of millets and targeting the customers (B2B and B2C) by FPOs will generate direct markets with better price for their produce.

ICAR-IIMR millet model for FPOs

ICAR-IIMR through its millets model (Figure 3) linked FPOs to various stakeholders like farm input centres, loan and credit

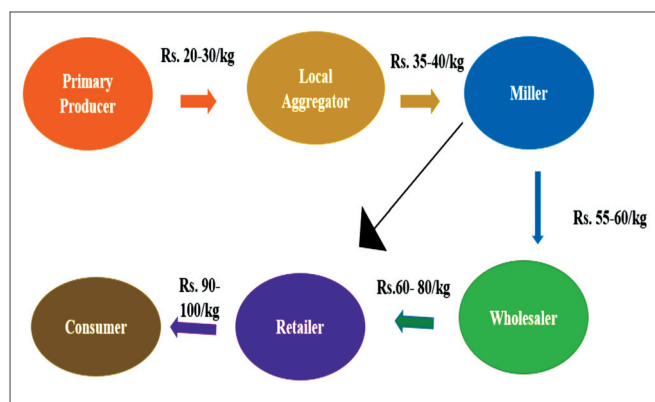


Figure 2. Millet farmer share in consumer rupee



Figure 3. ICAR-IIMR millets model for FPOs

systems, custom hiring centres (CHC), millets aggregation, storage and warehouse, processing and value addition of millets and linking the FPO to better market which is accessible that provide better price for the produce. Through Millet model primary requirements of arranging input licenses like seed, fertilizer, pesticide, machinery etc., and focus on output business for long-term sustainability of FPOs is possible. IIMR has been involved in facilitating advisory role, providing inputs like seeds, aggregation of produce, processing of produce, storage, and distribution of produce with better market linkages between the members of FPOs, food industries and other organizations.

Establishment of millet primary processing units by ICAR-IIMR

ICAR-IIMR is acting as CBBO for 41 FPOs in four states (Andhra, Telangana, Karnataka & Madhya Pradesh) and established primary processing unit in collaboration with KVKs, state universities to help small and marginal farmers through FPO at farm gate as shown in Table 1 where KVKs acts as light house for ranchers in disseminating the technology (Singh et al., 2023). More than 25000 farmers from various FPOs viz., Aland, Hulsoor, Shorapur, Vizianagaram, Anantapur, and Vishakhapatnam were benefited through this primary processing (Sarnaik et al., 2020). For strengthening the millet value chain ICAR-IIMR has taken this initiative (Table 2) by engaging FPOs/SHGs/rural women/unemployed youth in hands on training on preparing value added products and delivering them through GeM portal, ONDC, SFAC and online platforms (Pandey & Bolia, 2023). Anshu & Chaddha (2021) in their study revealed similar type of results that establishment of millet processing units at farm gate helped millet farmers to generate ensured profits by reducing cost of cultivation.

Success of ICAR-IIMR FPOs

Farm gate processing unit helped millet farmers and FPOs increased to generate better incomes by increasing the producers share in consumer rupee through processing and value addition of millets by altering the traditional supply chain. Shri. Prime Minister Narendra Modi appreciated ICAR-IIMR promoted FPOs i.e., Aland Bhootai Millets FPCL, & Hulsoor Mahila Kisan PCL from Karnataka during 97th Mann Ki Baat program for their contribution in promotion of millets and millet value added products through e-marketing platforms like ONDC, GeM, and FPO Kisan Bazar. Through these online platforms Aland FPCL and Hulsoor PCL generated a profit of 10.0 lakhs and 7.85 lakhs respectively during last quarter of 2022. Lambasingi Tribal Products FPO has made a business of 66 lakhs during 2022-23 with a profit of 19 lakhs. The profile characters of FPOs are shown in Table 3. These FPOs promoted by ICAR-IIMR are path makers for others in eliminating middlemen and thereby creating better market linkages and assured prices by increasing the collective bargaining power of farmers (Sangappa et al., 2022).

Aland Bhootai Millets FPCL, Hulsoor Mahila Kisan Millets PCL and Lambasingi Tribal FPO were registered under companies act in the year 2021. ICAR-IIMR is acting as facilitating agency for these FPOs. Lambasingi FPO is also involved in supplying agriculture inputs, Customer Hiring Centre (CHCs) to provide

Table 1. Millet primary processing units established by ICAR-IIMR at farm gate

S.No.	Name of KVK/University	Purpose
1.	KVK, Banavasi, Kurnool, Andhra Pradesh	To establish Millet processing unit in various districts of A.P. to organize millet-based trainings, capacity buildings and Hands on trainings to farmers, FPOs, SHGs and rural youth
2.	ANGRAU, ICAR-KVK, Garikapadu, Krishna, Andhra Pradesh	
3.	ANGRAU, ICAR-KVK, Darsi, Ongole /Prakasham Andhra Pradesh	
4.	ANGRAU, KVK, Rastakuntabai, Parvathipuram, Manyam Andhra Pradesh	
5.	KVKVizianagaram,Vizianagaram, Andhra Pradesh	To establish Millet Primary Processing unit at KVK, Vizianagaram
6.	KVK Kalburgi, Gulbarga District, Karnataka	To establish Millet processing Units in various parts of Karnataka to organize millet-based trainings, capacity buildings and Hands on trainings to farmers, FPOs, SHGs and rural youth
7.	KVK Kavadihatti, Yadgir District, Karnataka	
8.	KVK Bidar, Bidar District, Karnataka	
9.	KSN Agri and Horticulture University, Iruvakkai Shivamogga, Karnataka	
10.	OUAT, Bhubaneswar, Odisha	To establish Millet processing unit and organize millet-based trainings, capacity buildings and Hands on trainings to farmers, FPOs, SHGs and rural youth

Table 2. Trainings centers established by ICAR-IIMR

S.No.	Name of KVK/ University	Purpose
1	ANGRAU, ICAR-KVK, Kalikiri, Chittoor, Andhra Pradesh	To organize millet-based trainings, capacity buildings and Hands on trainings to farmers, FPOs, SHGs and rural youth
2.	ANGRAU, ICAR-KVK, Reddipalli, Anantapuram, Andhra Pradesh	
3.	ANGRAU, ICAR-KVK, Nellore, Andhra Pradesh	
4.	ANGRAU, KVK, Rastakuntabai, Parvathipuram, Manyam, Andhra Pradesh	
5	ANGRAU, College of Community Science, LAM, Guntur, Andhra Pradesh	
6.	Dr. YSRHU, KVK, Periyavaram, Tirupati, Andhra Pradesh	
7.	Dr. YSRHU, KVK, Vonipenta, Mydukur, YSR (Dst), Andhra Pradesh	
8.	KSN Agri and Horticulture University, Iruvakkai Shivamogga, Karnataka	

Table 3. Profile details of Selected ICAR-IIMR FPOs

S. No.	Name of FPO	Agency	No. of Share-holders	Crops cultivated	Type of business operated	Business turnover (Lakh Rs.)	Farmers benefitted
1.	Hulsoor Mahila Kisan Millets Producer Company	SFAC	312	Soyabean and Millets	Input business, Soyabean Seeds, CHC, Tarpaulin and Value addition of millets through e-commerce platforms like ONDC, GeM, FPO Kisan Bazar	19.5	2000
2.	Aland Bhootai Millets FPCL	SFAC	541	Soyabean Redgram Millets Safflower	Input business, Common Service Centers, Value addition of millets through e-commerce platforms like ONDC, GeM, FPO Kisan Bazar	27.5	3000
3.	Lambasingi Tribal Products Farmer Producer Company	NABARD	310	All Millets, Turmeric, Black Pepper and Coffee	Millet products and Spice sales	66 .0	4000

farm implements on hire basis to farmers, processing of millets, value addition of millets and marketing of products and these are in line with the findings of Kisku et al., (2022). Aland FPCL have diversified business activities and value-added products of millets as shown in Figure 4. With the support of IIMR - Millets model, Hulsoor PCL is involved in promotion and distribution of millet seeds and millet rice, primary processing of millets, advisory services to the members of FPO, and finding better marketing option for their produce as shown in Figure 5. Aland and Hulsoor FPCL were appreciated by Shri. P.M. Narendra Modi for their

efforts in promotion of millets during this IYOM-2023. Integrated approach to enhance value chain efficiencies of millets are establishment of primary processing units at farm gate, efficient sourcing of millets, increase transparency, develop processing facilities, build partnerships, promote consumer awareness, increase demand and assures economies of scale to millet growers (Pandey & Bolia, 2023). FPOs are the key functionaries that boost and strengthen millet value chain that increase farmer income by establishing primary processing unit at farm gate (highlighted in 97th Mann Ki Baat by PM).

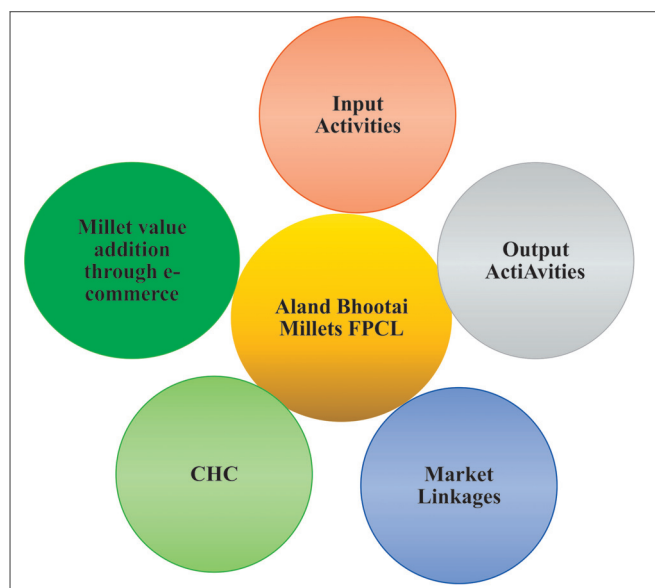


Figure 4. Aland Bhootai Millets FPCL

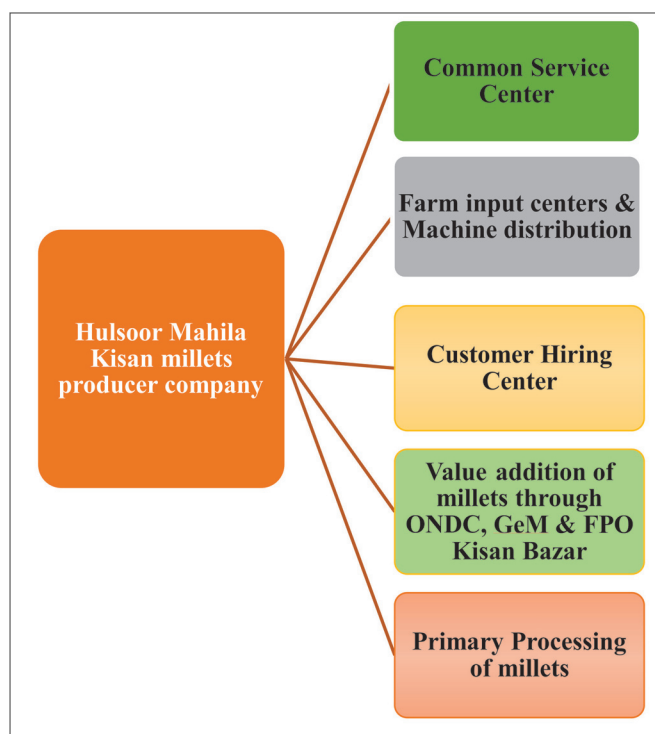


Figure 5. Hulsoor Mahila Kisan Millets PC

CONCLUSION

Millet cultivation has been showing a trend of increased productivity, but the declining area under millets is a major concern. Policy support such as incentivizing millet cultivation, opening processing industries in millet clusters, FPOs and KVKs can help to create demand and ensure a continuous supply of millets. ICAR-IIMR established primary processing unit at farm gate (Aland, Hulsoor, Shorapur, Vizianagaram, Anantapur) and engaged them in preparing value added products and thereby delivering them through GeM portal, ONDC and FPO Kisan Bazar. Millet

value chain is facing many challenges but the key to generate better incomes to millet growers and FPOs is by establishing primary processing units and value addition at farm gate. Inclusion of millet based mid-day meals at anganwadis, welfare hostels through PDS by state government will create better awareness of millets. Government should announce minimum support price for all millets and creating facilities to procure them at MSP by establishing millet food parks, millet shakti cafes and millet bazar.

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Effectiveness of Adaptation Mechanisms of Farmers in Flood Prone Area of Bihar

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ARTICLE INFO

Keywords: Flood, Farm livelihoods, Adaptation, Technological innovation, Institutional innovation

<http://doi.org/10.48165/IJEE.2023.59306>

Conflict of Interest: None

ABSTRACT

The state of Bihar is most vulnerable to floods in India and farmers in flood-prone areas have undergone adaptation through a combination of technological and institutional innovations. The present study aimed to explore the effectiveness of adaptation mechanisms as perceived by the farmers to mitigate the negative effects of flooding on their livelihoods covering a random sample of 80 farmers in flood-prone areas of Bhagalpur district in Bihar during 2022. The findings suggest that farmers have developed a range of adaptation strategies to cope with the impacts of flooding, the most effective being the changes in cropping patterns, adoption of flood-resistant paddy varieties, pest and disease resistance vegetable varieties, vaccination of livestock and management of fish ponds. Institutional innovations like self-help group, farmers interest group, farmers club, seed bank, village level weather advisories were also found crucial to enabling farmers to adapt to floods. Income, cultivated land, information availability, and use of communication sources have explained about 50 per cent variation in the perceived effectiveness of adaptation by farmers. Future extension efforts need to strengthen the institutional infrastructure to promote the flood resilient technologies to reduce the vulnerability of farm livelihoods.

INTRODUCTION

Worldwide flood damage to agriculture, households, livelihood systems, infrastructure, and public utilities each year. India is highly vulnerable to the impacts of climate change due to its reliance on agriculture, which provides livelihoods for 58 per cent of the country's population (Yadav et al., 2022). Flooding constitutes the largest share of natural disasters in India since 2008, and as much as 40 million hectares of land are regularly exposed to floods, making flooding one of the highest-priority disasters to be handled by regional authorities (National Disaster Mitigation Authority, Government of India, 2022). Numerous steps are taken by the Indian government to manage natural flood occurrences and minimize the resulting damage to manageable limits. Some of these steps include flood task forces, working groups, committees for water resource management, emergency

action plans, dam safety organizations, Rashtriya Barh Aayog (National Commission on Floods), and other such bodies (Mohanty et al., 2020). Indian states, which are in the Indo-Gangetic plains and northeastern part of India, are facing severe flood problems. Bihar is India's most flood-prone state. About 76 per cent (79.11 million) of Bihar's population lives in flood-prone areas, and over 73 per cent (68800 square kilometers) of the state's land area is classed as flood-prone (WRD, 2015).

Climate change has disrupted the balance of agriculture, food, and livelihood systems, putting them in jeopardy (Das and Ghosh, 2018). However, when farmers embrace technologies that help to tackle climate change, they can enhance their resilience to natural risks and restore equilibrium to the system (Das et al., 2020). Adaptation strategies are necessary to mitigate and cope with the effects of climate change. These strategies are designed to help individuals, communities, and organizations adjust their behavior,

practices, and infrastructure to reduce the negative impacts of climate change and increase their resilience to future changes (Shanabhoga et al., 2023). Agricultural adaptation entails adjustments of agronomic and agro-management practices towards the prevailing climate conditions to reduce the vulnerability and ensure a climate-resilient farming system (Jha et al., 2017). The farm households adapt by adopting on-farm and non-farm strategies (Thennakoon et al., 2020). Successful adaptation will require multiple stakeholders, including farmers, policymakers, extension agents, NGOs, researchers, communities, and the private sector (Bryan et al., 2009, 2013; Fraser et al., 2011). Interventions that provide long-term and sustainable benefits while also addressing resource conservation and strengthening local institutions have been found to be most effective. An approach has been developed to promote climate resilient interventions in natural resource management, crop production, livestock and fishery, and institutional mechanisms (Prasad et al., 2015). Resilient technologies related to crop production, crop protection, crop improvement, land and water management, breeding, feeding, health care and management practices of livestock help in attaining sustainable productivity and bringing resilience to agriculture and farm livelihoods in crop-livestock based agricultural production systems (Aryal et al., 2018). On this backdrop, the present study was undertaken to assess the effectiveness of adaptation mechanisms to tackle the flood from farmers' perspectives and unravel the determinants of perceived effectiveness of adaption to flood by the farmers in Bihar.

METHODOLOGY

Bihar is the most flood-affected state in India having 16.5 per cent of the total flood area and 56.5 per cent of the total flood-

affected people of the country. Therefore, the present study was purposively conducted in Bihar. Amongst the eight highly flood prone districts of Bihar, Bhagalpur district was selected from where two blocks, namely Sabour & Sultanganj, four villages from each block and 10 farmers from each village were sampled using a simple random sampling technique. Thus, a total of 80 farmers were chosen as the respondents for present study. The farmers' socio-personal, socioeconomic, and communicational attributes were taken into account as predictor variables or independent variables, which were measured with a schedule developed for the purpose. The effectiveness of adaptation mechanisms in terms of technological and institutional interventions as perceived by the farmers was measured as dependent variables. The technological interventions were categorized as natural resource management (soil and water), crop farming, livestock farming, and fish farming technologies/ practices. A 5-point continuum scale was used to record the farmers' responses on each intervention that was ranging from Very highly effective (5) to very low effective (1). Data were gathered from the selected respondents through an interview schedule that was developed and pretested before administration. The collected data were compiled and analyzed to obtain descriptive statistics like frequency, percentage, mean, standard deviation, and range, as well as relational statistics such as correlation and multiple regression models.

RESULTS AND DISCUSSION

The perceptions of farmers on flood resilient technological interventions were categorized under natural resources management, crop farming, livestock farming and fish farming (Table 1). The natural resource management innovations adopted by the farmers

Table 1. Adaptation of technological innovations for flood resilient farming

S. No.	Flood resilient technological intervention	% of respondents adopted	Mean perceived effectiveness score (SD)	Effectiveness index (%)
Natural Resource Management (NRM) interventions				
1.	Broad bed furrow	21.25	2.59 (0.87)	51.80
2.	Conservation tillage	10.00	3.25 (0.71)	65.00
3.	Land modification	28.75	2.77 (0.75)	55.40
4.	Water harvesting	3.75	3.33 (0.58)	66.60
Crop farming interventions				
1.	Flood resistant variety of paddy (Swarna Sub-1)	27.50	3.18 (0.96)	63.60
2.	Early maturity variety of maize (Sabour Shankar Makka-1)	10.00	3.50 (0.53)	70.00
3.	Pest and disease resistant variety of vegetables	38.75	3.23 (0.76)	64.60
4.	Short duration variety of paddy (Prabhat)	26.25	3.24 (0.54)	64.80
5.	Crop diversification (through growing of oilseed, pulses etc.)	45.00	3.42 (0.73)	68.40
6.	Cultivation of maize	15.00	3.17 (0.72)	63.40
7.	High yielding variety of paddy (Rajendra Sweta)	6.25	3.20 (0.84)	64.00
8.	Mentha cultivation	2.50	3.50 (0.71)	70.00
Livestock farming interventions				
1.	Preventive vaccination for FMD, goat pox etc. in livestock	73.75	3.86 (0.71)	77.20
2.	Cattle feed i.e., mineral mix	8.75	2.86 (0.69)	57.20
3.	Community land for fodder production	11.25	2.78 (0.83)	55.60
Fish farming interventions				
1.	Fish feed i.e., mineral mixture	5.00	3.25 (0.50)	65.00
2.	Management of fish ponds/tanks during water scarcity & excess water situation	8.75	3.43 (0.53)	68.60

of the flood prone areas in Bhagalpur district were water harvesting, conservation tillage (zero tillage in wheat, and maize), land modification and broad bed furrow (water-saving irrigation method) with mean perceived effectiveness index scores 3.33, 3.25, 2.77 and 2.59, respectively. The effectiveness index of different flood resilient natural resource management technologies ranged from 51.80 per cent to 66.60 per cent. Even though water harvesting and conservation tillage were perceived as more effective very few farmers adopted those which may be attributed to the high cost and unavailability of required infrastructure and extension advisory services. Land modification and broad bed furrow were adopted by more than 20 per cent respondents, adoption of these practices is also required to be increased.

With respect to the adaptation mechanisms in terms of crop farming technologies adopted by the respondent farmers, the most effective crop farming technologies include cultivation of early maturity variety of maize and Mentha cultivation followed by crop diversification, growing of short duration variety of paddy, pest and disease resistant vegetable varieties, high yielding variety of paddy, flood resistant Swarna-Sub1 variety of paddy, and, cultivation of maize with mean perceived effectiveness scores of >3.0 indicating the high level of effectiveness of flood resistant crop farming technologies. The effectiveness index ranged from 63.40 per cent to 70 per cent for aforesaid technological innovations related to flood resilient crop farming. Crop diversification, pest and disease resistant vegetable varieties, flood resistant Swarna-Sub1 variety of paddy, and short duration variety of paddy (Prabhat) were adopted by many of the respondents while rest were practiced by very few. Extension advisory services need to promote the technologies like cultivation of early maturity variety of maize and Mentha cultivation which were perceived highly effective but low adoption.

The most adopted livestock farming technology was preventive vaccination in livestock with a high perceived effectiveness (77%). Use of community land for fodder production in flood prone areas and cattle feed was adopted by very few with relatively low perceived effectiveness (56-57%). Livestock farming technologies like preventive vaccination in livestock (BQ, FMD, HS, for bovines, goat pox, etc.) and cattle feed (mineral mix, urea and molasses, etc.) were promoted by Block Veterinary Clinic; however, community land for fodder production during or after the flood was self-promoted practices by the farmers. Flood resilient fish farming practices were adopted by very few respondents despite both were perceived as highly effective (65-

68%). Management of fish ponds and use of fish feed were promoted by Krishi Vigyan Kendra and Office of Fisheries Development Officer at block level.

The institutional innovations were adopted by the respondents to combat the negative impact of the flood in their farming practice. Most of the respondents were associated with SHGs/ FIGs and Kisan club/farmers club with the highest perceived effectiveness of 68.80 per cent and 64 per cent, respectively. The other two institutional innovations preferred by the respondents were seed bank and weather-based agro-advisory at the village level with a perceived effectiveness index of 55.40 per cent and 57 per cent, respectively. Effectiveness as well as availing the services of fodder bank and village climate resilience development committee was quite low. Institutional innovations like SHGs and FIGs were promoted by Agriculture Technology Management Agency (ATMA) whereas Kisan club/Farmers club were promoted by the National Bank for Agriculture and Rural Development (NABARD) and institutional innovations like seed bank, weather-based agro-advisory at the village level, fodder bank and Village Climate Resilience Development Committee were promoted by Krishi Vigyan Kendra. Perceived effectiveness scores indicate a medium level of effectiveness of most of the institutional interventions to adapt with floods that require strengthening.

The influence of socio-personal, socio-economic, and communicational attributes of respondent-farmers as independent variables and effectiveness of technological adaptation and institutional innovation as dependent variables were assessed through correlation and multiple regression analyses (backward elimination method). It is evident that monthly income, annual family income, farming expenditure, resource position, total land, cultivated land, financial safety, and information availability are significantly and positively correlated with the perceived effectiveness of technological adaptation of farmers in flood prone areas (Table 3). While, the perceived effectiveness of institutional innovations of the farmers was having significant association with the attributes of farmers like monthly income, farming expenditure, resource position, total land, cultivated land, financial awareness, financial safety, mass media exposure, use of personal localite source of information, overall communicational sources use and information availability with significant and positive correlation coefficient values.

The multiple regression analysis was conducted following backward elimination methods (Table 4) in which nineteen models were generated eliminating eighteen out of 20 attributes over

Table 2. Adaptation through institutional innovations in flood prone area

S.No.	Institutional innovation	Percent of respondents adopted	Mean perceived effectiveness score (SD)	Effectiveness index (%)
1.	SHGs/ FIGs	93.75	3.44 (0.66)	68.80
2.	Kisan club/Farmers club, etc.	83.25	3.20 (0.77)	64.00
3.	Seed bank	48.75	2.77 (0.74)	55.40
4.	Weather based agro-advisory at village level/ climate literacy through a village level weather station	42.50	2.85 (0.78)	57.00
5.	Fodder bank	6.25	2.20 (0.84)	44.00
6.	Village Climate Resilience Development Committee / Village Climate Risk Management Committee	3.75	2.67 (0.58)	53.40

Table 3. Correlation between attributes of farmers and their perceived effectiveness of adaptation to floods

S.No.	Attributes of farmers	Correlation Coefficient (r)	
		Effectiveness of adaptation	
		Technological innovation	Institutional innovation
1.	Age	-0.098	-0.066
2.	Level of education	0.156	0.192
3.	No. of earning member in the family	0.057	0.030
4.	Organizational participation	0.120	0.127
5.	Monthly income	.340**	.253*
6.	Annual family income	.345**	0.218
7.	Monthly expenditure	0.135	0.084
8.	Farming expenditure	.340**	.374**
9.	Resource position	.339**	.252*
10.	Total land	.606**	.532**
11.	Cultivated land	.745**	.720**
12.	Credit behaviour	-0.047	-0.098
13.	Financial awareness	0.060	.256*
14.	Financial safety	.295**	.357**
15.	Use of mass media source of information	0.128	.242*
16.	Use of personal cosmopolite source of information	-0.039	0.057
17.	Use of personal localite source of information	0.156	.269*
18.	Overall communication source use	0.091	.260*
19.	Information availability	.351**	.533**
20.	Perceived flood intensity during last 10 years	0.008	-0.027

** Significant at 1% level and * Significant at 5% level

Table 4. Multiple regression (backward method) between perceived effectiveness of technological and institutional innovations, and attributes of farmers

S.No.	Attributes of farmers (independent variables)	Standard error	Beta coefficient	t-value	Significance
Perceived effectiveness of technological innovations (dependent variable)					
	(Constant)	3.090	(59.873)	19.377	0.000
1	Cultivated land	0.475	0.787	10.102	0.000
2	Overall communication source use	0.066	0.1419	1.810	0.074
R=0.757, R square= 0.574, F value= 51.771**					
Perceived effectiveness of institutional innovations (dependent variable)					
	(Constant)	1.823	(49.716)	27.266	0.000
1	Monthly income	0.000	-0.214	-2.489	0.015
2	Cultivated land	0.537	0.705	7.681	0.000
3	Information availability	0.041	0.276	3.341	0.001
R= 0.775, R square =0.601, F value= 38.089**					

nineteen steps. The analysis revealed that farmers cultivated land and overall communicational sources use explained 57.4 per cent ($R^2=0.574$) of variation in the perceived effectiveness of technological innovation. Multiple regression (backward elimination method) analyses were also carried out between attributes of farmers as independent variables and the perceived effectiveness of institutional innovations as dependent variables (Table 4). The analysis revealed that monthly income, cultivated land and information availability collectively determined the 60 per cent ($R^2=0.601$) variations on the perceived effectiveness of institutional innovations. The regression coefficient of monthly income (-0.214) is found negative which implies better-perceived effectiveness of institutional innovations by relatively poor farmers having less income. It reiterates that small and marginal farmers/ poor farmers require empowerment and capacity building through their

involvement in SHGs, FIGs, Farmers Clubs, farmer producer organization (FPOs) etc.

In this present study adaptation of technological innovations is broadly categorized under NRM, crop farming, livestock farming and fish farming. Similar classifications are made by Venkateswarlu et al., (2012) & Prasad et al., (2014). Adjustment in sowing time, crop diversification, crop rotation and shifting to new crops are some of the on-farm practices adopted by farmers (Sehgal et al., 2013). Sharma et al., (2019) reported several location-specific climate-smart crop production technologies as a subset of resilient measures, viz. stress-tolerant rice varieties (e.g., Swarna sub-1, MTU-1001 and MTU-1140) in flood-prone areas, lodging-resistant paddy cultivar (Bina Dhan), resource-saving through non-puddled transplanted rice, direct-seeded rice, diversification with green gram and ground nut, and improved maize production practices for

plateau ecology. In another study in Odisha, the major interventions prioritized are mainly flood tolerant varieties of paddy, disease resistant varieties of pulses, intercropping, preventive vaccination in livestock, high yielding breeds of livestock, cattle feed mixture (Das et al., 2022). Branca et al., (2021) have mentioned that technologies like minimum tillage, crop residues incorporation, use of cover crops, and inclusion of legumes has relatively higher economic returns. Conservation agriculture, rainwater harvesting, drought tolerant and early maturity seed varieties are the most suited climate resilient technologies for smallholder South African farmers; however, due to initial costs and management intensity, the adoption of first two practices is low while the seed varieties are widely preferred (Senyolo et al., 2018). The present study shows a relatively low level of adoption of flood resilient technologies despite being perceived as highly effective. The low rate of adoption and/ or non-adoption of climate smart agriculture technologies is attributed to the lack of involvement of farmers. It is also emphasized that prioritization and upscaling of climate smart agriculture require farmers' involvement (Shitu et al., 2018; Das et al., 2022; Azadi et al., 2021; Branca et al., 2021; Das & Ghosh, 2019).

To make technological innovations useful respondent farmers of present study frequently adopted institutional innovations such as the memberships in SHGs, farmers clubs, and the establishment of the seed bank, which are promoted by different organizations like KVK, State line departments functioning at Block level, etc. Venkateswarlu et al., (2012) also specified the importance of institutional interventions such as village-level weather advisory committees, seed banks, fodder banks, customs hiring centers, nursery enterprises, crop insurance systems for increasing farmers' resilience, FPOs and so on to establish at grass root level / village level with the participation of all stakeholders to put the flood resilient technologies into practices. Institutional innovations are key in putting scientific technologies in practice; therefore, the present research also focuses on institutional innovations. Tanti et al., (2022) in their study in the eastern Indian state of Odisha have reported the role of institutional factors in climate smart technology adoption, which are government extension service, farmer field school, subsidies, access to energy, and perception of climate shocks. Promotion and capacity building of farmers' groups to sustain climate smart agricultural system is also mentioned. It underlines the importance of agricultural policies to improve institutional support for upscaling climate resilient technologies.

CONCLUSION

The adaptation of farmers in flood-affected areas of Bihar highlights their resilience and ability to cope with the frequent flooding. One key adaptation strategy has been the adoption of flood-tolerant crop varieties and farming practices that can withstand the waterlogging and soil erosion caused by floods. Farmers have also diversified their income sources by engaging in diversified farming activities such as livestock rearing. Additionally, many farmers have availed community-based flood early warning systems, which help them to prepare for floods and reduce the risk of crop and livestock loss. Overall, the farmers have perceived adaptation strategies in flood-affected areas effective; however,

the extent of adoption requires improvement. Therefore, climate smart extension through capacity building of farmers and institutional strengthening would improve farmers' abilities to innovate and adapt to changing environmental conditions. The resilience and adaptability of farmers is the key for sustainable development in the face of climate extremes.

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Socio-economic Categorization- A New Classification for the Farm Households

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ARTICLE INFO

Keywords: Classification, NbClust, Socio-economic, Rural

<http://doi.org/10.48165/IJEE.2023.59307>

Conflict of Interest: None

ABSTRACT

In most of the social science research, farmers are classified into various categories based on their socio-economic status (SES), adoption levels, knowledge, and utilization patterns, where SES is the most commonly measured phenomenon. The study aimed to create a standard method of socioeconomic classification of the population for the developed scale with a scientific foundation that can be easily and simply applied to each sector or population stratum and is also useful for other variables of interest such as adoption, knowledge of farmers, etc. The socioeconomic status (SES) of the population in a nation is crucial since it is one of the key factors affecting a person's health, education, mortality, morbidity, and nutritional status. The study was conducted in the year 2022-23 with 300 farmers from the state of Telangana. The number of classes was obtained by applying NbClust package in R software. The score range for the respective classes was calculated using Cumulative Square Root of Frequency (CSRF). The Nblust analysis suggested a 5-class cluster. The new five socio-economic classes include upper, upper middle, middle, upper lower, and lower class with scores of 25 and above, 21-24, 17-20, 13-16, and below 13 respectively.

INTRODUCTION

Several studies in agriculture, sociology, economics, education and psychology etc. require information on the SES of people. Classifying people into categories would be convenient and provide better comprehension. Present study discusses on the classifications proposed by the past studies and provides a new method of classification for rural families. The new method of classification is based on a scale developed by the researcher to measure SES of farmers. The scale comprises of eight items with sub-items relating to education, family, land, house, income, social participation, farm power status and material possessions.

Confusion exists in grouping farmers/families into different SES classes. The notions, lower, middle, upper, etc., were understood differently in various studies. In majority of the studies measuring the socio-economy of rural people, a three-level classification namely low, medium and high are used (Devarani &

Bandhyopadhyay, 2012; Khwaja et al., 2015; Kumar et al., 2018; Virender et al., 2019). Whereas two-level SES categorization viz., low/medium and medium/high is employed by Shivani et al., (2013) & Kumari et al., (2021). The findings of most of these studies have revealed that farmers are mostly belonging to medium class followed by low class and there is no clear demarcation between the classes (Deeptangshu & Jahanara, 2021; Singh et al., 2021).

Though there are some standard socio-economic classes for farmers, past studies have not utilized these standardized categories and followed the three level classification. Coming to the standardized classes, the five-level categorization of socio-economic groups is highly prevalent (Tiwari et al., 2005; Gaur, 2013; Kadian, 2014; Pandey et al., 2018). Whereas, the method of scoring is done by mean and standard deviation (SD). The problem with scoring using mean and SD is, as it is based on the average value in the data, when employed allowing the data to cluster in middle level with wider difference between the categories at extreme ends

(Swetha et al., 2019; Singh et al., 2021; Mishra et al., 2022). Comparing and drawing conclusions of findings from similar studies becomes challenging. Due to this, the studies focusing on analyzing the transformation on socio-economic conditions as result of Govt. schemes, trainings, technology adoptions are not uniform in classifying farmers into SES classes (Kobba et al., 2020; Kumar et al., 2022; Vijayan et al., 2022).

When coming to the classification of rural population by other sectors, various research organizations and centers, a 12 class classification developed by the market research society of India is in utilization. Each family will be assigned to one of the 12 SEC groups ranging from A1-E3. According to the reports using the new SEC class, the rural population was at a high disadvantage as there exists a larger gap in the income levels, occupation and education with urban areas (Rachit, 2011). The real scenario of agrarian and rural conditions was not depicted. Scientific investigation requires standardized methods and concept, so that all could understand and comprehend in the same way. In this context, using the newly developed SES scale with modified and updated items, a redefined socio-economic classification with appropriate classes and scoring methods is put forth.

METHODOLOGY

In the present study, the socio-economic phenomena were observed without any external influence at a single point of time. Hence, cross sectional survey design was followed. The three agro climatic zones in the state of Telangana were used to choose the sample. Using the random sample approach, one district from each agro climatic zone, two mandals under each district and two villages under each mandal were chosen. Respondents were selected using stratified proportionate sampling bringing the sample's size to 300. Data was collected using the interview schedule based on the newly developed SES scale for farmers by the researcher.

Two key concerns had to be addressed in order to develop a classification scheme appropriate for the current study: the number of SES groups to be formulated, and to determine the scores of the category in which a respondent fall. The number of classes was fixed employing NbClust package in R software version 4.3.1 (Charrad et al., 2015; Vasu et al., 2019). The NbClust package provides 30 indices for identifying the clusters from the data set. It suggests to the user the best clustering based on several outcomes by trial and error with several combinations of cluster size, clustering techniques and distance measurements. The clusters range from 2 to 15 respectively. The k-means technique is used by the function to determine the optimal number of clusters for the dataset. Based on the past classification levels and experts suggestions, the maximum cluster range for the present study was fixed at 7. As classifying into more than 7 classes would be too vague and ambiguous in understanding and demarcating the farmer socio-economic conditions.

The next step, determining the score range for the obtained classes is calculated using the method Cumulative Square Root of Frequency (CSRf). This method proves to be highly efficient in determining strata boundaries of each class based on the total scores in the data set (Raghavarao, 1987). The foremost step in

this method is to obtain number of classes using the following formula.

Number of classes = $2.5 \times (\text{Number of samples})^{1/4}$

Next, class interval is calculated. Based on the class interval value, the upper and lower limit of the classes is formulated. The frequency of respondents falling in each class is calculated and cumulative square root frequency of all the classes will be determined based on the frequency values in the respective classes. Then the calculation of the boundary values of the each class was performed by using the following formula.

$$L = K + \left[\frac{L_i - C}{\sqrt{f}} \right] \times n$$

Where, K - Class lower limit in which L_i lies

L_i - Cumulative square root value i.e. $L_1, L_2, \dots, L_i$

C - Cumulative square root frequency of the preceding class where L_i lies

N - Interval of the class

F - Square root of frequency of i^{th} class where L_i falls

RESULTS AND DISCUSSION

The optimal and best numbers of clusters from the NbClust analysis were depicted in the Figure 1. The Hubert and Dindex index use a graphical visualization to provide the best clusters possible. Both the index seek a significant peak that relates to a considerable shift in the measure's value as shown in Figure 1. The summary of NbClust analysis was as follows: Among all indices: 1 proposed 3, 3 proposed 5, 1 proposed 4 and 1 proposed 6 as the best number of clusters. Based on the majority rule the best and optimum number of clusters for data set as given by analysis was 5. The result of the NbClust analysis for the number of socio-economic classification of the data set was in conformity with past literature where majorly a 5-level classification was used (Tiwari et al., 2005; Gaur, 2013; Kadian, 2014).

These obtained five number of classes were named as 'upper' the top most class, followed by the middle three 'upper middle', 'middle', 'lower middle', with the bottom class named 'lower'. The presence of odd number of classes, the number of classes was equal on either side of the "middle class". The scores calculated using CSRf were presented in the table. These scores satisfy the basic characteristics suggested by Rogers (1962) for a category set viz., exhaustive, mutually exclusive and were derived from the same classificatory principle (SES total score criterion).

Description of the five class socio-economic groups

The brief characteristics of each socio-economic group is given below. They were based upon information gathered during the research survey. These are, however, generalizations, and it's possible that they don't accurately characterize individuals when applied in another research area. A slight modification among the categories can be made for future use.

Upper category

The farmers belonging to this category scored more than 24 with highest score of 33 on the socio-economic status scale. They

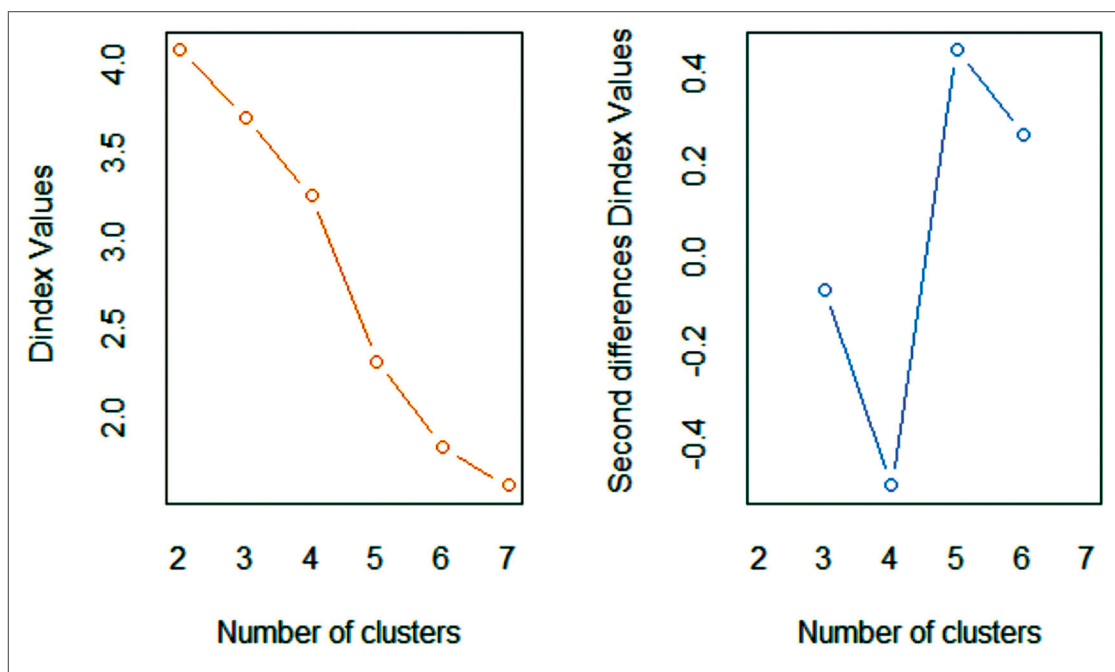


Figure 1. Results of NBClust analysis showing optimum number of clusters

Table 1. Five level socio-economic categorization using CSRF method

Category	Scores	Percentage of respondents
Lower	Below 13	15.33
Lower middle	13-16	22.00
Middle	17-20	30.33
Upper middle	21-24	18.33
Upper	25 & above	14.33

might be prominent figures or the community's elite. People outside the village were also familiar with them. As a result of their increased participation and connections, this group offered leaders to the society. They possessed more than 20 acres of land and had a permanent housing condition in which the roof and walls of house were made of permanent materials such as galvanized iron, cement, burnt bricks. Their main source of livelihood was agriculture, with employing both permanent and temporary farm labour. Their farm inventory includes a tractor, sprayer, cattle shed, cage wheels and leveler. All of them possessed household items such as refrigerator, cooler, mixer and grinder. The family living condition was a neutral family with 3-5 people. Their educational level varied between middle or higher secondary school grade. All were found to be active participants in more than one social organization and majority of them were office-bearers in any one of the social organizations. The monthly income of this group was above 20,000 rupees. Around 14 per cent of the farmers in the research area came in this category.

Upper middle

The range of socio-economic status score for this group was 21-24 points. They possessed 10-20 acres of land or more and had a permanent to semi-permanent housing condition which means

either the roof or wall of the house made of temporary materials like asbestos sheets or un-burnt bricks. Their main source of livelihood was agriculture, with employing farm labour for agricultural operations during sowing and harvesting. Their farm inventory included a tractor, sprayer and leveler. All of them possessed household items such as refrigerator, cooler and mixer. The family living situation was a neutral family with 3-5 people. Their educational level varied between middle or higher secondary school grade. All were found to be active participants in more than one social organization. The monthly income of this group was above 15,000-20,000 rupees. 18 per cent of farmers belonged to this level.

Middle

The socio-economic status score for farmers in this group ranged from 17-20. They possessed 5-10 acres of land and had a semi-permanent to temporary housing condition where both the roof and walls made of temporary materials. Their main source of livelihood was agriculture, with employing farm labour during harvesting. Their farm inventory included a sprayer and leveler. All of them possessed household items such as refrigerator and mixer. The family living condition comprised of both joint and neutral condition with 3-7 people. Their educational level varied between primary to post graduate level. All were found to be active participants in at least one social organization. The monthly income of this group was above 10,000-15,000 rupees. The middle class category comprised of 30 per cent of the sample population.

Lower middle

The range of socio-economic status score for this group was 13 to 16. Majority of them had education ranging from primary to under graduate level. They possessed 1-5 acres of land and had

a temporary housing condition. Their main source of livelihood was agriculture and working as casual labour during offseason. Their farm inventory included sprayer and possesses household items such as refrigerator. The family living condition is a neutral family with 2-3 people. Their educational level varied between primary to post graduate level. Farmers belonging to this category were either participants in atleast one social organization or no membership in any of the social organization. The monthly income of this group was above 5,000-10,000 rupees. This class accounted to around 22 per cent of respondents from the total sample.

Lower

This category had scores less than 13 points on the socio-economic status scale. All were illiterates and possessing land up to one acre. All were found to be simultaneously cultivating and working as agricultural labourers. They had non-serviceable housing condition mud walled and thatched house. None of them had any participation and possessions with income below 5000 rupees. 15 per cent of farmers in the study were poor. The description of the socio-economic classes in the present study confirms to past studies where farmers possessing land less than 10 acres were in middle class. Income above 2 lakhs per annum were of high class and lower class people with no social membership, material possessions (Devarani & Bandhyopadhyay, 2012; Kumar et al., 2018; Singh et al., 2019).

The description given in this paper could be seen as suggesting that a person who was previously associated with the top class or lower class in a social system will continue to be that way in the future. This isn't always the case. In fact, a large number of studies demonstrate that people in a social system migrate significantly over time from one class to another, and this could be particularly true for vertical mobilization. However, for the majority, the change could be to a neighbouring class. Rarely does anyone move forward or backward more than two categories. These transitions could be occurred as a result of a tragedy, such as the loss of a significant family member, family disputes, and similar events in the case of upper class individuals and as for lower class due to higher studies, additional land possessions, etc.

CONCLUSION

There should be a clear-cut demarcation of classes in to which an individual belongs, as it would help the extensionists, researchers and government officials to help the target population. As the presence of standard classes for rural people was long overdue in present scenario, present study was undertaken with new methodology to standardize these classes. Using the NBclust analysis in R, the best possible number of classes arrived at 5 class classification. The scoring attempted using CSRF ranged from below 13 for lower class to above 25 for upper class. These standardized classes were part of a scale developed for measuring SES of farmers. The proposed new socio-economic classification would have a wide range of application with extension researchers, policy makers for identifying the target population and initiate better developmental programmes. The classification methodology could be applied in categorizing farmers for measuring their adoption behavior, extent of utilization and knowledge levels pertaining to technologies, improvement practices etc.,

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Impact Assessment of Ri-Lajong FPO on the Livelihood of Farmers in Ribhoi District, Meghalaya

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ARTICLE INFO

Keywords: Farmer producer organisations (FPOs), Heckman selection model, Livelihood, Probit model, Farmers' income

<http://doi.org/10.48165/IJEE.2023.59308>

Conflict of Interest: None

ABSTRACT

The study was carried out on Ri-Lajong Farmer Producer Organisation (FPO), Nongpoh, Ribhoi district, Meghalaya with the objective of examining the factors' influence on the annual income of member farmers of FPO during the year 2021-22 and primary data consisted of 65 members collected from Ri-Lajong FPO. The Heckman two-stage selection model was applied. Results showed that FPO significantly influenced the income of farmers by providing various facilities to conduct activities crop production, forest products, piggeries, and fish farming. All farming activities except piggeries showed a positive response to increase the income of members of the FPO. The factors such as farmers' education and training provided by FPO showed positive influence while hired labour had influenced negatively to the income of farmers. Therefore, the study concluded that educated youth of the state should join the FPO and attend the training program organised by the FPO as it will be helpful in income enhancement and reduce the unemployment level of the state.

INTRODUCTION

Farmer producer organisations (FPOs) are established to organise the marginal and small farmers at different levels in state to improve the livelihood of its member (Singh & Vatta, 2019; Kumar et al., 2021; Srikar et al., 2021). FPOs are most convenient institute which mobilized the producers towards the capacity building and enhance the collective production and bargaining power of factors as well as farm's products (Manaswi et al., 2018; SFAC, 2022). The FPOs are usually worked as a legal organisation performed by primary producers such as farmers, fishermen, milkmen at production level. It can be worked as a cooperative organisation, Producer Company or any legal entity which provides incentive of profits to the members' organization (NABARD, 2015; Mukherjee et al., 2018). In India, numerous central level agencies and state departments are working in mobilizing the farmers into producer organisations under various central schemes

like *Rashtriya Krishi Vikas Yojana (RKVY)*, *Paramaparagat Krishi Vikas Yojana (PKVY)*, *Vegetable Initiative for Urban Cluster (VIUC)*, etc. The SFAC and NABARD are the major among central level institutions in working with the objective of promoting FPOs in the country (Manaswi et al., 2020; Kumari et al., 2022). Presently, total number of FPOs around 6000 are working in India as registered producer companies and around 3200 FPOs as cooperative societies (NABARD, 2021). The SFAC and NABARD have promoted total number 2961 FPOs out of which the Karnataka contributed maximum number i.e., 284 FPOs, whereas, Nagaland having minimum merely 2 FPOs. Under the State of Meghalaya total number of 25 FPOs was functional till March, 2022 (GoI, 2022).

The present study had been carried out on Ri-Lajong Farmer Producer Organisation, Nongpoh, Ribhoi, Meghalaya which was started by College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Imphal, Umiam, Meghalaya. The

FPO was started with 50 farmers during the year 2013 but now it is working with more than 500 farmers. The FPO is providing numerous facilities to its member farmers like hybrid seeds and saplings, improve breed of piglets, scientific method of cultivation, implements for hoeing and cultivation etc. with this backdrop the study has been carried out by considering of objectives viz., (a) to compare the farmers' income earned before and after participation of FPO (b) to examine the effect of various facilities provided by FPO on the income of farmers.

METHODOLOGY

The FPO is working with capacity of more than 500 member farmers of the locality area. Purposive sampling method was adopted for selection of respondents. The Ri-Lajong FPO was selected because it works with maximum number of farmers in the district. A total sample of 65 members were collected during the year 2021-22. In order to avoid the selection biasedness problem of variables, the Heckman selection two state model was applied to examine the influence of factors on the income of farmers (Heckman, 1979). In first stage of the model, the probit model was run with following equation:

$$P(0,1) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \mu_{2i} \quad \dots(1)$$

Where, $P(0,1)$ = indicating Probit estimates, β_0 = intercept, β_1 to β_{10} = slope coefficients, X_1 = gender, X_2 = education, X_3 = age of respondents, X_4 = dependency ratio, X_5 = farm size, X_6 = high yielding varieties (HYVs), X_7 = hired labour, X_8 = credit through KCC, X_9 = implements and machinery, X_{10} = provision of inputs by FPO and μ_{2i} = indicates the disturbance terms of model.

$$E_i = \beta_1 + \Sigma \beta_2 X_{1i} + \mu_{1i} \quad \dots (2)$$

Where, E_i = latent variable that indicates dichotomy (denoted by 1, otherwise 0), β_1 = intercept, β_2 = slope coefficient, X_{1i} = exogenous variables that affect the income of farmers and μ_{1i} = indicating disturbance term, and $\mu_{1i} \sim N(0, 1)$ means disturbance term is normally distributed.

In second stage of Heckman selection model, the ordinal least square (OLS) was run by adding value of Inverse Mill's Ratio (λ_i) as an additional exogenous variable of the model.

$$Y_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \alpha_9 X_9 + \alpha_{10} \lambda_i + \mu_{3i} \quad \dots (3)$$

Where, Y_i = denotes income of respondents, α_0 = intercept, α_1 to α_9 = slope coefficients, X_1 = gender, X_2 = education, X_3 = age of respondents, X_4 = dependency ratio, X_5 = farm size, X_6 = high yielding varieties (HYVs), X_7 = hired labour, X_8 = credit through KCC, X_9 = implements and machinery, λ_i = Inverse Mill's Ratio and μ_{3i} = disturbance terms.

RESULTS AND DISCUSSION

The member farmers of FPO were engaged in various agricultural enterprises like crop production, forest products, piggery, fisheries and non-agriculture sources which are presented in Table 1. Earning from all sources was observed to increase after

joining of the FPO where maximum increment was encountered by fish farming. The result was in conformity with the Parthiban et al., (2015); Sahu et al., (2017); Boskova et al., (2020). Other earning sources such as crop production and forest farming show significant increment in income. The gross income was measured by average income of 65 member of FPO. The income earned before November 2020 and up to November 2021 was considered before joining and after joining the FPO, respectively. In piggery enterprise the increment in income was lowest. It was reported that most of farmers sold their pigs during COVID-19 lockdown to earn instant income. At the same time farmers were not allowed to go out for work on daily wage basis, so could not earn income for daily consumption, hence need to sell out of compulsion.

Characteristics of member farmers of FPO

The exogenous variables used in the Heckman selection model have been presented in Table 1. Out of total respondent, 73.80 per cent member of FPO were found to be male. In case of educational status of farmers, around 50 per cent of total respondents were literate. The average age was recorded to be 43.61 years. The dependency ratio of members was observed at 0.54 indicating that on an average 54 per cent member of a household were under non-working category which may be due to under age or over age. The average landholding size of farmer was observed to be of 0.28 ha and out of total respondents, 21.53 per cent farmers adopted High Yielding Variety (HYV) of seeds and scientific method of cultivation. On an average, 81.53 per cent of total member farmers could be trained by FPO for scientific method of cultivation. Total 23.07 per cent of the member were sanctioned credit through *Kisan Credit Card (KCC)* for expansion of farming like establishment new fisheries pond, orchard and purchasing the power tiller etc. Out of total respondents, 30.76 per cent farmers adopted the implements and machinery for agricultural production. Total 73.84 per cent of farmers received input materials like improved varieties of pulses, oilseed, harrows and small iron plough from the FPO.

Testing assumptions of probit model

The study was analyzed by using Heckman two stages selection model including, estimation of probit model to determine the variables that influencing the income of the farmers. An assumption of probit model is that the data should be distributed normally which was tested by Jarque-Bera (JB) normality test. The value of JB statistics was estimated to be of 8.89 which was greater than 0.05 (p-value) indicated that data were distributed

Table 1. Sources of income of member farmers of FPO

Activities	Before (₹)	After (₹)	t-stat
Crop production	3000.97	6680.49	7.29***
Forest products	3332.93	7978.05	7.41***
Piggery	9787.80	7487.81	1.31
Fisheries	1369.76	5738.78	3.25***
Non-agriculture	120695.10	155941.50	5.47***

Source: Authors' calculation, Before = before joining of FPO, After = after joining of FPO, *** indicates the level of significance at 1%

Table 2. Descriptive statistics (exogenous variables) of member farmers employed under Heckman Selection Model (n = 65)

Exogenous Variable	Type	Parameters	Mean value	Parameter's Sign
Gender	Dummy	Gender of member of households (male=1, female=0)	48(73.80)	±
Education	Dummy	Education of member of household (Educated=1, Uneducated=0)	50(76.92)	+
Age	Continuous	Age of member of households	43.61	±
Dependency ratio	Continuous	No. of non-worker/Family size	0.54	±
Farm size	Continuous	Land under operation by household (ha)	0.28	±
HYVs	Dummy	Use of HYV (Yes=1, No=0)	14(21.53)	+
Training by FPOs	Dummy	Attended training programme organised by FPOs (Yes=1, No=0)	53(81.53)	+
Hired labour	Dummy	Hired labour employed under agricultural activities (Yes=1, No=0)	11(16.92)	+
Credit through KCC	Dummy	Suctioned loan from KCC (Yes=1, No=0)	15(23.07)	+
Implements & machinery	Dummy	Use of Implements and machinery in agricultural activities (Yes=1, No=0)	20(30.76)	+
Provision of inputs by FPOs	Dummy	Procurement of inputs from FPOs (Yes=1, No=0)	48(73.84)	+

Source: Field survey, 2021-22, Figure in parenthesis represents percentage of total respondents

normally. Moreover, another assumption is that exogeneous variables should not be correlated with each other or with the disturbance term (U_i) of the equation *i.e.*, no multicollinearity which tested by using Variance Inflation Factor (VIF) test. Value of VIF statistics was estimated to be less than 10, indicates no severe multicollinearity existed in the data. The selection biasedness of the variables was tested by using Inverse Mills Ratio (IMR) test found that the positive and significant value of 0.051, indicating unobserved factors were also influenced the income of the farmers which more likely to be associated with higher score on the dependent variable.

Determination of factor's influence on the income of member farmers

The factors influencing the income of member farmers were estimated by applying probit model presented in Table 3. The education was one of the significant factors influencing the income. As the farmers become more educated, they are not much willing to involve in farming but seeking towards other activities. The educated farmers were ahead and aware to take the advantage of facilities and subsidies provided by FPO. Similar finding reported

by Verma et al., (2019); Singh et al., (2022). Moreover, the age of member was also observed to be positively influencing the income indicating that age is not a limiting factor in joining FPO. Similar finding reported by Mukherjee et al., (2019). The marginal effect of 0.164 signifies that with the increase in the age by one year it will increase in the income by 16 percent. As the age of farmers increases, they have more farming experiences which help them in enhancing the income. They have more power to reduce the extent of loss or getting minimum loss even in huge loss of situation. Generally, the young farmers once they undergo losses in farming it demotivated them to carry out the same operation but old age farmers have more patience than new age.

Extent of factors' influence the income of member

The result of OLS showed that the male head of households had significant influenced by 13 per cent to the income of farmers, although the variable had not identified as influencing factor in stage-I of Heckman selection model. The educational factor was observed to have negative extent by 16 per cent as the literate farmers were responsible for decreased in the farmer's income that comes from agriculture enterprises. The illiterate farmers were fully engaged in

Table 3. Probit model estimates of the income influencing factors (n=65)

Variables	Coefficient	Std. error	p-value	Marginal effect
Const	0.19	0.051	00***	0.094
Gender	0.01	0.058	0.77	-0.098
Education	0.01	0.001	00***	0.009
Age	0.35	0.098	00***	0.164
Dependency ratio	0.16	0.176	0.34	-0.178
Farm size	-0.02	0.054	0.64	-0.131
HYVs	-0.01	0.069	0.81	-0.151
Hired labour	-0.07	0.062	0.21	-0.200
Credit through KCC	-0.02	0.053	0.62	-0.131
Implements and machinery	0.04	0.044	0.36	-0.047
Provision of inputs by FPOs	-0.00	0.043	0.91	-0.089

Censored: 11

Uncensored: 54

Source: Authors' calculation, *** indicate the level of significance at 1%

Table 4. OLS estimates of factors applied in Heckman model (n= 65)

Variables	Coefficient	Std. error	p-value
Gender	0.13	0.62	0.027**
Education	-0.16	0.80	0.038**
Age	0.003	0.02	0.209
Dependency ratio	0.10	1.37	0.462
Farm size	0.20	2.30	0.383
HYVs	-0.69	0.55	0.207
Training by FPOs	0.72	1.74	0.00***
Hired labour	-0.15	0.79	0.054*
Credit through KCC	0.11	0.85	0.179
Implements and machinery	-0.54	0.52	0.305
Inverse Mills Ratio (λ)	0.20	0.10	0.051*
rho	1.37		
sigma	0.15		
lambda	0.20		

Source: Authors' calculation, ***, ** and * are indicates the level of significance at 1%, 5% and 10%

agricultural operations and also seeking to earned more income from agricultural enterprises. The FPO should be organised youth motivation program towards agriculture and awareness about the extent of earning profit from agricultural business.

However, in stage-I, it was identified as positive factor influencing to increase the income of farmers. The farmers who had trained by FPO indicate positive and significant and it was observed to be 72 per cent responsible to increase the income of member. Moreover, those farmers who had hired the labour for agricultural operation observed as negative and significant influence on the income. Labour hiring factor decreased the income of member farmers by 15 per cent. Inverse mills ratio (λ) was an additional explanatory variable which was also observed to be significant at 10 per cent level, indicates that the income of member was also influenced by unobserved factors like self-motivation towards agriculture, getting innovation from other working farmers, availability of more own agricultural resources at farm and unavailability of other government and private jobs.

CONCLUSION

Farmer Producer Organisation has positive and significant impact on the livelihood of the farmers by providing various support like training, scientific method of farming and input material for farming. Moreover, various agricultural farming was operated by member of the FPO and has achieved positive growth except piggeries farming. The negative impact experienced may be due to COVID-19 lockdown. The training programs organised by FPO had positive influence on the income of farmers due to intervention of new crop and scientific method of cultivation. The education level had occurred negative impact on the extent on the income of farmers from the agriculture enterprises as most of the educated members were engaged in businesses other than agriculture. Overall, Ri-Lajong FPO was successful in enhancement of livelihood of farmers in Ri-bhoi, Meghalaya. From the above results it can be concluded that more FPO can be established in other districts of Meghalaya which will be helpful in agricultural growth ultimately enhancing the livelihood of the farmers.

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Livelihood Assessment of Fishers in Dal Lake, Kashmir

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ARTICLE INFO

Keywords: Livelihood, Vulnerability, Dal Lake, Kashmir, Network governance

<http://doi.org/10.48165/IJEE.2023.59309>

Conflict of Interest: None

ABSTRACT

The study investigates the livelihood conditions, vulnerability, and resilience of the Dal Lake fishers and their readiness and strength to withstand climate shocks and vulnerabilities. The study was conducted in 2019-2020 in three fishing villages of Dal Lake Kashmir, where the livelihood and vulnerability of fisheries-based livelihoods were assessed through a composite index development approach. The fishers of Dal Lake are moderately vulnerable to climate variability and changes. The status of the livelihood capitals of the fishers reveals that most of the capitals are of moderate type, however, the financial capital is poor horizontally among all the fishing villages. It was also found that the socio-economic conditions and resilience of the people are in very poor condition. The fisheries-related activities and policies are being side-lined because of giving more importance to tourism. The management of the lake is shared between the Fisheries & Tourism departments, and the Jammu and Kashmir Lakes Conservation and Management Authority (power). However, lack of coordination, less availability of resources, less priority to the fisheries sector, and lack of accountability hindered the desired outcomes. Proper management of the lake, coordination between the key stakeholders and fishers is very important and can be achieved through network governance.

INTRODUCTION

The fisheries sector is an essential source of food, nutrition, income, and livelihoods for millions of people and globally supports the livelihoods of around 59.51 million people through fisheries and aquaculture (FAO, 2022). Within the realm of fisheries management and development policy, the importance of sustainable small-scale fisheries has been increasingly recognized as a livelihood source for millions of households (Allison, 2001; Smith & Basurto, 2019).

As inland fisheries are an open access and culture system (Cooke et al., 2016), small-scale fishers mostly in developing countries, face different climatic shocks and stresses such as floods, cyclones, sea-level rise, droughts, land erosion, temperature, and rainfall fluctuations (IPCC, 2007; Islam et al., 2014). It leads to poverty, marginalization, and resource degradation of fishers. The

increase in climate variability and extremes, linked to climate change, are affecting negatively all dimensions of food security and nutrition (FAO, 2022; Meena et al., 2022). It needs to focus on more economically efficient approaches for resilient livelihood and different means to conserve fish stocks through a combination of management measures (Allison & Ellis, 2001; Purcell & Pomeroy, 2015). Fishers need to be resilient (Allison et al., 2011) to fulfill their potential, and resilient livelihoods can evolve in response to these changing stresses and shocks (Olsson et al., 2002). Over the last two decades, the Sustainable Livelihoods Approach (SLA) globally played an essential role in framing and informing the debate on sustainable livelihoods and in analysing what enables and inhibits resilient and sustainable small-scale fisheries (Allison & Ellis, 2001; Andrew et al., 2007; Serrat, 2017). The fisher folk of Kashmir valley is the marginalized section of the society, which are prone to various shocks and seasonality trend cause of their

poor socio-economic conditions (Mir et al., 2022), more sensitivity, and less adaptive capacity. For instance, the fisherfolk in the Kashmir valley were severely impacted by the massive fish stock mortality that resulted from the flood in 2014, which had disastrous effects on fish variety. They depend entirely on the local fisheries resources for their livelihood, and any fluctuation in management and governance of these common resources engraves a direct impact on them. The water bodies of Kashmir, especially the lakes, are important destinations for tourists because of which the fisheries activities and policies are always side-lined or sometimes ignored (Wani et al., 2013). Besides this, the fishers are always being marginalized/ ignored at the cost of others due to the involvement of many stakeholders in the governance and management of these fisheries resources. This paper proposes that livelihood analysis could provide a means to better understand the nature of small-scale fishery production systems, and to identify appropriate entry points for development intervention or policy support for poverty reduction and livelihood enhancement in fishing communities.

METHODOLOGY

This study was carried in Dal Lake, the second largest lake in the capital city of Srinagar in Jammu and Kashmir. The SLA framework given by UNDFID (1999) was adopted to assess the livelihood resilience of the fishing communities with a primary focus on their differential capabilities and assets to deal with any kind of stresses and shocks. The vulnerability of the fishing communities was assessed by a composite vulnerability index approach by analysing exposure, sensitivity, and adaptive capacity following Islam et al., (2014). Exposure indicators include the frequency of extreme events, the annual rate of floods, and variations in temperature, snowfall, and rainfall. In sensitivity, only indicators of dependence of livelihoods on climate-sensitive activities in the fisheries sector, like for employment, income, and nutrition were used as its indicators to avoid overlapping (Macfadyen & Allison, 2009). The adaptive capacity and livelihood capitals were assessed at the individual household level and measured in terms of capital and assets owned, infrastructure, facilities available and means of livelihood (Vincent, 2007; Paavola, 2008; Salluet al., 2010). Following (Czućz et al., 2009), each indicators was first normalized and then the average of respective indicators was taken to yield the three sub-indices for exposure, sensitivity, and adaptive capacity by using the formula:

$$SCvj = \sum_{i=0}^n Index\ svi$$

where $SCvj$ is the sub-index value of the component j for household v ; $Indexsvi$ represents the value of indicators indexed by component j , and n is the number of indicators in each component.

Sub-indices were combined to create a composite vulnerability index by using the multiplicative equation approach because it better reflects low and high indicators and sub-index values than the additive equation approach (Hajkowicz, 2006).

$$V = E \times S \times (1-AC)$$

where V , E , S , and AC represent a household's vulnerability, exposure, sensitivity, and adaptive capacity, respectively.

Among 10 fishing villages on the periphery of the lake with 880 total registered fishers, Tailbal, Fisherman Colony (FMC) Habak and Dobighat villages were purposively taken having 125,110 and 118 registered fishers respectively because of more number of fishers and high degree of involvement in fisheries activities (DoF, 2020). A total of 180 fishers were selected using snow-ball sampling technique, with 60 fishers from each village. The data was gathered from fishers using a structured interview schedule and discussions with key informants and some department officials were also held. Frequency, percentage analysis and Kruskal Wallis t-test was used to describe and compare various parameters among the fishing villages.

RESULTS AND DISCUSSION

Vulnerability context

As vulnerability is a function of exposure, sensitivity, and adaptive capacity, so the individual indices were calculated for exposure, sensitivity, and adaptive capacity to assess the vulnerability status.

The results show that all the villages are similarly exposed to climatic variations as they lie either close to the lake periphery or in the nearby areas (within a radius of 5 km) with the same geographical and topographical conditions. The temperature data revealed that the minimum temperature was recorded in January (-15°C) and the maximum in July (32°C). The overall average temperature is 13.6°C , with a maximum average monthly temperature in July (23.3°C) and a minimum in January (2.5°C). The average monthly rainfall is 59 mm, with a maximum in March (121 mm) and a minimum in November (28 mm). Snowfall in Kashmir usually occurs in December, January, February, and slightly in March, with an average annual snowfall of 77 mm with a maximum in February (120 mm) and a minimum occurring in March (32.7 mm). Figure 1 shows the contribution of various variables to the total exposure index of fishers is 0.56, which depicts a moderate level of exposure with a major contribution from fluctuations in the rainfall. The excessive freezing temperature in winter, heavy rainfall, and recurrent floods are the main factors that expose and affect the fishing communities. Tailbal village is more exposed to floods than other villages because the Tailbal

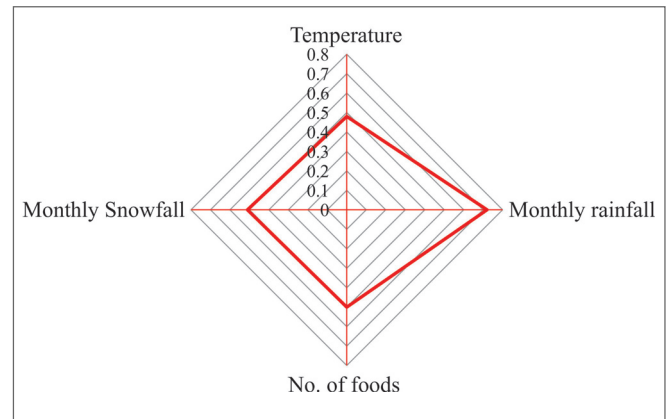


Figure 1. Exposure index of fishing villages

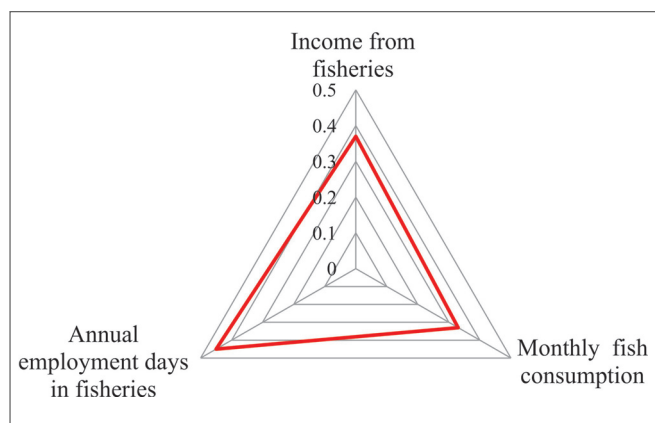


Figure 2. Sensitivity index of fishing villages

Nallah, the largest tributary of the lake, flows through the village and in the rainy season, gets fully flooded.

The results (Figure 2) show the higher sensitivity of fishers in Tailbal village is due to their dependence on climate-sensitive fisheries activities for employment, income, and nutrition and same was revealed by the discussions with the key informants from the village. This is depicted by the higher number of annual employment days in fisheries activities and also by the oral history and focus group discussion with key informants. This has increased their dependency on fisheries and, thus, their vulnerability.

The adaptive capacity index shows a value of 0.52, 0.51, and 0.44 for FMC Habak, Dobighat, and Tailbal villages respectively depicting the lowest adaptive capacity in Tailbal village. The cumulative index value for the adaptive capacity for all three villages was 0.48 showing that they have a moderate level of adaptive capacity. The lower index value was because of the poor economic condition of fishers, lack of capital assets, less livelihood diversity, poor access and availability of natural resources, and poor housing conditions. The same results have been revealed by livelihood capital analysis where the finance capital was the weakest in all three villages.

Table 1, shows the overall vulnerability scores of the three fishing villages and reveals that households of Dal Lake are moderately vulnerable. However, Tailbal village is more vulnerable

Table 1. Vulnerability index scores of fishing villages

Village	Index values			Livelihood Vulnerability Index (LVI)
	Exposure	Sensitivity	Adaptive capacity	
Tailbal	0.56	0.40	0.44	0.04
Dobighat	0.56	0.36	0.51	0.02
FMC Habak	0.56	0.35	0.52	0.01
Mean	0.56	0.38	0.49	0.02

Table 2. Test of significance among the fishing villages

Village	N	Adaptive capacity			Sensitivity			Vulnerability		
		Mean rank	Chi-square	p-value	Mean rank	Chi-square	p-value	Mean rank	Chi-square	p-value
Tailbal	60	3.15	0.366	<0.01	1.35	0.543	<0.01	55.27	6.872	<0.01
Dobighat	60	3.52			6.40			42.7		
FMC Habak	60	3.55			8.75			38.78		

to climatic variation than the other two villages, depicted by a high value of 0.04 (LVI ranges from -1 to +1, -1 low vulnerable and +1 more vulnerable- Islam et al., 2014). These findings are in line with Islam et al., (2014) & Meena et al., (2022). As these fishing villages are exposed uniformly, the Tailbal village is more vulnerable because of its high sensitivity and low adaptive capacity. The results highlight that for similarly exposed households, the higher livelihood vulnerability coincides with the higher sensitivity and lowest adaptive capacity.

The Kruskal-Wallis test was used to determine the significant difference between the villages in terms of adaptive capacity and sensitivity. The results from Table 2, inferred that there is a significant difference ($p < 0.01$) between the villages in terms of their sensitivity and adaptive capacity, with a low mean rank for Tailbal village and a high mean rank for FMC Habak. A comparison of vulnerability among fishing villages reveals a significant difference between the villages in terms of vulnerability with a high vulnerability mean score for Tailbal village, low in FMC Habak and intermediate in Dobighat.

Livelihood capitals

Evaluating livelihood resilience at the level of fishers and their households requires identifying the factors that enable or constrain livelihood resilience. The five livelihood capitals of the SLA framework were used, and under each capital, various attributes/variables were selected (5 to 9). All these attributes were chosen to determine the sustainability and resilience of fishers' livelihoods (modified from Stanford et al., 2017). These were grouped into five "fields," corresponding to the five standard capital categories of the SLA (Natural, Human, Physical, Financial, and Social Capitals). A brief description of each field is provided below:

Natural resources and environmental services, from which resources are derived and services necessary for subsistence are derived, are included in natural capital. The index values for natural capital were determined using the weighted normalised values of several variables under all attributes. The nearest town's distance had the highest natural capital value (0.88), indicating that villages are close to the main city-an average distance of 5 km-and possession of the land had the lowest value (0.04), reflecting the fact that the majority of respondents did not own any land assets. According to Table 3, the fishers have a moderate level of natural capital, with an average index value of 0.48.

Table 3 shows the various attributes of human capital, and it is evident that female members of the household play a significant role in the marketing of the catch. They act as primary bread earners for their families, especially during the ban/ winter season; as indicated by their attribute score (0.90). There is a lack of occupational diversity (0.37), among fishers as most of them were involved in capture fishery only. It has reduced their capability for

Table 3. Village wise index values of attributes of livelihood capitals

S.No.	Attributes	Normalized index values			
		Tailbal	Dobighat	FMC Habak	Average value
	Natural capital (0.47)				
1	Distance to the nearest town	0.64	1.00	1.00	0.88
2	Change in catch, over last 20 years	0.31	0.28	0.29	0.29
3	Change in revenue generated over last 20 years	0.23	0.28	0.29	0.27
4	Possession of land by household	0.04	0.02	0.08	0.05
5	Loss due to natural disaster	0.80	1.00	0.98	0.93
	Human capital (0.53)				
1	Availability of time and potential to do extra work	0.96	0.92	0.91	0.93
2	Market awareness	0.44	0.49	0.53	0.49
3	Occupational diversity	0.34	0.38	0.39	0.37
4	Entrepreneurial behaviour	0.07	0.03	0.03	0.04
5	Activities done by female household members	0.88	0.93	0.88	0.90
6	Number of children present in the family	0.60	0.63	0.61	0.61
7	Importance and aspiration of education for children	0.71	0.60	0.83	0.71
8	Planning for future	0.05	0.03	0.03	0.04
9	Daily household expenditure	0.62	0.85	0.72	0.73
	Physical capital (0.45)				
1	Possession of boat by the respondent/ fisher	0.68	0.72	0.73	0.71
2	Availability of fishing gears and their performance	0.53	0.53	0.63	0.57
3	Ownership of assets	0.33	0.31	0.34	0.33
4	Value addition/ processing of catch by household	0.65	0.63	0.62	0.63
5	Housing condition	0.43	0.50	0.48	0.47
6	Marketing of the catch	0.30	0.03	0.12	0.15
	Financial capital (0.40)				
1	Money saving habit/ ability	0.48	0.38	0.33	0.40
2	Collateral for credit	0.07	0.03	0.15	0.08
3	Access to credit from various sources	0.50	0.49	0.53	0.51
4	Repayment capacity of the respondent	0.37	0.41	0.54	0.44
5	Arrangement of money in different situations	0.38	0.46	0.64	0.49
6	Supplementary livelihood source besides fishing	0.27	0.25	0.33	0.28
	Social capital (0.51)				
1	Attitude of working together in community	0.02	0.02	0.02	0.02
2	Trustworthiness of people in the community	0.40	0.77	0.62	0.59
3	Helping behaviour of community leaders	0.32	0.55	0.20	0.36
4	If you have a problem who will help you	0.64	0.69	0.70	0.68
5	Everyone have an equal right to contribute their view	0.32	0.75	0.80	0.62
	Mean capital index score	0.45	0.49	0.50	0.48

doing any future planning because of a lack of necessary funds, as indicated by the attribute score of 0.03, and signifies the need for alternative livelihoods. The index value of human capital (0.52) is of moderate type and to make it stronger, more focus should be given to alternate livelihoods, involving women in livelihood activities and providing them with necessary credit facilities.

According to Daw et al., (2013), physical assets are the producer products and essential infrastructure required to support a way of life. Table 3 shows the scores for key physical capital features and illustrates fishers lack basic amenities, access to suitable marketing facilities, forcing them to sell their catch on Srinagar's pathways and in other villages. The physical capital is also of a moderate nature, with an index score of 0.47, like the aforementioned two capitals. It may be strengthened by providing appropriate marketing facilities, value-adding their catch, departmental subsidies for gear and crafts, and improving their overall housing situation.

For the purpose of pursuing any livelihood activity, financial capital includes a capital basis (cash, credit/debt, savings, and other financial assets). Table 3, shows the majority of fishers didn't have the requisite collateral to obtain credit, hence this attribute received the lowest score (0.08). However, friends and family were the principal sources of credit, and they had a very high repayment capability (0.64 on the index). Overall, the financial capital index indicates a value of 0.43, indicating a moderate level of financial capital also found by Qureshi et al., (2017). It should be strengthened by giving additional sources of income that will increase their ability to save money fair consideration.

Social capital includes social resources like networks, social claims, social relations, affiliations, and associations upon which people pursue different livelihood strategies. Table 3 shows that most of the fishers were unwilling to work together in groups (0.01) probably because of less importance to group work and absence of cooperative society. They have great concern for others

in their community and used to help each other as indicated (0.85). The average value of the social capital index is 0.52, which shows that their social capital is of moderate type. To improve the social capital of fishers, focus should be given to joint working activities, rotational type leadership, accountability and establishing cooperative societies.

Discussions with key informants and department representatives also showed that Dal Lake fishers have inadequate physical assets, and that they are financially weak due to a lack of capital for alternate sources of income and more dependence on fishing operations. However they care and support other fishers in the community, and they do support one another in times of need or crisis.

The Kruskal-Wallis test was used to compare the livelihood capitals of three fishing villages and it was found that there is a significant difference in livelihood capitals among the villages, $X^2(3) = 10.366$, $p < 0.01$ with a mean rank of 33.15 for Tailbal, 49.80 for Dobighat, and 53.55 for FMC Habak. The results show lower values of livelihood capital for Tailbal villages which indicate that

the livelihood capitals are weak in the Tailbal village fishers and is probably one of the reasons for their high vulnerability.

Suggestive measures

The J&K State Department of Fisheries (DoF), J&K State Department of Tourism (DoT), J&K Lake Conservation and Management Authority (JKLCMA), fishers, and people living on the lake periphery are involved to manage various facets of the lake. The primary issues with the fisheries components of the lake are the lack of cooperation between DoF and other departments and the lower priority given to fisheries activities because of their minimal financial contribution to the state (Mir et al., 2022). The creation of alternative livelihoods to decongest the lake should focus on the abilities of the fishers, such as cage culture, ornamental fish culture/rearing, aquarium manufacturing, and aqua-based ecotourism, and the fishers should be given suitable marketing facilities. Also, strict enforcement of laws preventing the flow of civic discharge into the lake by improving the already established STPs and developing new ones.

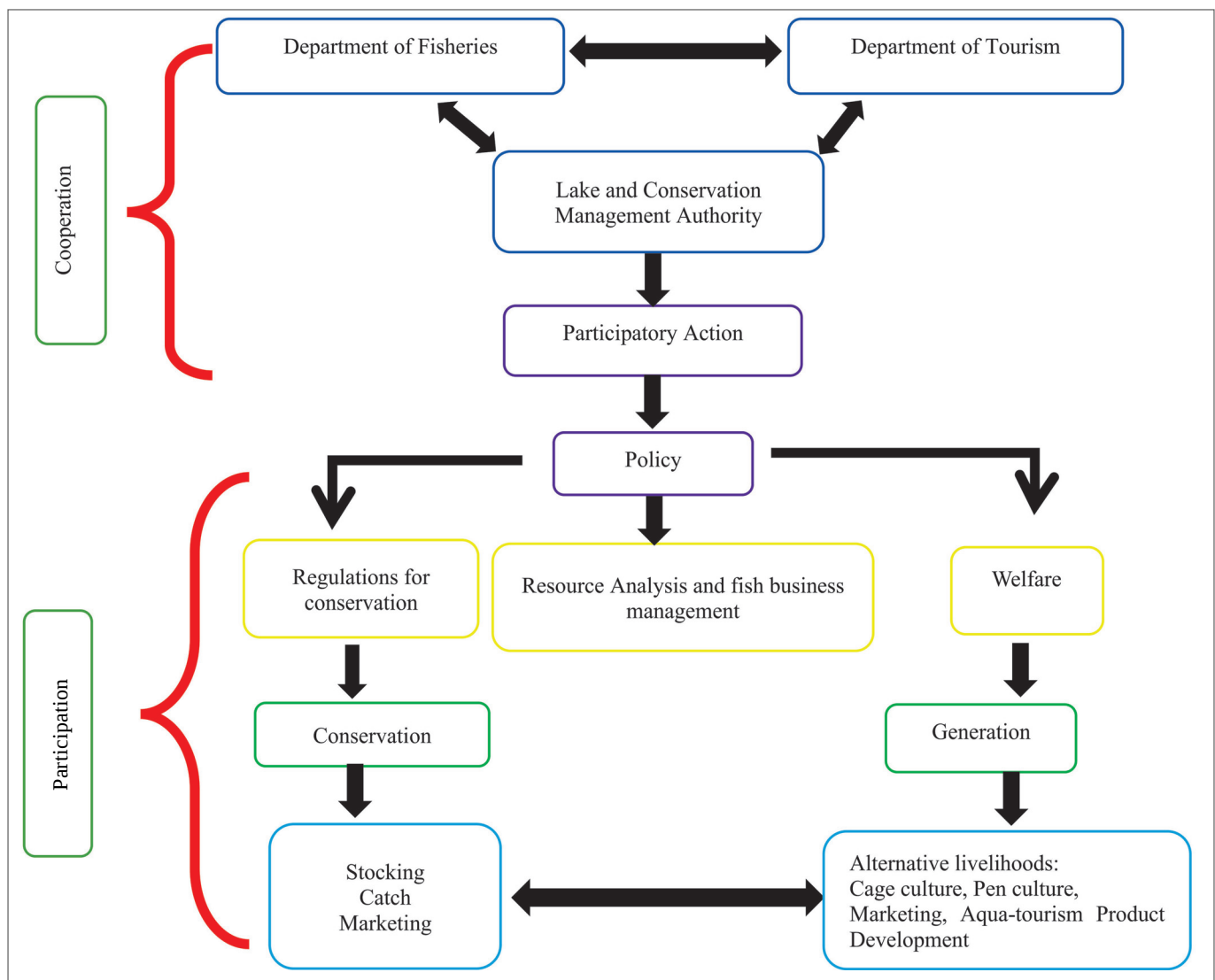


Figure 3. Network Governance for fisheries co-management in Dal Lake

Network governance

Institutional efficiency and networking performance need to be greatly enhanced, to enhance lake management as shown in Figure 3. This can be done in two steps:

Coordination and integration between the important parties involved in the governance and management of the lake is the first step. All participants should agree upon and evaluate the viability of any proposed policy, programme, or project before drafting and putting it into action also reported by also Priyanka & Devarani (2022). When these actors cooperate, the participation will be the next logical step and should ensure that policies and programmes are implemented correctly at the ground level. This will improve fishers well-being and contribute to the development and preservation of the ecosystem.

CONCLUSION

Dal lake being a famous tourist destination is also as an important source of fish and livelihood to the people. Most fisher households have a moderate vulnerability because of more sensitivity and weak adaptive capacity. The fishers livelihood depend on the lake and have moderate livelihood capitals, with social capital being the strongest and financial capital the weakest. The production and productivity of the lake has declined over the years, which resulted in the low income of fishers and thus made them more vulnerable. Proper management and governance, providing alternate livelihood to the fishers will help to prevent the over-exploitation of the fish and also improve the socio-economic condition of the people thus making them less vulnerable and more resilient to different climatic, social, economic, and natural shocks.

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Exploring the Relationship between Socio-economic Factors and ICT Adoption among Farmers

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ARTICLE INFO

Keywords: ICT, Extension contact, Exogenous variables, Residual effect, Utilization

<http://doi.org/10.48165/IJEE.2023.59310>

Conflict of Interest: None

ABSTRACT

The study was conducted in Uttar Pradesh, India to assess the relationship between ICT tools and socio-economic variables of farmers. The *ex-post-facto* research design and multi-stage random sample technique were used. The data was collected through personal interviews with farmers. The total sample size of the study was 120 farmers. The study data were analyzed with correlation, multiple regression, and path analysis. The coefficient of determination (R^2) revealed that 79.90 per cent of the total variation in the utilization of ICT tools by the farmers was explained by the selected independent variables. The path analysis was used to assess the total effect, which was decomposed into direct, indirect, and residual effects. The variable education (0.358) exerted the highest direct effect, while the total indirect effect of extension contact (0.493) was on the utilization of ICT tools by the farmers. The residual effect was 0.201, which means that 20.10 per cent of the variance could not be explained due to exogenous variables. Overall, the study suggests that education and extension contact are crucial factors that affect the utilization of ICT tools by farmers in Uttar Pradesh for agricultural purposes.

INTRODUCTION

Agriculture information is crucial for the overall development of agriculture as well as for enhancing farmers' quality of life in a dynamic and changing agricultural environment (Mittal & Mehar, 2016). One of India's most significant industries is agriculture, which might greatly benefit from the use of ICTs. Information and communication technology plays a crucial role in changing the socio-economic circumstances of impoverished and developing countries (Bansal & Joshi, 2019). ICT education should be built into the extension delivery package of extension agents to farmers particularly the use of the mobile phone (Osondu & Ibezim, 2015). The access usage index of ICT tools indicates that it is utilized mostly for social media and video calling but less for computer, global positioning system, web camera and radio (Panda et al., 2019).

ICT use in agriculture has become a key pillar of agriculture extension, concentrating on the improvement of rural and agricultural development enhanced communication and information processes (Dhaka & Chayal, 2010). Television, radio, agriculture officer and progressive farmers were categorized into strong group of information sources usefulness (Ravikumar et al., 2015). ICT refers is a collection of technologies that support the storage, processing, or dissemination/communication of data/information, or both (Kumar et al., 2017). Thus, ICTs refer to technologies that facilitate the creation, processing, and transfer of information across space and time. Agricultural development depends on agricultural extension, which is the application of new knowledge and scientific research to agricultural practices through farmer's education (DFI, 2017). ICTs are technologies that allow people to communicate and exchange information and knowledge in new ways. Stevenson

first time use the term “information and communication technology” in 1997 (Khare et al., 2011). The study looked into how well ICT tools are used to deliver services for agricultural extension. Social media like WhatsApp is a highly beneficial tool that saved time and money in the problem-solving process. It provided an immediate solution to farmers on a large-scale with this App, and the farming communities could have received need-based and time-based services (Mishra et al., 2020; Patel et al., 2020). Small farms typically lack the financial resources to stay up. This could change when information access and delivery become more affordable. However, even in the short run, there are creative methods for smallholder farmers with limited human and financial capital to maximize yields using digital technology like basic mobile phones (Meena et al., 2018). The content in social media platforms must be generated based on the needs of the users, and the interface in social media platforms must be simplified for ease of use. Farmers considered the information offered or obtained via social media platforms to be beneficial and valuable in helping them practice and adopt best agricultural practices (Nain et al., 2019; Sandeep et al., 2022).

METHODOLOGY

The study was conducted in the Banda district of Uttar Pradesh. The district comprises eight blocks. Out of these eight blocks, two blocks namely Baberu and Kamasin were selected randomly. Banda district was selected purposively because there the maximum numbers of farmers are pulse growers. The present study employed an *ex-post-facto* research design and multistage random sample technique. Five villages from each of these blocks were selected. Hence, 10 villages in total were selected for the study as a result. Twelve pulse farmers were purposefully chosen from each of the identified villages. Hence, a total of 120 farmers in all were selected for the study. A structured interview schedule was used to collect the data. The utilization patterns of ICTs were, the dependent variable represented by Y_1 . Age (X_1),

Education (X_2), Caste (X_3), Landholding (X_4), Family income (X_5), Occupation (X_6), Farming experience (X_7), Information seeking behavior (X_8), Extension contact (X_9), Mass media exposure (X_{10}), Achievement motivation (X_{11}), Scientific orientation (X_{12}), Innovativeness (X_{13}) were the independent variables. The data was subjected to a correlation analysis, multiple regression, and path analysis in order to determine the strength of the association, and combine effect (direct, indirect, and residual) between the chosen dependent variable and the independent variables. The computation and statistical significance of the correlation coefficient, multiple regression analysis, and path analysis were done for the utilization of ICT tools with the socio-economic attributes of farmers.

RESULTS AND DISCUSSION

Determinants of farmers' utilization of ICT tools

Table 1 presents the coefficient of correlation between farmers' utilization of ICT tools (Y) and socio-economic variables (X_1 - X_{13}) considered as dependent and independent variables, respectively. The finding revealed that the age of the respondents has recorded a negative and significant correlation with the dependent variable. This was because young farmers were more efficient in handling ICT tools than the elder ones. Younger people accept new changes and try new technologies more rapidly (Kumar et al., 2017); Roy et al., (2018); Prasad & Pradhan (2019); Mahajan et al., (2022). Education was positively and significantly correlated with the utilization of ICT tools. Because people gain knowledge through the formal education system (Anand et al., 2022). This may be the possible reason that the variable ‘education’ has shown a significant association with the dependent variable utilization of ICT tools. The findings are in conformity with the findings of Roy et al., (2018); Prasad & Pradhan (2019); Naik et al., (2020). Likewise, caste, land holding, and farming experience had a non-significant relationship with the dependent variable, indicating that

Table 1. Summarizes the correlation coefficients, regression coefficient, and Path analysis for the attributes of farmers and their utilization of ICT tools. (n=120)

S.No.	Variables	Correlation coefficient (r)	Regression analysis			Path analysis		
			Regression coefficient	Std. error	t-value	Direct effect	Total effect	Indirect effect
1	Age (X_1)	-0.353**	-0.200	0.020	-3.749**	-0.148	-0.205	0.017(X_3)
2	Education (X_2)	0.617**	0.354	0.126	6.149**	0.358	0.259	0.119(X_{12})
3	Caste (X_3)	0.145 ^{NS}	0.000	0.384	-0.007	-0.053	0.198	0.080(X_5)
4	Land holding (X_4)	0.132 ^{NS}	0.082	0.062	1.490	-0.021	0.153	0.091(X_5)
5	Family income (X_5)	0.493**	-0.101	0.026	-1.764	0.234	0.259	0.102(X_{12})
6	Occupation (X_6)	0.203*	0.189	0.431	3.478**	0.096	0.107	0.077(X_5)
7	Farming experience (X_7)	0.071 ^{NS}	0.078	0.026	1.122	0.113	-0.042	0.051(X_2)
8	Information seeking (X_8)	0.332**	0.091	0.100	1.716	0.101	0.231	0.077(X_2)
9	Extension contact (X_9)	0.409**	-0.080	0.064	-1.230	-0.084	0.493	0.172(X_{12})
10	Mass media exposure (X_{10})	0.273**	0.041	0.112	0.698	0.039	0.234	0.079(X_{12})
11	Achievement motivation (X_{11})	0.270**	-0.117	0.109	-1.968*	-0.071	0.341	0.128(X_{12})
12	Scientific orientation (X_{12})	0.683**	0.340	0.120	4.099**	0.309	0.374	0.195(X_{13})
13	Innovativeness (X_{13})	0.727**	0.264	0.091	2.963**	0.264	0.463	0.229(X_{12})

$R^2 = 0.799$, Adjusted $R^2 = 0.744$, S.E.E. = 1.761, F = 32.364

**Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level; NS: Non-significant

all farmers irrespective of their caste, land holding size, and farming experience, were using them. The farming experience of the respondents neither contributes to the factor of accessing different ICT tools nor influences the capability to use the ICT tools efficiently. The results in this study that the land holding had a non-significant relationship with the usage of ICTs are supported by the study done by Dhaka & Chayal (2010); Prasad & Pradhan (2019) & Tomar et al., (2016). Likewise, occupation and annual income with the utilization of ICT tools show a positive and significant relationship. The motive would possibly be that the annual income of the farmers directly affects the economic viability, stability, and rational behavior of an individual. The usage of ICT tools increases with the increase in family income, supported by the findings of Tomar et al., (2016). Occupation was a significant relationship with the utilization of ICT tools supported by the study done by Mahajan et al., (2022). Information-seeking behavior positively correlated with the utilization of ICT tools. If the person is motivated by any means to look forward to gaining knowledge and information, his willpower, attitude, and curiosity will drive him toward seeking different information from different sources. The findings are in conformity with the findings of Tomar et al., (2016). It was observed that extension contact and mass media exposure of farmers were found conducive to the utilization of ICT tools by farmers. They receive market information and a fair price for their produce, and ICT plays an important part in this (Anand et al., 2022). Farmers, who attended a greater number of pieces of training, had more extension contact and mass media exposure and tend to use more ICT tools (Roy et al., 2018). It might be the reason why mass media exposure and extension contacts are significantly and positively associated with ICT uses. The findings are in line with the findings of Tomar et al., (2016) & Roy et al., (2018). The attributes like scientific orientation and achievement motivation were also found to be positively and significantly correlated with the utilization of ICT tools by farmers. The favorable attitude towards the scientific method of usage of ICT tools might be the reason why scientific orientation was significantly and positively associated with ICT use (Naik et al., 2020). Innovativeness is one of the major key instruments in society for economic development; especially, when it comes to agricultural innovations for increasing production and productivity through advanced technology like ICTs. The innovativeness is found to be significantly associated with the dependent variable 'utilization of ICT tools' in a positive direction (Prasad & Pradhan, 2019).

Multiple regression analysis was employed to access the combined effect of (X_1 - X_{13}) independent variables in explaining the dependent variable. The coefficient of determination (R^2) of the independent variables was 0.799. It means that 79.90 per cent of the total variation in the utilization of ICT tools by the respondents was explained by the selected 13 independent variables. The value of 't' showed that utilization of ICT tools was significantly related to age, education, occupation, achievement motivation, scientific orientation, and innovativeness. As indicated by the t-test, these factors contribute to the majority of the prediction of the attitude of the respondents. The findings revealed that if one unit change in age, education, occupation, achievement

motivation, scientific orientation, and innovativeness, utilization of ICT tools was changed by -0.200, 0.354, 0.189, -0.117, 0.340, and 0.264 units, respectively. The regression coefficients on the remaining 7 variables were, however, not significant. This indicates that these attributes although desirable for the utilization of ICT tools did not contribute significantly when they were considered for study in the regression analysis.

Path analysis of the dependent variable, the farmer's utilization of ICT tools (Y), wherein the total effect has been decomposed into direct, indirect, and residual effects. It has been recorded that the variable education (0.358) has exerted the highest direct effect on farmers' utilization of ICT tools (Y). It implies that the utilization of different ICT tools has got a collateral impact exerted by educational status. This is because education status is the backbone of cognitive enlargement. The person acquires their knowledge from the formal education system and that makes the individual more receptive towards sources of information like ICT tools which in turn makes the person more capable to access different ICT tools and it creates a positive attitude towards utilization of ICT tools (Panda et al., 2019). The variable scientific orientation (0.309) and innovativeness (0.264) represent the second and third ranks in terms of direct effect. The total indirect effect of extension contact (0.493) on the utilization of ICT tools by the respondents was found to be high. It might be due to the bet that extension contact exposes farmers to new areas of farming strategies with knowledge and achievement. Frequent contact with extension agencies provides the chance for gaining knowledge about agricultural innovation. This exploration and influence imposed by the extension contact enhance the ICT tools usage by the people (Naik et al., 2020). Innovativeness (0.463) and scientific orientation (0.374) occupied the second and third place in total indirect effect on the utilization of ICT tools. Further, it was observed that 6 out of 13 selected independent variables had their largest indirect effect on the utilization of ICT tools through scientific orientation. The scientific orientation has been a strong determinant in deciding the extent of utilization of ICT tools by the farmers. This is because scientific orientation leads to knowledge acquisition which in turn may lead to the adoption of new technology (Madhuri et al., 2020). The scientific orientation had an indirect effect on utilization of ICT tools through innovativeness. The residual effect being 0.201 means 20.10 per cent of the variance could not be explained by the present set of socio-economic variables (exogenous).

CONCLUSION

India's agriculture is transitioning from subsistence farming to a means of improving the quality of life and livelihoods. To accomplish this, there is a critical need for a comprehensive Knowledge Management System that integrates all available knowledge from public and private domains. In this ICT is play a crucial role in organizing and modernizing communication and information. Society's quality of life depends on its ability to apply scientific knowledge in everyday life, and this necessitates to speedy dissemination of information to agri-stakeholders. A cost-effective and strong research-extension-user system linkage is required. In addition, the farming community requires user-friendly technology that maximizes the potential of ICT gadgets. The

finding suggested that attributes such as education, occupation, scientific orientation, and innovativeness play a significant role in influencing the utilization of ICT tools among farms. It also guides policy interventions for promoting ICT adoption & innovative agricultural practices.

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Information Receiving Behavior of Farmers: The Structural and Functional Analysis

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ARTICLE INFO

Keywords: Farmers, Farmers network, FPO members, Information seeking behaviour, Farmers' interactions

<http://doi.org/10.48165/IJEE.2023.59311>

Conflict of Interest: None

ABSTRACT

Farmers, who are the primary producers of food and other allied agricultural commodities, play the pivotal role in Indian agriculture and economy.. Farmers need fast and accurate information on a variety of farming-related issues including weather, markets, pests and diseases, farming techniques, and agricultural inputs, to make informed decisions. Farmers' information-seeking behaviour, however, differs based on several conditions. The proficiency in information-receiving behavior and its interpretation merit humongous importance for the triumph of entrepreneurial success far beyond subsistence farming. The study was conducted in the Nayagarh district of Odisha by selecting one hundred FPO member farmers following multistage and snowballing sampling techniques. A structured interview schedule was prepared and data were collected using the personal interview method. The study envisages that variables viz. age, crop yield, no. of male workers, marketed surplus, and materials possessed and training exposure have significant contributions to the functional contribution of information receiving behaviour of the farmers. The study suggests that improvement of farmers' network and extension agent farmers' relationship may be helpful for quick technology dissemination and overall improvement of the farming community.

INTRODUCTION

The world's expanding population depends heavily on farmers for its food needs. Nonetheless, their access to information can dramatically alter their agricultural practices and yields (Fróna, 2019). In the current digital era, farmers have access to a wealth of information via a variety of media, including mobile phones, television, and the internet (Chowhan, 2020). The adoption of sustainable and climate-resilient agricultural practices can also be facilitated by good communication, assuring the long-term viability of agriculture and the wellbeing of the farming community (Rao et al., 2016). Several studies suggest that, the formation of group of farmers may act as the catalyst in increasing the information receiving abilities of the farming community (Munoz et al., 2015;

Fleming et al., 2021). Farmer Producer Organization (FPO) is one of the greatest institutional innovations tailored to the much needed transformation of subsistence farming into entrepreneurial farming in India through reducing transactional costs (Parthiban et al., 2015). Producer organizations (POs) are formal rural organizations comprised of smallholder farmers who organize with the goal of increasing farm income through improved production, marketing, and local processing activities (Rondot & Collion, 2001). FPO leads to enhanced income for farmers by providing them with access to institutional credit, informed and better decisions, access to better and improved inputs, effectiveness & efficiency in farming operations, and better marketing facilities (Sharma et al., 2019). Smallholder farmers who form FPOs with the aim of raising farm revenue through enhanced production, marketing, and regional

processing activities are its members (Ameer, 2021) when compared to respondents from non-functional FPOs, members (including management) of functional FPOs had higher risk bearing capacity, greater economic motivation, and more innovativeness (Singh, 2022). FPOs have better opportunities for direct marketing which is a need of the hour for the people of villages (Harikrishna et al., 2022; Kumari et al., 2022). The majority of farmers perceived that with respect to management and governance characteristics of FPO had fair group communication (Amitha et al., 2021). Younger respondents have recorded a significant effect on entrepreneurial information received from cosmopolite sources (Acharya et al., 2022) Within a high performing FPO, individuals' attitudes about their FPO and cooperation were discovered to be important contributors to improving group stability (Gorai et al., 2022). Members facilitating for profitable farming includes increase in knowledge of improved production technology and increase in adoption towards production technology (Venkatesan et al., 2020). The perceived effectiveness of producer members towards the social indicators such as knowledge on production technology was found to be fair (Venkattakumar et al., 2019). It is found that education, experience and annual income were determinant factors that influenced the performance of FPOs (Vedasi et al., 2019). In terms of entrepreneurial attributes, majority of the pineapple growers possessed indigenous knowledge, farm decision-making ability; self-confidence and economic motivation were found important (Jha, 2012).

METHODOLOGY

Considering the COVID-19 restrictions, the study was conducted in the purposively selected two farmer producer organizations (FPOs) from Ranpur block of Nayagarh district of Odisha. One hundred (100) respondents in total were selected from two FPOs, fifty (50) from each of FPOs to conduct the study following snowball sampling method. Data collection was carried out by administering personal interview schedules. Prior to actual fieldwork, a pilot study was conducted to understand the area, its people, communication and social system in order to establish an overall picture for conducting the study. Appropriate operationalization and measurement of the variables helped the researcher to land upon the accurate conclusions. Therefore, the selected variables for this study had been operational and measured in the following manner i.e., (i) Independent variables and (ii) Dependent variable. Independent variables selected for the study were age (x_1), education (x_2), no. of enterprise (x_3), year of enterprise (x_4), training exposure (x_5), family size (x_6), mean family education (x_7), material possessed (x_8), size of holding (x_9), size of homestead land (x_{10}), size of cultivated land (x_{11}), size of land under irrigation (x_{12}), no. of fragments (x_{13}), crop yield (x_{14}), livestock yield (x_{15}), cropping intensity (x_{16}), income (x_{17}), family expenditure (x_{18}), marketable surplus (x_{19}), marketed surplus (x_{20}), family labor (x_{21}), no. of male workers (x_{22}), no. of female workers (x_{23}) and dependency ratio (x_{24}). Dependent variable selected for the study was Entrepreneurial information received from cosmopolite sources (10 point scale) (y). Appropriate statistical tools had been used to carry out the study viz. correlation coefficient, multiple regression analysis, step wise regression analysis and path analysis with the help of IBM SPSS v26.0.

RESULTS AND DISCUSSION

The subjective information was measured utilizing explicit numerical methodology. Then data analysis i.e. coefficient of correlation, multiple regression analysis, stepwise regression analysis and path analysis have been done to understand the functionality of the selected variables for the study. Table 1 presents the coefficient of correlation between entrepreneurial information received from cosmopolite sources (y) and selected twenty four socio-ecological variables. It was found that the following variables viz. age (x_1), marketable surplus (x_{19}) and marketed surplus (x_{20}) of FPO members are having negative but significant correlation with the dependent variable. The variables number of enterprise (x_3), year of enterprise (x_4), training exposure (x_5), materials possessed (x_8), size of holding (x_9), size of cultivated land (x_{11}), size of land under irrigation (x_{12}), number of fragments (x_{13}) crop yield (x_{14}), income (x_{17}), family labour (x_{21}), no. of male workers (x_{22}) and no. of female workers (x_{23}) recorded positive significant correlation with the dependent variable.

The coefficients of correlation revealed that younger respondents had been accessing higher and cosmopolite information sources. Similar studies also suggested that new members in producer groups exhibit strong association with information received from cosmopolite sources (Acharya et al., 2022). At the same time respondents having more no. of enterprises (x_3), more years of enterprises (x_4), more training exposure (x_5), more no. of material possessed (x_8), larger size of holding (x_9), higher size of cultivable

Table 1. Relationship between entrepreneurial information received from cosmopolite sources (y) and selected socio-ecological variables (x_1 - x_{24})

S.No.	Independent variables	'r' Value
1	Age (x_1)	-0.269**
2	Education (x_2)	0.176 ^{NS}
3	Number of enterprise (x_3)	0.352**
4	Year of enterprise (x_4)	0.377**
5	Training exposure (x_5)	0.381**
6	Family size (x_6)	0.160 ^{NS}
7	Mean family education (x_7)	0.081 ^{NS}
8	Materials possessed (x_8)	0.317**
9	Size of holding (x_9)	0.315**
10	Size of homestead land (x_{10})	0.106 ^{NS}
11	Size of cultivated land (x_{11})	0.337**
12	Size of land under irrigation (x_{12})	0.350**
13	Number of fragments (x_{13})	0.549**
14	Crop yield (x_{14})	0.379**
15	Livestock yield (x_{15})	0.137 ^{NS}
16	Cropping intensity (x_{16})	-0.184 ^{NS}
17	Income (x_{17})	0.227*
18	Family expenditure (x_{18})	0.121 ^{NS}
19	Marketable surplus (x_{19})	-0.294**
20	Marketed surplus (x_{20})	-0.333**
21	Family labour (x_{21})	0.231*
22	No of male workers (x_{22})	0.540**
23	No of female workers (x_{23})	0.381**
24	Dependency ratio (x_{24})	0.056 ^{NS}

**Correlation is significant at the 0.01 level, *Correlation is significant at the 0.05 level, ^{NS} Non Significant

land (x_{11}), more land under irrigation (x_{12}) and more number of fragments (x_{13}) have also been dove-tailed to higher access and utilization of information. Income (x_{17}), marketable surplus (x_{19}), marketed surplus (x_{20}) and family labor (x_{21}) for their obvious reasons; they have been intrigued with the consequent variable. Family labor (x_{21}), no. of male workers (x_{22}) and no. of female workers (x_{23}) have been found to be involved in the FPO Functioning. These have correlated with the access and use of cosmopolite sources of entrepreneurial communication (Panda et al, 2019; Acharya & Roy, 2021).

Table 2 presents the full model of regression analysis between criterion variables, Entrepreneurial information received from cosmopolite sources (y) vs. 24 causal variables. It was found that 24 causal variables together had contributed 72.60 per cent of variance in consequent variable entrepreneurial information received from cosmopolite sources (y). The Beta coefficient of the causal variable size of holding is negative but significant which implies that the possession of the respondent has got substantive effect on the access of entrepreneurial information from cosmopolite sources.

Table 3 presents the step down regression analysis. In stepwise regression analysis, it was found that the variables, number of fragments (x_{13}), crop yield (x_{14}), no. of male workers (x_{22}), marketed surplus (x_{20}), materials possessed (x_8) and training exposure (x_5) had been retained in the last step. It implies that fragmentation is not just physical disintegration of land masses. Beyond that it characterizes the behavior of communication pattern and behavior disposed off by the FPO members. The socio-ecological behavior due to fragmentation of land, has elicited more psychic effect due to the stress associated with utilization of more labor, resources and time. Fragmentation transformed land holding as cost and energy prodigal. In order to scale up entrepreneurial information received from cosmopolite sources by the FPO members, the prime concerns could have been to improve crop yield, give need based training and provide proper assistance to male workers of the FPO. The R square value being 68.70 per cent, these six variables had together contributed to 87.04 per cent of 71.00 per cent total variance of explicated variables to vindicate their distinctive contribution in characterizing entrepreneurial

Table 2. Multiple regression analysis of entrepreneurial information received from cosmopolite sources (y) vs. 24 causal variables (x_1 - x_{24})

S.No.	Variables	Reg. Coef. B	S.E. B	Beta	t Value
1	Age (x_1)	0.082	0.121	0.082	0.677
2	Education (x_2)	-0.134	0.123	-0.134	-1.089
3	Number of enterprise (x_3)	0.008	0.130	0.008	0.064
4	Year of enterprise (x_4)	-0.010	0.092	-0.010	-0.108
5	Training exposure (x_5)	0.272	0.126	0.272	2.163
6	Family size (x_6)	0.034	0.103	0.034	0.327
7	Mean family education (x_7)	-0.034	0.085	-0.034	-0.402
8	Materials possessed (x_8)	0.300	0.097	0.300	3.109
9	Size of holding (x_9)	-0.693	0.531	-0.693	-1.303
10	Size of homestead land (x_{10})	0.088	0.068	0.088	1.300
11	Size of cultivated land (x_{11})	0.656	0.552	0.656	1.189
12	Size of land under irrigation (x_{12})	0.082	0.111	0.082	0.737
13	Number of fragments (x_{13})	0.287	0.095	0.287	3.023
14	Crop yield (x_{14})	0.233	0.085	0.233	2.735
15	Livestock yield (x_{15})	0.049	0.069	0.049	0.700
16	Cropping intensity (x_{16})	-0.009	0.077	-0.009	-0.117
17	Income (x_{17})	-0.033	0.075	-0.033	-0.442
18	Family expenditure (x_{18})	-0.036	0.076	-0.036	-0.472
19	Marketable surplus (x_{19})	-0.033	0.083	-0.033	-0.394
20	Marketed surplus (x_{20})	-0.191	0.092	-0.191	-2.080
21	Family labour (x_{21})	-0.022	0.088	-0.022	-0.251
22	No of male workers (x_{22})	0.396	0.095	0.396	4.189
23	No of female workers (x_{23})	0.030	0.083	0.030	0.358
24	Dependency ratio (x_{24})	-0.097	0.070	-0.097	-1.388

**R square: 72.60%; The standard error of the estimate: 0.602

Table 3. Stepwise regression analysis of entrepreneurial information received from cosmopolite sources (y) vs. 24 causal variables (x_1 - x_{24})

S.No.	Variables	Reg. coef. B	S.E. B	Beta	t value
1	Number of fragments (x_{13})	0.253	0.070	0.253	3.609
2	Crop yield (x_{14})	0.234	0.062	0.234	3.756
3	No of male workers (x_{22})	0.453	0.071	0.453	6.419
4	Marketed surplus (x_{20})	-0.176	0.063	-0.176	-2.808
5	Materials possessed (x_8)	0.256	0.065	0.256	3.915
6	Training exposure (x_5)	0.197	0.063	0.197	3.120

**R square: 68.70 per cent; The standard error of the estimate: 0.577

Table 4. Decomposition of entrepreneurial information received from cosmopolite sources (y) into 24 exogenous variables (x_1 - x_{24})

S.No.	Variables	TE	DE	IE	HIE
1	Age (x_1)	-0.269	0.084	-0.353	-0.168 (x_5)
2	Education (x_2)	0.176	-0.129	0.305	0.182 (x_5)
3	Number of enterprise (x_3)	0.352	0.012	0.340	0.178 (x_8)
4	Year of enterprise (x_4)	0.377	-0.013	0.390	-0.324 (x_9)
5	Training exposure (x_5)	0.381	0.267	0.114	-0.207 (x_9)
6	Family size (x_6)	0.160	0.031	0.129	0.154 (x_9)
7	Mean family education (x_7)	0.081	-0.037	0.118	-0.124 (x_5)
8	Materials possessed (x_8)	0.317	0.299	0.018	-0.084 (x_9)
9	Size of holding (x_9)	0.315	-0.744	1.059	0.709 (x_{11})
10	Size of homestead land (x_{10})	0.106	0.086	0.020	0.068 (x_5)
11	Size of cultivated land (x_{11})	0.337	0.715	-0.378	-0.739 (x_9)
12	Size of land under irrigation (x_{12})	0.350	0.078	0.272	-0.573 (x_9)
13	Number of fragments (x_{13})	0.549	0.286	0.263	-0.329 (x_9)
14	Crop yield (x_{14})	0.379	0.234	0.145	0.097 (x_8)
15	Livestock yield (x_{15})	0.137	0.048	0.089	-0.131 (x_9)
16	Cropping intensity (x_{16})	-0.184	-0.007	-0.177	0.153 (x_9)
17	Income (x_{17})	0.227	-0.035	0.262	0.101 (x_{14})
18	Family expenditure (x_{18})	0.121	-0.034	0.155	-0.155 (x_9)
19	Marketable surplus (x_{19})	-0.294	-0.035	-0.259	-0.087 (x_9)
20	Marketed surplus (x_{20})	-0.333	-0.194	-0.139	-0.156 (x_9)
21	Family labour (x_{21})	0.231	-0.020	0.251	-0.125 (x_9)
22	No of male workers (x_{22})	0.540	0.395	0.145	0.203 (x_{11})
23	No of female workers (x_{23})	0.381	0.030	0.351	-0.266 (x_9)
24	Dependency ratio (x_{24})	0.056	-0.098	0.154	0.093 (x_{13})

**TE - Total effect; DE - Direct effect; IE - Indirect effect; HIE - Highest indirect effect; residual effect: 0.274, Highest indirect individual effect: x_9 (13)

information received from cosmopolite sources. Similar studies suggested that number of enterprises, materials possessed, livestock yield and training exposure have also found to have substantive contribution to entrepreneurial information received from cosmopolite sources (Acharya & Roy, 2021).

Table 4 evinced that the variable size of holding (x_9) exerted the highest indirect effect on entrepreneurial information received from cosmopolite sources (y). This is well discernible that size of holding had got a direct and sustainable effect on y and size of cultivated land (x_{11}) had also exerted substantive impact, i.e., direct effect on y. Land resources came out as the strongest determinant to characterize the consequent variable. It is also interesting to note that size of holding (x_9) had enrooted the highest indirect effect through as many as thirteen (13) variables to ultimately characterize the dependent variable, entrepreneurial information received from cosmopolite sources. (Acharya & Roy, 2021) No. of fragments (x_{13}) had exerted the highest total effect. Fragmentation of land emerging as the strongest determinant to characterize the process of modernization, else it could act as stronger barrier to modernization because it will make the fragmentation of land as cost and energy prodigal. The residual effect being 0.274, it is to conclude that even with the combination of 24 exogenous variables, 27.4 per cent variance in dependent variable could not be explained. This suggests the inclusion of more numbers of relevant and consistent variables for this framework of study.

CONCLUSION

Communication is the most crucial precursor for changing entrepreneurial behavior and reshaping business ecosystem to make it more compatible and resilient. The study reveals that the generation of marketable surplus and marketed surplus both unleashed stark and decisive impacts on information receiving behavior as well as entrepreneurial communication process. A plethora of multivariate analytical techniques have been applied to analyze an enterprise along with direction, impact, characteristics of information receiving behavior as well. This may in future go in contributing up scaling of the information management techniques and strategies to make enterprising agriculture a successful one. The other side of story is that this kind of research can be replicated in different socio-ecological situation so that a robust policy framework can be generated to support the national economy and growth through enterprising agriculture.

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Attitudes of the Postgraduate Students of Manipur University towards Entrepreneurship

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ARTICLE INFO

Keywords: Affective, Behavioural, Cognitive, Entrepreneurship, Manipur, Students Attitudes

<http://doi.org/10.48165/IJEE.2023.59311>

Conflict of Interest: None

ABSTRACT

The attitudes of the student were studied using affective, behavioural, and cognitive components during 2020-2021 among the postgraduate students of Manipur University (MU). A structured interview schedule was used and data were collected from 160 respondents using stratified random sampling from five Schools of Studies of the university. Entrepreneurship Attitudes Score of students was found to be '0.647' for the School of Humanities; '0.635' for the School of Human & Environmental Sciences, '0.702' for the School of Social Sciences, '0.609' for the School of Life Sciences; '0.677' for the School of Mathematical and Physical Sciences. The overall score of students' attitudes towards entrepreneurship was found to be 0.65, revealing that the majority of the students (58.28%) were moderately favourable towards entrepreneurship. Kruskal-Wallis test was used and found that students of the School of Social Sciences and male students showed higher attitude towards entrepreneurship; 44.14 per cent of the students showed highly favourable towards entrepreneurship. School of Social Science students were found to be more aware of the potential resource and were more aware of different programmers, schemes, ideas and strategies. Such potent and knowledgeable students should be selected and nurtured with proper training, exposure and making them aware of different Government schemes.

INTRODUCTION

Unemployment is one of the basic problems the world is facing. Around 50 to 100 million people are unemployed or underemployed in India (Chand et al., 2017). India, the largest young population in the world is poised to increase further; nearly two-thirds of India's population is under 35 years (Arntz et al., 2020). According to the 2011 census, the youth population in the country including adolescents is around 550 million (National Youth Policy, 2012). As per the CSDS-KAS Youth Survey, 2016, 70 per cent of young people aspire to become entrepreneurs, only 6 per cent are actual entrepreneurs at present. Most youth (65%)

prefer a government job in India, while only 19 per cent prefer to have their own business. The private sector job is favoured by 7 per cent of students; 33 per cent of the youth accorded the most significant priority to having a permanent position, while 22 per cent prefer high-paying jobs (Chaudhary et al., 2017). In India, 55.75 per cent of the graduates and 14.20 per cent of the youth with postgraduate degree or above are still unemployed. Consequently, the country's unemployment rate for young people with higher school credentials is very high (Statista, 2022).

Entrepreneurship is the art of setting up and running an enterprise profitably and sustainably. They are not simply

innovators; their roles are vital in developing countries (Raju et al., 2022). Enterprises play a crucial role in creating new employment and creating new work environments and are seen as a means of improving the socio-economic performance of economic development (Nain et al, 2013; Singh et al., 2014; Singh et al, 2016; Kumar, 2023). Factor in an individual's development is their attitude, which has a significant impact on how they think, perceive and act which determines whether a vibrant endeavour succeeds or fails (Patel & Sharma, 2022). Attitude is the individual's reaction or feeling about someone, something, or some circumstance (Saha et al., 2023). Attitudes play a vital role in becoming a successful entrepreneur (Teshome, 2014). As a result, the entrepreneurship of the individual is becoming increasingly important in all activities related to economic development, social stability which depends heavily on entrepreneurship. Institutional arrangement for facilitation of networking among enterprising stakeholders and resources is the foremost requirement for enhancing farm income (Nain et al., 2019) and the unique needs of rural youth can be addressed through a holistic approach that places high-quality small business and life skills training alongside relevant technical training (Nain et al., 2019).

According to the 2011 population census, the total literacy rate of Manipur is 76.94 per cent; unemployed youths is 3,46,690 in 2018, registered in the state employment exchange as per the records of the Directorate of Labour and Employment; and Human Development Index (HDI) ranked 15th (0.696), Guite et al., (2022). Despite the state's high literacy rate, youth unemployment and entrepreneurship are the major problems. Due to the fact that there have been few studies on students' views towards entrepreneurship in the NE Region, researchers have a vast amount of room to explore this topic. Recently, there has been a significant increase in the number of entrepreneurs in the state; awareness of the various government initiatives and roles need to be alerted. In this regard, a survey was done at Manipur University (MU) to

determine how students from various academic programs/schools feel about entrepreneurship.

METHODOLOGY

The study was conducted during 2020-2021 to assess the attitudes of postgraduate students towards entrepreneurship covering different disciplines/schools of studies of Manipur University (MU). Primary data was collected using a structured interview schedule from 160 students which were selected through stratified random sampling based on the number of students in each school viz., School of Humanities (n=30), School of Human and Environmental Sciences (n=30), School of Social Sciences (n=50), School of Life Sciences (n=24), School of Mathematical and Physical Sciences (n=26) through stratified random sampling. Convenience sampling was used to select the university, prevalence of more students and the fact that it is the oldest and the leading University in the state. It was established on 5th June 1980 under the Manipur University Act 1980 as a teaching-cum-affiliating University at Imphal.

Attitudes have three components: affective, behavioural, and cognitive (Rosenberg & Hovland, 1960). The cognitive component of philosophy refers to the person's thoughts, ideas, or perceptions towards the object of the attitude. The affective component is about the emotional reaction or the feeling towards the object of the attitude. At the same time, the behavioural component of attitudes is related to behavioural reaction towards the object of the attitude (Thomas, 2021). Attitudes of students using three components were measured using a 5-point Likert Scale ranging from strongly agree (SA), Agree (A), Neutral (N), Disagree (DA) to strongly disagree (SDA) with each of the points assigned a value as follows: SA=5, A=4, N=3, DA=2, SDA=1. An attitude scale was created using the method of normalization ranging from 0 to 1. A mean score in the range of 0-0.33 was regarded as unfavourable; any mean score between the ranges of 0.34-0.67 was regarded as moderately favourable and any mean score higher than

Table 1. Cognitive component of attitudes to entrepreneurship

Cognitive component	Score					Average (n=160)
	Hum	H & Env Sc	S.Sc	L.Sc	M & Phy Sc	
I am able to identify business opportunities.	0.65	0.64	0.67	0.62	0.62	0.64
I can successfully develop a business plan.	0.56	0.60	0.67	0.54	0.55	0.58
I have the skills to create a new business.	0.46	0.48	0.54	0.47	0.50	0.48
I can create products and services that satisfy customers.	0.47	0.53	0.54	0.50	0.51	0.51
I can successfully identify sources of business finance.	0.63	0.62	0.69	0.57	0.65	0.63
I can anticipate, tolerate and manage unexpected market changes, setbacks, and risks that may affect my market business.	0.55	0.50	0.61	0.51	0.63	0.56
I want to be an entrepreneur because it will help my skills, and knowledge to improve.	0.70	0.65	0.75	0.64	0.82	0.71
I have many ideas for business ventures.	0.63	0.70	0.78	0.64	0.76	0.70
If I open a business, I have a chance to become successful.	0.65	0.60	0.78	0.65	0.52	0.64
Self-employment is a potential field during this present period of extreme unemployment	0.74	0.75	0.83	0.65	0.73	0.74
Self-employment will help one become self-sufficient in life	0.75	0.76	0.80	0.67	0.80	0.76
Total	0.69	0.66	0.71	0.61	0.68	0.67

Hum - School of Humanities; H & Env Sc - School of Human and Environmental; S.Sc - School of Social Sciences; L.Sc - School of Life Sciences; M & Phy Sc - School of Mathematical and Physical Sciences

0.67 was regarded as highly favourable. Students' attitudes were analysed using normalized values of all three components and percentage analysis was used for its determinants. Mann-Whitney U test and Kruskal-Wallis test were used to determine the significant differences between the different components of attitude with other independent variables.

RESULTS AND DISCUSSION

Cognitive component of entrepreneurial attitude

Table 1 reveals cognitive component scored 0.67 and that 'Self-employment will help one become self-sufficient in life' (0.76) scored the highest followed by 'Self-employment is a potential field during this present period of extreme unemployment' (0.74) and 'I want to be an entrepreneur because it will help my skills, knowledge to improve' (0.71). Similar findings were seen by Rudhumbu et al., (2016) that students showed positive cognitive intentions towards entrepreneurship and entrepreneurship education. This may be due to the reason that self-employment gives individuality the opportunity to be their boss and able to control their own destiny.

Affective component of entrepreneurial attitudes

The average affective component scored 0.66 which showed students are moderately favourable in their feeling towards entrepreneurship (Table 2) and revealed that 'Entrepreneurship is a rewarding career' scored the highest followed by 'Entrepreneurship is a good idea.' (0.74) and "Entrepreneurship is an honourable profession' (0.73). In the study by Rudhumbu et al., (2016) found that the general feeling and emotional disposition of students towards entrepreneurship and entrepreneurship education is positive and the overall affective intentions of students towards entrepreneurship and entrepreneurship education are positive.

Behavioural component of entrepreneurial attitudes

From Table 3, it was found that the average behavioural component scored 0.63, which shows that their behavioural reaction

towards the object of the attitude is moderately favourable and revealed that 'self-employment is an independent profession as it offers freedom scored the highest followed by 'Entrepreneurship can make innovative and informed decisions about career choices' (0.74) and 'I consider entrepreneurship very important' (0.68). In the study by Rudhumbu et al., (2016), most students have a very positive behavioural attitude towards entrepreneurship as a result of taking part in entrepreneurship education and also shows there is willingness and acceptance by most of the students that entrepreneurship is a desirable career option and that entrepreneurship education is important in preparing them to become entrepreneurs.

From Tables 4 and 5 it was found that the overall score of students' attitude towards entrepreneurship is 0.655 which reveals that the majority of the students (58%) were moderately favourable towards entrepreneurship, had optimistic entrepreneur's image and showed their desirability of new venture creation and view entrepreneurship as a future career option. This was supported by the findings of Singh et al., (2022) which showed that the majority (66.67%) of respondents, had a medium level of entrepreneurial behaviour and Students understand and appreciate the role the entrepreneurs, the economic environment and the challenges of unemployment and view entrepreneur as a career option. Similar conditions was confirmed in the study by Zain et al., (2010) who found that more than 50 per cent of students intended to become entrepreneurs after going through the entrepreneurship programme. The study's findings are consistent with those of the findings by Chauhan (2022) & Kumar et al., (2022) which concluded that respondents had a favourable attitude towards entrepreneurship. Verma et al., (2012), found that majority of the rural youths have favourable attitude towards transferring agricultural information in rural areas, similar findings were reported by Sharma et al., (2004); Meshram et al., (2006); Geeta & Natikar (2021), who concluded that the majority of the respondents had a medium level of entrepreneurial behaviour. They still require some encouragement from the government or an organization to prepare favourable and supportive policies, as well as to strengthen and revitalize the

Table 2. Affective component of attitudes to entrepreneurship

Affective component	Score					Average (n=160)
	Hum	H & Env Sc	S.Sc	L.Sc	M & Phy Sc	
Entrepreneurship is a good idea.	0.72	0.79	0.82	0.66	0.71	0.74
I desperately want to work for myself.	0.48	0.47	0.69	0.48	0.52	0.53
The idea of owning my own Business is pleasing.	0.72	0.67	0.69	0.65	0.60	0.66
I consider self-employment as something significant/desirable.	0.59	0.63	0.67	0.65	0.77	0.66
My satisfaction with self-employment is very high.	0.72	0.58	0.56	0.50	0.69	0.61
The idea of becoming an entrepreneur excites me.	0.70	0.65	0.65	0.65	0.62	0.65
I am very interested in setting up my own Business immediately after my degree.	0.63	0.53	0.64	0.55	0.78	0.63
I will be very satisfied if I become an entrepreneur.	0.73	0.68	0.72	0.63	0.75	0.70
Entrepreneurship is an honourable profession	0.77	0.73	0.79	0.66	0.71	0.73
Entrepreneurship is a rewarding career	0.81	0.83	0.81	0.68	0.68	0.76
I accept entrepreneurship as a profession	0.80	0.68	0.78	0.65	0.69	0.72
Total	0.64	0.59	0.72	0.64	0.71	0.66

Hum - School of Humanities; H & Env Sc - School of Human and Environmental; S.Sc - School of Social Sciences; L.Sc - School of Life Sciences; M & Phy Sc - School of Mathematical and Physical Sciences

Table 3. Behavioural component of attitudes to entrepreneurship

Behavioural component	Score					Average (n=160)
	Hum	H & Env Sc	S.Sc	L.Sc	M & Phy Sc	
I consider entrepreneurship a desirable career option.	0.76	0.70	0.62	0.55	0.69	0.66
I consider entrepreneurship very important.	0.66	0.54	0.79	0.63	0.77	0.68
Entrepreneurship can make innovative and informed decisions about career choices.	0.72	0.64	0.82	0.70	0.82	0.74
The university encouraged students to pursue entrepreneurship ventures.	0.51	0.43	0.76	0.60	0.60	0.58
Successful entrepreneurs motivated me towards entrepreneurship as a career.	0.56	0.69	0.81	0.64	0.60	0.66
I have increased my interest in pursuing an entrepreneurial career.	0.54	0.59	0.58	0.61	0.68	0.60
Entrepreneurship will prepare me to make informed decisions.	0.65	0.56	0.60	0.66	0.74	0.64
I am interested in venturing into entrepreneurship.	0.65	0.58	0.63	0.63	0.72	0.64
Successful entrepreneurs motivate me to become an entrepreneur.	0.65	0.52	0.66	0.66	0.65	0.63
Self-employment is an independent profession as it offers freedom	0.76	0.71	0.88	0.70	0.83	0.78
Total	0.61	0.62	0.69	0.59	0.64	0.63

Hum - School of Humanities; H & Env Sc - School of Human and Environmental; S.Sc - School of Social Sciences; L.Sc - School of Life Sciences; M & Phy Sc - School of Mathematical and Physical Sciences

Table 4. Entrepreneurship attitudes score of the respondents

Components	Score					Average
	Hum	H & Env Sc	S.Sc	L.Sc	M & Phy Sc	
Affective	0.697	0.658	0.710	0.614	0.683	0.672
Behavioural	0.646	0.596	0.715	0.638	0.710	0.665
Cognitive	0.614	0.621	0.697	0.587	0.644	0.633
Mean Score	0.647	0.635	0.702	0.609	0.677	0.655

Table 5. Percentage of students interested to take up entrepreneurship

Attitude Score	Hum	H & Env Sc	S.Sc	L.Sc	M & Phy Sc	Average
Unfavorable (< 0.4)	09.99	16.65	06.00	08.33	07.69	09.73
Moderately Favorable (0.4-0.67)	46.62	59.94	48.00	79.16	57.69	58.28
Highly Favorable (>0.67)	43.29	23.31	46.00	13.50	34.61	44.14

existing extension system, responsible for the technical know-how and other relevant details. Out of five Schools of Studies, the School of Social Sciences scored the highest i.e. 0.70, which revealed that the students of Social Sciences are more interested and aware of the technical know-how and other relevant details to start ups and are more exposed to this field and also shows that students are thinking about how they can start a business /earn as a career option.

Kruskal-Wallis test presented in Table 6 depicts that a significance difference was found in attitude towards entrepreneurship among the students of different Schools of Studies. School of Social Science students showed a higher positive attitude towards entrepreneurship. Since Social Science had different departments related to business and entrepreneurial development viz., Department of Entrepreneurial Development, Department of Mass Communication, Department of Management, Institute of Management Sciences, these departments are more intended to focus on topics of entrepreneurial development, management, administration, etc. which contribute more positively to the student's attitude towards entrepreneurship and students who opted for these subjects had more exposure and interest in this

field and may also be due to their exposure in different sociological and psychological aspects of human behaviour and also due to their discipline which deals with different entrepreneurial opportunities in the society. Boubker et al., (2021) also found that there is a statistically significant relationship between attitude towards entrepreneurship, entrepreneurial intention and management students' entrepreneurship education.

Significance difference was found in the attitude towards entrepreneurship between males and females. Males had significantly higher positive attitudes than females towards entrepreneurship. The reasons may be due to the engagement of females in different household activities/chores and also due to the restrictions in performing different outdoor activities. A similar finding was seen from Rudhumbu et al., (2016) which shows relationship between gender and students' attitudes towards entrepreneurship and how students view entrepreneurship. Students with family occupations as business showed the highest attitude towards entrepreneurship, followed by family occupation as private services, farming and allied activities and the government sector. Students with salaried family backgrounds worry less about their monetary expenditure since their parents get regular salary and

Table 6. Significant difference in attitude to entrepreneurship under Kruskal-Wallis test

AEI	Mean rank	p-value
Among different Schools of Studies		
Hum	75.31	0.005*
H & Env Sc	64.43	
S.Sc	96.99	
L.Sc	62.38	
M & Phy Sc	86.79	
Among male and female students		
Male	87.13	0.011*
Female	67.92	
Among students with different family occupations		
Farming and allied activities	52.26	0.044*
Services (Govt.)	43.69	
Services (Private)	53.33	
Business	84.36	
Among Gen, OBC, SC, and ST students		
GEN	81.08	0.848
OBC	77.87	
SC	89.61	
ST	81.56	
Between joint and nuclear students		
Joint	64.69	0.001*
Nuclear	44.90	

*Significant at 5% level of significance

have least/no time to spare for business activities. However, students, with business as a family background, may have more inclination towards business activities as their financial expenditure and income wholly depend on their business. This may also influence and motivate their children to take up the business in the long run. Therefore, they may have a more positive attitude towards entrepreneurship. The p-value is >0.05, among Gen, OBC, SC, and ST students toward attitudes in entrepreneurship, so the significant difference was not found. It was also found that a significant difference was observed among students of the joint and nuclear family which may be due to the reasons that students in the joint family have more support, guidance, supervision and financial support from elders and other family members thereby providing them more exposure and knowledge towards entrepreneurship.

CONCLUSION

Majority of the students view entrepreneurship as a career option, understand and appreciate the role of entrepreneurs, economic environment, challenges of unemployment. Awareness on government schemes like *Pradhan Mantri Matsya Sampada Yojana*, Agri-clinics and agri-business centre and technology business incubators for providing opportunities for agribusiness and start-up should be given to change the students' attitude towards entrepreneurship from medium to highly favourable. Wide publicity of the course, market-oriented knowledge, skill-oriented entrepreneurial development programmes, visits/tours to various enterprises, initiation of business/enterprise through creative

strategies and innovative tactics, identification of trends & opportunities and sharing inspiring success stories should be given. Students' entrepreneurship behaviour depends on the family business background, personnel skills, capabilities, education and gender.

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Contribution of Integrated Farming System (IFS) Units Towards Household Income in Kerala

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ARTICLE INFO

Keywords: Annual household income, Apiculture, Crop, Dairy, Fisheries, Mushroom, Poultry, Integrated farming system

<http://doi.org/10.48165/IJEE.2023.59313>

Conflict of Interest: None

ABSTRACT

From an economic point of view, combining various components in the same unit helps to diversify farmers' income. An attempt was made to determine the contribution of various components, adopted in an IFS unit, to the annual household income among the IFS units of Kerala during 2022. In this study, total annual household income was computed by summing up the gross income from all the on-farm sources. The study revealed that 52.78 per cent of respondents were found in the low-income category, followed by one-third in the medium-income category. Among the selected components, the contribution of income from the crop component, dairy component, and poultry component, was found to be low to medium, while the trend in income generation from fish component was from medium to low. In the case of apiculture and mushroom components, medium to high-income generation was also noticed. It was also found that farm size, experience in farming, economic motivation, training undergone, and herd size were positively correlated with the total farm income of households.

INTRODUCTION

Kerala is notable for having a variety of microenvironments that may support different kinds of agriculture and related activities. The unique features of Kerala agriculture are the homestead system of cultivation, shrinkage of area, prevalence of cash crops and dominance of marginal holders (Jeromi, 2007). However, the economic situation of the state has been confronted with numerous hurdles in the past few years. Kerala is highly prone to various natural disasters like cyclones, droughts, floods and landslides (GoK, 2020). The unexpected crisis due to Covid-19 pandemic has also hit the state very hard. Any agricultural production becomes sustainable only when it fetches due economic benefits to the farmer. In addition to improve production related aspects, the current emphasis of national agricultural policies focuses on raising farmer's income also (Nain et al., 2019; Tiwari et al., 2023).

Since the risk of mono-cropping is increasing, IFS is a feasible choice to ensure sustainable income as well as nutritional security to farm families. It also enables maximum productivity per unit area and allows for maximum profit while maintaining ecological and socioeconomic balance (Rejula et al., 2017; Nair et al., 2019). Every component of IFS has the potential to influence the livelihood security and economic condition of the family (Meshram et al., 2019). By realizing these facts, several programmes have been introduced in Kerala by various formal institutions to promote the IFS concept, thereby enhancing the productivity and profitability of farmers. The Integrated Farming System Research Station (IFSRS) of Kerala Agricultural University has developed many IFS models and has also won national recognition for its activities. These models have also been included in the state plan for popularization at the panchayat level. According to the Tenth Agriculture Census 2015-16 of Kerala, the average size of holdings has declined to

0.18 hectares in 2015-16 as compared to 0.22 hectares in 2010-11, which is quite modest when compared with other states. The official figures show that 96.7 per cent of the total number of landholdings belong to marginal farmers (GoK, 2019). In this context, IFSRS Karamana has developed four IFS models of 0.20 ha each. Among these four models, Kerala homestead gardens are widely accepted as a viable land use system in the state (John, 2014). As a result of these initiatives, the number of farmers who have shifted from monocropping systems to IFS has increased to a certain extent in the last few years. Based on the differences in components present in a unit, several IFS models can be seen in Kerala. Each model is unique in terms of productivity as well as economic returns. The income obtained from each IFS unit depends on the components adopted in it. In this context, an attempt was made to analyse the component-wise contribution towards annual household income among the IFS adopted farmers.

METHODOLOGY

The study was conducted purposively in Kerala. To get a complete understanding of the state, three districts were selected randomly, one each from southern, central and northern part of Kerala. The selected districts were Kollam, Thrissur and Kannur respectively. From each selected district, two Agro Ecological Units (AEUs) were selected and from each AEU two panchayats were randomly selected. A list of farmers who had adopted IFS with dairying as one of the components was prepared with the help of officials of ATMA, KVK, Department of Agriculture, Department of Animal Husbandary, Department of Dairy Development and Other Local Leaders in selected panchayat. From the list, randomly 15 farmers were chosen from each selected panchayat and in total 180 IFS farmers were selected for the study.

Income refers to the total earnings of the IFS farmer's household in a year accrued from farm activities and other sources, represented generally in monetary terms. Total annual household income was estimated in this study by adding the gross income from all on-farm sources. By conducting PRA techniques, focussed group discussion with experts in the relevant field and through secondary data collection, different IFS components had been identified in the IFS units of Kerala. They were categorized as major components and supporting components. Only six, out of the nine identified components, were giving financial assistance to farmers. Those components were dairy, crop, poultry, fisheries, mushroom and apiculture. Component-wise net income was computed separately to know about the contribution of each component to their annual household income. A pretested schedule was used to obtain data on those components. Respondents were categorized in to three categories namely, low, medium and high-income category based on their cumulative square root frequency. To know the relationship between socio-economic profile characteristics of IFS farmers and their total farm income, correlation analysis was conducted.

RESULTS AND DISCUSSION

From an economic point of view, combining various components in the same unit helps to diversify farmer's income.

An attempt was made to determine the contribution of various components to the annual household income of IFS farmers.

Categorization of IFS farmers based on the annual income from various IFS components

From the study it was found that among the nine identified components only six components had contributed to their household farm income. There was no significant contribution noticed from other components towards annual income in any of the units. The table given below show the distribution of farmers based on their component wise contribution to annual household income (Indian rupee).

From Table 1, it was evident that among the selected components, the contribution of income from the crop component, dairy component and poultry component was found to be low to medium. Whereas income from apiculture and mushroom was from medium to high. Different types of crops were seen in IFS units of Kerala, among these, the main income yielding crops were rice, tubers, fruit crops, pulses, oil seeds and plantation crops. In the study area, most of the units had vegetable cultivation. The products were mainly utilized for household consumption rather than marketing purposes. According to John (2014), in the homestead systems of Kerala, plants were used for various purposes, such as wood, food and so on, which helps to reduce outside purchase to a greater extent. This might be a reason for low income. Since they cultivate crops for maintaining the food security of their families and crop wastes were fed to different components, the IFS farmers were generally following organic cultivation practices, which affected pest and disease incidence and productivity and therefore resulted in low yields. Crop loss due to climate related issues can also be considered a reason. Apart from these, the hike in fertilizer prices, as a post-Covid impact, increased their cost of cultivation and reduced the profit from crop components.

In the case of dairy, more than half (58.89%) of the dairy farmers were getting low income, from their dairy units. District wise data also follows the same trend. According to the latest Livestock Census Report, 2019, crossbred cattle produced 93.82 per cent of the milk in Kerala (GoK, 2020). In the study area, the majority of the dairy farmers had small herd size and they were selling their milk to dairy cooperative societies (MILMA). As an impact of Covid-19 and lockdown, the price of feed was hiked, but the price of milk has not changed significantly over the past three years (Sudhish, 2022). Sreeram et al., (2018) had conducted a study in Kerala and found that hiked price of feeds and non-remunerative price for milk were the top ranked constraints associated with the dairy sector in Kerala. The finding was similar to that of Suraj (2021), who had conducted a study among dairy entrepreneurs and found that 77.05 per cent of the dairy entrepreneurs in Kerala fell into the low income level.

With respect to poultry component as well, the majority (51.26%) of the respondents belonged to the low income category, whereas for fisheries component most of them were in medium (47.37%) category. Since the majority of the IFS farmers were following backyard poultry, a major portion of the eggs were utilized in the home itself. Most of them were not following the proper diet balance, which also affected productivity. These reasons

Table 1. Component wise annual farm income from IFS units

Components	Kollam (%)	Thrissur (%)	Kannur (%)	Total (%)
Crop component (n=180)				
Low (<175016)	51.67	55.00	58.33	55.00
Medium (175016-499903)	33.33	31.67	25.00	30.00
High (>499903)	15.00	13.33	16.67	15.00
Total	100	100	100	100
Dairy component (n=180)				
Low (<79232)	58.33	56.67	61.67	58.89
Medium (79232-148261)	30.00	33.33	21.66	28.34
High (>148261)	11.67	10.00	16.67	12.77
Total	100	100	100	100
Poultry component (n=158)				
Low (<2217)	42.00	51.92	58.93	51.26
Medium (2217-5571)	34.00	34.62	21.43	29.75
High (>5571)	24.00	13.46	19.64	18.99
Total	100	100	100	100
Fisheries component (n=95)				
Low (<368456)	35.48	31.25	25.00	30.53
Medium (368456-529279)	48.39	40.63	53.13	47.37
High (>529279)	16.13	28.12	21.87	22.10
Total	100	100	100	100
Apiculture component (n=55)				
Low (<43523)	20.00	18.75	25.00	21.82
Medium (43523-77466)	53.33	43.75	45.83	47.27
High (>77466)	26.67	37.50	29.17	30.91
Total	100	100	100	100
Mushroom component (n=11)				
Low (<27320)	50.00	0	14.29	18.18
Medium (27320-31190)	50.00	50.00	57.14	54.55
High (>31190)	0	50.00	28.57	27.27
Total	100	100	100	100

might have resulted in low income from poultry components. The findings were on par with that of Kumar et al., (2013). They found that the average flock size reported in villages of the northern zone of Kerala was 5.62 and discovered that as high as 52.15 per cent of the eggs and 59.38 per cent of the cockerels produced are consumed at home. In case of fisheries component most of the respondents were not following the scientific fish production and management technologies. As there were no regional procurement centers to collect fish directly from farmers, they were having trouble in marketing their products. As majority of the farmers depended on the local market for selling their product, they were highly susceptible to price fluctuations. Low adoption of processing technologies also made the situation difficult. In Kerala, during the post-monsoon season, fish are generally sold at very low prices, whereas retail prices skyrocket during times of recession (Salim et al., 2017)

In the case of apiculture and mushroom components, medium to high income generation was noticed. Even though the number of farmers who had adopted these two components were relatively low, the majority of the adopted farmers were getting a remunerative income when compared to other components. Even though the farmers who adopted apiculture were facing a lot of difficulties, the demand for honey was still very high, so this helped them to earn a sustainable income. The result emphasized that more

programmes like training, awareness classes, field visits etc. should be conducted to attract more farmers to these sectors, through which the income from IFS units can be increased.

Categorization of IFS farmers based on their overall annual farm income

It is clear from Table 2 that 52.78 per cent of the respondents were found in the low total income category. Same pattern was visible in all districts. According to the findings of Chandran and Chakravarty (2022), in the IFS units of Kerala, the rate of adoption of identified components were found to be low and none of the units possessed all the identified components. Among the components, least adoption was noticed for mushroom and apiculture. Since crop and dairy components were found to be the dominant components in all the selected systems, the high cost of cultivation associated with these components affected the profitability. Besides these, frequent crop failures due to unexpected climate change also affected productivity and profitability. Furthermore, the attitude of farmers towards IFS is also important. Some of the farmers considered IFS as an option to ensure family's food security. For such farmers, income generation is secondary. They consumed the majority of the product in their own homes and sold only rest of the quantity. On such farms, the adoption of scientific management practices might be

Table 2. Overall annual income from adopted components.

Categories (Total annual farm income)	Kollam (%)	Thrissur (%)	Kannur (%)	Total (%) (n=180)
Low (<361254)	56.67	48.33	53.34	52.78
Medium (361254-823059)	31.67	35.00	33.33	33.33
High (>823059)	11.66	16.67	13.33	13.89
Total	100	100	100	100

very low, as high investment and low income might affect their financial conditions.

The hiked price for feeds, fertilizers and other inputs affected the economical balance of the system severely. Since IFS contains several components, the cost of production for each component was increased due to the hiked price of various inputs, especially during the post Covid situation. Some of the challenges necessitate quick action from government level, such as reducing the skyrocketing cost of inputs, bringing scientific pricing of various farm products, increasing availability and supply of quality inputs and establishing more regional government procurement centres. With respect to crop component, diversification techniques can be promoted among these units, as several researchers have indicated that these practices were more likely to be used by farmers, who have suffered losses in cultivation (because of climate change issues, environmental stress and so on), to protect themselves against further losses (Raghuvanshi & Ansari, 2020; Dupdal et al., 2021). Ghouse & Hassan (2020) found that crop diversification was positively correlated with risk orientation, economic motivation as well as innovativeness of farmers and was a viable option to increase farmer's income and ensure sustainability. These results were in line with those of Priscilla et al., (2021), who also found that crop diversification can significantly influence the income of farm families.

Factors associated with total farm income of households

Correlation analysis was conducted to understand the relationship between socio-economic profile of farmers and total annual farm income. The results were given below (Table 3).

From the Table 3, it was found that, farm size, experience in farming and economic motivation were positively correlated with total farm income at 1% level of significance and training undergone as well as herd size at 5% level of significance. The existence of IFS depends significantly on the size of the farm because it contains several components. As farm size increases the chances for the adoption of various components as well as the expansion of existing units also increases, which can improve the profit. A study conducted by Ponnusamy & Devi (2017) in two districts of Tamil Nadu found that, landholding was a key element in keeping different agricultural enterprises in an IFS unit. Farming experiences aid the farmers to identify the threats and opportunities in advance, which enables them to adopt better strategies in their unit to increase production and subsequently profitability. Experiences also help in the improvement of their knowledge, skills and confidence, which contribute to the effective performance of diverse activities. Attending trainings help them to update their knowledge, skills and earn more. High economic motivation drives

Table 3. Correlation coefficient of total income with socio economic characteristics of farmers

Independent Variables	Correlation Coefficient ('r')
Age	-0.055
Education	0.026
Family size	-0.019
Occupation	0.113
Farm size	0.456**
Experience in farming	0.256**
Mass media exposure	0.108
Extension agency contact	0.120
Participation in extension programmes	0.112
Market orientation	0.059
Irrigation potential	-0.034
Economic motivation	0.228**
Innovativeness	0.061
Risk orientation	0.118
Social participation	0.097
Training undergone	0.183*
Awareness towards IFS	0.062
Herd size	0.190*

*Significant at 5 percent level, ** Significant at 1 per cent level

them to adopt more components and more scientific practices to maximize their profit. In a dairy based IFS unit, herd size has a significant role in the net farm income. Livestock is a vital aspect of IFS which provides income on a daily/weekly basis. Aside from income generation, dairy is an important connecting link for integrating various components in a unit. Most of the farmers in the study area had small herd size, which reflected in their profitability also.

CONCLUSION

The rate of adoption of available components was noticed as low in selected IFS units. It has reflected in the annual household income as well. From an economic point of view, the existence of each unit directly related to the profit obtain from each component. For establishing and maintaining some components farmers are facing certain constraints. Hence, more effort should be taken to mitigate those constraints faced by the farmers for improving productivity and profitability from those components. As the adoption of some components like apiculture and mushroom was found to be low, more effort is needed for conducting more training and designing new programmes with adequate incentive structures that would accelerate the adoption of least adopted income generating components at farm level, which can influence the overall expansion and profitability of each unit.

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Intergenerational Social Mobility among Scheduled Caste Families in Haryana

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ARTICLE INFO

Keywords: Social mobility, Intergenerational, Scheduled caste families, Education, Occupation

<http://doi.org/10.48165/IJEE.2023.59314>

Conflict of Interest: None

ABSTRACT

To explore the intergenerational social mobility among scheduled caste families in Hisar district of Haryana state, the study was conducted in the year 2020 with 200 respondents. The results revealed that there has been a significant improvement in the educational qualifications of subsequent generations. Similarly, the occupation distribution of successive generations showed a decreasing proportion of individuals engaged in farm labour and livestock, while an increasing proportion of individuals engaged in non-farm labor, private service, and business. There is a shift in the occupational class distribution of consecutive generations. A strong and positive correlation was found between occupational mobility and factors such as family size, family income, and livelihood status. On the other hand, educational mobility was positively correlated with family size, family income, education status, and information source utilization, but negatively correlated with age. Additionally, social mobility is negatively correlated with livelihood status.

INTRODUCTION

Social mobility is a complex notion that is often associated with the ability of individuals from disadvantaged backgrounds to improve their social status, reflecting the idea of equal opportunities. It involves a change in an individual's, group's, or category's position within the social hierarchy (Young & Mack, 1962). The term social mobility has been defined as the process by which individuals in their lifetime and between generations move from one position to another in society positions, either upwards or downwards which by general consent have been given specific hierarchical values (Breen, 2004). The idea of social mobility is related to equality of opportunities so that individuals can achieve higher social position regardless of the social background of their parents (Corak, 2020). In rural areas income from animal husbandry, income from marginal works and income from labouring, are positively correlated with livelihood diversity; but land holding, income from agriculture, possession of household assets, average

family education and maximum family education are negatively correlated with diversity (Pal et al., 2017)

In ancient India, education, skills and occupation were determined by the caste of a person, thus there was not much freedom for moving between different levels of society (Singh et al., 2021). Despite the emphasis on abolishing the caste structure and providing equal opportunities to all since 1950, strong limitations still exist in the occupational structure of the country (Reddy, 2015). In rural areas, lower castes still face challenges in moving away from caste-specific occupations and accessing resources, which can impede social mobility. Amongst the various inequities typically associated with the caste system in India, probably one of the most debilitating is the perception that one is doomed by birth, i.e., social and economic mobility across generations is difficult (Hnatkovska et al., 2013). In recent years, various modern developments in rural India have had a significant impact on changing the occupational and educational status of individuals, as well as the intergenerational occupational structure.

These changes have been rapid and extensive, leading to shifts in status from father to son and alterations in the overall occupational structure. (Raj et al., 2018). However, in urban areas, caste has become less influential in daily life, although it still functions as a means of competing for resources and power in modern India, such as better educational opportunities, new jobs, and improved life prospects (Sekhon, 2000). This trend is linked to India's preferential policies and their implementation.

Intergenerational educational mobility and intergenerational occupational mobility are important determinants of intergenerational social mobility. As it has been well-demonstrated, education is the main factor in both upward mobility and the reproduction of status across generations (Hout & DiPrete, 2006). In the literature on social mobility, occupation is considered a good indicator of social status, incomes, and living standards (Weeden, 2002), (Goldthorpe & McKnight, 2006) and (Lambert & Bihagen, 2014). Therefore, the present study was conducted to assess the intergenerational social mobility of Schedule Caste (SC) families in Haryana. The findings of the present study would help in better understanding of the social mobility pattern of the SC families that can help in making policies more inclusive.

METHODOLOGY

The area for present investigation was *Hisar* district of Haryana state, specifically five villages selected randomly from a comprehensive list of villages with a high percentage (40%) of Scheduled Caste population according to the 2011 census. The chosen villages were Nangthala from Agroha block, Mangali and Dahima from Hisar I block, while Patan and Ludas from Hisar II block. A total of 200 respondents were included in the study, where 40 respondents were randomly selected from each village. The study was conducted in the year 2020 and data was collected by personal interview using a well-structured interview schedule. The pre testing of interview schedule was done on a non-sample population outside the locale of study. Necessary modifications were done based on pre testing. It was developed with the provisions for all the relevant variables in keeping with the objectives of the investigation. Before administering the interview schedule, the objectives of study were explicitly explained to them in their dialect, ensuring that they perceived the questions correctly. The present investigation examined social mobility in terms of intergenerational educational and intergenerational occupational mobility across three generations. For the purpose of the study the parents of selected respondents were considered as the 1st

generation, respondent and their spouse as the second generation, and respondent's children as the third generation. For the present study, education and was operationalized as the education attained by parents, respondents and offspring. The occupational mobility was operationalized as the specific major work which parents, the respondents and children perused to earn livelihood. For calculating the mobility each educational qualification and occupation was given assigned a numeric value. The score obtained by the each generation were calculated. The score obtained by the each generation was subtracted from the previous generation. In order to assess the extent of relationship between the selected dependent variable and the independent variables, the data was subjected to Pearson's correlation analysis.

RESULTS AND DISCUSSION

Intergenerational educational mobility of scheduled caste families

Intergenerational educational mobility status of SC families was studied and data is presented in Table 1 that shows the educational qualifications of three generations (1st, 2nd, and 3rd). Overall education mobility increased in 2nd and 3rd generation. The table shows, the first generation has a larger proportion of illiterate individuals (92%), while the second and third generations have a significantly lower proportion of illiterate individuals (32.5% and 0.7%, respectively). The proportion of individuals with up to primary education is highest in the third generation (19.4%) and lowest in the first generation (5.2%). Similarly, the proportion of individuals with up to secondary education is highest in the third generation (35.4%) and lowest in the first generation (1.5%). The proportion of individuals with higher education qualifications such as Diploma/Certificate, Graduate, Technical education, and Postgraduate is very low in all three generations. However, there is a slight increase in the proportion of individuals with higher education qualifications in the later generations (2nd and 3rd) compared to the first generation.

An overview of intergenerational educational mobility of SC families depicts that literacy increased significantly in 3rd generation. An increasing trend for higher education was also observed. Similar findings were reported by Chouhan (2013). Another study conducted on education and occupation intergenerational mobility, utilizing data from National Sample Survey Office (NSSO) rounds spanning from 1983 to 2005 has indicated that the rates of conditional probabilities of education mobility among non-SC/STs and SC/STs caste groups are converging. (Hnatkovska et al., 2013).

Table 1. Intergenerational educational mobility of Scheduled Caste families

Educational qualification	1st Generation (n=400)	2nd Generation (n=400)	3rd Generation (n=513)
Illiterate	368(92.0%)	130(32.5%)	4(0.7%)
Up to Primary	21(5.2%)	105(26.2%)	100(19.4%)
Up to Secondary	6(1.5%)	86(21.5%)	182(35.4%)
High & 10+2	5(1.2%)	67(16.7%)	156(30.3%)
Diploma/ Certificate course	0	1(0.2%)	9(1.7%)
Graduate	0	7(1.7%)	47(9.1%)
Technical education	0	1(0.2%)	9(1.7%)
Post graduate and above	0	3(0.7%)	7(1.3%)

Intergenerational occupational mobility of scheduled caste families

Jena & Kanungo (2022) in their study noted that the occupations which were adopted by the parents now not remained the same in the new generation. The data in Table 2 presents observations regarding generational occupational mobility of Scheduled caste families. The number of members engaged in work increased from first to 2nd generation and declined in 3rd generation may be probably because they were still young and of school going age.

From the presented data, it is clear that in the first generation Scheduled caste population has a larger proportion of individuals engaged in farm labor (42%), followed by non-farm labor (21.5%) and livestock (14.9%).

In the second generation, the job profile of the scheduled caste shows only a little up-gradation. A significant percent of people have shifted from farm labor to non-farm labor works and the business sector. The in-depth analysis of the table shows that the second generation has a higher proportion of individuals engaged in non-farm labor (40.5%), followed by private service (10.1%) and farming (7.8%). The third generation also has a higher proportion of individuals engaged in non-farm labor (53%), followed by private service (19.7%), farming (11.1%) and govt. service (4.9%). Caste-based occupation perished in the second generation, while no individual from the third generation is engaged in livestock. Similar results are in line with Ray & Majumdar (2010). The proportion of individuals engaged in business and government service is also low in all three generations, although there is a slight increase in the proportion of individuals engaged in business in the later generations (2nd and 3rd) compared to the first generation.

With a decreasing proportion of individuals engaged in farm labor and livestock and an increasing proportion of individuals engaged in non-farm labor, private service, and business,. Similar observations were made by Tiwari et al., (2023) which revealed that the households are shifting from crop-based enterprises towards wages & salaries at all India levels. The overall data suggests that there has been a significant shift in the occupation distribution of subsequent generations.

Period of work engagement mobility

Period of work engagement mobility was studied among three generations of SC families and data is presented in Table 3. Full time work engagement was maximum in third-generation (83.9%), followed by second-generation (80.0%) whereas (68.0%) of the first generation were least engaged in full time work.

An opposite trend was observed in part time work engagement. In first-generation, 31.1 per cent, in second-generation 19.9 per cent were working part time. However, a mere 16.0 per cent of 3rd generations were engaged in part time work.

Intergenerational class wise occupational mobility

Class wise occupational mobility of SC families over three generations is presented in Table 4. Administrative/ managerial and Class I posts were held only by (5.0%) from 3rd generation and none other from 2nd or 1st generation. Class II posts among second generation was held by (12.7%) whereas among the third generation 15.0 per cent occupied Class II posts. The share of first-generation was maximum in Class III posts (73.3%). From second generation 21.2 percent were at Class III posts. 55.0 per cent of third generation were at Class III posts. Class IV posts were dominated

Table 2. Intergenerational occupational mobility of scheduled caste families

Occupation	1st Generation (n=302)	2nd Generation (n=306)	3rd Generation (n=81)
Farm labor	127 (42.0%)	50(16.3%)	5(6.1%)
Non-farm labor	65 (21.5%)	124(40.5%)	43(53.0%)
Livestock	45 (14.9%)	37(12.0%)	0
Caste occupation	4 (1.3%)	0	0
Business	4 (1.3%)	24(7.8%)	4(4.9%)
Farming	43 (14.2%)	24(7.8%)	9(11.1%)
Govt. Service	10 (3.3%)	16(5.2%)	4(4.9%)
Private Service	4 (1.3%)	31(10.1%)	16(19.7%)

Table 3. Period of work engagement mobility

Period of work	1st Generation (n=302)	2nd Generation (n=306)	3rd Generation (n=81)
Full time	208(68.0%)	245(80.0%)	68(83.9%)
Part time	94(31.1%)	61(19.9%)	13(16.0%)

Table 4. Intergenerational class wise occupational mobility

Occupational Class	1st Generation (n=15)	2nd Generation (n=47)	3rd Generation (n=20)
Administrative/ managerial	0	0	1(5.0%)
Class I	0	0	1(5.0%)
Class II	0	6 (12.7%)	3(15.0%)
Class III	11(73.3%)	10 (21.2%)	11(55.0%)
Class IV	4(26.6%)	31 (65.9%)	4(2.0%)

Table 5. Relationship between respondent's socio personal antecedents with social mobility

Variables	Occupational mobility	Educational mobility	Social mobility
Age	.015	-.320*	.019
Family type	.127	-.085*	-.071
Family size	.217*	.245*	.267*
Occupation of Head of household	-.199*	.056	.182*
Family income	.206*	.242*	.260*
Education status	.064	.409*	.411*
Information source utilization	.038	.146*	.150*
Social participation	-.034	.001	-.002
Livelihood status	.446*	.184*	-.329*

*significance level = $p < 0.05$

by second-generation (65.9%) followed by first-generation 26.6 per cent male. However, only 2.0 per cent from third generation were at Class IV posts.

Overall, the data suggests that there has been a significant shift in the occupational class distribution of subsequent generations, with a decreasing proportion of individuals belonging to lower occupational classes (Class III and Class IV) and an increasing proportion of individuals belonging to higher occupational classes (Class II, Class I, and administrative/managerial). Similar findings in regards of steady increase of SC at class I job were reported by Jadhav (2008). Overall, the picture of intergenerational class mobility in India is hence one of "continuity and change" (Vaid, 2018), with high stability, but steady increases in absolute mobility, and changes in relative mobility for men.

Relationship between respondent's socio personal antecedents with social mobility

The data presented in Table 5 convey the relationship between respondent's personal antecedents and social mobility (occupational mobility and educational mobility). The data point out that variables viz; family size ($r = 0.217^*$), family income ($r = 0.206^*$) and livelihood status ($r = 0.446^*$) were found to be significantly and positively correlated with occupational mobility. Contradictory results were reported by Shaik & Chauhan (2022), the study revealed that annual income was non-significantly correlated with the willingness of farmer's next generation (son) to stay physically and work in the rural area. However, occupation of head of household ($r = -0.199^*$) was found negatively and significantly associated with occupational mobility. Krishna (2017) in the study revealed that SC and ST children of professional fathers are at much higher risk of large occupational descents and concluded that sustaining occupational achievements is harder for minority households. Equalizing opportunity can help unleash the potential of the population, which as it stands is constrained by persistent income and occupational rigidity (Chapman, 2020).

As far as educational mobility is concerned family size ($r = 0.245^*$), family income ($r = 0.242^*$), education status ($r = 0.409^*$) and information source utilization ($r = 0.146^*$) and livelihood status ($r = 0.184^*$) were significantly and positively correlated with educational mobility. Age ($r = -0.320^*$) was found to be significantly and negatively correlated with educational mobility, thus indicating that younger generation, with large family size, more income, better education information source utilization and

better livelihood status had more educational mobility. Similar results with regards to relationship of age with livelihood security were reported by Pradhan et al., (2021).

Thus it can be concluded from Table 5 that family size ($r = 0.267^*$), occupation of head of household ($r = -0.199^*$) family income ($r = 0.260^*$), family education status ($r = 0.411^*$) and information source utilization ($r = 0.150^*$) were positively and significantly associated with social mobility. Livelihood status was found to be significantly and negatively correlated with social mobility ($r = -0.329^*$).

CONCLUSION

The literacy rate increased significantly over three generations. An increasing trend for higher education was also observed. Encouraging occupational mobility may act as a catalyst for uplifting the Scheduled Castes. Family size, family income and livelihood status were found to be significantly and positively correlated with occupational mobility. Occupation of head of household was found negatively and significantly associated with occupational mobility. Educational mobility was significantly and positively correlated with family size, family income, education status and information source utilization whereas it was significantly and negatively correlated with age. Livelihood status was significantly and negatively correlated with social mobility. Equalizing opportunities can help unleash the potential of the population, which is currently constrained by persistent income and occupational rigidities. Further research is recommended to identify the issues and concerns that impact social mobility among scheduled castes and to develop strategies to improve it.

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Appraisal of Farm Diversification and Livelihood System of Bihar (India)

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ARTICLE INFO

Keywords: Farm diversification, Simpson index of diversification, Ordinal regression, Dairy farmers, Constraints

<http://doi.org/10.48165/IJEE.2023.59315>

Conflict of Interest: None

ABSTRACT

The paper examines state-level trends in Bihar for determining patterns in farm diversification for the period 1990-91 to 2018-19, using the Simpson Index of Diversification (SID) and ordinal linear regression analysis to analyse the determinants. The study, conducted in the year 2022, reported that the cropping system at the state level is transforming from food grains to different high-value crops and allied farming sectors. The transformation was not uniform across the regions. The SID values have demonstrated how the agricultural economy has been more diverse over time, with some variations in the production of food and non-food crops. The result of multiple regressions has revealed earning members, social work participation, and government donations to be the major determinants of farm diversification, and various constraints were identified using the Garrett ranking method. Hence, the study suggests that policy support for the development of dairy farmers should be more focused on increased cropping intensity, insurance protection, investments in agricultural research and education, and technology development.

INTRODUCTION

Farm diversification refers to the efforts made by individuals and households to incorporate current portfolios of income-generating activities that will support the livelihood and improve their standards of living. Recent research shows that a key strategy for decreasing poverty and raising people's standards of living is the diversification of sources of income (Ezung, 2021). Rural communities tend to diversify more because they cannot rely just on agriculture for existence. As a result, they work in the forest industry as wage workers and are also engaged in fishing, crafts, and other activities to increase their income. Diversification in urban areas is generally lower than in rural areas, as urban households rely on one or two high-income jobs (Ersado, 2006). In developing countries like India, small and marginalized farmers' land-based livelihoods are becoming increasingly unsustainable in emerging nations like India since the land can no longer provide their families' demands for food and fodder (Hiremath, 2007). So, people

can engage in different activities and earn enough to sustain themselves. Livelihood diversification occurs in both agricultural and non-agricultural activities i.e. cultivation of high-value and multiple crops. Starting small enterprises or deciding on non-agricultural careers like temporary employment or migration are non-agricultural activities (Khatun & Roy, 2012). Modern rural livelihood programmes in developing nations prioritize diversification (Reardon et al., 2001; Barrett et al., 2001; Niehof, 2004). In India livestock provides a substantial contribution to livelihood security and symbiotically contributes to its growth. Livestock is an integrated part of the agricultural systems that stand as the pillar of the farm family. According to economic survey report (2019-20) in India about eight crore farmers are directly dependent upon livestock for their livelihood. It contributes to 4.35 per cent of GDP and 29.35 per cent of the total agricultural GDP. It has also registered about 8.15 per cent growth in livestock sector during the last five years. In addition to a fast economic growth, a wide area difference in household income found among

the different regions of country. The Indian growth pattern has been highly varied in economic, social, institutional and agricultural at state level. “Aspirational districts” program has been launched by NITI Ayog (2018) as a bold and promising strategic step towards least developed regions across the country and to remove the huge chasm in the performance of different states. Development by means of diversification is a compulsory requirement for any developmental strategies for such areas (Minot et al., 2006). Bihar’s economy is mostly reliant on agriculture. Including forestry and fisheries, agriculture provided 18.1 per cent of the state’s GDP in 2016–2017 and employed 77 per cent of the workforce, which is significantly more than the national average (www.krishi.bih.nic). Even if the state is self-sufficient in food grains, the rural community’s economic situation is still miserable. The focus of this study was to provide information that will aid the policy makers in designing and developing rural upliftment a strategy and public investment programmes that will assist rural people in diversifying their sources of income.

METHODOLOGY

The Simpson Index of Diversification (SID) was calculated using information gathered on the worth of output for the years 1999–2000 to 2018–19 to assess the level of diversification both generally and across various sectors. For the period, i.e. 1999-00 to 2018-19 for Bihar, data on the value of output of agriculture and related activities were gathered from the Ministry of Statistics and Programme Implementation (MoSPI), Government of India. The constraints study was carried out in aspirational districts of Bihar. The set of four districts also representing different types of agro-climatic, socio-economic conditions, and having lowest per capita agricultural income of the state was selected from all the zones. Two blocks from each district and two villages from each block were selected randomly. Twenty households of dairy farmers in each village were randomly selected to representing a total sample size of 320. Based on available literatures, survey reports and discussions with various stakeholders a semi-structured questionnaire was prepared pre-tested prior to the survey. Regression model using ordinal least square techniques was applied to identify determinants of livelihood diversification. In this study, OLS assumptions were establishing a causal link between the dependent and predictor variables, the relationship was carefully examined and held. For instance, the model’s factors are presumed to be linear and its variables are selected at random. Additionally, it is expected that there is no significant linear correlation between the explanatory variables presented and the situational mean value is zero for error term. However, it was presumed that there would be homoscedasticity in the error terms and no multicollinearity with the treatment variables. The regression model is given in

$$\text{Equation (1): } D_{ij} = \beta_0 + \beta_i X_i + \mu \quad \dots (1)$$

Here, D_{ij} is the responding variable indicating diversification of household, i = measured in the number of activities j , β_0 = referred as constant, β_i = defined as vector of parameter, X_i = Vector of independent variables and, μ = is the disturbance term

Collected information was analyzed using a range of statistics and econometrics tools. “Farm Diversification” was quantified as

the process through which farm or rural people build an ever-diversifying collection of ventures and possessions to thrive and raise the level of living condition. Those respondents who had livestock as a part of their farm diversification were treated as respondents during the data collection process.

Farm diversification of was quantified with the help of ‘Simpson Index of Diversity’ (1949). The Simpson Index of Diversity (SID) is operational as:

$$SID = 1 - \sum_{i=1}^n P_i^2$$

$$P_i = \frac{\text{Value of output for } i^{\text{th}} \text{ crop / enterprise}}{\text{Total value of output from all agriculture and allied enterprises in farm}}$$

Where, P_i represents as the proportion of income generating from source i . However, SID value always ranges between 0 and 1. The statistical tools used for constraint analysis was Garrett’s ranking method to help find the most important factors influencing the survey variables. Standard Garrett’s formula that converts ranks into percent was used.

RESULTS AND DISCUSSION

Current livelihood systems pursued by the farmers

It is evident from the Figure 1, that among the several means of livelihoods used by the respondents in the research area, integration of agricultural farming and livestock farming is found to be maximum preferred livelihood system, followed by (31.87%) of dairy farmers. This result was found to be in concordance with Khan et al., (2007). The second most significant livelihood system being practiced by the (19.06%) of the dairy farmers found to be the alignment of livestock farming and business activities. The integration of livestock rearing and wage labour was reported for (14.06%) of the dairy farmers. Agricultural farming along with cattle-rearing and wage labour was reported by (11.25%) of the dairy farmers. Agricultural farming along with livestock farming and government and private service was practiced by (6.87%) of the farmers while the combination of service and cattle rearing was followed by (11.87%) of the respondents. The least common kind of subsistence, practiced by only (5.00%) of respondents, was crop production together with livestock rearing and business. The findings suggest that respondents pursued agricultural production as a significant source of livelihood in all seven of the livelihood systems that were common in the study region, except in the livelihood system of livestock rearing. Most of the respondents from the whole sample were discovered to be working in agriculture sector. This shows that agriculture farming is still highly significant means of income generation for farmers. This might be because most of the farmers were having marginal land holding. They were not in a position to meet the expenditure required to run the family with only one source of income. Hence most of the households earned a living by maintaining a diversified pattern of occupations viz., on farm activities, wage employment, services, and small enterprises. The study was found in concordance with Parmanand et al., (2012) explained that (Crop production + Livestock) livelihood system was followed by most (28.75%) of the farmers.

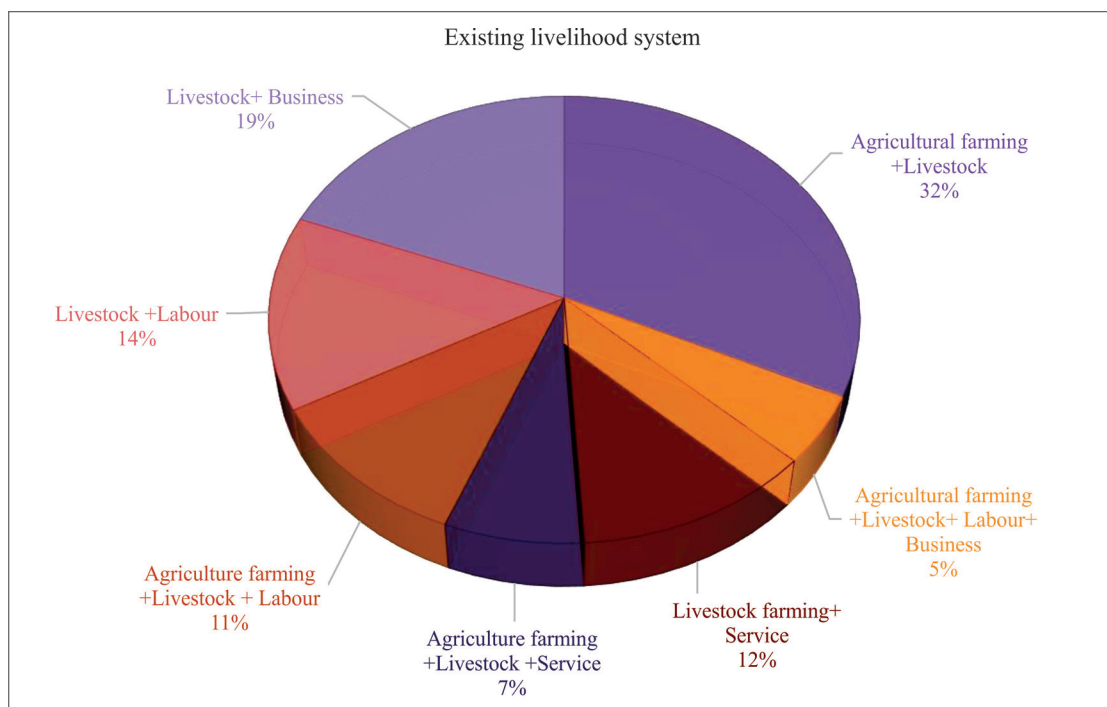


Figure 1. Distribution of respondents on the basis of existing Livelihood systems

Extent of farm diversification, as prevalent in the study area

The extent of farm diversification across the year over last 19 years in the state is presented in Figure 2. The value of Simpson Index of Diversification (SID) indicates the diversification value in overall agriculture including horticulture and livestock. Among cereals and pulses the SID for pulses was found higher in all the years. SID for oilseed was seen increasing over few years followed by declining trend in 2009-11 and 2017-19. Similarly, the SID value of cash crop in the state was found to decreasing from 2011 onwards to 2019. SID for pulses and spices and condiments was seen almost similar round the year. The diversification was seen most for vegetables as compared to fruits in the state the mean value of SID for vegetables was 0.727 while for fruits it was found to be 0.664. The SID for byproduct was drastically low compared to the other entire sector share. The diversification was seen most for vegetables, spices and condiments, pulses, cash crop as compared to fruits, cereals, oilseeds in the state. Though diversification in agriculture can be seen in state but individual sub sector wise Simpson index of diversification gives different picture.

The SID for overall agriculture and allied in Bihar was, found to be of medium level with an average of 0.543 over last twenty years (Table 1). However, the value of SID was found to be increasing over last few years from 2013 onwards for overall agriculture and allied sector. The Table 1 shows a declining trend of Simpson Index of diversification for Livestock over 2014 onwards in Bihar which depicts that state indicates shifting towards specialized production of these commodities. However, SID values ranging from 0.71 to 0.80, is reported for Indian states like Rajasthan, the Jammu and Kashmir region, Uttar Pradesh, Jharkhand, Chhattisgarh, Bihar, and Himachal Pradesh, showing a medium level of agricultural diversification (Sen et al., 2017).

Table 1. Sector wise Simpson Index of Diversification for Agriculture, Livestock, Fishery, and Overall Agri and allied sectors of Bihar state

Year	SID Agriculture	SID Livestock	SID Fishery	SID Agri and Allied
1999-00	0.532	0.525	0.000	0.511
2000-01	0.588	0.520	0.000	0.510
2001-02	0.591	0.521	0.000	0.527
2002-03	0.603	0.517	0.000	0.538
2003-04	0.613	0.502	0.000	0.540
2004-05	0.646	0.438	0.000	0.541
2005-06	0.619	0.439	0.000	0.540
2006-07	0.573	0.421	0.000	0.534
2007-08	0.596	0.416	0.000	0.535
2008-09	0.547	0.419	0.000	0.536
2009-10	0.616	0.419	0.000	0.536
2010-11	0.626	0.396	0.000	0.534
2011-12	0.639	0.382	0.000	0.533
2012-13	0.634	0.383	0.000	0.534
2013-14	0.654	0.400	0.000	0.560
2014-15	0.652	0.383	0.000	0.567
2015-16	0.620	0.347	0.000	0.568
2016-17	0.677	0.371	0.000	0.578
2017-18	0.599	0.347	0.000	0.569
2018-19	0.620	0.347	0.000	0.574

Determinants of farm diversification

The important determining elements discovered that influences, farm diversification activities between the dairy farmers by using the ordinal linear regression analysis. Findings of regression analysis depicts that the coefficient of age (years), total number of family members and qualification of family members has an extreme influence, however statistically it was found to be non-significant

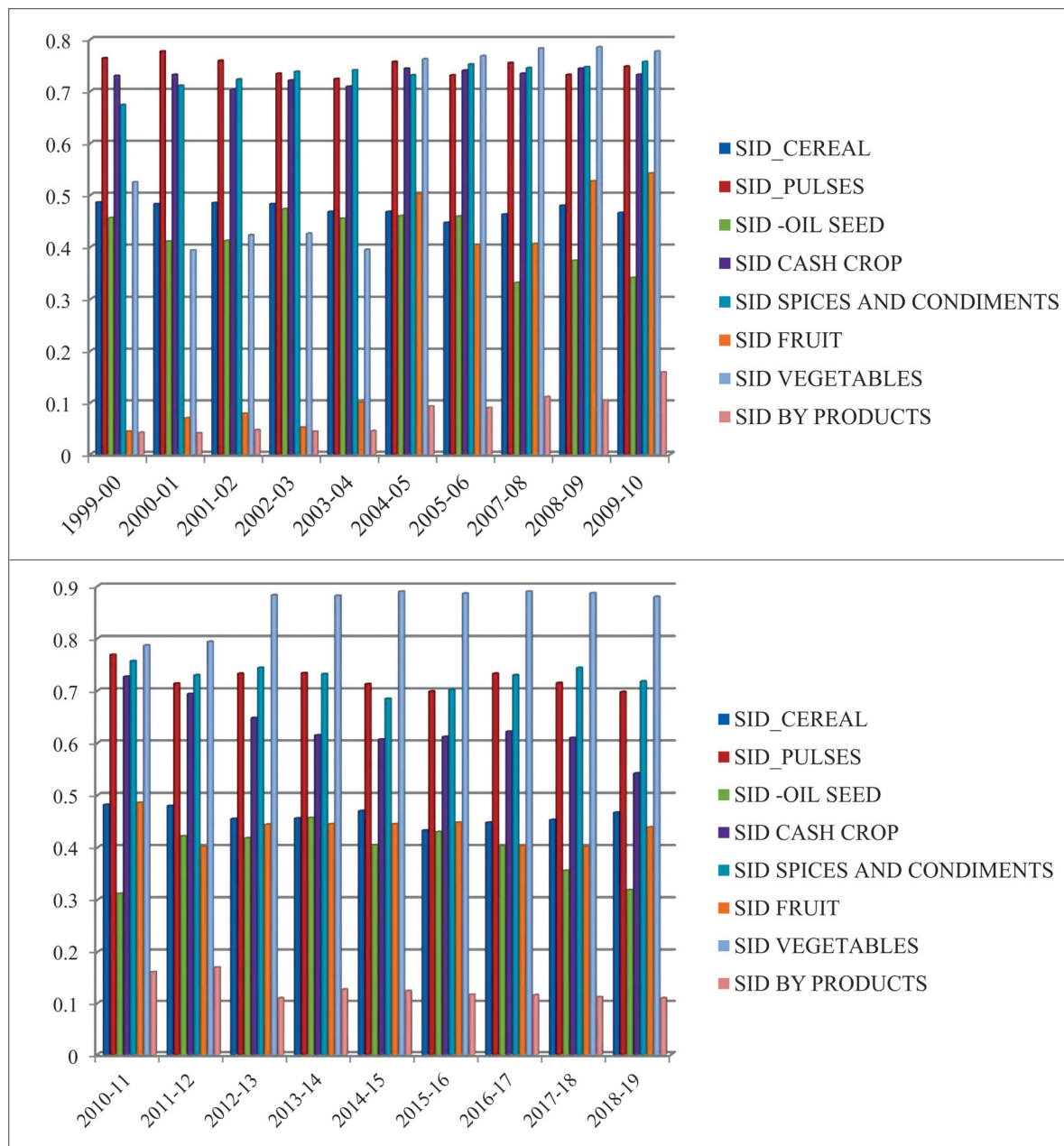


Figure 2. SID of various crops over last 19 years in Bihar

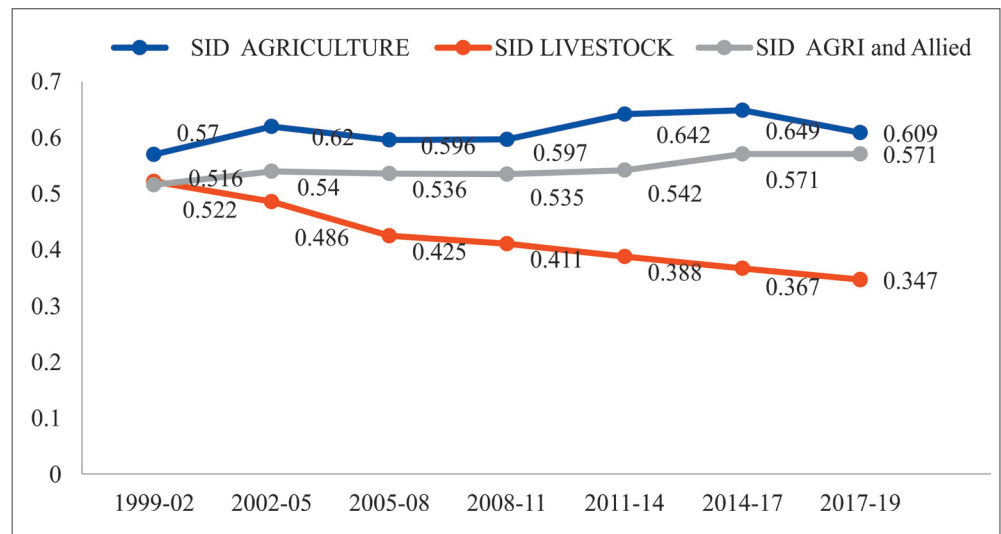
on the scale of accepting farm diversification activities (Table 2). By implementing on-farm and off-farm activities, qualified or educated family members are able to rapidly determine the most beneficial alternative economic pursuits for the family's well-being. But it was determined that the computed coefficients were not statistically significant. However, study conducted by Mentamo & Geda (2016) farming experience facilitates to accept different suitable income generating activities in the previous years. Families having a large number of members are benefited by having more human resources that can be used to engage in non-farm activities. An increase in the number of earners in a household has statistically shown to be positive with the number of diverse activities, as shown by the estimated coefficient of total earning members (Table 2). This finding is allied with the result of (Mottaleb & Ali,

2018). The interpersonal relationships and network of dairy farmers develops as a consequence of participation in various social activities. In the study area, it was found that venture diversification is higher among dairy farmers who often participated in social activities. A comparable understanding is assumed by (Ellis, 2000) since the government provides all the necessary social facilities, the work of government assistance (financial and directional) gives good contribution towards expanding diversified activities (Smith et al., 2001), and the crucial role of government schemes and support is reported to be statistically significant for the dairy farming community. The livelihood diversification was also positively impacted by income (earning members of the family). When one's financial status is secure, they are better positioned to benefit from innovative strategies that increase their capacity

Table 2. OLS regression table

Variable	Coefficients	Standard error	t	P> t
Age (X_1)	0.007	0.01	0.42	0.64
Education (X_2)	0.024	0.06	0.44	0.63
Family member (X_3)	0.019	0.11	0.15	0.78
Earning members (X_4)	0.452*	0.25	1.84	0.03
Educated family member (X_5)	0.231	0.18	1.35	0.19
Loan (X_6)	-0.167	0.17	-0.45	0.63
Training (X_7)	-0.230	0.07	-0.55	0.58
Social work participation (X_8)	0.560*	0.38	1.69	0.05
Health/financial problem (X_9)	0.299	0.45	1.12	0.27
Government donation (X_{10})	0.867**	0.33	2.46	0.01
R^2	0.58	-	-	-
F value	2.56	-	-	-
Observation	320	-	-	-
Mean VIF	1.75	-	-	-

Note: ** and * - significance at one and five per cent, respectively

Figure 3. Mean Simpson Index of Agriculture, Livestock & Agri & allied**Table 3.** Distribution of respondents according to Constraints

S.No.	Statements	GMS	Rank
1	Limited availability of credit services	45.39	VI
2	Poor coordination and collaboration among stakeholders	53.15	III
3	Lack of technical support from relevant organizations	60.55	II
4	High charges by veterinarians for treatment of animals	63.80	I
5	Poor access to market and lack of working capital	48.27	IV
6	Scarcity of farm land	40.93	VII
7	Poor infrastructure, including inadequate roads and transportation etc.	36.98	VIII
8	Lack of awareness and training programme	46.58	V

for earning a living. The current finding is consistent with (Dagar & Upadhyay, 2022; Gautam & Jha, 2023).

Constraints of rural livelihood diversification

There are several barriers to successful livelihood diversification in the area, despite the fact that it is a crucial plan of survival for rural households to maintain livelihoods and reduce vulnerability. One of the main obstacles to livelihood diversification in the area, according to focus group participants, is the high

charges by veterinarians for treatment of animals, as well as issues with roads and transportation, the scarcity of farmland, the lack of technical support from relevant organisations, the limited availability of credit services, the poor connectivity between rural and urban areas, the lack of market access and the lack of working capital, the lack of awareness, and poor coordination and collaboration among stakeholders. Data in Table 3 depicts the ranking of different constraints identified by respondents. It was found that “High charges by veterinarians for treatment of animals”

was ranked I by the respondents while “Poor infrastructural facilities such as proper road, transportation facilities etc.” was ranked least important by the respondents with Garrett mean score value of 36.98. The findings of the research were found in line with Das et al., (2014; Gireesh et al., (2019) & Gupta et al., (2020) who also reported that lack of appropriate marketing facilities, and insufficient number of demonstrations of new technologies, were some major challenges identified by the respondents. However according to the study conducted by Mishra et al., (2023) depicted that poor knowledge on pest and disease control and low profit were the major challenges faced by the respondents.

CONCLUSION

Unchecked population growth, smaller farm sizes, reliance on rainfall, irregular rainfall patterns, and low returns from farming activities have forced farmers to engage in a variety of income-generating activities in order to sustain and develop their living standard while also overcoming obstacles to their livelihoods. The study comes to the conclusion that enhancing livelihoods, increasing food security, and reducing poverty in the study region cannot be accomplished in the area alone through the agricultural sector. Therefore, it is determined that a comprehensive development strategy that supports effective livelihood diversification is essential and necessary. The main focus of policies and actions should be aimed at improving the livelihood of farming communities through building and growth of rural infrastructures, such as the road network, market center, strengthening rural-urban linkages, accessibility of financial services trainings, as well as awareness-raising initiatives and institutional arrangements.

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Distribution and Preference of Selected Dairy Breeds among Farmers of Bihar: A Socio-economic Analysis

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ARTICLE INFO

Keywords: Breeds, Ease of rearing index, Farmers, Graded Sahiwal, Preference, Qualitative

<http://doi.org/10.48165/IJEE.2023.59316>

Conflict of Interest: None

ABSTRACT

The preference for dairy breeds is likely to depend on resource availability. This study attempted to analyze the distribution of the selected breeds of dairy animals among the farm size category, education, and experience of the dairy farmers. The study was conducted in the central region of Bihar and primary data was collected from January–March 2021, from 70 farmers in respect of the selected dairy animals using a pre-structured interview schedule. Ease of rearing index was developed and the preference of the dairy farmers towards the selected dairy breeds was estimated. The key findings revealed that 55 per cent of farmers were marginal farmers and mostly preferred indigenous breeds like Graded Sahiwal and Graded Murrah. The farmers rearing Graded Sahiwal (67%) and Graded Murrah (69%) were having qualifications up to secondary education. Highly experienced farmers were rearing buffalo whereas Graded Sahiwal (67%) and crossbred (72%) animals were kept by farmers having experience less than or equal to 20 years. The ease of rearing index revealed that most of the farmers were preferring indigenous breed to rear because of its qualitative parameters. It can be concluded that farmers are having likeness towards indigenous breeds which needs to be promoted.

INTRODUCTION

Indian dairy sector has undergone massive changes since the advent of the white revolution and becoming a world front-runner in terms of milk revolution and hence the dairy sector is having enormous potential to provide job opportunities to a massive population (Aski & Hirevenkanagoudar, 2010; Das et al., 2020; Mandi et al., 2022). Dairy farming is supplement to agricultural growth and an effective tool to uplift the socio-economic status of the rural areas as well as the farmers (Gangasagare & Karanjkar, 2009; Vekariya et al., 2016 & Mondal et al., 2022). India is well versed with bovine diversity and possess one-ninth of cattle germplasm (Bhandari et al., 2020). The total livestock population is 535.78 million in the country showing an increase of 4.6 per

cent over livestock census-2012. The indigenous female cattle population has increased by 10 per cent and the total exotic crossbred cattle population increased by 29.3 per cent in 2019 as compared to previous census (20th Livestock Census). The milk production has grown at a compound annual growth rate of 6.2 per cent to reach 209.96 million tonnes in 2020-21 from 146.31 million tons in 2014-15. The all-India per capita availability of milk has been reported as 427 gram per day in 2020-21 (Economic Survey, 2021-22). There are about 53 recognized indigenous breeds of cattle and 20 buffalo in India (NBAGR, 2022). The major indigenous cattle breeds of India are Gir, Red Sindhi, Sahiwal, Amrit Mahal, Umbalacheri, Deoni, Hariyana, Ongole, Rathi, Vechur, etc. The major indigenous breeds of buffalo are mainly Bhadawari,

Jafarabadi, Mehsana, Murrah, Surti, etc. Among dairy animals, India has a large population of Indigenous breeds which have survived over a long time and fits well into the agro-ecological environment of their habitat (Kumar et al., 2022). They are robust, have the capacity to thrive in conditions of great dietary deprivation, and have the ability to tolerate heat (Sharma et al., 2015; Savalia et al., 2019). They are also known for their gentle temperament and ease of Calving. Ease of rearing index is one criterion which can help in comparison of the different breed on the basis of their qualitative parameter. The socio-economic status of the farmers has an effect on animal and farm management, decision making, and the general perception of breed and species of the farmers. High milk yield, less expenditure on feed, breeds suitable for an area and climate, availability of government support schemes, specific farm conditions is having direct relationship with breed preference (Kumar et al., 2016). Without understanding these factors, it would be difficult to analyze the requirements of the farmers and to persuade them to fully participate and cooperate in a breeding program (Kosgey et al., 2006).

METHODOLOGY

The present study was designed to know the societal status of the farmers keeping different breeds of dairy animals of different lactation group. The study was conducted in central region of Bihar based on the report of Livestock sector analysis (Singh et al., 2018) in Bihar stating that Sahiwal breed of cattle, Murrah buffaloes and Jersey/ HF crossbred dairy animals are the suitable breeds for the region. These breeds are performing well in their breeding tract and having good livestock infrastructure to support, but in the non-traditional areas like Bihar, where the agroclimatic condition and the livestock services are not alike to the traditional regions. Hence, this study was purposively conducted in order to explore breed's performance and preference among the farmers in Bihar. Primary Data was collected from 70 farmers during January-March 2021, with the help of pre tested survey schedule of a sample size of 108 animals from three lactation groups of each selected breed i.e., 1-3 lactation number, 4-6 lactation number and ≥ 7 lactation number to cover the productive life of a breed. 12 animals in each lactation group were selected by snowball sampling method. The aspects discussed in this section are distribution of animals of different breeds across operational holdings, education status and experience of the owner of a breed.

An Ease of Rearing Index was also developed to capture the preference of the farmers towards keeping the dairy animals of different breed. The qualitative traits apart from their milk production aspect namely handling of animals, incidence of diseases, incidence of ticks and worms, feed and fodder requirement, and out of pocket expenses were kept in mind to ask the farmers for keeping the particular animal. To combine all the six indicators, into one value of the EoR index, weights were assigned to each selected indicator with the help of the expert opinion method. As the scores were having negative functional relationship with the EoR index, the following formula was used to normalize the score in order to range between zero and one.

$$\text{Normalization} = \frac{\text{Maximum value} - \text{Actual value}}{\text{Maximum value} - \text{Minimum value}}$$

The Ease of rearing (EoR) index was computed by the normalized score of each indicator with assigned weight of the respective indicator.

$$\text{EoR} = \frac{\sum_{i=1}^n X_i W_i}{\sum_{i=1}^n W_i}$$

Where, X_i represents the normalized value of the i^{th} indicator (normalized), W_i is the weight of i^{th} indicator and 'i' varies from 1 to 6.

Finally, EoR was calculated by taking the average of the indices of the indicators. Based on the computed EoR index for all the animals, the selected animals were categorized into the low, medium and high range of EoR index by cumulative square root frequency method.

RESULTS AND DISCUSSION

In the selected sample, there were about 56 per cent marginal farmers and 13 per cent medium farmers. The average farm size operational holding of marginal, small and medium farmers was 0.64 ha, 1.22 ha and 3.07 ha, respectively. The share of operation holding allocated to fodder production was about 30 per cent (0.19 ha) by marginal farmers, 20 per cent (0.24 ha) by small farmers and 12 per cent (0.38 ha) by medium farmers.

Table 1 reveals that the more animals of Graded Sahiwal and Graded Murrah were kept by marginal farmers while the crossbred animals were more with medium farmers. It might be due to the fact that marginal farmers were more resource scarce as compared to medium farmers and hence the maintenance of indigenous breeds was easier for marginal farmers compared to crossbred. Similar result was reported by Rangnekar (2006) in International Livestock Research Institute report. The percentage share of Graded Sahiwal and Graded Murrah with marginal farmers was 55.55 and 41.67 per cent, respectively. The share of crossbred animals was the highest (41.67%) with small farmers. The table further shows that, marginal farmers were having 40 to 60 per cent of animals in their late lactation except in case of crossbred animals (25%) due to lack of capital and resource scarcity. They used to keep old animals rather than buying early lactation animals as less maintenance was required to keep old lactating indigenous animals. Late lactation crossbred was not kept because they used to get frequent health issue in their late lactation and hence the rise in veterinary cost was not easy to bear by marginal farmers. Kabir et al., (2010) also reported similar result for goats where adult goats were having higher frequency of disease compared to young ones.

Distribution of breed across educational level of head of house hold

About 67 per cent of Graded Sahiwal (cumulative) and 69 per cent of Graded Murrah (cumulative) were reared by the head of the households having education qualification up to secondary level (Table 2). Contrast was the case in crossbred, about 58 per cent of the animals of this breed (cumulative) was reared by the head of the households who were having education qualification more than secondary education. It shows that highly qualified farmers preferred to rear crossbred cattle (Hossain et al., 2005). This might be due to the fact that higher qualified persons are

Table 1. Distribution of different age group animal's breed across farm size categories (number of animals)

Breed	Lactation Number	Farm household (number)		
		Marginal	Small	Medium
Graded Sahiwal	1-3	7(58.33)	3(25.00)	2(16.67)
	4-6	5(41.67)	3(25.00)	4(33.33)
	≥7	8(66.67)	2(16.67)	2(16.67)
	Total	20(55.55)	8(22.22)	8(22.22)
Crossbred	1-3	2(16.67)	4(33.33)	6(50.00)
	4-6	3(25.00)	5(41.67)	4(33.33)
	≥7	4(33.33)	3(25.00)	5(41.67)
	Total	9(25.00)	12(33.33)	15(41.67)
Graded Murrah	1-3	3(25.00)	5(41.67)	4(33.33)
	4-6	7(58.33)	3(25.00)	2(16.67)
	≥7	5(41.67)	3(25.00)	4(33.33)
	Total	15(41.67)	11(30.55)	10(27.78)

Figures within parentheses indicate percentage of the row total, and some farmers were having more than one breed

Table 2. Distribution of different age group animal's breed across educational level of head of household

Breed	Lactation Number	Educational level of household head				
		Illiterate	Primary	Secondary	Higher Secondary	Grad. & Above
Graded Sahiwal	1-3	(25.00)	(16.67)	(25.00)	(16.67)	(16.67)
	4-6	-	(8.33)	(50.00)	(16.67)	(25.00)
	≥7	(25.00)	(8.33)	(41.67)	(8.33)	(16.67)
	Total	(16.67)	(11.11)	(38.89)	(13.88)	(19.44)
Crossbred	1-3	(8.33)	(33.33)	-	(25.00)	(33.33)
	4-6	-	(16.67)	(41.67)	(8.33)	(33.33)
	≥7	(16.67)	(8.33)	(8.33)	(58.33)	-
	Total	(8.33)	(19.44)	(16.67)	(30.55)	(22.22)
Graded Murrah	1-3	(25.00)	(33.33)	(8.33)	(8.33)	(25.00)
	4-6	(25.00)	(8.33)	(41.67)	(16.67)	(8.33)
	≥7	(16.67)	(25.00)	(25.00)	(16.67)	(16.67)
	Total	(22.22)	(22.22)	(25.00)	(13.88)	(16.67)

Figures within parentheses indicate the percentage of the row total

adopting the modern practices (Alene & Manyong, 2007). Observing the results of distribution of breeds among farm size categories and the education status of household, clearly reveals that indigenous breeds are preference over crossbred by the resource poor farmers having lower education level might be due to the fact that the rearing of indigenous breeds requires fewer modern inputs and services (Balaraju et al., 2016; Duguma & Janssens, 2016).

Distribution of breed across experience of the farmers in dairying

The dairy animals of different lactation number have been distributed across the experience of the farmers in dairying (Table 3). It reveals that crossbred (72%) animals were kept by farmers having experience less than or equal to 15 years. It might be because less experienced farmers would be more profit oriented to get more return from crossbred (Balaraju et al., 2016). While farmers having experience of less than or equal to 20 years were keeping Graded Sahiwal (83%) and Murrah (77%). Less experienced farmers rarely go for animals in their advanced lactation number (≥ 7th lactation number) as there was no crossbred and Graded

Murrah in this lactation number group among the farmers of 0-5 years of experience. It might be because of the lack of information about management practices in late lactation. Around 55 per cent of respondents had 11 to 20 years of experience in buffalo rearing. The result was somewhat similar to findings of Sivaji et al., (2018) who reported 35 per cent of respondents were having experience of 11 to 20 years in rearing buffalo. It might differ from region to region.

Average index score of indicators for the dairy breed

Table 4 gives the score value of individual indicators and overall index value for different breeds. It indicates that the overall EoR index value was the highest for Graded Sahiwal (0.705) followed by Graded Murrah (0.611) and crossbred (0.334). The EoR index of Graded Sahiwal and Graded Murrah was 2.110 times and 1.829 times higher than EoR index of crossbred cow. This clearly indicates that overall ease of rearing of indigenous breeds was almost double the ease of rearing of crossbred.

The overall EoR index was based on score value of six indicators as mentioned in Table 4. The Graded Sahiwal was

Table 3. Distribution of breeds across experience of the farmers in dairying

Breed	Lactation Number	Experience in dairy farming (years)				
		0-5	6-10	11-15	16-20	>21
Graded Sahiwal	1-3	(8.33)	(41.67)	(33.33)	(16.67)	-
	4-6	(8.33)	(33.33)	(25.00)	(25.00)	(8.33)
	≥7	(8.33)	(16.67)	(25.00)	(8.33)	(16.67)
	Total	(8.33)	(30.55)	(27.77)	(16.67)	(8.33)
Crossbred	1-3	(16.67)	(25.00)	(33.33)	(8.33)	(16.67)
	4-6	(25.00)	(16.67)	(50.00)	(8.33)	-
	≥7	-	(8.33)	(41.67)	(25.00)	(25.00)
	Total	(13.89)	(16.67)	(41.67)	(13.89)	(13.89)
Graded Murrah	1-3	(8.33)	(16.67)	(33.33)	(25.00)	(16.67)
	4-6	(16.67)	(8.33)	(16.67)	(33.33)	(25.00)
	≥7	-	(16.67)	(25.00)	(33.33)	(25.00)
	Total	(8.33)	(13.89)	(25.00)	(30.55)	(22.22)

Figures within parentheses indicate the percentage of the row total

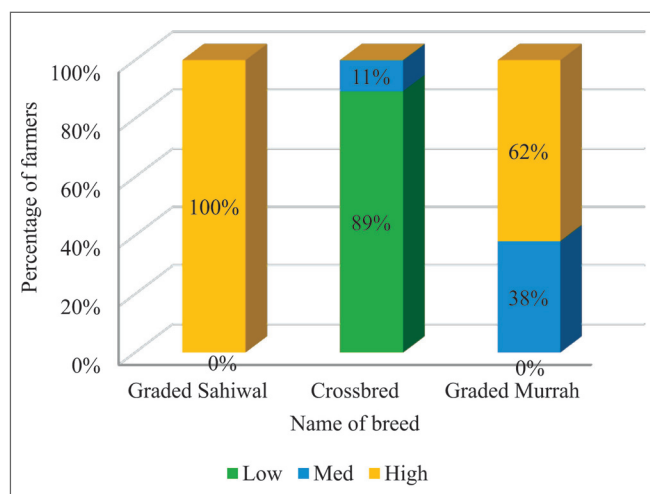
Table 4. Index score for the different indicators and overall index of the breeds

Indicators	Selected breeds			
	Weights assigned (Per unit of 100)	Graded Sahiwal	Crossbred	Graded Murrah
Handling of animal	16	0.286	0.518	0.862
Out of pocket expense	20	0.650	0.376	0.629
Incidence of diseases	15	0.768	0.179	0.759
Incidence of ticks and worms	11	0.813	0.268	0.517
Fodder requirement	18	0.830	0.339	0.474
Feed requirement	20	0.875	0.295	0.457
EoR index (overall)		0.705	0.334	0.611
EoR index ratio (based CB)		2.110	1.00	1.829

having the highest score value of all the indicators except one, that is, handling of animal. The average score of handling of animal of Graded Sahiwal was the lowest (0.286) and it was the highest (0.862) for Graded Murrah which indicates that it is the easiest to move, milk and feed the Graded Murrah animal as compare to other two breeds and the vice-versa was the true for Graded Sahiwal animal.

Classification of dairy breeds based on ease of rearing index (EoR)

From Figure 1, it can be inferred that Graded Sahiwal was considered having high rearing index by 100 per cent of the farmers. Similarly, crossbred was considered for low rearing index by 25 (89%) farmers and 3 (11%) farmers considered for medium rearing index and none of the farmers considered it for high rearing index which showed its disadvantage over Graded Sahiwal. It is because, indigenous breed like Graded Sahiwal is superior in the qualitative parameters like ease of feed and fodder requirement, disease resistance, quality of milk compared to crossbred. Similar results were also reported by Balaraju et al., (2016); Rahman et al., (2013) & Siddiquee et al., (2013). Whereas for Graded Murrah, 11 farmers (38%) considered medium ease of rearing index, 18 farmers (62%) reported for high rearing index and none of the farmers reported for low rearing index. In contrast, Singh et al., (2022) reported that Murrah was found more preferred (81.42%) followed by Crossbred (65.82%) in Punjab. It might be due to

**Figure 1.** Categorization of breeds according to Ease of Rearing Index (EoR)

variation in availability of feed and fodder, availability of grazing areas and milk price from region to region. It is inferred that indigenous breeds (Graded Sahiwal and Graded Murrah) were having higher ease of rearing as compared to crossbred cattle therefore, these breeds are preferred by the farmers in situations where there is scarcity of resources as supported by findings of Balaraju et al., (2016).

CONCLUSION

It can be concluded from the study that marginal farmers were mostly preferring indigenous breeds as per the availability of the resources and small farmers preferred crossbred animals. Farmers having less than secondary education and experience less than twenty years were mostly found to rear Graded Sahiwal and Graded Murrah. Late lactation animals were marginally favored by less experienced farmers. Based on the estimated ease of rearing index, farmers had greater preference for Graded Sahiwal. It shows that, still farmers prefer to keep indigenous breeds due to its qualitative parameter despite of its low milk yield. There is a need to have more robust study on improving the genetic value of the indigenous breeds as well as a method to estimate the economic value of the qualitative parameters to conserve the indigenous breeds.

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Effectiveness of Farmer Producer Organizations (FPOs) at Different Growth Stages in Transitioning to Secondary Agriculture

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ARTICLE INFO

Keywords: Farmer producer organizations, Effectiveness, Secondary agriculture, Farmers' income, Sustainability of FPO

<http://doi.org/10.48165/IJEE.2023.59317>

Conflict of Interest: None

ABSTRACT

FPOs are gaining recognition as institutions for improving the small holders' farming in India. However, the extent to which FPOs effectively facilitate the transition to secondary agriculture for the sustainable development of these farmers has not been extensively studied. This study was conducted during 2022-2023 to assess the effectiveness of randomly selected four FPCs in Bihar, which are functional for 1-3 years, >5 years, and >10 years. A random sample of 160 members, 40 from each FPC, was selected. The overall effectiveness of 50.55 per cent to 56.20 per cent in FPCs at their initial stage of functioning; while the FPCs being functional for more than 5 years and more than 10 years showed overall effectiveness of 60.03 per cent and 68.40 per cent, respectively. The FPC diversifying their products and performing processing, manufacturing, and marketing functions showed the highest effectiveness (68.40%) as compared to the FPCs dealing with single products and/or performing selected functions like providing agricultural inputs, and marketing. A one-way ANOVA followed by Post hoc test revealed significant variations in the effectiveness of FPOs. The present study provides valuable insights into the role of FPOs in the transition to secondary agriculture providing better income and livelihoods to farmers.

INTRODUCTION

In India, approximately 86.21 per cent of the country's total land holdings are owned by small and marginal farmers as per the Agriculture Census of 2015-16. Due to small patches of land, small and marginal farmers encounter difficulties in economy of scale particularly identifying markets, establishing market connections, reaching out to markets, obtaining fair prices for their produce, lack of storage facilities, high transportation costs, presence of intermediaries, and limited access to credit (Kumar et al., 2018; Nain et al., 2019; Bishnoi & Kumari, 2020), which are referred as the components of secondary agriculture. The collectivization of farmers has proven to be significant in reducing transaction costs and providing scale advantages through bulk

purchase of inputs (Singh, 2008; Trebbin & Hassler, 2012; Parthiban et al., 2015). India's agricultural system is shifting from social welfare to welfare capitalism, necessitating policy reforms for the capitalization of farmers (Trebbin & Hassler, 2012). Farmer Producer Companies (FPCs) have gained attention as a solution to marketing challenges faced by small farmers (Singh et al., 2022) and it was found that FPOs improve the livelihoods of farmers by facilitating collective input purchases and providing forward linkages (Mukherjee et al., 2018a). Currently, there are 33,711 registered FPOs in India, with over 28.20 lakh farmers affiliated across 28 states and 7 Union Territories. Notably, Bihar, Maharashtra, Odisha, Rajasthan, Tamil Nadu, and Uttar Pradesh are the primary contributors, accounting for 21,285 FPOs (63%)

and 18.36 lakh shareholders (65%). Maharashtra leads with 8,261 FPOs, followed by Uttar Pradesh with 3,106 FPOs (Balamatti, 2023; Kumar et al., 2023). FPOs provide farmers with benefits such as risk mitigation, access to extension services, improved inputs, credit, storage, and processing facilities. They enable farmers to compete with larger corporations, utilize digital platforms, and share profits (Singh & Vatta, 2019; Adhikari et al., 2021; Kumar et al., 2021; Rathour et al., 2022). Factors like attitudes, cooperation, member responsibilities, and entrepreneurial traits contribute to FPO stability (Mukherjee et al., 2018b; Gorai et al., 2022; Singh et al., 2022). The effectiveness of FPOs is crucial for empowering farmers, improving their livelihoods, and ensuring sustainable agricultural development. Through the promotion of collective action, market access, knowledge sharing, and advocacy for farmers' interests, effective FPOs can bring about positive changes in the lives of farmers and the agricultural sector (Mukherjee et al., 2019a; Kumari et al., 2022).

To date, numerous studies have explored the efficacy of various agricultural-based FPOs across different sectors of agriculture. However, there remains a notable research gap pertaining to the assessment of FPO effectiveness during the different growth stages of FPOs specifically operating in secondary agriculture. A comprehensive investigation into the performance and impact of FPOs at various developmental stages within the secondary agriculture sector was need of the hour. On this backdrop present study was undertaken to assess the effectiveness of FPOs dealing with both agricultural and horticultural produce and are at different stages of functioning in the state of Bihar.

METHODOLOGY

An exploratory sequential design was followed in present study including a qualitative approach followed by a quantitative approach. Qualitative data were collected first to explore the phenomenon under study, then quantitative data were gathered to explain the relationships among elements of the phenomenon explained through qualitative data. The study was conducted in the purposively selected state of Bihar, which is one of the six major states promoting FPCs in India. The list of registered and functioning FPCs in Bihar was obtained from the National Bank for Agriculture and Rural Development (NABARD), Krishi Vigyan Kendra (KVK) and Indian Council of Agricultural Research (ICAR) institutes. A total of four FPOs were selected randomly, which were dealing with agricultural and horticultural produce and existing for a period of 1–3 years, more than 5 years and more than 10 years. A random sample of 40 farmers from each FPO were chosen, thus covering 160 farmer-members as respondents of the present study.

Effectiveness of FPC refers to the perceived degree of successful accomplishment of FPC objectives as perceived by the members. The researchers contacted the representatives of all FPCs to ascertain their exact status and assess their perception on effectiveness of their respective FPC. To evaluate the effectiveness, index developed by Mukherjee et al., (2019a) with some modification was used, which was based on five components: (1) functioning efficiency, (2) increase in income, (3) increase in farmers' share in consumer prices, (4) farmers' satisfaction, and

(5) empowerment. The functional efficiency was measured on the basis on ten parameters, viz. members' interaction, cooperation among members, interpersonal trust, decision-making, cohesiveness among members, goal achievement, leadership, manageable size, administration systems, and rules, regulations, and procedures (Figure 1). The increase in income as well as farmers' share in the consumer rupee were determined by comparing the income before and after joining in FPC. Farmers' satisfaction with the services provided by the FPC was assessed through 15 statements, each rated on a 5-point continuum scale. The empowerment of farmers resulting from their involvement in the FPC was evaluated based on 14 statements covering various aspects of empowerment, rated on a 5-point continuum scale. To test the significant differences between FPCs with respect to five dimensions of effectiveness an analysis of variance (ANOVA) and Scheffe post-hoc test was done.

RESULTS AND DISCUSSION

A brief description of four selected FPCs is given in Table 1. The Saraiya Kisan Farmer Producer Company Limited (SKFPCL) is located in Muzaffarpur district, which was promoted by NABARD. It involves in the activities related to produce of maize, wheat, and pulses. It supplies agricultural inputs to their member and markets the agricultural produce. The Mithila Makhana Farmer Producer Company Limited (MMFPCL), located in Darbhanga, specializes in various makhana-based products such as roasted *makhana*, *makhana* flour, *makhana*-vita, *makhana* honey mix, and raw *Makhana*. Both these FPCs have been functioning since 2021 & 2020, thus within three years of functioning. The Satyam Shivam Farmer Producer Company Limited (SSFPCL) was established in 2016 and has been focusing on the production, processing, packaging, and branding of products like sun dried lentil dumpling (*dalbari*), candies, amla marmalade (*murabba*), roasted gram flour (*sattu*) and various pickles, etc. The Aranyak Agri Producer Company Limited (AAPCL) is a 14 years old company was established in 2009. Over a period AAPCL has diversified its activities and presently provides a collective market for various high-value commodities, including maize, fruits (banana), semi-perishable vegetable like potato; it is also engaged in various poultry feeds (pre starter, starter crump and grower), makhana processing packaging branding, and supplying of kitchen garden inputs (Table 1).

The effectiveness of selected FPCs was calculated by an index (FPC effectiveness index). This index comprised of five key components viz. functional efficiency, increase in income, increase in farmers' share in consumers price, farmers' satisfaction and empowerment. Among these, functional efficiency emerged as a critical determinant of a company's overall performance which consisted of 10 various sub dimensions. From Table 2, it is evident that AAPCL had a high level of interaction with its members with highest mean perception score of 4.98 followed by SSFPCL (4.86), SKFPCL (4.42), and MMPCL (4.29). Cooperation among members refers to the extent of collaboration and teamwork within the FPOs, for which AAPCL obtained the highest mean Score of 4.98 followed by SSFPCL (4.79), SKFPCL (4.62) and MMPCL (4.47). Interpersonal trust relates to the level of confidence and reliance

Table 1. Profile of the selected FPCs

S.No.	Name of FPC	Year of registration	Promoting organization	No. of members	Area of operation	Turnover (Rs.)	Products (Single /multi commodity)	Market landscape	Service provided
1.	Saraiya Kishan Farmer Producer Company Ltd. (SKFPCL)	2021	NGO (Kasauliya foundation)	325	Saraiya, Muzaffarpur	09 lakhs	Maize	Local and regional markets	Supply of inputs, training of members and marketing.
2.	Makhana Mithila Farmer Producer Company Ltd. (MMFPCL)	2020	NABARD	400	Bareta, Darbhanga	20 lakhs	Makhana based products	National markets	Supply of inputs and processing, value addition of makhana based products and marketing.
3.	Satyam Shivam Farmer Producer Company Ltd. (SSFPCL)	2016	NABARD	1500	Laheriasaria, Darbhanga	41 lakhs	Pickles, <i>dal bari</i> , <i>channasattu</i> , amla candy, value added products	National markets and state market of Bihar	Supply of inputs & training of members. Food processing, packaging and branding. Provides technology for value addition and marketing
4.	Aranyak Agri-producer company Ltd. (AAPCL)	2009	BRLPS, JEEVIKA	5753	Subhash nagar, Punea	5.42 crores	Maize, banana, poultry feed (pre starter, starter crump and grower), Makhana, inputs, potato, kitchen garden inputs.	National and international market	Supply of inputs, regular training of members, food processing, packaging and branding, marketing through online platform NCDX.

among the members of the FPOs. In terms of interpersonal trust, MMPCL received the highest mean score of 3.59; while other three FPCs obtained a low score (<2.0). With respect to decision making, AAPCL demonstrated the highest level of effectiveness, with a mean score of 5.0 and closely followed by SSFPCL with a mean score of 4.93; on the other hand, SKFPCL and MMPCL obtained mean scores of 4.49 and 4.0, respectively. The results indicate that MMPCL had the highest perceived level of cohesiveness among its members with a mean score of 4.8; SSFPCL followed with a mean score of 4.05; while AAPCL and SKFPCL had mean scores of 3.83 and 3.39, respectively. Both AAPCL and MMPCL exhibited the highest perceived level of goal achievement with mean scores of 5.0, closely followed by SSFPCL (4.94), and SKFPCL (4.65). In terms of leadership effectiveness, SSFPCL showed the highest perceived level with a mean score of 5.0 followed by MMPCL (4.80); while SKFPCL and AAPCL obtained mean respective scores of 4.76 & 4.02. When it comes to manageable size, which refers to the optimal size of an organization for effective management and coordination, the mean perception scores indicate that MMPCL was perceived best (4.4); while others were perceived relatively low (mean score <3.75). The administration systems, referring to the processes and structures in place for managing and coordinating organizational activities, received the highest mean score of 5.0 for MMPCL, indicating well-developed and effective systems followed by AAPCL (3.57); while SSFPCL and SKFPCL were perceived low with mean scores of 2.84 and 1.80, respectively. Lastly, rules, regulations, and procedures, which refer to the established guidelines and protocols for conducting organizational activities, AAPCL received the highest mean score of 3.81 followed by MMPCL (3.80), SKFPCL (2.99) and MMPCL (2.88) indicating the need to strengthening their rules, regulations and procedures for improved functional efficiency. It is interesting to observe here that both AAPCL and MMPCL obtained highest perception scores in five out of 10 sub-dimensions of functional efficiency. The overall functional efficiency is found highest in case of MMPCL (4.41) followed by AAPCL (4.07), SSFPCL (3.99) and SKFPCL (3.62). Increase in both income and farmers' share in consumer prices was highest in AAPCL followed by SSFPCL, MMFPCL & SKFPCL. When it comes to farmer's satisfaction, AAPCL had a high-level farmers satisfaction with mean score of 4.94 followed by SSFPCL (4.72), SKFPCL (3.92) and MMFPCL (3.82). With respect to empowerment also, AAPCL had a high-level of farmers satisfaction with mean score of 4.83 followed by SSFPCL (4.57), MMFPCL (4.39) and SKFPCL (3.87).

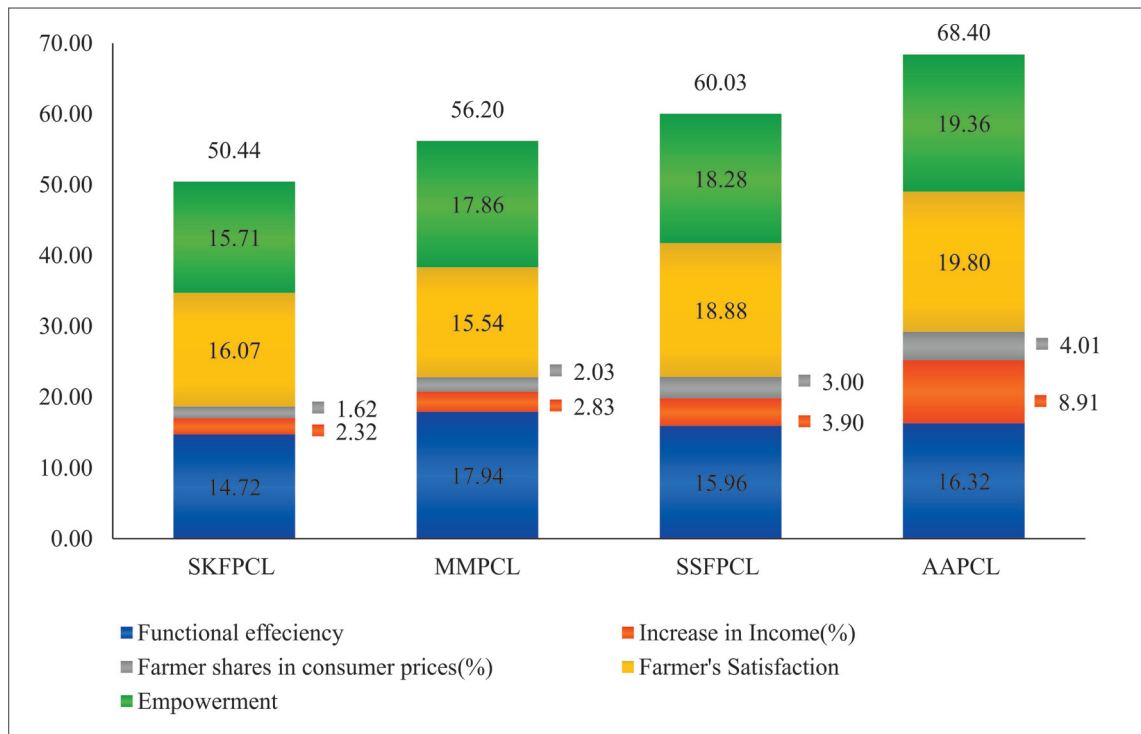
AAPCL, working more than ten years, consistently displayed the highest mean perception scores in several sub-dimensions, suggesting its effectiveness in interacting with members, cooperation, decision-making, and goal achievement. MMPC eleven newly registered, exhibited notable performance in cohesiveness, goal achievement, leadership effectiveness, manageable size, and administration systems. Conversely, SSFPCL, functional for more than 5 years and newly registered SKFPCL scored relatively lower in several dimensions, indicating areas that require attention and improvement.

Comparing the FPCs based on their operational period, it is interesting to observe that effectiveness dimensions are not strictly

Table 2. Differential perceptions of selected members of FPCs on different aspects of functional efficiency

S.No.	Statements	Perception of selected members of FPCs			
		SKFPCL (n=40)	MMPCL (n=40)	SSFPCL (n=40)	AAPCL (n=40)
A.	Functional efficiency [#]	Mean± Standard deviation			
1	Members Interaction	4.42±0.28	4.29±0.26	4.86±0.22	4.98±0.09
2	Cooperation among members	4.62±0.17	4.47±0.18	4.79±0.33	4.98±0.11
3	Interpersonal trust	1.75±0.20	3.59±0.62	1.97±0.42	1.84±0.23
4	Decision making	4.49±0.51	4±0	4.93±0.12	5.0±0.04
5	Cohesiveness among members	3.39±0.46	4.8±0	4.05±0.18	3.83±0.12
6	Goal achievement	4.65±0.20	5±0	4.94±0.09	5±0.03
7	Leadership	4.76±0.18	4.80±0.03	5±0	4.02±0.16
8	Manageable size	3.36±0.30	4.4±0.00	3.66±0.25	3.73±0.17
9	Administration systems	1.80±0.50	5±0	2.84±0.30	3.57±0.19
10	Rules regulation and procedures	2.99±0.41	3.80±0.31	2.88±0.21	3.81±0.06
Overall functional efficiency [#]		3.62±0.32	4.41±0.14	3.99±0.21	4.07±0.12
B.	Increase in income (%)	11.41±2.28	13.90±3.95	19.5±1.79	44.75±7.79
C.	Increase in farmers' share in consumer prices (%)	8±0	10±0	15±0	20±0
D.	Farmers' satisfaction [#]	3.96±0.30	3.82±0.19	4.72±0.20	4.94±0.07
E.	Empowerment [#]	3.87±0.89	4.39±0.25	4.57±0.70	4.83±0.15

Note: [#] measured in 1-5 scale 1 = very low and 5= very high

**Figure 1.** Differential effectiveness of selected four FPCs

associated with the length of operation. AAPCL, which has been operating for more than 10 years, demonstrated higher effectiveness in various dimensions, suggesting that longer operational experience contributes to enhanced performance (Simpson, 2010). However, MMPCL, which has been functioning for only 1-3 years, outperformed SSFPCL and SKFPCL in multiple dimensions, indicating that functional effectiveness can be achieved in a shorter timeframe as well (Harvey et al., 2000). Thus, the overall

effectiveness of FPC is influenced by the type(s) of commodity dealt by it, extent of diversified activities and its growth stage.

The findings suggest that the functional effectiveness of FPCs is not solely determined by their operational period, but rather by the quality of internal processes and organizational structures. FPCs need to focus on strengthening collaboration, trust, decision-making, cohesiveness, and leadership effectiveness to improve their functional efficiency and overall performance (Mukherjee et

al., 2019b). Additionally, the findings highlight the importance of well-defined rules, regulations and procedures for all FPCs, except MMPCL, to enhance functional efficiency.

The overall effectiveness of FPOs at their initial stage (SKFPCL and MMFPCL) of functioning was found to be 50.44 per cent and 56.20 per cent, respectively; while the FPOs being functional for more than five years (SSFPCL) and more than 10

years (AAPCL) showed effectiveness at 60.03 per cent and 68.40 per cent, respectively (Figure 1). The findings suggest that FPOs operating over an extended period demonstrate enhanced market penetration owing to their involvement in secondary agriculture (Manjula, 2021). Consequently these FPOs have facilitated increased income for farmers, greater share for farmers in the consumers' rupee, heightened levels of farmer satisfaction and

Table 3. ANOVA and Post hoc tests showing differences between FPCs with respect to their perceived effectiveness by selected member farmers

		Sum of squares	df	Mean square	F	Sig.
Functional efficiency	Between Groups	5092.297	3	1697.432	391.530	.000
	Within Groups	684.990	156	4.335		
	Total	5777.286	159			
Increase in income	Between Groups	28724.203	3	9574.734	446.562	.000
	Within Groups	3387.680	156	21.441		
	Total	32111.883	159			
Farmer's satisfaction	Between Groups	12525.613	3	4175.204	249.258	.000
	Within Groups	2646.583	156	16.751		
	Total	15172.195	159			
Empowerment	Between Groups	4947.791	3	1649.264	24.048	.000
	Within Groups	10836.157	156	68.583		
	Total	15783.948	159			
Overall effectiveness	Between Groups	6852.708	3	2284.236	341.525	0.000
	Within Groups	1056.756	156	6.688		
	Total	7909.464	159			

Scheffe post-hoc tests

Variable	Comparison between FPCs		Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
	I	J				Lower bound	Upper bound
Functional efficiency	SKFPCL	SSFPCL	-7.351*	0.466	0.000	-8.667	-6.035
		AAPCL	-9.045*	0.466	0.000	-10.361	-7.729
		MMFPCL	-15.868*	0.466	0.000	-17.185	-14.553
	SSFPCL	AAPCL	-1.693*	0.460	0.005	-2.993	-0.394
		MMFPCL	-8.518*	0.460	0.000	-9.817	-7.218
		MMFPCL	-6.824*	0.460	0.000	-8.123	-5.524
Increase in income	SKFPCL	SSFPCL	-8.102*	1.036	0.000	-11.029	-5.175
		AAPCL	-33.468*	1.036	0.000	-36.395	-30.541
		MMFPCL	-2.492	1.036	0.127	-5.419	0.435
	SSFPCL	AAPCL	-25.366*	1.023	0.000	-28.256	-22.476
		MMFPCL	5.610*	1.023	0.000	2.720	8.500
		MMFPCL	30.976*	1.023	0.000	28.086	33.866
Farmer's satisfaction	SKFPCL	SSFPCL	-15.157*	0.915	0.000	-17.744	-12.570
		AAPCL	-19.505*	0.915	0.000	-22.092	-16.918
		MMFPCL	-.0347	0.915	1.000	-2.622	2.552
	SSFPCL	AAPCL	-4.348*	0.904	0.000	-6.903	-1.794
		MMFPCL	15.122*	0.904	0.000	12.568	17.677
		MMFPCL	19.470*	0.904	0.000	16.916	22.025
Empowerment	SKFPCL	SSFPCL	-9.668*	1.852	0.000	-14.903	-4.433
		AAPCL	-15.451*	1.852	0.000	-20.686	-10.217
		MMFPCL	-6.770*	1.852	0.005	-12.004	-1.535
	SSFPCL	AAPCL	-5.783*	1.829	0.021	-10.952	-0.615
		MMFPCL	2.899	1.829	0.475	-2.270	8.068
		MMFPCL	8.682*	1.829	0.000	3.514	13.851
Overall effectiveness	SKFPCL	SSFPCL	-9.456*	0.578	0.000	-11.091	-7.821
		AAPCL	-17.894*	0.578	0.000	-19.529	-16.260
		MMFPCL	-5.433*	0.578	0.000	-7.068	-3.798
	SSFPCL	AAPCL	-8.439*	0.571	0.000	-10.053	-6.825
		MMFPCL	4.023*	0.571	0.000	2.409	5.637
		MMFPCL	12.461*	0.571	0.000	10.847	14.076

improved farmer empowerment as also reported by Mukherjee et al. (2019b). Notably, the study did not establish a significant association between functional efficiency and the duration of operation rather the functional efficiency appears to be influenced by internal governance and management practices within the FPOs.

One-way ANOVA was conducted to examine whether there were significant differences in effectiveness among the companies (Table 3) and the significant value of F statistics in ANOVA indicates that the companies differed significantly from each other in terms of four dimensions of effectiveness of the selected FPCs, except in case of increase in farmers' share in consumer prices. However, Scheffe post-hoc tests were done to reveal the FPCs significantly differ with each other under each dimension of effectiveness. The selected four FPCs significantly differed with each other with respect to their functional efficiency as well as overall effectiveness at 1% level of significance. In terms of the increase in income and farmers' satisfaction dimensions, there were no significant differences between SKFPCL and MMFPCL. However, significant differences were observed among the other pairs of FPCs, indicating variations in the effectiveness of these FPCs in terms of increasing farmers' income and their satisfaction. Regarding perceived empowerment by the member farmers of FPCs, SSFPCL and MMFPCL, did not significantly differ from each other. However, there were significant differences among the other pairs of FPCs in terms of the perceived empowerment of their member farmers. This suggests that the FPCs have ability to empower farmers and provide them with a sense of control and ownership. The findings are in line with Mukherjee et al., (2020) who found that FPO has enhanced the empowerment of hill farm women in terms of bettering the economic gain, social recognition and political participation.

The study indicates that FPOs in their initial years (1-3 years) of functioning, such as SKFPCL, which primarily focus on input supply and marketing of a single crop (cereal), were perceived as relatively less effective by their member farmers. This suggests that these FPOs might face challenges and require further development to enhance their functional effectiveness. On the other hand, FPOs in their initial years that dealt with a high-value crop, such as *makhana*, were found to be functioning more effectively. This highlights the influence of the type of crop or produce on the effectiveness of FPCs. The variation in functional effectiveness based on the crop type can be attributed to several factors. High-value crops often require specialized knowledge, better market linkages, and stronger coordination among farmers and other stakeholders (Poulton et al., 2010). FPCs dealing with high-value crops might have developed more robust systems, collaboration mechanisms, and marketing strategies, leading to enhanced effectiveness. In contrast, FPCs focused on single crops, particularly cereals, may face challenges related to market saturation, lower profit margins, and limited value addition opportunities, resulting in relatively lower effectiveness. Tailored strategies, capacity-building initiatives, and value chain development efforts can help FPCs improve their functional effectiveness and contribute to the overall development of the agricultural sector.

CONCLUSION

It is crucial for FPCs to consider the temporal factors of functioning duration, with FPCs operating for longer periods demonstrating higher effectiveness. By implementing targeted support and interventions, FPCs can overcome challenges and further enhance their effectiveness. The findings demonstrate that FPCs engaged in a wider range of produce and business activities, as seen in successful examples like AAPCL and SSFPCL, exhibited higher effectiveness, turnover, and net profit. The findings provide valuable insights for policymakers, FPC management, and stakeholders in devising strategies to enhance the overall functioning of FPCs. The study suggests the need to address challenges faced by FPCs in initial growth stages dealing with single crops and encourages the promotion of diversification and the adoption of processing, manufacturing, and marketing functions to improve effectiveness.

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Index based Assessment of Factors Affecting Farm Diversification in Haryana

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ARTICLE INFO

Keywords: Factors, Diversification, Haryana, Mono cropping, Sustainability

<http://doi.org/10.48165/IJEE.2023.59318>

Conflict of Interest: None

ABSTRACT

The study aimed to assess the factors affecting farm diversification was conducted in Kaithal, Hisar, and Bhiwani districts of Haryana in 2021 by selecting 180 farmers and 60 experts. The factors influencing farm diversification were assessed through the index method, Garret ranking, and RBQ method. The proximity of the National Capital Region (NCR), increased road density, and improved access to market information were found to favour the diversification of farm enterprises whereas, market uncertainties and climate induced factors were perceived to hinder it. Farmers did not show interest in *kharif* crops such as maize, sorghum, pearl millet, and cotton in the study area, mainly because of non-availability of labour at an affordable rate for manual harvesting. The findings act as supporting evidence of the factors that are beneficial for achieving sustainability in the future farming sector of Haryana.

INTRODUCTION

Agriculture provides the basic ingredients for the existence of humankind. About 68 per cent of India's population lives in rural areas where agriculture is the main occupation (Census, 2011). Indian agriculture is characterized by small farms. The average farm size is 1.15 hectares. About 86 per cent of farmers possess land size less than 2 ha, on which almost 44 per cent of the arable land is cultivated. On the other hand, only 14 per cent of the farmers have above 2 ha operational land holdings, however utilizing 56 per cent of the total cultivated land (Agricultural research data book, ICAR, 2020). In the late 1960s, the Green Revolution, which was successfully implemented in the states of Haryana, Punjab, and Western Uttar Pradesh, enabled India in overcoming a severe food shortage and achieving food grain self-sufficiency, particularly in the case of wheat and paddy. But on the other hand the sustainability of the future agricultural production system in terms of soil, water and climate characteristics is threatened by continuous mono cropping and the rice-wheat cropping system. Therefore, special efforts are needed to support diversified farming systems to improve the ground water table, handle issues with procuring and storing farm products, and address changes in food

consumption patterns, particularly among middle-class and high-income groups (CRRID, 2017).

The current pace of progress of Indian agriculture needs to be ramped up to the demand of growing population and various targets set forth by national and international organizations. The importance of integration of other enterprises was always felt in Indian agriculture system to promote efficient use of available resources and convert them into a possible means of profitability by changing the focus of research from cropping systems towards farming systems. In this context present study has been undertaken to assess the factors affecting farm diversification in Haryana, which aimed to prioritize the factors which can accelerate diversification options in the state.

METHODOLOGY

The study was undertaken purposively in three agro ecological zones of the state (HKA, 2017). One district from each Agro-Ecological Zone (AEZ) was chosen randomly (Kaithal from AEZ1, Hisar from AEZ2 and Bhiwani from AEZ3). Two blocks namely Kaithal and Siwan blocks from Kaithal district, Hisar I and Hisar II from Hisar district and Bhiwani and Bawanikhera blocks from

Bhiwani district were selected for the study. A total of twelve villages were selected randomly for the study by selecting two villages from each block. With the help of expert opinion and progressive farmers, fifteen farmers from each village is selected constituting 60 farmers from each district. In addition, 20 extension functionaries from each district were also contacted for the study. Thus a total sample size of present study was 240 comprising 180 farmers and 60 extension functionaries. The primary data were collected from the respondents by interview and focus group discussion. In this study, factors affecting farm diversification is assessed through three different measures based on the set criteria. Index values calculated for assessing importance of different factors affecting farm diversification at macro level. Garret ranking was used for identification of factors affecting diversification at micro level. For assessing the importance of factors disfavoured from paddy to alternate crops, RBQ method was followed.

Factors affecting farm diversification were listed with the help of review of literature and expert consultation. The respondents were provided with a list of factors and were asked to indicate score for each item. Then, score assigned by respondents were converted into index by applying the following formula. Factors were measured with help of Likert's three point scale

$$\text{Index} = \frac{\text{Obtained score}}{\text{Maximum obtainable score}} \times 100$$

Garrett's ranking technique (Garret & Woodworth, 1973) was used to rank the major factors of diversification which are prevalent in the study area. The respondents were provided with a list of parameters and were asked to indicate their rank for each item. Then, ranks assigned by respondents were converted into per cent position by applying the standard formula.

Finding the best alternatives for overcoming limitations and encouraging farm diversification was made possible by the examination of the constraints. Through a participatory approach, the characteristics that make the adoption of non-paddy crops unfavourable were discovered. The respondents were asked to list the constraints that prevented them from adopting non-paddy crops, and this was done using the preferential ranking technique. The major constraints were first identified by literature review and expert opinion. Based on that, in all 4 major Kharif crops (maize, pearl millet, sorghum and cotton) 16 constraints were listed. The intensity of these perceived constraints in the actual field situation was measured to determine the extent to which farmers perceived them as constraints in agricultural production. Farmers were also asked to indicate their opinion for constraints that they perceive as limiting agricultural production. The data collected in this way were tabulated and analyzed statistically to interpret the results. To quantify the data, the constraints were ranked based on the responses obtained from the respondents and then calculated the Rank Based Quotient (RBQ) as advocated by Sabarathnam (1988).

RESULTS AND DISCUSSION

Table 1 depicts the proximity of NCR (0.896), increased road density (0.857) and improved access to market information (0.801) were found to have major implicit in favoring diversification in

Haryana state. The location of districts bordering Delhi has a major advantage in terms of potential market opportunities, as farmers have an assured disposal of farm produce. Moreover, the well laid - out road facilities smoothen the transport of farm produce in order to reach the destination markets within the shortest possible time period. Further, progressive farmers maintain the well - knit link with middleman in NCR and urban clusters which also hasten opportunities for these diversified farmers for disposal of the produce. Good market and market knowledge can help farmers bypass middlemen when selling crops and thus get more profit. Market uncertainties (0.876) and climate induced factors (0.796) were perceived to hinder the farm diversification. Mostly market risks are related to cost, price, and market uncertainty. It might also encourage farmers to engage in risk-free activities like off-farm ventures. Due to the extreme climate conditions, crop yields are drastically reduced, which may compel farmers to give up farming. Farm related tasks are moving from the non-mechanized sector to well-mechanized and other simpler ways due to rising labour costs and a labour scarcity.

In case of field crops, *delay* in the *payment* brings about reduced satisfaction as a result the farmer may not show an interest for the next cropping season. The state of Haryana faces heavy losses due to lack of adequate crop specific storage. *Farmers* must be paid for their produce within a short span of time. The harvesting of the crop has been severely hampered by the acute labour shortage (Mohan, 2023). It will particularly impact crop harvests in areas with little or no established mechanization. Farmers are discouraged from undertaking new ventures, due to a lack of information about new techniques and inputs as well as insufficient abilities. Even in the majority of Haryana's crop-intensive areas, inadequate training is quite prevalent. The importance of receiving training in farm level packing, storage, processing, and value addition has been emphasized to farmers (Rani et al., 2021). Farmers should be motivated and encouraged to employ better farm management techniques, by providing demonstrations (Kumar et al., 2025). In livestock farming, dairy farmers struggle mainly due to the lack of good germplasm in indigenous cattle as purebred high-yielding animals are costlier and lesser in number. Haryana farmers experience difficulty with quality feed and fodder, efficient disease-management techniques and hurdles with milk quality. In addition, they are not receiving milk prices that are commensurate with the cost of production (Arora, 2019). The majority of farmers are still unaware of adequate livestock immunization, which results in a high mortality rate and financial losses for the farmers. Although Haryana is one of the few states that have launched the livestock insurance scheme, the response from farmers has not been positive. Disposal of unproductive animals (0.802), social taboo existing in certain communities regarding the pig farming (0.731) are found to be the major factors, inhibiting diversification in livestock sector.

Wide variations in the sale prices of horticulture products (0.803) and lack of specialized modern mandies for horticulture produce (0.658) were the major factors hindering the horticulture diversification. Due to lack of awareness, poor irrigation infrastructure, inadequate post-harvest infrastructure, price fluctuations, etc., the rate of growth of horticulture in Haryana has

Table 1. Index values of farm diversification factors in Haryana

Factors favoring diversification	Index value
Rising urbanization (per cent of urban population to total population)	0.548
Increasing proportion of small and marginal holdings in total farm holdings	0.707
Increased Road density or Proportion of all-weather road	0.857
Increased Market density (number of organized market per net sown area)	0.676
Proximity to National Capital Region/ Proximity to urban clusters	0.896
Availability of incentives for diversification	0.780
Improved access to market information	0.801
Changes in consumption pattern, life style and dietary uptake	0.548
Climate change effects (Diversification as an adaptive strategy)	0.799
Increased off-farm income level	0.778
Factors hindering diversification	
General factors	
Increased fertilizer consumption rate (kg/ha)	0.650
Labour unavailability or increasing labour cost	0.773
Market uncertainties	0.876
Climate induced factors	0.796
Hurdles in getting credit for crop and dairy farming	0.571
Difficulties in insurance coverage and settlement	0.574
Lack of adequate incentives for critical inputs	0.744
Improved Irrigation Intensity (Proportion of gross irrigated area to gross cultivated area)	0.651
Specific factors (sector wise)	
Field crops	
Lack of demand from buyers for other crops as like paddy and wheat	0.722
Lack of crop centric mechanization for all crops	0.776
Inadequate area wise and crop specific storage/processing units	0.788
Untimely procurement operations of first crop affecting sowing of second crop	0.804
Shortage of labour during in peak agricultural operations	0.870
Lack of adequate knowledge of alternative crops	0.653
Delayed payment by the procurement agencies	0.876
Livestock	
Lack of remunerative price for milk and meat	0.653
Lack of supply of good quality semen and AI facility in every village	0.658
Disposal of unproductive animals	0.802
Non-availability of critical inputs at affordable rates	0.780
Social taboo preventing pig farming	0.731
Horticulture	
Lack of specialized modern mandies for horticulture produce with cold chain and primary processing/packaging facilities	0.658
Wide fluctuations in sale prices of horticulture produce	0.803
Lack of market intelligence to avoid seasonal glut and scarcity	0.656
Inadequate knowledge of hi tech horti production	0.521
Damage of horticulture crops by wild animals including blue bull	0.568
Shortage of quality planting materials	0.630
Less awareness of market interventions of horticulture department	0.598
Fisheries	
Lack of knowledge for integration of fish in farming system	0.556
Poor domestic demand for fish products	0.732
Input availability and accessibility at affordable rates	0.793
Rising urbanization (per cent of urban population to total population)	0.548
Increasing proportion of small and marginal holdings in total farm holdings	0.707
Increased Road density or Proportion of all-weather road	0.857
Increased Market density (number of organized market per net sown area)	0.676
Proximity to National Capital Region/ Proximity to urban clusters	0.896
Availability of incentives for diversification	0.780
Improved access to market information	0.801
Changes in consumption pattern, life style and dietary uptake	0.548
Climate change effects (Diversification as an adaptive strategy)	0.799
Increased off-farm income level	0.778

stayed below expectations (Singh, 2021). Farmers earn good profits from horticulture, but there is little safeguard against glut, while food grains protected by a minimum support price mechanism. Lack of market intelligence, inadequate knowledge of hi tech horticulture, damage of horticulture produce by wild animals, shortage of quality planting material are the other reasons for farmers reluctance towards horticulture sector. According to Kaur et al., (2023) state horticulture can reach to an appropriate level by installing suitable cold storage facilities for perishable horticulture crops and creating a more effective system for educating farmers. Bansal et al., (2020) reported that the farmers found difficulty in selling their produce in the nearby market and had to go far, which added more cost and decreased their share of return. Input availability (0.793), lack of trained manpower (0.793) and poor domestic demand of fish (0.732) were the major factors hindering fish farming. Lack of knowledge regarding integration in fish farming, lack of remunerative fish MSP policy, wide price variations, high price of fish seed and lack of cold storages at local level are the other constraints of fish farmers. Training programmes for farmers are urgently sought to enhance shrimp farming.

Diversification factors at micro level

The factors affecting farm diversification at micro level throw light on only the major factors which are disclosed by the respondents of the surveyed area. Ranking of these factors helps

Table 2. Ranking of diversification factors at micro level using Garret method

S.No.	Diversification factors	Average score	Rank
1.	Meeting family requirements	76.30	I
2.	Enhancing profit from farm	70.17	II
3.	Reducing risk and uncertainties	63.4	III
4.	Better resource utilization in farm	56.93	IV
5.	Motivation from authorities	50.17	V
6.	Change in consumption pattern	49.83	VI
7.	Availing subsidy from government	38.93	VII
8.	Conservation of agro-ecology	34.00	VIII
9.	Maintaining culture and tradition	23.80	IX

to identify the most prominent factors that decide the diversification preferences. Factors affecting farm diversification at macro level gives a larger view of the factors affecting the entire state of Haryana, which were revealed by literature and expert opinion, whereas at micro level, the factors pertaining to the respondents' point of view on diversification at household level, are deliberated

Information provided in Table 2 shows that the respondents had given preponderance to meeting family requirements with score value of 76.30 as they can be able to derive multiple products by diversifying their farms. At the same time, profit enhancement (70.17) would be the prime criterion for farm diversification as farmers always expect assured income. Farm diversification can also help in reducing the risk and uncertainties as revealed by the score value of 63.4 with third rank as it is possible to shift or share the risk burden which might be challenging in solo enterprise. Better resource utilization emerged as fourth ranked factor as wastage can be drastically reduced with multiple farm enterprises. Based on the advice from experts (50.17) of agriculture and horticulture department, some people opted diversification as a strategy for water conservation. Increasing consumption demand to milk, egg, fish and meat (49.83) encouraged some farmers to change the farming system pattern. The rising trend of back yard poultry and village ponds reveals this change. Farm diversification policies provide incentives (38.93) to farmers in order to improve the adoption rate of different enterprises. Diversity is essential for proper balance of ecosystem. Moreover, diversification towards non paddy-wheat crops helps in conserving soil and water quality. Different crops and animals are maintained by farmers as part of their culture (23.80). Most farmers preferred Murrah buffalo and at their farm due to traditional attachment and awareness of benefits from such breed.

Ranking of disfavoured factors of diversification (using RBQ value)

Table 3 shows that the non-availability of labour for manual harvesting at an affordable rate was reported as a major factor in the non-adoption of maize, sorghum, pearl millet and cotton. In addition, insufficient prices and lack of assurance are the factors

Table 3. Ranking of factors (using RBQ value) which disfavour diversification from paddy to alternate crops

Crops	Factors disfavoring diversification from paddy	RBQ value	Ranks
Maize	Non availability of labour for manual harvesting	51.39	I
	No assurance to the price of the produce	50.02	II
	Crop damages by birds, stray cattle and pest attack	44.44	III
Sorghum	Non availability of labour for manual harvesting	52.50	I
	Less productivity (532 kg/ha)	47.22	II
	Lack of adequate marketing facilities	40.08	III
	Inadequate minimum support price	31.94	IV
Pearl millet	Non availability of labour for manual harvesting	48.89	I
	Less productivity (1609 kg/ha)	46.11	II
Cotton	Non availability of labour for regular picking up of cotton	43.06	I
	Inability of Bt cotton to withstand in stagnant water due to lack of tap root system	39.58	II
	Root rot, fusarium wilt and viral diseases	25.00	III
	Storage problems	22.92	IV
Vegetables	Non availability of labour for periodical plucking	34.81	I
	Wide price fluctuation	33.33	II

leading to the non-adoption of crops such as sorghum and maize. Paddy cultivation is fully mechanized from sowing to harvesting. But the mechanization facilities are lacking in every stages of other suggested alternate crops. Owing to this people shows reduced interest in cultivating these kharif crops. Strict government policies related to the procurement of produce at MSP in maize and sorghum can further promote adoption of these crops. The areas that are suited for cotton cultivation should get promotion through adequate pest management measures. A study related to cotton cultivation in Haryana indicates that the usage of drip irrigation technology has proved to be major reason of change in the status of the farmers in Haryana (Kumari et al., 2022).

CONCLUSION

In the context of ground water declining scenario, diversification is an essential requirement for the state like Haryana. Certain factors have much impact on promoting diversification like increased road density, improved access to market information and proximity to NCR etc. do not create the same impact in all regions like, the access to market information possessed by progressive farmers differs from those who are deprived of those facilities, and areas with well-developed transportation infrastructure are significantly superior to those that lack the same. However, among these resource-constrained farmers, there is a significant potential for diversification. So the policy makers can take appropriate measures to address this. Other fact revealed that, paddy cultivation is fully mechanized from sowing to harvesting, whereas, mechanization is lacking in every stages of alternate crops. Strict government policies related to the procurement of other than paddy crops at MSP may address this issue.

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Climate Change Impact in the Tribal Localities of High Rainfall Zone of Tamil Nadu

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ARTICLE INFO

Keywords: Climate change, Impact, Ecosystem, Environment conservation, Awareness, Perception, Tribes

<http://doi.org/10.48165/IJEE.2023.59319>

Conflict of Interest: None

Funding: ICSSR, New Delhi

ABSTRACT

The study was conducted in the high rainfall zone of Tamil Nadu during the years 2022-23 to document the impact of climate change, assess awareness and perception of the tribal communities and to suggest suitable strategies. The study was conducted in two tribal dominant villages of Kanyakumari district with 60 tribal respondents selected using simple random sampling technique. The PRA methods such as focused group discussion, seasonal calendar, time line and interactive group meetings were employed to document the climate based issues and further categorized in to eco system based, livelihood based and socio cultural life based. On these impacts, awareness and perception of the respondents were assessed. Standardized interview schedule was employed for data collection. The results showed a marginal increase in the maximum temperature and minimum temperature. Marginal declining trend was observed in relative humidity and rainfall distribution compared with the base year value. The wind behaviour showed an erratic variation. Respondents faced different issues on their livelihood, ecosystem and socio-cultural life. It has been suggested to establish a separate climate based nodal agency to address the issues of climate change in the tribal localities.

INTRODUCTION

The indigenous tribes all over the world are dependent on the resources of the natural ecosystem. The forest products like, wild edible fruits, plants, medicinal herbs, tubers, honey, tree bark and other forest collections such as wild mushrooms provide them income from local markets. Their food system is mostly dependent on the local millets, fruits, vegetables, tubers, wild banana and to some extent local varieties of rice and other cereals. The over utilization / mismanagement of the natural reserve base, deforestation, excessive carbon emission have modified the climatic factors in the localities of the tribal communities, which affect their sociological life. The climate variabilities have not been much studied due to several constraints like poorly distributed meteorological stations, poor strength of remote sensing data, sudden and unpredicted variations in cloud distribution and micro

climatic variations of the naturally bound tribal localities (Hallegatte et al., 2009; Rana et al., 2013; Pepin et al., 2015). In this angle, UNSDN (2021) reported that the effect of climate change is disproportionately distributed among tribal communities. Ghosh et al., (2021) stated that these changes have created severe effect on these tribes' income generation activities and food system which are very much related to the ecological subsistence and maintaining the forest resources.

The undesirable climatic variations are mostly erratic variations in the rainfall distribution, increased levels of day and night temperature, unpleasant relative humidity, erratic wind behaviour and unpleasant snow fall distribution. Sejian (2013) stated that the local fodder and pastures are very much affected by unfavourable variations in climatic factors, especially the higher temperature. In the same line Rani et al., (2013) stated that declined crop yield is a prime consequence of the unfavourable higher temperature. Kayet

et al., (2016) reported that the climate change have impacted the livelihood, ecosystem and socio-cultural activities of local tribes.

As regard resilient practices, Sai et al., (2022) reported that the local tribes have repaired their surface water storage structures and provided vaccination and nutritive fodder to their animals. They also followed other advocated animal health care management practices. Vijayabhinandana et al., (2022) opined that the local tribes have to be trained on the management of the unfavourable climate variability to protect their own natural ecosystem. Rajeshkumar (2019) strongly observed that the local tribes are having close association and in-depth knowledge of their own natural ecosystem and guarding their ecosystem. Their climatic perceptions reflect local issues and response, which are relatively accurate and for devising appropriate remedial strategies. Minj (2013) and Sharma (2019) opined that the variations in climatic factors affect food system and general sociological life of tribes and hence an in-depth study is required to be carried out. Ghanghas et al., (2015) stressed the need for the knowledge of the climate change impact of the local ecosystem by the extension functionaries so that appropriate remedial measures could be taken up. Negligence of human and social dimensions of climate change on Indigenous peoples create serious concern and hence the study has been taken up.

METHODOLOGY

Among the seven agro climatic zones of Tamil Nadu, the present study was conducted in the High Rainfall Zone considering the presence of large volume of tribal communities. From the High Rainfall Zone, the Kanyakumari district was identified for the study considering the maximum tribal population in this district. Again on the same criteria the block 'Thiruvattar' was selected. The villages viz., Mudavan Potrai and Moncode were selected from this block considering the large volume of tribal communities. The 'Kani tribe' is the most prominent local tribe in both villages. From each village thirty tribal respondents having vast experience in the local ecological and socio-cultural aspects were identified hence totally there were sixty tribal respondents, among whom the present study was conducted.

The first step focuses on the documentation of the climate induced impacts from the study area. By employing the PRA methods such as focused group discussion, seasonal calendar, time

line and interactive group meetings with the local tribes, the climate-based issues were documented. The expertise of the local extension workers, social workers and tribal development authorities were utilized to document the climate induced issues. Such documented impacts were further categorized in to eco system based, livelihood based and socio cultural life based. Secondly, on these impacts, the level of awareness and perception of the native tribes were assessed. For this analysis, thirty tribal respondents from each identified village were selected and thus the total sample size was 60tribal respondents Structured and standardized interview schedule was employed for data collection from the sample respondents. The data were collected during January – February 2023. Finally, based on the above results, appropriate policy recommendations, suggestions and strategies were proposed by involving the eminent personalities and experts in this field.

RESULTS AND DISCUSSION

Recent changes in the climatic factors

To study the recent changes in the climatic factors, the average values from the years 2012 to 2021 were considered. The average values for the years from 1981-2021 were kept as base year values. Against the base year values, the recent year values were compared to find out the recent variations / changes in the climatic factors. For easy understanding, the above facts are presented in the Table 1. With regard to the maximum temperature, there existed a marginal increase against the base year value of 29.02°C. As regard the minimum temperature, the same marginal increasing trend was observed throughout the assessment years against the base year value of 26.04°C. Regarding the relative humidity, the study area experienced a marginal decrease till 2020 against the base year value of 80.41 per cent. Only during 2021, there as a sudden increase in the relative humidity of +2 per cent against the base year value. The rainfall distribution showed a marginal declining trend against the base year value of 4.02 mm. Only during 2021 there was a noticeable increase in the rainfall seen (+1.23 mm). The wind velocity showed a marginal increase during the initial years from 2012 to 2014 against the base year value of 4.47 m/s, after which it showed a marginal declining trend till 2021.

Table 1. Recent changes in the climatic factors of the study area

Year	Increase or decrease in maximum temperature (°C)	Increase or decrease in maximum temperature (°C)	Increase or decrease in relative humidity (%)	Increase or decrease in rainfall (mm)	Increase or decrease in wind velocity (m/s)
Base Year [#]	29.02	26.04	80.41	4.02	4.47
2012	+0.49	+0.39	-2.21	-1.93	+0.25
2013	+0.25	+0.20	-0.92	-1.21	+0.16
2014	+0.22	+0.28	-0.26	-0.61	+0.05
2015	+0.25	+0.43	-0.11	-0.09	-0.34
2016	+0.73	+0.28	-1.51	-2.18	-0.11
2017	+0.44	+0.22	-0.48	-0.91	-0.06
2018	+0.22	+0.08	-0.11	-1.27	-0.34
2019	+0.74	+0.67	-1.14	-0.28	-0.23
2020	+0.56	+0.55	-0.20	-0.60	-0.12
2021	-0.15	+0.25	+2.07	+1.23	-0.02

[#] Previous thirty years average values

Impact of climate change on the livelihood activities of the respondents

The climate based issues and issues on the mismanagement of the natural resources are interrelated and hence both of these issues were documented and studied. By having vast interaction with tribal leaders, extension workers, social workers and tribal development authorities, we have documented 09 issues which are presented in the Table 2. All the tribal respondents were aware that honey collection is highly affected nowadays due to higher atmospheric temperature coupled with erratic wind behaviour and they also had the right perception for this particular issue. An overwhelming majority of the respondents (96.67%) were aware that the cashew crop once provided profitable returns, failed nowadays due to frequent cyclonic storms. They were also very much aware of the fact that the present local ecosystem fails to support them financially and hence they are forced to work as labourers outside. Almost the same percentage of the respondents had the right perception on the cause of the above issues. 91.67 per cent of the respondents were aware that some of the local promising medicinal plants have disappeared due to deforestation coupled with resultant unfavourable variations in climate change and they also possessed a right perception about this issue. There were few such medicinal plants, viz., Panampazham, Vittipazham, Kodampuli, Elengi, Muttapazyham and Berikai which provided them rich income for the local tribes. They collected the leaves, flowers and roots of these local medicinal plants and sold them in the outside market. Further most of the respondents (86.67%) were aware that the local wild edible fruits viz., Redmunthiri, Puzhipumunthri, Bilimbipazham, Kollampazham which once provided promising income almost vanished from the locality due to varying higher temperature coupled with deforestation, on which 80.00 per cent of the respondents were seen with right perception. The local turmeric, yellow myrobalan (kadukkai), gooseberry, tree barks, anantamul (vetiver-nannari), Sal tree (kungaliyam) once provided them promising income, couldn't fetch income now due its declined quality on the changing climatic factors (Higher

Temperature, unseasonal rainfall, unfavourable higher RH), coupled with suitable low priced alternatives in the outside market. A good majority of the tribal respondents (66.67%) were aware about this fact and at the same time almost a similar percentage of the respondents (65.00%) have correct perception.

Impact of climate change on ecosystem and socio-cultural life

All the respondents were well aware about the fact that the endemic birds like sparrow, weaver bird (sleepless sparrow), parrot, cuckoo (kuyil), and peacock had almost disappeared due to deforestation and current changes in climatic factors (Rainfall, temperature and wind) (Table 3). They also possessed right perception on the cause of this issue. An overwhelming majority of the respondents (96.67%) were aware that the local native banana varieties like neipoovan, kathali, ethan and karpooravalli were out of the system due to crop lodging issue as they encounter frequent cyclonic storms. The area experiences intensive deforestation now a days and even a less intensive cyclonic storm hit their locality in a great way. Here 91.67 per cent respondents had right perception on the cause of the issue. An overwhelming majority of the respondents (96.67%) were aware about the disappearance of a locally promising fodder crop called 'seenampul' due to land conversion and camp fire activities by the tourists.

The respondents were aware about the changing food habits. Previously they consumed lot of millets (samai, varagu), bamboo rice, local wild fruits, vegetables, greens and tubers. Now due to human mismanagement activities of the natural resources like deforestation, land conversion and land promotion activities and associated variation in the local climatic conditions, these local crops are vanishing from their locality gradually and hence they are gradually shifting to majorly on rice and other non-locality based food products. The results on their perceptual understanding also reveal that, cent per cent of the respondents were seen with right perception about this issue and associated causes (Table 4). Further, they were well aware that their culture experienced changes due to political situations and introduction of modern values. The

Table 2. Awareness and perception of the climate change impact on livelihood

S.No.	Issues	Awareness (%)	Perception agree (%)	Perception disagree (%)
1.	Profitable traditional millet cultivation is almost disappeared now due to the changing climatic conditions	83.33	75.00	25.00
2.	Cashew was the one of the profitable crops, which failed now due to frequent cyclonic storms	96.67	96.67	3.33
3.	The local major crops failed to give profitable returns due to crop lodging issues owing to heavy rainfall and erratic wind behavior now a days	75.00	66.67	33.33
4.	Honey collection was affected due to higher temperature coupled with erratic wind behavior	100	100	0
5.	The local wild edible fruits once provided promising income almost vanished from the locality due to varying higher temperature coupled with deforestation	86.67	80	20.00
6.	The local medicinal plants once provided rich income miserably disappeared due to deforestation coupled with resultant unfavourable variations in climate change	91.67	91.67	8.33
7.	The local tubers fail to give usual yield with marketable quality due to continuous water logging on the unseasonal and erratic rainfall	73.33	63.33	36.67
8.	Declined quality of local tree / plant parts on the changing climatic factors (Higher Temperature, unseasonal rainfall, unfavourable higher RH), coupled with suitable low priced alternatives in the outside market	66.67	65.00	35.00
9.	As local ecosystem fails to support financially, now working as laborers outside	96.67	90.00	10.00

Table 3. Awareness and perception of the climate change impact on ecosystem and socio cultural life

S.No.		Awareness (%)	Perception agree (%)	Perception disagree (%)
Ecosystem				
1.	Endemic birds almost disappeared due to deforestation and current changes in climatic factors (Rainfall, temperature and wind)	100	100	0
2.	Local native banana varieties were out of the system due to crop lodging issue as they encounter frequent cyclonic storms	96.67	91.67	08.33
Socio cultural life				
1.	Changing water use tradition due to the destruction of natural surface water storage structures	83.33	78.33	21.67
2.	Changing food habits due to changing local crops	100	100	0
3.	House roofing previously with locally available grass called 'Tharuvaipul', coconut thatches and bamboo– Now concrete. This is due to changing socio cultural values, non availability of these plant materials due to deforestation and gradual negligence	100	91.67	08.00
4.	Jack tree urn for grinding purpose now mixie introduced	98.33	90.00	10.00
5.	Their culture changed due to political situations and introduction of modern values, camp fire, tourist, plastic materials, alcohol bottles	10	100	0
6.	Previously they prepared cultural dress with 'Mara yuruvi' tree bark materials and used them during their temple festivals, now changed due to the non availability of these tree (deforestation)	90.00	80.00	20.00
7.	Restricted family and social ceremonies and festivals due erratic climatic factors and the associated factors	83.33	75.00	25.00

frequent trespass by the tourists and others in the name of development workers introduce the modern values in to the local system knowingly or unknowingly. The camp fire activities by the tourists create lot of disturbances to the local ecosystem besides deteriorate their socio-cultural values. There were lot of garbage of plastic materials and alcohol bottles. The respondents also possessed right perception on this issue.

House roofing was previously constructed with locally available grass called 'Tharuvaipul', coconut thatches and bamboo and now they shifted to concrete. This is due to changing socio cultural values, non availability of these plant materials due to deforestation and associated unfavourable variations in the climatic factors. Cent per cent of the tribal respondents were well aware of this issue and most of them were possessed with right perception. The respondents were also aware about the changing trends in the household utensils made up of local materials. Previously used mud pots, leaf plates, urns prepared out of local wood and other

house hold furniture and utensils made out of local wood and stones. Now, due to intensive deforestation, soil erosion, soil transportation and non availability compatible plant / tree materials, they depend more on modern utensils and household items. Previously they prepared their cultural dress with 'Mara yuruvi' tree bark materials and used them during their temple festivals, now changed due to the non availability of these tree due to deforestation and associated variations in the climatic factors lead to the declined quality of the bark material. Ninety percentage of the tribal respondents were aware about this issue and a vast majority (80.00%) of the respondents had right perception about this issue. The local tribes had their own tradition of celebrating family and social festivals and ceremonies during the monsoon months and after harvesting their major food crops. Now due to erratic variations in the climatic factors, these festivals and ceremonies are being celebrated with restricted days and even foregone sometimes.

Table 4. Endangered native vegetation / birds / animals as results mismanagement of natural resources and consequent unfavourable climate change

Crops - Area reduced / disappearing	Wild fruits and vegetables	Native birds / animals	New crops / Exotics introduced
- Cashew - Local banana - Neipoovan - Kathali - Ethan - Karpooravalli - Millet - Little millet - Kodomillet - Bamboo rice - Local wild tubers	<u>Wild edible Fruits</u> Redmunthiri, Puzhipumunthri, Bilimbipazham, Kollampazham <u>Medicinal herb</u> Panampazham, Vittipazham, Kodampuli, Elengi, Muttapazyham and Berikai <u>Wild Edible plants</u> Mullukeerai, Camparavalli, Naluellaikerai, Yanainerunjil and Kalthamarai, Kovakkai, Kantharichillies, Sathurapayiru (local beans), Pirandai, Valuthulangai brinjal, Thoppi brinjal, local pumkin, Kari pirandai, Red bhendi, Vella matti (Mattipayir) <u>Local fodder</u> Seenampul, Tharuvaipul <u>Tree bark</u> - Mara yuruvi	- Sparrow - Weaver bird (sleepless sparrow) - Parrot - Cuckoo (kuyil) - Peacock	<u>Crops</u> - Paddy - Rubber - Neeruzhavan Kottai <u>Birds</u> - Poultry (Giriraja)

Table 5. Socio cultural issues and the major contributing factors

Changes in regular food habits	Changes in the health management practices	Changes in the dressing pattern	Changes in the celebration of family festivals / ceremonies	Changes in the housing pattern	Disappearance of traditional utensils	Changing culture of water use tradition
1. Introduction of exotic vegetables	1. Pollution of Overall environment	1. Changes in the environment	1. Disappearance of Local crops/ varieties	1. Changes in environment	1. Introduction of modern utensils	1. Shortage of water for domestic purpose
2. Promotion by MNC processed grains, vegetables and value-added products with profit motive	2. Erratic changes in climatic factors	2. Climatic variations	2. Changes in the attitude of local tribes	2. Non availability of local construction materials	2. Non availability of local materials	2. Drinking water diverted to farming (spring)
3. Habitat destruction	3. Contamination in the food products	3. Tourism (societal pollution)	3. Disappearance of endemic plants	3. Frequent land slides	3. Changes in the food habits	3. Construction of exotictrees
4. Conversion of agricultural land and forests into commercial sites	4. Water pollution				4. Changes in the attitude	
	5. Changes in the food habits					
	6. Air pollution					

Suggestions and strategies

The local tribal leaders, local extension workers and experts having rich experience in tribal ecosystem were requested to suggest their views in developing appropriate strategies. In line with their suggestions to mitigate the documented climate based issues in line with the results given in the Tables 5 & 6. Based on their suggestions the following modules are proposed. This module covered the aspects viz., stabilizing their livelihood activities, protecting and maintaining the ecosystem resources and socio-cultural values.

CONCLUSION

There existed a marginal increasing trend in the maximum and minimum temperature, marginal declining trend in relative humidity and rainfall distribution and erratic wind behaviour. Their local millets, cashew and major crops declined to give profitable yield in a great way. The major wild edible plants, fruits, tubers and medicinal plants also disappeared. Honey and forest collection also affected. Their endemic plants, fruits, tubers, medicinal plant, local fodder and endemic birds almost disappeared. Land degradation, environmental pollution and loss of soil fertility are common. They faced many socio-cultural issues like, changing water use tradition, hanging food habits, changing house construction materials, preparation of house hold utensils and home furniture, change of their total culture. It is recommended to establish a government nodal agency specially to protect their indigenous overall culture including their livelihood and ecosystem. Periodic educational training programmes are suggested to educate them on preserving their ecosystem.

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Identification of Core Competencies for Managing Farmer Producer Organizations Using Factor Analysis

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ARTICLE INFO

Keywords: FPO, Core managerial competencies, Competency inventory, Factor analysis NCR of Delhi

<http://doi.org/10.48165/IJEE.2023.59320>

Conflict of Interest: None

ABSTRACT

The study was conducted to identify core competencies essential for efficient management of Farmer Producer Organizations (FPOs) and their contribution to performance of FPOs in the national capital region of Delhi during 2021. Using random sampling procedure, data were collected from 80 farmer-directors from twelve FPOs in six districts of Delhi, Haryana and Uttar Pradesh in NCR of Delhi. Since directors of FPOs were found to lack managerial capabilities, they were exposed to several training programmes on how to manage their FPOs efficiently. But gaining knowledge and skills may not reflect in the competencies of trained farmers. Competency being the ability to apply knowledge and skill in accomplishing a task successfully. To measure the degree of competency possessed by directors of FPOs, a competency inventory was developed. The data were subjected to factor analysis to arrive at significant core competencies vital for success of FPOs. The factor analysis could confirm that six core competencies as indispensable for managing producer companies were: competencies for planning and business development, marketing management, controlling operations, financial management, democratic leadership, and managing business operations. Out of these, four competencies were found to significantly contribute to the performance of FPOs.

INTRODUCTION

Farmer producer companies are member-based organizations meant to do agribusiness aggregating and marketing farm produce of small and marginal farmers to profit from economies of scale and to avert exploitation of market intermediaries. Farmer Producer Organizations (FPOs) can be an important platform for transforming smallholder farming, increasing agricultural productivity and farmers' income (Mukherjee et al., 2018). In 2019, Government of India has announced formation of 10,000 new FPOs on cluster basis under Central Sector Schemes, for development of FPOs over the next five years to ensure economies of scale for farmers. (Press Information Bureau, February 09, 2021). These FPOs get supported by several promoting agencies including NABARD, SFAC,

NAFED, NCDC and ICAR in terms of technical, managerial and financial aspects (Kumari et al., 2022). A great hope was raised by Venkatesan et al. (2020) as they opined that FPOs would usher in economic growth, enhanced per capita income and bring in new opportunities for value addition and processing of agricultural products.

Like any other businesses, the FPOs also require technical and managerial expertise to carry on their business operations for making their FPOs sustainable and profitable for all shareholders. (Parthiban et al., 2015; Kumar et al., 2022). All the agribusiness operations can be conducted by board of directors possessing adequate managerial competencies. Importance of managerial competencies was emphasized in many research studies: 'professional and honest management is essential to run farmers'

cooperatives' (Gupta, 1989); 'competent and convincing management' (Chamala & Shingi, 1997), and 'management and entrepreneurial skills' essential for successful and stable organizations. (Pingali et al., 2005). SFAC (2012) explicitly pointed out the importance to build governance structure and develop managerial capabilities for successful FPOs. Some other researchers have reported lack of managerial skills as the primary cause of failure of producer companies. These were: lack of management skills, lack of entrepreneurial spirit, and lack of long-term business plans (Senanayake, 2004); lack of entrepreneurial and management skills (Esham & Usmi, 2007); lack of business leadership and business strategy (NABCONS, 2011); lack of professional managers among board of directors (Singh & Singh, 2012) and lack of knowledge about running business (Venkataraman, 2017).

All these research studies emphasized that the significant challenge faced by FPOs was lack of professional management capabilities among office bearers for running the farmer producer organisations efficiently. Office bearers need competencies to develop agri-business plans and implement them, manage finances and marketing operations of producer companies. Building managerial competencies among FPO directors assume urgency and relevancy. Competence means ability to apply the knowledge and skill in completing a task. So, measuring degree of competency of directors of FPO will be essential and valuable for understanding the functioning of producer company. Hence, this study has attempted to assess degree of managerial competencies of office bearers and identify core competencies essential for efficient management of FPOs to move further towards realizing the goal of better farm incomes for small and marginal farmers.

METHODOLOGY

The National Capital Region (NCR of Delhi was selected purposively. Twelve 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 three years from the villages of six districts, two each from Delhi, Haryana and Uttar Pradesh of NCR of Delhi. From each FPC, about seven office bearers were selected, adjusting the total sample size of the study up to 80. A detailed interview schedule was prepared and the data were collected through personal interview method.

Competence is operationally defined as the degree of ability to do something successfully and efficiently. Competence includes not just knowledge and skill, but the ability to use and apply knowledge and the skill in completing a task. So, a scale to measure the degree of competence of office bearers of FPO was developed using summated rating method. First, managerial skills and competencies required to run the farmer producer company were identified and listed. This list of managerial competencies was shown to experts and judges from the disciplines of agricultural extension, agricultural economics and agribusiness management to arrive at a final chosen list of managerial competencies that may be essential for running the farmer producer company. They were: planning and business development, managing the operations, controlling operations, democratic leadership, financial management and marketing management.

Then self-assessment statements were written for each competency. Thirty-four statements were made by taking care to write simple statements representing farming situations. These were then screened using the fourteen criteria proposed by Edward & Kilpatrick (1948) & Edwards (1969) for scale construction. A final set of twenty-five statements were selected through judging by the experts and judges for achieving clarity. A pilot survey with farmers was done for further refining the scale items. Thus, the competency inventory was made on six competencies to elicit response of agreement on five-point rating scale of very little true, somewhat true, moderately true, highly true, and very highly true, with scores of 1, 2, 3, 4, and 5. Data were collected from 80 respondents (office bearers of FPOs) by recording responses on competency inventory. Factor analysis (with principal component analysis and varimax rotation) was done to confirm clustering of statements under specific core managerial competency. Inter-correlation coefficients were calculated to test whether these competencies were independent of one another.

RESULTS AND DISCUSSION

First, existing literature was scanned to enlist managerial functions and scrutinized by experts for choosing the most essential management functions. It was found that management is a general term, and comprises of several managerial functions: short-term planning, long-term or strategic planning, developing business projects, organising, directing, leading, motivating, decision-making, delegating, supervising, monitoring, coordinating, budgeting, reporting, managing finances, and managing and controlling business operations. In addition, FPOs need such skills as marketing, enrolling members, aggregating farm produce, accounting and bookkeeping and finally coordinating all the activities of FPOs. With so many variables under management it becomes very difficult to provide a simplified model for parsimonious explanation for the concept of managerial competencies for running FPOs. There is a need to reduce the number of these management variables into meaningful sets or components.

Second, competence statements were written for the chosen set of managerial functions, including marketing, planning, coordinating, controlling, leading, motivating, decision-making, supervising, and managing finances & business operations. Competency inventory was developed with 25 statements judged by experts. The detailed procedure is already mentioned in previous section. In this stage, the attempt to reduce the number of management variables was done by experts working with FPOs. They could choose only those managerial variables - competencies relevant to the directors of FPOs.

Third stage is a statistical procedure to cluster related variables into meaningful components. In this stage, the raw scores of the competency inventory scale were subjected to factor analysis to arrive at the final list of core competencies essential for managing FPOs. Factor analysis was first developed by Thurstone (1931) to propose his multiple factors theory of intelligence and pioneered a new trend that gradually replaced the unidimensional factor in social research. In this study, factor analysis was adopted to reduce the number of variables to a small set of factors to facilitate understanding of the concept of managerial competency.

Table 1. Total variance explained and number of components (factors) extracted by Factor Analysis (Principal component analysis with varimax rotation)

Component	Total variance explained								
	Initial eigen values			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Percent of variance	Cumulative (%)	Total	Percent of variance	Cumulative (%)	Total	Percent of variance	Cumulative (%)
1	4.654	18.615	18.615	4.654	18.615	18.615	4.218	16.871	16.871
2	3.627	14.508	33.123	3.627	14.508	33.123	3.227	12.909	29.780
3	2.800	11.201	44.324	2.800	11.201	44.324	3.027	12.107	41.887
4	2.527	10.108	54.431	2.527	10.108	54.431	2.609	10.435	52.322
5	1.864	7.456	61.887	1.864	7.456	61.887	2.020	8.080	60.402
6	1.387	5.547	67.434	1.387	5.547	67.434	1.758	7.032	67.434
7	1.195	4.781	72.215						
8	.947	3.788	76.003						

Factor analysis is a statistical procedure that brings together those closely related variables together. The technique of factor analysis helps researchers to differentiate the factors by grouping variables into different dimensions or factors, each of which is ideally unrelated with the others. In factor analysis, principal component analysis was done to get the amount of variance explained by each variable (the scale item or statement). The initial eigenvalues, variance explained, percent of variance and percent of total variance are presented in Table 1. The eigenvalues of about six components were included and the six components or factors could explain 67.43 per cent of total variance.

Since our objective was to minimize the number of variables that have high loadings on each factor, varimax rotation was used to get component matrix with factor loadings on six factors. The variables (scale item or statement) with highest factor loadings on a single factor will be grouped under that factor. This component matrix of six factors is presented in Table 2. The results in Table 2 are the final results of six factors, the output of factor analysis. The results reveal the factor loadings and factors. The variables with highest factor loading are highlighted to show that those variables are clustered under that factor.

The first five variables (marked P1 to P5) were found to cluster under the factor 1, This factor1 is labelled as Competency for planning and business development. This factor on planning competency includes such variables as goal-clarity, shared vision by pooling ideas from all for strategic planning, making operational plans, short and long-term plans, and skills in writing business plans. The next factor had a mix of two sets of variables, three marked MK1 to MK3 represented marketing management and two variables marked M3 and M4 with highest factor loadings in Factor 2 and this can be labelled marketing management competency. This factor on managing marketing competency clustered the variables as market intelligence, orientation for direct marketing, developing marketing strategies, conflict resolution mechanisms and delegation of works with authority and responsibility. The next factor 3 is found to cluster five variables marked C1 to C5 represented controlling business operations and this factor can be termed competency for controlling operations. Under this competency of controlling operations, the clustered variables included monitoring implementation of plans, developing control mechanisms, constantly watching changing business environment,

handling uncertainties, mitigating risks and adjusting to changes in market forces. The fourth one, factor 4 is found to cluster four variables marked F1 to F4 represented financial management and this factor can be termed as financial management competency. This factor on managing finances of FPOs has clustered such

Table 2. Factor Loadings on six identified factors depicting six managerial competencies

Variables	Factors					
	1	2	3	4	5	6
Planning and business development						
P 1	.871	.047	-.065	-.030	-.092	.022
P 2	.910	.039	-.078	.031	.031	.018
P 3	.896	-.024	-.045	-.086	.012	.093
P 4	.922	.022	-.097	-.073	.010	-.015
P 5	.898	.067	-.126	-.008	.002	.004
Marketing management						
M3	.008	.820	-.023	.034	.013	.086
M4	-.133	.736	-.086	-.142	.060	-.154
MK1	.123	.772	.071	.115	.033	.296
MK2	.132	.764	.149	.181	.033	.272
MK3	.066	.774	-.112	.028	.076	.133
Controlling operations						
C1	-.121	-.028	.809	.046	.103	-.096
C2	.026	-.049	.839	-.092	.103	.081
C3	-.139	.141	.805	-.031	.139	-.061
C4	-.032	-.011	.777	.087	-.114	-.003
C5	-.146	-.107	.539	.006	-.259	-.085
Financial management						
F1	.081	-.011	.064	.814	-.109	.237
F2	-.007	.004	.000	.830	-.060	.149
F3	-.138	.261	.023	.709	.101	-.306
F4	-.158	-.010	-.055	.651	.104	-.331
Democratic leadership						
D1	-.004	-.045	-.117	.190	.514	.154
D2	-.068	.141	.019	.242	.616	.101
D3	-.028	.035	.078	-.313	.763	.001
D4	.053	.066	.076	-.186	.779	-.181
Managing business operations						
M1	.046	.219	-.066	-.032	.088	.750
M2	-.001	.212	-.072	.013	.019	.775

variables as regular recording of income statement and balance sheet, assessing fund status of FPO, raising concern for breakeven point in agribusiness and managing cash flows and arranging working capital for every operating cycle of agribusiness. The fifth one, factor 5 is found to cluster four variable marked D1 to D4 represented democratic leadership and this competency can be labelled as democratic leadership competency. This factor on democratic leadership competency included member's belief in mutual help and cooperation, decision-making through democratic process, enabling leadership, commitment, and encouraging whole-hearted participation of members in all activities of FPO. The last one, factor 6 is found to cluster only two variables represented by managing business operations. This can be labelled as competency for managing operations. This factor on managing business operations clustered variable as adhering to uniform rules and policies in business operation and coordination skills for smooth operation of business affairs.

In the second stage, managerial competencies (scale items or statements included in competency inventory) were decided by the experts. This pre-designed set of variables under six managerial competencies have been confirmed by this confirmatory factor analysis, which in itself is a very significant finding of this study. Since these competency statements were rated by the respondents of the study - directors of FPOs and since the scores are those given by directors of FPOs, these six core managerial competencies have passed through three stages and finally confirmed statistically by factor analysis. Thus, management has been found to be a multiple-factor concept and the management competencies of FPO are grouped under six core competencies essential for FPOs – is a significant finding from this study. Thus, it can be observed that these six competencies can be ascertained as core competencies needed to manage the farmer producer organisation successfully by the office bearers. The core competencies were, in their order of importance:

- (i) Competency for planning and business development
- (ii) Marketing management competency
- (iii) Competency for controlling operations
- (iv) Financial management competency
- (v) Democratic leadership competency and
- (vi) Competency for managing business operations.

Frequency distribution of core managerial competencies

The results given in Table 3 indicated that the frequency distributions of respondents on various competency scores were found to fall into normal distributions with slight skewness in some of them. This result indicates that these frequencies are found to distribute more or less evenly on either side of mean, thereby falling closer to population. The computed degrees of competencies of the sample of the study represent the reality of levels of competency among directors of FPOs.

Correlation among core managerial competencies

One of the pre-conditions is that the factors extracted from factor analysis should ideally be unrelated to one another and that they are independent in character.

To test whether these are independent competencies or overlap on one another, the combined scores of this new set of competencies were subjected to correlation analysis. The results are given in Table 4. It is evident from the results that they were independent competencies and did not overlap, except in two cases. Competency for planning and business development and competency for controlling operations were found to be related and their association was negative and significant at 0.05 level of probability. This negative association was inevitable as these two phenomena of planning and controlling were reciprocal in nature. Controlling function is necessary to monitor and watch proper implementation of business plans of the FPO. One guards the other. Marketing management competency and competency for managing business

Table 3. Mean scores and standard deviation of the six core competencies for managing the FPO

Core competencies	Mean	Standard deviation	Min-Max	Frequency distribution			
				Low	Medium	High	Total
Competency for planning and business development	18.23	4.464	6–25	18.75	63.75	17.50	100
Marketing management competency	17.73	4.523	9–25	22.50	57.50	22.00	100
Competency for controlling operations	16.69	4.043	10–24	22.50	56.25	21.25	100
Democratic leadership competency	14.73	3.048	10–20	16.25	60.00	23.75	100
Financial management competency	13.93	3.337	7–20	18.75	63.75	17.50	100
Competency for managing operations	8.40	1.572	4–10	13.75	57.50	27.75	100

Table 4. Inter correlations among the six core managerial competencies

Inter-correlations with competency variables	PB	CO	DL	FM	MO	MM
Planning and business development (PB)	-	-.196*	-.012	-.096	.086	.071
Controlling operations (CO)	-.196*	-	.022	.025	-.111	-.038
Democratic leadership (DL)	-.012	.022	-	-.080	.032	.130
Financial management (FM)	-.096	.025	-.080	-	-.015	.090
Managing operations (MO)	.086	-.111	.032	-.015	1-	.332**
Marketing management (MM)	.071	-.038	.130	.090	.332**	-

* Significant at 0.05 level of probability; ** Significant at 0.01 level of probability

operations were also found to be significantly and positively associated at 0.01 level of probability. These two managerial competencies act complementary to each other and contribute to better performance of FPOs.

CONCLUSION

Farmer producer organizations are formal agribusiness companies owned by farmers and must be managed effectively by directors of the FPOs. This study could identify six core managerial competencies through rigorous measures scrutiny and statistical techniques. The study established that managerial competency is not unidimensional but involved multiple factors. Competency inventory helped in understanding and measuring managerial competency. Frequency distributions of these six factors fell into normal distributions indicating close relation to the population and real-life settings. Correlation analysis among the six competency factors has confirmed that they are independent components of management. These results have implications for policy makers, trainers and FPO promoting institutions to focus on developing these essential core competencies among board of directors for efficient agribusiness management. So, it is imperative to develop training modules and promotion strategies to teach and enable farmers and directors of FPOs and make them competent.

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Participatory Evaluation of Chickpea Production Technology under Central Punjab Conditions

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ARTICLE INFO

Keywords: Chickpea, Cluster frontline demonstrations, Economics, Technological gaps, Yield

<http://doi.org/10.48165/IJEE.2023.59321>

Conflict of Interest: None

ABSTRACT

Cluster Front Line Demonstrations (CFLD's) of chickpea variety PBG7 on 82 locations were conducted to document the economic viability of technology dissemination in central plain conditions of Punjab during 2019-20 and 2020-21 to evaluate chickpea production technology. The demonstrations created an average yield production of 17.80 q/ha, which was 21.03 per cent greater than the traditional farming method (14.70 q/ha). Because of significant variation in the extent of adoption of recommended technology the yield levels were much lower under local practices. Other economic parameters like more B:C ratio (3.63), gross return (57220/ha), and net return (40465.5/ha) were comparatively more under advanced technology demonstrated plots. An average extension gap, technology gap, technology index, and additional returns of chickpea were recorded at 3.09 q/h, 2.2 q/ha, 11% and Rs. 14485/ha, respectively. Variations in agro-climatic factors and management practices were found to be responsible for variations in the technology gap and index percentage which can be reduced by farmer's participation in adopting new technologies. It is concluded that by opting for new variety and management practices there is a huge scope to increase chickpea production at different strata viz, farmer, district, state and national level.

INTRODUCTION

Despite an exponential increase in food grain production from 50 million tones to about 300 million tones after independence, food security is still the most threatening and challenging issue for ever fast-growing country like India. However, in order to ensure national food security, pulses can play very significant role. They are frequently termed as “underprivileged population’s food.” who cannot afford other protein rich foods and become an answer to malnourished population of India. Among pulses, chickpea (*Cicer arietinum* L.) commonly called chana or Bengal gram which is predominantly grown in Northern India, is a very crucial pulse crop. It is a significant rabi pulse crop with 18-22 per cent protein, 62 per cent carbohydrates and good amount of fat, lysine

and tryptophan (Meena et al., 2021). It is a very beneficial crop as it fixes nitrogen from the environment and contributes in organic carbon to soil which ultimately improves soil productivity level.

In India, 10 million hectares of chickpea were grown in 2020-21 producing 11.91 million tons with an average productivity of 11.92 quintals per hectare (Kumar, 2023). Under Punjab conditions, it was grown in 2,000 hectares of land with a yield of 2.6 thousand tones along with an average productivity of 13.22 quintals per hectare (PAU, 2022). Although, India contributes 26 per cent in international market of pulses, India's average productivity is still quite low i.e. 841 kg/ha, compared to the international average of 1023 kg/ha (DES, 2018). The per-person availability of pulses in India was 60.70 g/day per person in 1951 which had declined sharply to 31.6 g/day/person in 2010 (Singh et al., 2020 & Kumar

& Singh, 2021). This steep decline occurs because of exponential increase in population in combination with low production and productivity of chickpea because of lack of knowledge about improved scientific cultivation practices. However, to meet country's demand for pulses, still Indian government relies heavily on export from international market. So, for the uninterrupted production of pulses, CFLDs was initiated by the Indian government financed by National Food Security Mission. The frontline demonstrations can have a significant impact on farmers' adoption level about advanced scientific cultivation practices as they are firm believer of "Seeing is believing" theory. The present CFLDs were executed with an objective to attain the full productivity potential by boosting current production and productivity of the chickpea and to close yield gap by exhibiting the most advanced and cutting-edge scientific crop management techniques at farmer's fields in a participatory manner.

METHODOLOGY

Under National Food Security Mission Scheme, 82 CFLDs were conducted on a 36 ha area across two blocks of Kapurthala district in 2019-20 and 2020-21. Among 82 CFLDs, 37 demonstrations were conducted in Sultanpur Lodhi block and 45 in Kapurthala blocks, respectively. For conducting CFLDs, farmers were identified on the basis of group meetings. It was noted that full gap was found in weeds management, improved varieties, fertilizers and seed rate, whereas, partial adoption gap was recorded in land preparation, sowing schedule, sowing method and irrigation schedule. These selected farmers were trained with specific skill training that includes advised crop production and plant protection measures for raising the crop. These demonstrated technologies were according to recommendations of the Punjab Agricultural University, Ludhiana and comprised of improved variety of chick pea PBG 7, appropriate tillage, accurate seed rate, a balanced fertilizer application approach. Farmers' practice (FP) was employed as a check/control during these demonstrations. To know the impact of demonstrated technologies, regular field visits of demonstration plots were conducted by KVK scientists. In order to conduct CFLDs in best way, field days, kisan goshties, trainings, field days and group meetings were also executed. These extension activities serve as a means, to create awareness and to show the benefits of adopted technologies to the farming community. At harvesting time to understand the significance of imparted technologies, the yield data from farmers practice plot and demonstrated plot was recorded and pooled. The formulas provided

by Dayanand (2012) were used to compute percent increase in yield, technology gap, technology index and extension gap.

Extension gap = yield of demonstrated plot (Dy) (kg/ha) – Yield of plot under farmer practice (kg/ha)

Technology gap = Potential yield (Py) (kg/ha) – Yield under improved practice (kg/ha)

Technology index (%) = $\frac{Py - Dy}{Py} \times 100$

Percent increase in yield = $\frac{\text{Increase of yield under demonstrated plot (q/ha) - increase of yield under farmers plot (q/ha)}}{\text{increase of yield under farmers plot (q/ha)}} \times 100$

Additional returns = Demonstration returns – Farmers practice

Insect-pest/disease incidence (%) = $\frac{\text{Damaged plants}}{\text{healthy plants}} \times 100$

Additional cost (Rs./ha) = Demonstrated technology cost – farmer practice cost

Effective gain (Rs./ha) = Additional returns of demonstrated practice – Additional cost of demonstrated technology

Yield Gap I = $\frac{[(\text{Potential yield (YP)} - \text{yield of demonstration plot (YD)})/\text{YP}]}{\times 100}$

Yield Gap II = $\frac{[(\text{yield of demonstration plot (YD)} - \text{yield of farmer's plot (YF)})/\text{YD}]}{\times 100}$

RESULTS AND DISCUSSION

Impact of CFLDs on reduction of insect-pest population

Cluster frontline demonstrations studies were conducted in Kapurthala district of Punjab during 2019-20 and 2020-21 in the *rabi* season. According to this two year study, it was discovered that enhanced technology performed most effective in controlling least number of attacked plants per m² as well as least number of pods/plants (Table 1). The average per cent reduction in attacked plants per m² and per cent reduction in affected pod/plant were recorded 45.4 and 42.4, respectively. Similarly, in 2020-21, under demonstrations, number of pods per plant and seed index was 40.4 and 21.9, respectively over the farmer practices results (31.6 and 15.4). The percent increase in number of pods per plant was 27.84 after following recommended practices. The average yield under demonstrated plots was 17.7 q/ha whereas, in farmer practice plots it was 14.7 q/ha.

The per cent increase in yield in improved technology fields was 20.4 over traditional practices. This data clearly showed the impact of advanced technology over farmer practices as enhanced

Table 1. Effect of scientific interventions on insect-pests in chickpea

Year	Number of pods/plant			Reduction percentage of attacked plants/m ²	Reduction percentage of attacked pods/plant	Yield		Impact (% change)
	DP	FP	Percent increase			Demonstration	Farmer practice	
2019-20	38.7	30.9	25.2	46.4	43.3	17.3	14.2	21.9
2020-21	40.4	31.6	27.84	44.4	41.6	18.2	15.2	19.7
Average	39.5	31.3	26.5	45.4	42.5	17.7	14.7	20.4

DP: Demonstration plot; FP: Farmer's plot (Local check)

seed yield. Similar trend of yield enhancement under frontline demonstrations was documented by Dwivedi et al., (2013); Sakti et al., (2016) and Meena and Singh (2017) who highlighted the concept of integrated pest management practices in enhanced yield of chickpea through frontline demonstration.

Technology gap, extension gap and technology index

During the study, average technology gap of 2.20 q/ha (Table 2) was calculated during demonstration period. It reflects that there is further potential for production growth with improved technologies, so that farmers can achieve the potential yield. The findings are in confirmation with that reported by Kumbhare et al., (2014); Nain et al., (2014); Nain et al., (2015); Vijya Lakshmi (2017); Singh et al., (2019); Mitra & Samajdar (2010); Sharma et al., (2020) that in order to tackle this situation, area specific cultivation practices, are need to be developed. The difference between demonstrated yield and yield under demonstrated existing farmer practice is extension gap. An extension gap of 3.12 and 3.06 q/ha (Table 2) was calculated during 2019-20 and 2020-21, respectively. On an average, extension gap observed during both the years was 3.09 q/ha which is a wide gap. The alarming trend of the increased extension gap would be reduced by educating farmers regarding adoption of different recommended practices by various extension (cluster frontline demonstration training programmes, awareness campaigns, and media coverage etc.) and research related programmes in conjunction with high yielding varieties. Present finding is in corroboration with the findings of Meena et al., (2020); Hiremath & Nagaraju (2010); Ojha & Bisht (2020); Singh et al., (2019). Technology index is represented as ratio of potential yield to technology gap as a percentage. An increased technology index value indicated inadequate transfer of tested technology to growers and inadequate extension facilities, while a lower technology index number indicates a higher likelihood of improved technology. Technology index observed under

improved technology plots during different years 2019-20 and 2020-21 was 13.3 and 8.7, respectively (Table 2). It indicated the possibility of adoption of new variety by the farmer and technical interventions' efficiency (Dudhade, 2009). Mitra & Samajdar (2010) also emphasized on the need to bridge the technology gap index by means of specific area suitable interventions. In addition to this, Singh et al., (2019) also reported that by implementing better technological intervention, the technological gap can be reduced; that will ultimately lower down the technology index.

Impact of scientific interventions on yield component of chickpea

The technological interventions employed in pulse crops consists of improved cultivars, method of sowing, recommended seed rate, integrated nutrient management, seed treatment, weed control techniques, and appropriate plant protection measures results in improved productivity.

It is evident from the results that the average seed yield was 17.80 q/ha in demonstrated plot in comparison to control plots where it was 14.70 q/ha (Table 3). The highest average chickpea productivity i.e. 18.26 q/ha was recorded in 2020-21 followed by 17.34 q/ha in 2019-20. These results clearly revealed the importance of introduced interventions over farmer practices as there was 21.03 per cent increase in yield recorded in improved practices plots in comparison to local/check plot practices. The yield parameter also compared at district, state and national level productivity and it was recorded significantly more at district, state and national level productivity. The outcome made it evident that in demonstrated technology plots, the average productivity increased by 71.1, 32.0 and 120.8 per cent over district, state and national yields, respectively. There is variety of reasons responsible for the increased chickpea production, like adoption of improved variety, scientific package of practices, integrated pest management, micro irrigation at critical growth stage, bio fertilizer seed treatment, and judicious application of pesticides.

Present findings clearly demonstrate higher yield under adopted practices in comparison to farmer's practices. Similar results were documented by Rajpoot (2020) that when compared to farmers' methods (11.2 q/ha), better technologies yielded a chickpea yield of 18.8 q/ha. The present findings are corroborated by findings of other workers like Kumar et al., (2010); Dwivedi et al., (2011 & 2013); Khedkar et al., (2017); Ojha & Bisht (2020); Singh et al., (2018) Poonia & Pithia (2011); Patel et al., (2013);

Table 2. Extension parameters studied under CFLD and local/check practice in Kapurthala district

Year	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
2019-20	2.66	3.12	13.3
2020-21	1.74	3.06	8.70
Average	2.20	3.09	11.0

Table 3. Yield attributes of demonstrated chickpea variety PBG7

Year	Demo.	Av. yield of DP (q/ha)	Av. yield of FP (q/ha)	% increase in yield	Dist. Av. yield	State Av. yield	Nat. level Av.	Potential yield (q/ha)	Improved tech. yield (q/ha)	% change in yield over dist. (q/ha)	% change in yield over state (q/ha)	% change in yield over national (q/ha)	Yield gap I (%)	Yield gap II (%)
2019-20	42	17.34	14.22	21.94	10.4	13.75	8.06	20.0	3.12	66.7	26.1	115.1	13.3	17.9
2020-21	40	18.26	15.2	20.13	10.4	13.22	8.06		3.06	75.6	38.1	126.6	8.7	16.75
Average	82	17.8	14.7	21.03	10.4	13.48	8.06		3.09	71.1	32.0	120.8	11	17.32

Av: Average; DP: demonstrated practice; FP: farmer's practices; Dist.: district; Nat: national

Table 4. Economics of chickpea CFLDs in Kapurthala district

Year	COC (Rs./ha)		ACOC in IT (Rs./ha)	Sale price (Rs./q)	COC increase over FP (%)	AGR (Rs./ha)		Increase in GR over FP (%)	AR in IT (Rs./ha)	ANR (Rs./ha)		Increase in NR over FP (%)	EG (Rs./ha)	BCR	
	IT	FP				IT	FP			IT	FP			IT	FP
2019-20	14959	14200	759	3600	5.34	55655	42125	32.12	13530	40696	27925	45.13	12771	3.72	2.96
2020-21	16550	14900	1650	3800	11.07	58785	43345	35.62	15440	40235	28445	41.44	11790	3.55	2.90
Average	15754.5	14550	1204.5	3700	8.21	57220	42735	33.89	14485	40465.5	28185	43.57	12280.5	3.63	2.93

COC: Cost of Cultivation; IT: improved technology; FP: Farmer practice; ACOC in IT: Average cost of cultivation in Improved technology; AGR: Average gross return; AR: Additional return; ANR: Average Net return; EG: Effective gain; BCR: Benefit cost ratio

Raj et al., (2013); Gireesh et al., (2019); Kumari & Singh (2022) also reported increase in yield under frontline demonstrations on pulses and oilseed crops.

Yield gap and economics

Projected yield gaps between potential and farmers' yields, including yield gap between potential and demonstrated plot yield (YG1); demonstrated and local/check plot yield (YGII) and complete yield difference between potential and farmer's yield are presented in Table 4. The average yield gap I and II was 11 and 17.32 per cent, respectively. Similar results were documented by Singh et al., (2012 and 2019); Sultana et al., (2019); Tripathi et al., (2018). During the present study wide yield gap was calculated among district, state and national yield which can be reduced by providing farmers with education through a variety of channels to encourage the use of better production and defense techniques along with combination of high yielding varieties and integrated plant protection components will subsequently revert this vast yield disparity pattern. Similar findings were quoted by Dubey et al., (2022) that yield gap at farmers' fields could be minimized if large scale demonstration repeated over time along with easy access to high yielding varieties.

Economics acts as a cornerstone for both embracing and rejecting technology which depends upon number of factors like seed yield, variable input costs, labour costs, and output sale prices. Compared to farmers' practices, improved technological interventions increased the average cost of agriculture by 8.21 per cent (Table 4). On the basis of current market rates, the economics of upgraded technology under CFLDs were assessed. On average basis, an additional investment of Rs. 1204.5/ha was recorded under demonstrated technology plots. Similarly, the cost of cultivation was increased by 8.21 per cent after introduction of scientific techniques in demonstration plots. In addition to these, other returns like greater average gross return (57220), maximum additional net returns (40465.5/ha), high effective gain (12280.5/ha), an additional returns (14485/ha) and increased benefit: cost ratio (3.63) was recorded under improved intervention plots, whereas in under farmer's practice plots there was visible fall in these parameters, like less gross return (42735/ha), decreased net return (28185/ha) and low benefit cost ratio (2.93). The farmers' increased gross financial returns demonstrate the technology's economic viability. At demonstrated plots the expenditure involved is higher because of additional cost of cultivation than the farmers' field. Yet, the demonstrated plot also has a higher yield, which is

supported by calculated cost-benefit ratio. Raghav et al., (2021) observed similar findings where more B:C ratio was recorded under demonstrated practices over check plots. Similar economic benefits after adoption of improved technologies like high cost benefit ratio, high yield and maximum net return under frontline demonstrations on pulses were documented by Dwivedi et al., (2011); Dwivedi et al., (2014); Meena & Singh (2017); Reager et al., (2020); Singh et al., (2018) & Singh et al., (2019).

CONCLUSION

Approach of CFLDs is proved good not only for adopters but also for the rest of the farming community, as they are conducted under supervision of the scientists with proper framework of technologies. These performed technologies have a sustained effect on chickpea productivity as the maximum yield potential (21.94%), high net return (40696/ha) and B:C ratio of 3.72 could be obtained only after following all improved technologies. The gaps related to extension, technology, adoption, yield and technology index must be lower down by popularizing the technologies through different extension means. Apart from these factors, high economic returns serve as the prime factor to disseminate them among farmers for adoption at large scale. Therefore, close association of agricultural scientists and extension functionaries along with timely allocation of funds plays a pivotal role in elevating farmer livelihoods, state agriculture production, and India's agricultural output to achieve new heights in pulses production.

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Impact of Anganwadi Workers' Soft Skills on Anganwadi Children's Developmental Milestones

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ARTICLE INFO

Keywords: Soft skills, Developmental milestones, Non formal pre-school education, Anganwadi workers, Correlation, Anganwadi children

<http://doi.org/10.48165/IJEE.2023.59322>

Conflict of Interest: None

ABSTRACT

A study was conducted in urban and rural *anganwadi* centers (AWC), to assess the soft skills such as communication skills, time management, positive attitude, and teamwork of *anganwadi* workers (AWW) as well as how this relates to the children's developmental milestones. 60 AWW from 30 rural and 30 urban AWC and five 3-6-year-old children from each AWC by random sampling were chosen. There was a significant difference in communication skills, positive attitude, and teamwork. Gross motor skills of rural children were found significantly higher than in urban children and language skills were significantly higher in urban children rather than rural children. Teamwork of AWW was found positively correlated with cognitive skills and socio-emotional skills. It was imperative that need-based training programmes for AWWs, including early childhood education and other training initiatives, focus on improving soft skills of preschool education and developmental milestones can be maintained.

INTRODUCTION

The Integrated Child Development Services (ICDS) includes Non-Formal Pre-School Education (NFPSE) as an important component. Under the scheme pre-school education activities are to be organized for children between the ages of three and six (Arya et al., 2018). It is not intended to impart formal learning or teach 3 Rs, but to develop in the child a desirable social attitude, values, and environmental stimulation. A flexible approach to programme content and methods is employed, and the child is encouraged to develop at his own pace (Singh et al., 2019). Under ICDS, Non-Formal Pre-School Education provides a significant contribution to a strong foundation for development and to the universalization of primary education (Singh & Bisht, 2021). Children attending pre-school centers had significantly better scores on pre-reading, early number, and language skills than children who attended local schools. Hence, quality pre-school education is critical to the development of children's social, cognitive, and language skills (Arya & Vig, 2022). In spite of this, NFPSE

remains a weak component of the scheme. Although ICDS is supposed to approach the development of children in an integrated manner, its focus on health and nutrition remains more prominent in practice (Jadav et al., 2021). There is a low priority given to the visible key component of NFPSE by program implementers, which has resulted in low community participation and acceptance. The success of the ICDS program is greatly dependent on how the *anganawadi* workers (AWW) are trained, qualified, experienced and skilled. However, at *anganwadi* centre (AWC), lack of skill-based training of AWW is a major barrier to effective pre-school education (Arya et al., 2023). Thus, the government may not spend on physical amenities and pre-school activities. It is important that AWW develop soft skills such as teamwork ability, management skills, appropriate attitude, and communication skill to maintain good working relationships and workplace harmony. In addition, soft skills are the personal characteristics and aspects of an employee's character that motivate him or her to do their best (Singh, 2018). The *anganwadi* worker designs and carries out the activities in the *anganwadi* centre for encouraging the developmental

milestones in the children. The developmental milestones of a child are the skills a child learns at each stage of his or her life, which can be categorized as motor, social, emotional, physical, language and cognitive skills. In order to improve the quality of service in *anganwadi* centers, it is necessary to examine the status of the implementation of early childhood programs. *Anganwadi* centers must have adequate supervision, guidance, and training in the role of educators in order to incorporate pre-school education into their programs (Arya et al., 2018). In the present scenario where implementation of NFPSE programme is the least priority of the AWW as well as the government, it is essential to study the impact of these deplorable conditions on developmental milestones of *anganwadi* children. The present study assessed the soft skills of *anganwadi* workers as correlates with developmental milestones in *anganwadi* children.

METHODOLOGY

The present study was conducted in 30 Urban and 30 Rural AWC of Ludhiana district in Punjab and a sample of 60 AWW and 300 children were selected from these centers. The Ministry of Women and Child Development, Government of India, reports that Ludhiana Urban has 606 *anganwadi* centers and Ludhiana Rural has 213 *anganwadi* centers. Thirties *anganwadis* were randomly selected from 606 *anganwadis* located in Ludhiana Urban areas and 30 *anganwadis* were chosen at random from 213 *anganwadis* located in Ludhiana rural areas during December 01, 2020 to November 30, 2021. Among the selected each *anganwadi* centers, five children aged 3-6 years and one *anganwadi* worker was selected by using simple random method. With the permission of the District Program Officer (DPO) and the Child Development Project Officer (CDPO), the study was conducted in selected *anganwadi* centers by sending a letter of request explaining the purpose of the study. A self-structured checklist was pretested to provide an overview of the quality of the checklist, worksheet and questionnaire of the sample. The self-structured personal information sheet was designed to collect the personal profile details viz. age, marital status, educational qualification, work experience and number of trainings/refresher courses of the *anganwadi* workers selected for the study. In this selection process, soft skills such as communication skills was measured by Teacher Child Communication Scale (Erbay et al., 2012), time management skills measured by Time Management Questionnaire (Alay & Kocak, 2002), positive attitude was assessed by Positive Thinking Scale (Diener et al., 2009) and teamwork was assessed by Team Work Questionnaire (Kuras & Moran, 1997) for *anganwadi* workers. The developmental milestones checklist was used to collect information concerning various domains of developmental milestones checklist viz. physical and motor, cognitive, language and social and emotional development (ICDS Manual). The checklist included worksheets, activities and observation to be recorded related to each component of developmental milestones. The data were coded, tabulated, categorized, and analyzed using statistical package SPSS version 20.

RESULTS AND DISCUSSION

Table 1 illustrated the percentage distribution of *anganwadi*

Table 1. Different domains and levels of soft skills of *anganwadi* workers

Domains and levels of soft skills	Urban ($n_U=30$) f (%)	Rural ($n_R=30$) f (%)	Total ($n=60$) f (%)
Communication skills			
High	12(40)	6 (20)	18(30)
Average	12(40)	15(50)	27(45)
Low	6(20)	9 (30)	15(25)
Time management			
High	9(30)	7 (23.33)	16(26.67)
Average	15(50)	10 (33.33)	25(41.66)
Low	6(20)	13(43.33)	19(31.66)
Positive thinking			
High	12(40)	14 (46.66)	26(43.33)
Average	18(60)	16 (53.33)	34(56.67)
Low	0	0	0
Team work			
High	7(23.33)	8 (26.66)	15(25)
Average	14(46.66)	15(50)	29(48.33)
Low	9(30)	7 (23.33)	16(26.67)

workers across different domains and soft skill levels. There was an average level of communication skills (45%) and time management skills (41.66%) among *anganwadi* workers. More than half (56.67%) of the *anganwadi* workers had an average level of positive attitude and teamwork (48.33%). In the study, the majority of respondents had medium levels of communication behavior. However, the rural *anganwadi* workers are less proficient in time management than the urban *anganwadi* workers. In urban rural areas, there were no negative attitudes among *anganwadi* workers and average level of team work.

The data indicated that mean scores for communication skill of the rural *anganwadi* workers (109.43 ± 10.62) were significantly higher ($t=2.10$, $p \leq 0.05$) than urban *anganwadi* workers (103.80 ± 10.14), indicating rural *anganwadi* workers had better communication skills than urban *anganwadi* workers (Table 2). Similarly, rural *anganwadi* workers had significantly ($t=2.30$, $p \leq 0.05$) better teamwork skills than urban workers. There is no significance difference in time management. Whereas, positive thinking of urban *anganwadi* workers (21.23 ± 1.63) were significantly higher ($t=2.80$, $p \leq 0.05$) than rural *anganwadi* workers (19.50 ± 2.96). Communication skills and team work ability of rural AWW are significantly higher than urban *anganwadi* workers. In this study, AWW demonstrated adequate knowledge of communication skills, but were unable to apply them effectively.

Table 2. Mean score ($\pm$ SD) difference of *anganwadi* workers' soft skills

Domains of soft skills	Urban ($n_U=30$) Mean $\pm$ SD	Rural ($n_R=30$) Mean $\pm$ SD	t-value
Communication skills	103.80 $\pm$ 10.14	109.43 $\pm$ 10.62	2.10*
Time management	115.60 $\pm$ 26.47	104.36 $\pm$ 24.29	1.71
Positive thinking	21.23 $\pm$ 1.63	19.50 $\pm$ 2.96	2.80**
Team work	2.75 $\pm$ 0.42	2.98 $\pm$ 0.32	2.30*

*Significant at 5% **Significant at 1%

The result indicated that rural AWW performance has been lower than the urban AWW for activities related to time management. *Anganwadi* workers should be trained in the use of time management so that they can perform their jobs more efficiently and effectively (Phillips and Kurian, 1989). In urban *anganwadi* workers, positive perceptions were found to be higher than in rural *anganwadi* workers, as a variety of factors influence their perceptions, including their socioeconomic status, family support, performance, knowledge, job satisfaction, as well as their salaries and other benefits.

The finding revealed that at average level of gross motor skills percentage (72.67%) of rural children were found significantly ($Z=2.43$, $p\leq 0.05$) higher than urban children (59.33%) indicating that rural children had better performance in gross motor activities like jumping, running, hopping and marching against the urban children (Table 3). Similarly, at the average level of fine motor skills, significantly ($Z=2.68$, $p\leq 0.05$) higher proportion of rural children (73.33%) were found as compared to urban children (58.66%). It was observed that in case of cognitive skills in the rural children were found significantly ($Z=3.39$; $p<0.01$) at high level (32%) than urban children (15.33). Whereas, the urban children (78%) at average level was found significantly ($Z=4.05$; $p<0.01$) than rural children (56%) in cognitive skills. Further language skills were significantly ($Z=2.22$; $p<0.05$) higher in urban children (32%) rather than 20.66 per cent in rural children. In contrast of language skill, this average level was found significantly ($Z=2.22$; $p<0.05$) in rural children. Whereas socio-emotional skills were found significantly ($Z=3.44$; $p<0.01$) at high level in urban children but at average level were found significant ($Z=3.44$; $p<0.01$) in rural

Table 3. Centre-wise difference in developmental milestones of the *anganwadi* children across different domains and levels

Domains and levels of developmental milestones	Urban ($n_u=150$) Frequency (%)	Rural ($n_r=150$) Frequency (%)	Z-value
1. Physical and motor development			
(a) Gross motor skill			
High	49(32.67)	36 (24)	1.66
Average	89(59.33)	109(72.67)	2.43*
Low	12(8)	5(3.33)	1.74
(b) Fine motor skill			
High	50(33.33)	35(23.33)	1.52
Average	88 (58.66)	110(73.33)	2.68**
Low	12 (8)	5(3.33)	1.74
2. Cognitive skill			
High	23(15.33)	48(32)	3.39*
Average	117(78)	84(56)	4.05**
Low	10(6.66)	18(12)	1.58
3. Language skill			
High	48(32)	31(20.66)	2.22*
Average	102 (68)	119(79.33)	2.22*
Low	0	0	0
4. Social and emotional skill			
High	63 (42)	35(23.33)	3.44**
Average	87(58)	115(76.66)	3.44**
Low	0	0	0

*Significant at 5%, **Significant at 1%

Table 4. Mean scores difference ($\pm$ s.d) of the *anganwadi* children at different domains of developmental milestones

Domains of developmental milestones	Urban ($n_u=150$) Mean $\pm$ SD	Rural ($n_r=150$) Mean $\pm$ SD	t-value
1.(a) Gross motor skill	11.90 $\pm$ 2.69	13.11 $\pm$ 1.81	2.68*
b) Fine motor skill	13.38 $\pm$ 3.51	12.32 $\pm$ 3.28	1.24
2. Cognitive skill	12.86 $\pm$ 3.48	11.65 $\pm$ 3.10	1.78
3. Language skill	10.90 $\pm$ 2.75	10.30 $\pm$ 2.17	2.09*
4. Social-emotional skill	15.38 $\pm$ 2.79	16.58 $\pm$ 3.50	3.27**

*Significant at 5%, **Significant at 1%

children (76.66%) rather than urban children (58%).

The Table 4 revealed that rural *anganwadi* children had higher mean score (13.11 $\pm$ 1.81) than urban *anganwadi* children with a significance difference ($t=2.68$; $p<0.05$) in gross motor skills (Table 4). In case of language skills, the mean scores (10.90 $\pm$ 2.75) of urban *anganwadi* children had superceded than rural *anganwadi* children with a significance difference ($t=2.09$; $p<0.05$). Whereas, in socio-emotional skills rural *anganwadi* children scored comparatively greater mean score (16.58 $\pm$ 3.50) than urban *anganwadi* children with a significance difference ($t=3.27$; $p<0.01$).

In developmental milestone, children's creativity and intellectual development are positively impacted. Children from 3-6 years old, attending the *anganwadi* centers, develop physically, cognitively, socially, emotionally, and self-help by reaching milestones. Rural children scored significantly higher in gross motor activities such as jumping, skipping walking etc. than urban children because they have more open spaces that allow them to engage in physical activities, sports and play (Egger & Angod, 2006). Similarly in socio-emotional activities such as developed friendships and cooperation with others etc, as compared to urban children. However, urban *anganwadi* children more fluent in verbal communication like reciting poems and storytelling than rural children.

The data revealed that communication skills of *anganwadi* workers were found to be positively correlated with language development skills ($r=0.27$; $p<0.01$) as well as socio-emotional skills ($r=0.18$; $p<0.05$) of the children (Table 5). Time management of AWW found positively correlated with gross motor skills ($r=0.17$; $p<0.05$), fine motor skills ($r=0.18$; $p<0.05$) as well as socio-emotional skills ($r=0.25$; $p<0.01$) of the *anganwadi* children. Positive attitude of *anganwadi* workers also showed a significant positive correlation with gross motor skill ($r=0.27$; $p<0.01$) and cognitive skill ($r=0.22$; $p<0.05$) of the *anganwadi* children. However, further team work was also found positively correlated with cognitive skills ($r=0.22$; $p<0.05$) and socio-emotional skill ($r=0.31$; $p<0.01$).

In the present study, the gross motor skill and socio-emotional skill of rural *anganwadi* children is more advanced than that of urban *anganwadi* children, while the language skill is more advanced than that of urban *anganwadi* children. The data showed that higher was the communication skills of *anganwadi* worker and more was the language skill and socio-emotional skills of the children. It can be concluded that higher was the communication skill of the rural *anganwadi* workers and more was the command in language like sound, gestures, sentences and build a positive

Table 5. Correlation between soft skills of *anganwadi* workers and developmental milestones of the *anganwadi* children (n=300)

Soft skills	Domains of developmental milestones				
	Gross motor (r) skill	Fine motor skill (r)	Cognitive skill (r)	Language skill (r)	Social and emotional skill (r)
Communication skills	0.06	0.06	0.13	0.27**	0.18*
Time management	0.17*	0.18*	0.02	0.01	0.25**
Positive attitude	0.27**	0.03	0.22*	0.13	0.03
Team work	0.15	0.12	0.22*	0.02	0.31**

*Significant at 5%, **Significant at 1%

relationship, experience, manage and express emotions of the child. The result indicated that time management skills of *anganwadi* workers made a positively impacted to gross motor, fine motor and socio-emotional skills of children. Positive perceptions towards the work of the AWW were noted to be highly concerned not only with promoting gross motor skills such as jumping, running, hopping, etc. but also with developing children's cognitive skills, which include reading, writing and arithmetic. It has been demonstrated that the teamwork activities of *anganwadi* workers enhance children's cognitive and socio-emotional development. The correlation analysis revealed that better soft skills among *anganwadi* workers will lead to an increase in the development milestones of the children.

CONCLUSION

The research demonstrated that focusing on soft skills such as communication skill, time management, positivity, and teamwork improves not only job competence, work efficiency, and quality of life, but also actively engaging the center. Thus, the government should provide AWWs with need-based and quality training programs to enhance their soft skills. By improving their soft skills, pre-school education and developmental milestones can be maintained. A preschool education component needs to be integrated into *anganwadi* centers through adequate supervision, guidance, and training to ensure that they are performing well as educators. A much greater emphasis will be placed on NFPSE first and foremost by reviewing the scheme's priorities.

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Attributes of a Mobile App as Perceived by Field Veterinarians: Case of Pig Master

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ARTICLE INFO

Keywords: Pig master, Mobile application, ICT tool, CVE, Perception, Field veterinarians, Andhra Pradesh

<http://doi.org/10.48165/IJEE.2023.59323>

Conflict of Interest: None

ABSTRACT

This study presents the perceived characteristics of pig master, a mobile app developed as a Continuing Veterinary Education (CVE) tool for veterinarians. The CVE programmes are being taken up by various institutions in India and it was observed that many of the field veterinarians are not able to attend the regular CVE programmes for obvious reasons, for whom ICT tools like mobile devices can be useful. In this context, veterinarians' perception of the mobile application on pig farming developed after the need assessment. The study was carried out with the veterinarians of the State Department of Animal Husbandry (SDAH), Andhra Pradesh. A sample of 91 field veterinarians was studied to whom Android Package on pig farming and questionnaires were sent. The 'pig master' mobile application was found to have good visual quality, more credible, effective in arousal of curiosity and was with high information coverage along with user-friendliness. Moreover, the app was also found with remarkable utility and helpful in decision-making as expressed by the majority of the field veterinarians. This study emphasizes the need of making CVE programmes effective by using digital media towards enrichment of knowledge of veterinarians.

INTRODUCTION

In India, pig farming is taken up mostly as a traditional caste occupation and by the socio-economically weaker sections of the society, whereas, status of livestock ownership at national level suggests that pig production is an economic activity dominated by marginal and smallholders (NSSO, 2019). Pig farming is one of the untapped livestock sectors and gaining momentum in India as a promising source of unconventional livestock farming and is attracting entrepreneurs from all dimensions. Moreover, the increase in per-capita consumption of pig meat at a rate of 1.40 per cent per annum in the last three decades (Bardhan, 2007) presenting good potential for commercial pig farming. Relevant and needy

extension advisory services by the key stakeholders i.e. veterinary extension workers play vital role. Lack of veterinary services and need of development of comprehensive community-based vet care system to promote profitable pig production was reported by Sravan & Syed (2020).

Veterinary profession is continually evolving and there is wide gap between research and adoption in piggery enterprise of India (Seth et al., 2018) is necessitating the need of enrichment of the field veterinarians' knowledge, the middle level extension professionals. Delivery of veterinary services is vital to animal health and productivity which depends on well trained and skilled animal health professionals (Endacott et al., 2020). Continuing Veterinary Education (CVE) aimed at increasing the professional

competence of veterinarians by providing the latest information in order to improve the quality of animal health services is being carried out by various state universities and national institutes in the form of trainings, seminars and workshops. However, many of the field veterinarians couldn't attend the continuing veterinary education (CVE) programmes due to various reasons like limited manpower availability and excess workload. Less manpower for veterinary services and extension activities was also reported by Jena et al., (2019) in their study on extension service delivery through mobile veterinary units in Odisha. To meet these situations, CVE rendering agencies can make use of methods like video conferencing, social networking, digital messages, mobile applications etc., for information dissemination (Barton et al., 2017). Moreover, Information and Communications Technology (ICT) can be an important useful media which complements with face-to-face communication in reaching a wider audience more rapidly at relatively low cost (FAO, 2017), whose potential need to be explored to bring location specific and commodity oriented transformative changes in the agriculture extension delivery system (Nain et al., 2019).

Among ICT tools, mobile based applications are gaining a huge popularity now-a-days, because of their easy access and faster dissemination of information. Kasch et al., (2016) in a study reported that veterinary students and the next generation of veterinary practitioners are using mobile devices to a great extent and suggested that new information tools through mobile devices may help veterinarians to seek and share information. To promote commercial pig farming and also to enrich the veterinarians, a mobile app 'pig master' was developed based on the information needs of field veterinarians of Andhra Pradesh and the effectiveness of mobile app was studied.

METHODOLOGY

The state of Andhra Pradesh (12°41' and 22°N latitude and 77° and 84°40'E longitude) was selected for the study which was carried out among the field veterinarians of State Department of Animal Husbandry, Andhra Pradesh using ex post-facto research design. Out of the total 1854 veterinarians working at the field level (Veterinary Assistant Surgeon and Assistant Director), a sample of 91 veterinarians were selected from the total thirteen districts of Andhra Pradesh @ of seven from each district through simple random sampling. Thus, multistage sampling was followed in selection of the study area and finally the respondents.

Sample size was arrived with Confidence level (95%) and Margin of error (10%).

$$\text{Sample size} = \frac{\frac{Z^2 X p(1-p)}{e^2}}{1 + \left(\frac{Z^2 X p(1-p)}{e^2 N}\right)}$$

N = population size e = Margin of error (percentage in decimal form) z = z-score

The selected veterinarians were sent google forms for prioritization of information needs in pig farming. Android mobile app pig master according to prioritised information needs was developed and made it available to the same group of field veterinarians through google play store and its effectiveness was studied through mailed questionnaires and google forms and data was analysed through suitable statistical tools.

RESULTS AND DISCUSSION

Social media utilisation pattern

Among the active members in usage of various online platforms, 94.51 per cent had membership in WhatsApp and it was the major communicating media used by field veterinarians with farmers as well as with other veterinarians (Table 1).

Table 1. Utilisation pattern of social media by veterinarians

Social media	Active member F (%)	Communication behaviour through social media	
		Advice to farmer F (%)	Sharing information with veterinarians F (%)
WhatsApp	94.51	43.96	92.31
Facebook	76.92	30.77	68.13
YouTube	71.43	3.30	56.04
Telegram	60.44	05.49	32.97
Twitter	10.99	—	3.30
LinkedIn	10.99	—	—
Hike	02.20	—	—

WhatsApp messenger is a proprietary, cross platform of smart phones for sharing knowledge and information was also stated by Patel et al. (2020). The most popular social media in India were YouTube and Facebook followed by social app i.e. WhatsApp and hence, can be one among the outreach initiatives (Ahmed and Deepak, 2019).

Information needs of the veterinarians

Government extension officials were the dominant informants on the sustainable agricultural practices was reported by Niranjana et al., (2022) and also the field veterinarians help in enhancing the socio-economic status of livestock owners to whom designing of need based training modules may serve the purpose (Nanda et al., 2020). In this study, majority of the veterinarians expressed that breeding, feeding, ration formulation, project report making and marketing information were the areas they need updated information (Table 2) in scientific and sustainable pig production.

Effectiveness of mobile app among field veterinarians

Based on the findings of the study (Table 1 and 2) i.e. utilisation of mobile based social media for communication and also need of the information requirement in pig farming, it was planned to develop a mobile application. Pig master mobile app was developed as a Continuing Veterinary Education tool for the field veterinarians and was made available through google play store. Effectiveness of pig master mobile app among field veterinarians was assessed in terms of content quality and level of satisfaction.

Content quality of the pig master application as perceived by veterinarians

Content quality of the developed mobile app was assessed in terms of its relevance, preciseness, simplicity, visual quality and credibility of information (Table 3).

Table 2. Veterinarians' information needs in piggery

Information needs on Pig farming	Required			Not required	
	Frequency	Percentage	Ranking	Frequency	Percentage
Breeds	86	94.51	II	05	05.49
Breeding management	87	95.60	I	04	04.40
Housing management	83	91.21	IV	08	08.79
Feeding management	87	95.60	I	04	04.40
Ration formulation	87	95.60	I	04	04.40
Health care and preventive measures	84	92.31	III	07	07.69
Project report making	87	95.60	I	04	04.40
Marketing information	87	95.60	I	04	04.40

Table 3. Content quality of the pig master application as perceived by veterinarians

Characteristics of content	Level	Percentage
Relevancy of the content	Most relevant	79.12
	Relevant	18.68
	Less relevant	02.20
Preciseness of content	Very precise	64.84
	Precise	35.16
	Less precise	–
Simplicity of content	Very simple	59.34
	Simple	40.66
	A bit difficult to understand	–
Visual quality	Very good	76.92
	Good	20.88
	Poor	02.20
Credibility of the information	More credible	60.44
	Credible	39.56
	Less credible	–

More than three fourth of the field veterinarians opined that content of the mobile app on pig farming was most relevant to the topic offered, whereas, two third of the veterinarians perceived that the information of the application was very precise. More than half of the veterinarians perceived that the information in the pig master mobile application was very simple to understand and about three fourth of the veterinarians expressed that the visual quality of the developed mobile app on pig farming was very good.

Majority (60%) of the veterinarians felt that the information provided was more credible. The app Pig Master was developed by a veterinarian after analysis of information needs and care was taken to include the information in an interesting way and hence the credible perception. Teza & Sharma (2016) in their study on quality of mobile apps stated that the quality of the mobile app was good on different aspects like holding the interests, visuals and content.

Satisfying and motivating characteristics of mobile application

The use of technology is an integral part of extension-client interaction and nowadays digital technologies can help fulfil the extension's mission of extending knowledge and effective engagement requires satisfaction (Barton et al., 2017). Hence, satisfaction with the usage of mobile application was assessed in terms of arousal of curiosity and interest, information coverage,

presentation of information and user friendliness. More than half (56.04%) of the veterinarians opined that mobile app on pig farming developed was very effective in arousal of curiosity and interest in the information which results in satisfaction and enhanced learning (Table 4).

Majority (83.52%) of the veterinarians expressed that the developed application has good information coverage on pig farming and three fourth were highly satisfied with information in the mobile application and felt that the app will have high utility and helps in decision-making in the field conditions which is a motivating factor. It has been reported by Huang & Chueh (2020) that increased levels of perceived accuracy of information could increase satisfaction of the user, which would translate into a greater perceived behavioural intention to use the application. Johnson et al., (2021) also found that the 'VetCan' mobile application was highly functional, possessed pleasant aesthetics, and contained highly informational content. Use of Information and Communication Technology by various agricultural research institutions in the dissemination of information to the stakeholders is in vogue offering excellent possibilities for empowering stakeholders and establishing appropriate communication between research and extension system (Rathore and Sumanth, 2021).

Table 4. Satisfying and motivating characteristics of mobile application

Characteristics of content	Level	Percentage
Arousal of curiosity & interest	Very effective	56.04
	Effective	43.96
	Least effective	–
Information coverage	Good	83.52
	Moderate	16.48
	Poor	–
Presentation of information	Highly satisfied	75.82
	Moderately satisfied	19.78
	Needs improvement	04.40
Perceived utility	High utility	76.92
	Moderate utility	20.88
	Less utility	02.20
Information helpful	Very helpful	70.33
	Helpful	29.67
	Not helpful	–
Helps in decision-making	Highly helpful	53.85
	Moderately helpful	39.56
	Less helpful	06.59

CONCLUSION

Field veterinarians investigated in Andhra Pradesh were the active users of mobile application for extension advisory services, communication as well as knowledge enrichment media. Mobile applications with rich repositories of information can be valuable continuing veterinary education tools for the veterinarians in view of the ever changing needs of various stakeholders like farmers and consumers. The satisfying utility and applicability of pig master mobile app in this study reiterates the need to develop such ICT tools to provide authentic information. Characteristics of the developed mobile application was well understood by the field veterinarians, however, suggested improvement for more refined usage. In the coming years agencies concerned with continuing veterinary education and higher education institutions, can take into account the versatile social media tools like mobile apps for strengthening the veterinary profession by ensuring better and timely extension and advisory services to the farming community.

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Feasibility Analysis of Solar-Powered Tubewells in Arid and Sub-humid Regions of Rajasthan

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ARTICLE INFO

Keywords: Solar-powered pump, Capital investment, Economic feasibility, Bootstrap data development analysis, Rajasthan

<http://doi.org/10.48165/IJEE.2023.59324>

Conflict of Interest: None

ABSTRACT

The study analysed the investment and returns of installing solar-powered pumps, besides their economic feasibility and efficiency in arid and sub-humid regions of Rajasthan based on primary data collected for the year 2018-19. The feasibility analysis while accounting for different climatic regions of Rajasthan is imperative to examine since it influences the depth of water table and required power to extract groundwater which would, affect economic feasibility of pumps. Only subsidised investment in solar-powered tubewells was found to be economically feasible in both regions. The efficiencies of solar-irrigated farms and savings in cost after installing solar-powered pumps were found to be higher for sub-humid region, which may be attributed to better utilisation of solar pumps, cultivation of high-value vegetables and adoption of improved technologies. The major constraint faced by farmers in adoption of solar-powered pumps in arid region was found to be their non-functioning in higher water table situations, while in sub-humid region, it was a high initial investment. Hence, there is need to have custom-made policies according to climatic regions of the country and to increase awareness regarding benefits of adoption of advanced technologies and high-value crops which can complement the benefits of adoption of solar-powered pumps.

INTRODUCTION

Since the 1970s, India's policy focus on achieving food self-sufficiency led to liberalised energy policies for the agriculture sector viz., elimination of metering, introduction of flat electricity tariffs and then subsequently free electricity and subsidised diesel supply to agriculture. This has led to indiscriminate extraction of groundwater in the country led by electricity (76%) and diesel-powered tubewells (22%). Central Ground Water Board has estimated 14 per cent of its assessment units as 'over-exploited' in India (GoI, 2022). India has been categorised as the world's

largest user of groundwater and out of the total extraction, 87 per cent is utilised for irrigation purposes in the country. However, these liberalised policies have created a water-food-energy nexus in India where food security has been achieved at the cost of groundwater, energy and environmental sustainability (Mukherji, 2017; Yashodha et al., 2021; Mukherjee et al., 2022; Kaur & Sharma, 2022).

Recognising this, *Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan Yojana* (PM-KUSUM) was launched in 2019 with a target to install 30.8 GW solar capacity by March 31, 2026. As on December 2022, around 5 lakh solar pumps have been

installed in the country (GoI, 2023). Solar pumps provide an emission-free power supply and can be available to farmers during the daytime too which helps in ensuring timely irrigation for the crops (Kishore et al., 2017; Kumar & Kandpal, 2007). Grid-connected solar pumps also provide an additional source of income to farmers. Thus, solar irrigation has the potential to make a substantial contribution towards enhancing access to irrigation and increasing farmers' income (Singh et al., 2017).

Rajasthan is one of the most attractive destinations to harness solar energy as it has the highest solar energy potential (142.31 GWp) among Indian states based on land availability and solar radiation (GoI, 2023). Rajasthan has a share of 21.7 per cent of the total cumulative solar pumps installed in the country as on Dec 2022. Several studies have estimated that solar-powered pumps have near-zero operational cost, have a long life and their use could raise the productivity of crops, increase farmers' income and they can also provide higher resilience to drought (Kishore et al., 2015; Kishore, 2004; Mukherji, 2007; Pramod et al., 2022). Some studies have estimated the economic feasibility of solar-powered pumps and found that only subsidised investment in solar-powered pumps generated impressive net present worth, benefit-cost ratio and internal rate of return, while it is not found feasible to invest in solar pumps without subsidy (KPMG, 2014; Singh et al., 2017; Gautam & Singh, 2020).

However, the feasibility analysis of solar pumps while accounting for the different climatic regions of Rajasthan has not been done which is very imperative to examine since it influences the depth of water table in any region and the power required by pump to extract the groundwater, which would, in turn, affect the economic feasibility of pumps. Therefore, the present study aims to analyse economic feasibility as well as efficiency of solar-irrigated farms for arid and sub-humid regions of Rajasthan, separately.

METHODOLOGY

To analyse the feasibility and efficiency of solar-irrigated farms, a multistage sampling framework was used to collect the primary data from arid and sub-humid climatic regions of Rajasthan. Three blocks were chosen purposively each from arid and sub-humid regions based on the criteria of adoption of improved technologies like solar pumps and micro-irrigation technologies. These blocks fall in the district of Jodhpur, Jaipur, and Alwar. Thus, primary data from 180 randomly selected farmers were collected from randomly selected village clusters from these blocks for the year 2018-19.

Tabular analysis was done to analyse the investment and returns of installation of solar-powered pumps. The returns of installation of a solar-powered pump over an electricity-powered pump are estimated by calculating the average savings in cost after the installation of a solar pump, which is the difference between the average total variable cost per ha for an electricity-powered pump and the average total variable cost per ha for a solar-powered pump. Thus, these savings in cost mainly comprise savings in maintenance and fuel (electricity/diesel) cost.

The economic feasibility of investing in solar-powered pumps was estimated with the help of net present worth (NPW), benefit-

cost ratio (B:C) and internal rate of return (IRR). The net economic groundwater productivity of solar-irrigated farms was calculated by dividing the total value of crop output by the total cost of irrigation. It tells how much of the value of crop output is produced per unit of cost of irrigation. The efficiencies viz., technical efficiency (TE), allocative efficiency (AE) and economic efficiency (EE) of solar-irrigated farms under variable returns to scale (VRS) assumption have been estimated by using the bootstrap data envelopment analysis (BDEA) approach, which provides accurate and reliable efficiency estimates after correcting biases present in traditional data envelopment analysis approach.

Gross return on irrigated land (Rs./ha) was used as the dependent variable to calculate the efficiency of irrigated land. The independent variables used in the TE model are- irrigation applied (m³/ha), seed (kg/ha), fertilizers used (kg/ha), manure (kg/ha), labour (days/ha) and machine hours (hrs./ha). The prices of these independent variables were used for the EE model- irrigation charges (Rs./ha), seed prices (Rs./ha), fertilizer prices (Rs./ha), manure prices (Rs./ha), labour charges (Rs./ha) and machine charges (Rs./ha).

Garrett's ranking method was also used to rank the various constraints faced by farmers in the adoption of solar-powered pumps in the arid and sub-humid regions, separately.

RESULTS AND DISCUSSION

In the arid region, most of the sampled farmers belong to medium and large categories and the average size of landholdings was larger (9.4 ha). On the other hand, in the sub-humid region, most of the surveyed farmers belong to the small and semi-medium categories and the average size of landholding was comparatively smaller (2.8 ha). The major crops cultivated in the arid region were bajra, wheat, cumin, groundnut, mustard and cotton and 32.4 per cent of the cropped area was under high-value crops (Table 1). The farmers with both electricity and solar energy sources were found to have highest cropping intensity as expected and were practicing a diversified farming system. The farmers mentioned that while the solar pumps have provided them a flexibility to irrigate the crops during day time, but they (especially 3 HP pumps) are not useful to pump out the water from a deeper groundwater table. That might be the reason behind the farmers having only solar energy source going for lesser diversified cropping system with less water-requiring crops.

Farmers in the sub-humid region had mainly grown wheat, bajra, mustard, cotton, and cucumber and cabbage among vegetables with 44 per cent share of the cropped area under high-value crops. Farmers with electricity energy source were found to be having highest cropping intensity followed by farmers with both electricity and solar energy source. Farmers with both electricity as well as solar energy source were found to have cultivated more of high value vegetables like cucumber, tomato and cabbage, while farmers with only electricity energy source had grown mainly field crops like wheat, bajra, mustard and cotton.

Investment and returns of solar-powered tubewells

In arid region, all of the large category farmers had tubewell, while only 33 per cent of small and semi-medium farmers had

Table 1. Cropping pattern prevailing in arid and sub-humid regions of Rajasthan

Energy source	GCA (ha)	NCA (ha)	CI (%)	Share in GCA (%)							
				Bajra	Cotton	Wheat	Cumin	Mustard	Groundnut	Vegetables	Others
Arid region											
Electric	15.3	10.3	156.9	17.8	9.2	19.0	11.7	7.9	17.3	14.3	2.9
Electric + Solar	28.0	14.8	180.6	32.5	9.1	11.1	20.1	8.1	3.1	15.9	-
Solar	9.8	5.5	177.3	30.8	-	5.1	38.5	-	-	25.6	-
Total	15.2	9.4	169.4	21.9	9.1	17.2	14.5	9.7	14.2	11.6	1.8
Sub-humid region											
Electric	4.5	2.3	198.5	21.2	12.8	22.7	1.7	15.1	3.9	20.6	2.0
Electric + Solar	12.8	6.4	177.9	1.6	-	14.7	-	-	-	77.8	6.0
Solar	3.5	2.0	175.0	20.0	10.0	17.5	-	12.5	-	40.0	-
Total	5.4	2.8	191.9	20.4	12.6	21.9	1.1	12.9	2.5	25.3	3.4

Source: Authors' survey-based findings.

Note: GCA: Gross cropped area, NCA: Net cropped area, CI: Cropping intensity.

ownership of tubewell. 73.2 per cent of the farmers had electricity only while only 2.8 per cent had solar only as the energy source and 23.9 per cent had both electricity as well as a solar energised tubewells. While in sub-humid region, almost 77.8 per cent of the sampled farmers had tubewell. 68.6 per cent of the farmers had electricity only as the energy source while 5.7 per cent had solar only and 25.7 per cent had both electricity as well as a solar energy source. Farmers opined that electricity for agriculture-related work is not available round the clock in Rajasthan and having solar energy along with electricity benefits them by ensuring the availability of adequate and timely irrigation for their crops.

The average investment in the installation of solar-powered pumps and resulting returns (savings in cost over electricity-operated pumps) in both arid and sub-humid regions is given in Table 2. In the arid region, the average own investment per farm in solar tubewell installation was found to be Rs. 1.78 lakh and Rs. 2.12 lakh for 3 HP and 5 HP tubewells, respectively. While in the sub-humid region, it was Rs. 71,500 and Rs.1.34 lakh for 3 HP and 5 HP tubewells, respectively. Gautam & Singh (2020) also found the farmers' share in average cost of installation of tubewell in Jaipur district in the similar range. The higher total and own investment in solar pump installation in arid region may be attributed to larger landholdings and higher depth to the water table. The average subsidy on solar tubewells was found to be 86 and 64 per cent in arid region and 86 and 69 per cent in the sub-humid region for 3 HP and 5 HP tubewells, respectively. The farmers revealed

that the average expected life of the solar system is 19-20 years in the arid region and 16-17 years in the sub-humid region.

The savings in cost (difference between the average variable cost for an electricity-powered pump and a solar-powered pump) due to the adoption of the solar-powered pump was found to be Rs. 15,955 per farm or Rs. 1,245 per ha for 3 HP pump and Rs. 25,295 per farm or Rs. 1,605 per ha for 5 HP pump in arid region. For sub-humid region, it was found to be Rs. 32,723 per farm or Rs. 8,555 per ha for 3 HP pump and Rs. 74,836 per farm or Rs. 9,614 per ha for 5 HP pump, which is comparatively higher than that in the arid region. It may be because most of the farmers had both electricity and solar energy source as solar alone can't be operated effectively due to the higher depth of water table in arid region. On the other hand, in the sub-humid region, comparatively, a larger number of farmers had only solar-powered pumps as solar can be operated effectively there. Though the average variable cost per ha was higher in the sub-humid region, but the average savings in cost after the adoption of solar pumps was found to be higher because of better utilisation of solar pumps coupled with the adoption of advanced technologies and cultivation of high-value agricultural crops. Singh et al., (2017) in their study also found the similar range of cost savings due to adoption of solar-powered pump, moreover, they also found that these savings in cost have been in fact higher over the diesel operated tubewells in comparison to savings over electricity operated tubewells.

Table 2. Average investment and returns of solar-powered tubewells

Particulars	Arid		Sub-humid	
	3 HP	5 HP	3 HP	5 HP
Average net cropped area (ha)	9.1	12.8	3.8	8.5
Average own investment per farm (Rs.)	1,77,500	2,12,000	71,500	1,33,500
Average own investment per ha (Rs./ha)	7,700	28,782	25,139	35,378
Average subsidy (%)	0.86	0.64	0.86	0.69
Average expected life (years)	19	20	16	17
Average savings in cost per farm (Rs.)	15,955	25,295	32,723	74,836
Average savings in cost per ha (Rs./ha)	1,245	1,605	8,555	9,614

Source: Authors' survey-based findings.

Table 3. Economic Feasibility of Solar-Powered Tubewells

Region	3 HP Pump				5 HP Pump			
	Subsidy	NPW	B:C	IRR (%)	Subsidy	NPW	B:C	IRR (%)
Arid	Without	-417507	0.3	-	Without	-520125	0.1	-
	60 %	-58578	0.8	-	60 %	-159314	0.4	-
	86 %	96957	2.1	15	75 %	69111	1.6	12
Sub-humid	Without	-274359	0.5	-	Without	-122831	0.7	-
	60 %	32070	1.2	2	60 %	381218	3.1	28
	86 %	164856	3.1	29	75 %	445815	4.9	51

Source: Authors' calculations.

Feasibility of solar-powered tubewells

The economic feasibility analysis of solar-operated tubewells showed that with 86 per cent of subsidies on investment, solar tubewells generated an NPW of Rs. 96957 for 3 HP pumps in arid region with a B:C ratio of 2.1 and an IRR of 15 per cent (Table 3). With 75 per cent of subsidy for 5 HP pumps, solar tubewells generated an NPW of Rs. 69111 with a B:C ratio of 1.6 and an IRR of 12 per cent. However, with a 60 per cent subsidy and without subsidies, investment in solar pumps was not found economically feasible for both 3 and 5 HP pumps in arid region.

In sub-humid region, 86 per cent subsidy on investment in 3 HP solar pump and 75 per cent subsidy on investment in 5 HP solar pump was found to be impressively economically feasible. With a 60 per cent subsidy also, 5 HP solar tubewells generated an impressive NPW of Rs. 381218, a B:C ratio of 3.1 and an IRR of 28 per cent. However, 3 HP solar tubewell with a 60 per cent subsidy generated a moderate NPW of Rs. 32070, B:C ratio of 1.2 and a poor IRR of 2 per cent. Further, as expected, without subsidies, investment in solar tubewells was not found economically feasible for both 3 and 5 HP pumps in sub-humid region too. Similar results were also reported by Singh et al., (2017) and Gautam & Singh (2020). In another study by KPMG (2014), IRR was found to be higher for the replacement of diesel pumps with solar pumps compared to the replacement of electricity pumps.

Economic productivity and efficiency of solar-irrigated farms

The net economic groundwater productivity was found to be 39.3 and 65.2 for 3 and 5 HP, respectively for sub-humid region (Table 4). However, net economic groundwater productivity was found to be poor as 10.1 for 3 HP and 4.9 for 5 HP solar pumps in arid region. It indicates that farmers in the sub-humid region were able to generate higher value of crop produce per unit of money spent on irrigation.

The above measure of groundwater irrigation productivity tells the productivity of farms with respect to only irrigation. Since irrigation as an input affects the marginal productivity of other inputs too viz., fertilizer, manure, labour, etc., it becomes imperative to analyse the overall efficiency of solar-irrigated farms in the regions. The average technical efficiency (TE) of the solar-irrigated farms in arid region was estimated to be 0.61 for 3 HP pump and 0.55 for 5 HP pump and the average economic efficiency (EE) was 0.43 and 0.42 for 3 and 5 HP pump, respectively (Table 4). These efficiency scores denote that the farms are overusing inputs and there is a scope of reduction of input use without affecting the level of output. There exists significant cost inefficiency too in the farms in arid region. On the other hand, allocative efficiency (AE) was found to be comparatively higher i.e., 0.71 and 0.72 for 3 and 5 HP pump, respectively.

The average TE of the solar-irrigated farms in sub-humid region was estimated to be 0.66 for 3 HP pump and 0.57 for 5 HP pump and the average EE was 0.46 and 0.44 for 3 and 5 HP pump, respectively. Here also, there is a scope of reducing input use without affecting the level of output. Here too, AE was found to be comparatively higher i.e., 0.67 and 0.72 for 3 and 5 HP pump, respectively. Similar efficiency scores of solar-irrigated farms were reported by Kumar (2021) which were though lower than the efficiencies of farms having electric pumps but were higher than the efficiencies of farms having diesel-operated pumps. The low estimates of efficiencies reveal that the output is not being produced with the optimal combinations of inputs, given their respective prices. The efficiencies of solar-powered farms in sub-humid region were found to be higher than that in the arid region. As explained above, the higher efficiencies in sub-humid region may be attributed to the cultivation of high-value vegetables and the adoption of improved agricultural technologies.

Table 4. Net economic groundwater productivity and efficiency of solar-irrigated farms

Region	3 HP pump				5 HP pump			
	Net economic groundwater productivity	Technical efficiency	Allocative efficiency	Economic efficiency	Net economic groundwater productivity	Technical efficiency	Allocative efficiency	Economic efficiency
Arid	10.1	0.61	0.71	0.43	4.9	0.55	0.72	0.42
Sub-humid	39.3	0.66	0.67	0.46	65.2	0.57	0.72	0.44

Source: Authors' calculations.

Table 5. Constraints to the adoption of solar-powered pump

Rank	Arid	Garrett score	Sub-humid	Garrett score
1	Doesn't work as higher water table	71.7	High initial investment	72.6
2	Non-availability of subsidy for more than > 5 HP	68.2	Small land holding	68.3
3	High initial investment	62.7	Doesn't work the whole year	62.4
4	Lottery-based subsidy provision	60.0	Inadequate subsidy and difficulty in getting it	60.1
5	High fragmentation of holding	56.0	Lack of capital to cover whole land holding	52.4
6	Diggi is required for subsidy but land is less	52.6	High fragmentation of holding	50.4
7	Doesn't work the whole year	52.0	Delay in supply of system	48.2
8	Inadequate subsidy and difficulty in getting it	47.4	Poor off-farm income	47.8
9	Delay in sanction of loan	44.5	Delay in sanction of loan	46.6
10	Inadequate loan	36.3	Lack of demonstration in KVK/Agri. Dept.	40.5

Source: Authors' survey-based findings.

Constraints to the adoption of solar-powered pump

Garrett's ranking method was used to rank the various constraints faced by farmers in the adoption of solar-powered pumps in both arid and sub-humid regions (Table 5). For arid region, the highest ranked constraint was found to be its non-functioning in higher water table situations. Because of this reason, farmers were found to be using electricity-powered pumps to extract the groundwater and collect it in diggi (water storage structure) while solar energy is used for pumping the water from diggi to the fields. The next highest ranked constraints were found to be the non-availability of subsidy for more than 5 HP pump and high initial investment. These constraints are followed by lottery-based subsidy provision, high fragmentation of landholding, requirement of diggi for subsidy but the constraint of land, its non-functioning round the year, inadequate subsidy and difficulty in getting it, delay in sanction of loan and inadequate loan amount.

Whereas for sub-humid region, the highest ranked constraint in the adoption of solar-powered pumps was found to be high initial investment followed by small landholding, and its non-functioning round the year. These constraints are followed by inadequate subsidy and difficulty in getting it, lack of capital to cover whole landholding, high fragmentation of holding, delay in supply of system, poor off-farm income, delay in sanction of loan and lack of demonstration in Krishi Vigyan Kendra (KVK)/Agriculture Department. The small size of landholding and lack of ability of solar pumps to work for the whole year were also identified as constraints to the adoption of solar pumps in past studies viz. Kumar (2021) and Singh et al., (2017). High initial investment as a major constraint to the adoption of solar pump was also reported by Choudhary et al., (2022).

CONCLUSION

The study has reported significant benefits of the installation of a solar-powered pump while its economic feasibility is considerably dependent on the provision of subsidy. Thus, there is a need to expand the installation of subsidised solar pumps among the small and marginal farmers too where the adoption is still poor. Since the major constraint in the adoption of solar-powered pump in arid region is deeper water table, there is a need to increase the capacity of solar pumps. The custom-made policies according to the climatic regions of the country might be more

beneficial to have a sustainable use of groundwater resources. There is a need to increase awareness, especially among the farmers in the arid region regarding the benefits of the adoption of advanced technologies and high-value crops which can complement the benefits of adoption of solar-powered pumps.

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Are Happy Seeder and PUSA Decomposer Potential Options for Sustainable Ways of Paddy Straw Management

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ARTICLE INFO

Keywords: Happy seeder, PUSA decomposer, Paddy straw management, Stubble burning, Economic analysis

<http://doi.org/10.48165/IJEE.2023.59325>

Conflict of Interest: None

ABSTRACT

The study was undertaken to assess the effect of *in-situ* paddy straw management by the adoption of Happy Seeder and PUSA decomposer on the profitability in wheat cultivation and constraints to the adoption of these technologies using primary data collected from randomly selected 121 farmers in the Karnal district of Haryana in the year 2022. The results showed that the adoption of these technologies has reduced the cost and increased the profitability in wheat cultivation. However, the adoption of these technologies especially among small farmers remains limited. Financial constraints to the adoption of Happy Seeder and the longer duration for the decomposition of straw by PUSA decomposer were reported to be major hindrances in their adoption. Educating the farmers regarding the consequences of stubble burning and the potential benefits of adopting these technologies and addressing financial constraints and improving the efficacy of PUSA decomposer may be the potential options for sustainable management of paddy straw.

INTRODUCTION

One of the most significant cropping patterns for South Asia's food security is the rice-wheat (RW) cropping system. In 2019, the Indo-Gangetic Plains' rice-wheat cropping system stretched close to 13.5 million hectares of land (Gupta, 2019). Farmers find it difficult to diversify into other crops due to irrigation facilities at nominal electricity charges (Singh et al., 2008), assured procurement at minimum support price, availability of subsidized fertilizers and irrigation responsive high yielding cultivars, as well as crop adapted machinery (Chaudhary et al., 2019). Over the past sixty years, there has been an overall 2.53 per cent rise in crop residue availability in India (Devi et al., 2017). Among the whole, paddy contributes 154–235.8 million tonnes (MT), followed by wheat (131 MT) (Hiloidhari et al., 2014; Abraham et al., 2016). In these years, rice residue burning

is becoming a matter of concern since burning of crop residue not only harms the environment but also account for the performance of soil-active herbicides and the loss of valuable nutrients. The burning of paddy straw in the field leads to nutritional losses of up to 100% C, 90% N, 60% S, and 25% each P and K (Singh et al., 2020). Besides affecting the environment, it also has a negative influence on rural populations, such as respiratory difficulties, pneumonia and diminished visibility (Choudhary et al., 2022). Need of one and half months' time to the straw for proper decomposition (Rohilla et al., 2022), relative ease and economic feasibility of straw burning, unavailability of labour for harvesting operations, paucity of equipment, time consuming and expensive manual harvesting, short window between paddy and wheat (Kadhian et al., 2021) and poor industrial demand for paddy stubble (Roy, 2016) are the reasons forcing the farmers to practice burning. Approximately 30 per cent of the pollution in

and around Punjab and Haryana is caused by burning crop leftovers (Lieberink, 2020), where farmers burn an estimated 23 million tons of straw waste from rice harvests every year (Kumar et al., 2019). Since most of the farmers in Haryana raise late-maturing, fine-grained rice, which causes wheat to be sown later than usual forces them to burn (Tripathi et al., 2013). To solve the problem of burning, there are various alternative ways which are eco-friendly and also manages paddy straw at proper time without delaying in sowing operation of wheat crop (Kaur et al., 2021). Adoption of these alternatives like sowing the wheat with Happy Seeder not only prevents burning but also have indirect benefits like timely sowing, increased yield and reduction in cost of cultivation of wheat due to savings in many inputs. Also the stubble acts as manure and compost for the crops, thus use of decomposer improves soil fertility and productivity, requiring less fertilizer in the future (Ranjan et al., 2021).

METHODOLOGY

Karnal district of Haryana was purposively selected for the study as the district accounted for the highest paddy area burnt in 2021. Further, all 5 tehsils were considered and proportionate sampling was followed to decide the number of farmers. A cluster of villages was selected randomly and lists of Happy Seeder user farmers were procured/ prepared and adopters were selected randomly and almost same number of non-adopters was also selected randomly from the same villages. And primary data were collected from a total number of 121 farmers comprising 59 Happy Seeder adopter and 62 non-adopters. A total of 66 farmers were also applied PUSA decomposer for *in-situ* straw management. Eight custom hiring centers and 10 Happy Seeder service provider farmers were also interviewed. Selected farmers were classified as small (less than 2 ha), semi-medium (2 to 4 ha), medium (4 to 10 ha) and large (more than 10 ha) to study the inclusiveness of adoption of these technologies. Cost and return concepts, Partial budgeting and Garrett Ranking technique were used to attain the objectives.

The basis of cost of cultivation was the standard one as given by Commission for Agricultural Costs and Prices (CACP), Ministry of Agriculture and Farmers Welfare. Total cost has been segregated as Cost A1, Cost A2, Cost B1, Cost B2, Cost C1, Cost C2, Cost C3 and Cost A2+ Family labour. The returns is calculated as Gross income= Grain yield x grain price + straw yield x straw price, Income over Cost A2 +family labour = Gross income-(Cost A2 + imputed wages of family labour) and Net income = Gross income –Cost C3

The partial budget weighs the advantageous and disadvantages of adoption of Happy Seeder in wheat cultivation. We have calculated additional income in terms of enhanced yield and reduced cost (ploughing, seed, human labour and irrigation). Additional cost was observed to be as increased cost in Happy Seeder use, fertilizers and plant protection chemicals. Then, total added cost was subtracted from total added income to get net benefit of Happy Seeder adoption.

Stakeholders' (farmers, custom hiring centers and Happy Seeder service provider farmers) perception on constraints to the adoption of Happy Seeder and PUSA decomposer were recorded

and analysed. Technical constraints involved in use of Happy Seeder like configuration problem, need of high HP tractor, which also needs more fuel, accessibility problems like timeliness in availability of machine, cost, cumbersome procedures in obtaining loan and subsidy etc. Problems which arise after sowing may be germination problem, less effective weedicides, weed infestation problems, pest attack etc. The problems faced by custom hiring centers and individual farmers for providing services of Happy Seeder to farmers were also recorded. The perceptions were analysed using Garrett Ranking technique and frequency distribution.

RESULTS AND DISCUSSION

Among the 121 sample farmers, 49 and 51 per cent were adopters and non-adopters of Happy/Super Seeders, respectively. The average size of land holding was 9.4 and 6.1 ha for adopters and non-adopters of Happy Seeders. The proportion of lessee farmers were almost same across Happy Seeder adopters and non-adopters, however, share of leased-in land was more (26%) on non- adopters farms in comparison to adopters farms (19%). The adoption of PUSA decomposer was higher (57%) on non-adopter farms than Happy Seeders adopter farms (53%). The results showed that adoption of Happy/Super Seeder was good as 36 per cent paddy straw was in-situ managed by them (Figure 1). However about 46 per cent of the paddy straw was still burnt and a meager quantity was used for animal feed, to incorporate on field, mushroom production, fuel purpose and for other things.

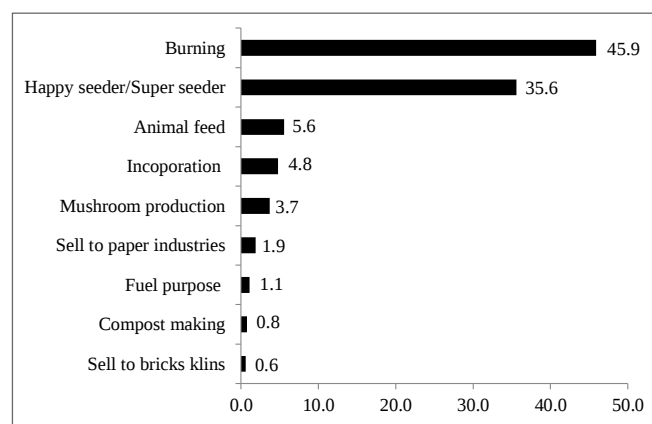


Figure 1. Methods of handling paddy straw in the region (%)

Cost of cultivation of wheat on Happy Seeder adopter and non-adopter farms

Happy Seeder adopter and non-adopter farmers incurred a total input cost of Rs. 47,145 and Rs. 49,015 per ha in wheat cultivation (Table 1). Total input costs were found to be increasing with increase in farm size on both types of farms. The higher input expenditure in conventional cultivation was due to higher expenditure on machine, irrigation and seed. On the other, fertilizer and plant protection chemicals uses were found to be more on Happy Seeder adopter than non-adopter farms. Compared to conventional technology, Happy Seeder adopters incurred higher expenditure on plant protection chemicals owing to the higher incidence of rats, slugs, and pink army worms. These results can

be supported by the findings of Tripathi et al., (2013) who states that adopters have saved 6.68 per cent human labour, 46.30 per cent machine labour, and 17.65 per cent irrigation water when compared to the conventional method.

The different costs in wheat cultivation were calculated using costs concepts for adopter and non-adopter farms (Table 2). Average cost A1 incurred was Rs. 44,365 and 47,374 per ha on adopter and non-adopter farms and increasing with farm size. Cost A2 was quite high (Rs. 66,194 per ha) on non-adopters than adopter farms (Rs. 57,379 per ha) due to a more proportion of wheat cultivation was undertaken on leased-in land. Increase in cost B2 was also very high because of high imputed rental value of owned land in the study area. The total cost of cultivation (Cost C3) were observed to be Rs. 1,32,812 and Rs. 1,39,260 per ha on adopter and non-adopter farms. The paid-out cost of cultivation (Cost A2 + family labour) was found to be Rs. 61,693

and Rs. 71,077 per ha and paid-out cost of production was Rs. 1148 and Rs. 1428 per quintal of wheat grain production on adopter and non-adopter farms, respectively.

Profitability in wheat cultivation on Happy Seeder adopter and non-adopter farms

Realization of wheat yield on Happy Seeder adopter farms was 53.8 quintals per ha which was 4 quintals higher than non-adopter farms (Table 3). Realization of gross, farm business and family labour incomes were also higher on Happy Seeder adopter than non-adopter farms. Return over Cost A2+family labour which indicates income over all paid out cost and imputed value of family labour was Rs. 66,534 per ha for adopters which was Rs. 14,871 more than non-adopters which indicates the higher profitability due to Happy Seeder adoption. This finding is in accordance with Yogi et al., (2015) whose study indicates that net

Table 1. Input costs in wheat cultivation on Happy Seeder adopter and non-adopter farm

Particulars	Input costs (Rs/ha) of adopters					Input costs (Rs/ha) of non-adopters				
	Small	Semi-medium	Medium	Large	All	Small	Semi-medium	Medium	Large	All
Family labourwages	7350 (17.1)	5684 (12.2)	2899 (6.2)	1321 (2.8)	4314 (9.1)	8485 (18.8)	4607 (9.6)	4215 (8.3)	2227 (4.3)	4883 (10.0)
Hired labour wages	2218 (5.1)	3939 (8.5)	6890 (14.8)	8573 (18.0)	5405 (11.5)	1834 (4.1)	5986 (12.4)	6778 (13.3)	9072 (17.5)	5917 (12.1)
Machine charges	13980 (32.4)	15116 (32.5)	14730 (31.6)	14994 (31.4)	14994 (31.8)	14333 (31.8)	15830 (32.9)	16844 (33.1)	16747 (32.3)	15939 (32.5)
Seed cost	3590 (8.3)	3791 (8.2)	3782 (8.1)	3881 (8.1)	3835 (8.1)	4153 (9.2)	4172 (8.7)	4327 (8.5)	4397 (8.5)	4262 (8.7)
Fertilizer cost	5098 (11.8)	5108 (11.0)	5618 (12.0)	6002 (12.6)	5788 (12.3)	5097 (11.3)	5115 (10.6)	5672 (11.1)	5772 (11.1)	5414 (11.0)
Irrigation charges	4305 (10.0)	5285 (11.4)	5082 (10.9)	5386 (11.3)	5256 (11.1)	5089 (11.3)	6145 (12.8)	6344 (12.5)	6606 (12.7)	6046 (12.3)
PPC cost	5938 (13.8)	6871 (14.8)	6889 (14.8)	6788 (14.2)	6816 (14.5)	5467 (12.1)	5563 (11.5)	5939 (11.7)	6173 (11.9)	5786 (10.8)
Total input cost	43093	46495	46644	47743	47145	45111	48175	50925	51848	49015

(Figures in parenthesis are percent share of respective cost in total cost).

Table 2. Cost of cultivation in wheat on Happy Seeder adopter and non-adopter farms

Particulars	Cost (Rs/ha) of adopters					Cost (Rs/ha) of non-adopters				
	Small	Semi-medium	Medium	Large	All	Small	Semi-medium	Medium	Large	All
Cost A1	38528	43974	46088	47232	44365	42018	46501	48500	50209	47374
Cost A2	41653	45421	57197	63221	57379	44943	51242	60415	89872	66194
Cost B2	108662	118996	119872	117929	116425	117472	122718	122410	124569	121717
Cost C3	127614	137148	135048	131176	132812	138552	140058	139287	139475	139260
Cost A2+FL	49003	51105	60096	64542	61693	53428	55849	64630	92099	71077
Cost A2+FL/(RS/qlt)	975	986	1126	1188	1148	1142	1167	1300	1802	1428

Table 3. Returns in wheat cultivation on Happy Seeder adopter and non-adopter farms

Particulars	Cost (Rs/ha) of adopters					Cost (Rs/ha) of non-adopters				
	Small	Semi-medium	Medium	Large	All	Small	Semi-medium	Medium	Large	All
Yield (qtl/ha)	49.3	50.8	52.4	54.3	53.8	46.8	47.8	49.7	51.1	49.8
Gross income	120529	124961	127269	129462	128227	116645	115949	122073	127501	122740
Income over Cost A2+FL	71525	73856	67173	64920	66534	63217	60100	57443	35402	51663
Net income	-7085	-12186	-7779	-1714	-4585	-21908	-24109	-17214	-11974	-16520

income has been found higher in Turbo Happy Seeder method, mainly due to lower cost of production compared to that in conventional method. However, realization of net income of this year (2022) was found to be negative on both the adopter and non-adopter farms, this may be due to decrease in wheat yield on account of heat stress at the time of grain maturity. However, negative net income realization was very low on Happy Seeder adopter than non-adopter farms. This may be the on account of less effect of terminal heat in paddy straw mulched farms under Happy Seeder cultivation.

Financial feasibility of Happy Seeder adoption

A financial viability of adoption Happy Seeder was assessed using partial budgeting approach and the results are presented in Table 4. It was observed that Happy Seeder adopter farmers realized additional income of Rs. 8223 on account of increased yield of approximately 4 quintal per ha. This method of wheat cultivation also reduces the cost by Rs. 8799 per ha which is due to saving in use of 32.7 hours of human labour (Rs. 2062), 4.4 number of ploughing for land preparation (Rs. 5520), 12 kg per ha of seed (Rs. 427) and irrigation of Rs 790 per ha. On the other hand, the method has also resulted in additional expenses of Rs. 6948 per ha due to an increase in the cost of some practices like sowing by Happy Seeder, increased usage of fertilizers, pesticides and rodenticides per ha. This analysis showed that adoption of Happy Seeder generated a net benefit of around Rs. 10,074 per ha in wheat cultivation. This result is consistent with the findings of Keil et al., (2021) who states that the Happy Seeder leads to significant savings in wheat production costs, amounting to 161 per quintal or approximately Rs. 8800 per ha.

Adoption and benefit of PUSA decomposer

PUSA decomposer is a new technology for paddy straw management. In our study, overall 66 sample farmers have adopted this technology and 46 per cent of Happy Seeder adopters have also adopted PUSA decomposer. The cost of application of this technology is very less (Rs. 20 per pouch of 4 capsules for one hectare with 10-12 tonnes of straw and labour cost of spraying). It was found that around a half of the users were fully satisfied with the use of technology and especially the large farmers are more satisfied than the small farmers (Table 5). Further, more than a half of the farmers were found partially satisfied with this technology. More dissatisfied farmers lied in the category of small (75%) and decreased to 36 per cent in large category. Burning was reported as the predominant practice by 53 percent of partially satisfied farmers. The farmers engaged in stubble burning were relatively higher in small and semi medium categories and less in medium and large farmers. Around one-third of partially satisfied farmers reported extra ploughing to manage paddy straw. Although more than a half of the farmers were reported to be not satisfied by the efficacy of PUSA decomposer, the realization of wheat yield was found to be more on PUSA decomposer adopter farms. PUSA decomposer adopters realized higher yield by 0.30 qtl per ha, which highlights potential economic advantage along with environmental and soil health advantages.

Constraints to adoption of Happy Seeder and PUSA Decomposer

Under accessibility of Happy Seeder by farmers, four major constraints were identified like high operational cost of Happy

Table 4. Partial budgeting of the Happy Seeder adoption

	Additional income	Rs/ha	Reduced income	Rs/ha
Grain yield (4.00 qtl/ha)	8223	-	-	-
Total added income (A)	8223		Total reduced income (C)	-
Reduced cost	Rs/ha		Additional cost	Rs/ha
Human labour (32.7 hrs/ha)	2062		Human labour (7.5 hrs)	472
Ploughing (4.4 No./ha)	5520		Happy Seeder use	5070
Seed (12 kg/ha)	427		Fertilizer use	374
Irrigation per ha	790		Plant protection chemical	1032
Total reduced cost (B)	8799		Total added cost(D)	6948
Total gain (A+B)	17022		Total added cost (C+D)	6948
Net Benefit per ha (Total Gain –Total added cost)				10074

Table 5. Adoption of PUSA decomposer for straw management

Row Labels	Small	Semi-medium	Medium	Large	Grand Total
PUSA decomposer user (No.)	8	10	34	14	66
Fully satisfied (decomposed properly) (%)	25	50	47.10	64.30	48.50
Partially satisfied (not decomposed properly) (No.)	75	50	52.90	35.70	51.50
Straw management by partially satisfied farmers					
Burnt (%)	83.30	80	38.90	40.0	52.90
Manually cleaned (%)	16.60	-	22.20	-	14.70
Extra ploughing (%)	-	20	38.90	60.0	32.40

Source: Compiled from field survey, 2022

Seeders, delay in payment of subsidies, cumbersome procedure for availing subsidy, the lack of timely availability of Happy Seeders and the requirement of high power tractors to operate Happy Seeders. The higher weed infestation was identified as post-adoption constraints. Poor seed germination was not a major constraint hindering the adoption of Happy Seeder. The small farmers ranked the perceived bias of CHC to large farmers as an impediment in adoption of CHC technologies. These findings are similar with that of Chaudhary et al., (2019).

Custom hiring centers are key stakeholders in scaling up the adoption of CRM technologies. Examining the constraints faced by custom hiring centers for Happy Seeders would prove vital in enhancing the efficacy of custom hiring centers. The delay in disbursement of subsidies by government agencies was a major constraint hindering the operational efficacy of custom hiring centers. Custom hiring centers also rank difficulties in obtaining credit as a major constraint, while the seasonal nature of demand for Happy Seeders often affect the finances of these institutions. The lack of support from local Government institutions also limits the operational efficacy of custom hiring centers. Delay in return of equipment by farmers and farmers returning the equipment in poor condition were also ranked high among operational constraints of custom hiring center.

Farm households owning Happy Seeders rely on rental services of Happy Seeder as an alternative source of income and have emerged as prominent service providers. Among the sampled farm households, ten households were engaged in providing rental services to neighboring farm households. The disparity in subsidy amount given to CHC and farmers was ranked a major concern by farmers engaged in rental services. Custom hiring centers avail a subsidy of 80 per cent while farm are beneficiaries of 50 per cent subsidy. Nearly, 80 per cent of the households faced credit constraints, while 50 per cent reported an increase in wear and tear of machines on account of rental services. The delay in payment for rental services by kith and kin were deemed to affect the financial viability of rental services by nearly three fifth of the farmers.

PUSA decomposer user and aware-non user farmers' perceptions on adoption of PUSA decomposer were recorded and most of the respondents revealed that the need of extra irrigation and the time of about 25 days for proper decomposition as the major hindrance as they cannot wait and delay wheat sowing. Poor know how of this technology and accessibility were opined to be other factors for either poor or non-adoption or partial satisfaction after adoption of Pusa decomposer.

CONCLUSION

In-situ residue management of paddy straw by use of Happy Seeder has garnered satisfactory level of acceptability among the farmers. Although, Happy Seeder adoption led to considerable reduction in irrigation, machine and labour expenditure, adopters were found to have more expenditure on plant protection and fertilizers. The total cost of cultivation of wheat on Happy Seeder adopted farms was found to be lower than that of non-adopters and they realized more yield of about 4 quintal per ha. PUSA decomposer was adopted by a good proportion of farmers and generated additional yields. However, more than a half of the

adopter farmers were found partially satisfied with the efficacy of PUSA decomposer. Therefore, educating the farmers by using multi-media and training camps regarding the consequences of stubble burning on environment and soil health and potential benefits of adoption of these technologies will help to reduce the menace of straw burning.

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Development and Validation of Farmer's Attitude Scale towards Anand Agricultural University

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ARTICLE INFO

Keywords: Attitude, Anand Agricultural University, Farmers, Scale product method, Reliability, Validity

<http://doi.org/10.48165/IJEE.2023.59326>

Conflict of Interest: None

ABSTRACT

Anand Agricultural University is a premier agricultural university in India. The purpose of this study was to develop a valid and reliable instrument for assessing farmers' attitudes toward Anand Agricultural University. The scale product method was used to construct the scale. It is a hybrid of the Likert and Thurstone techniques. A comprehensive list of 33 statements was prepared and finally, 26 statements were selected as they were found to be non-ambiguous. Based on the S value and Q value, 14 statements including 11 positive statements and 3 negative statements were chosen to construct a scale that would assess the attitude of farmers towards Anand Agricultural University. The scale was found reliable, with a reliability coefficient (0.827). The scale's validity was evaluated using expert judgment. This scale may be used to measure farmers' attitudes towards similar institutions or domains with suitable modifications.

INTRODUCTION

Anand Agricultural University is an esteemed agricultural institution in India with a rich history of over 75 years. It is widely recognized as a top-tier institution for agricultural education, research, and extension services. The university aims to assist the farming community in three key areas: education, research, and extension, focusing on fields such as agriculture, horticulture, food processing technology, agricultural engineering, agricultural information technology, and agri-business management. The university covers nine districts in Central Gujarat, including Ahmedabad, Anand, Botad, Chhotaudepur, Dahod, Kheda, Mahisagar, Panchmahals, and Vadodara encompassing 17.41 per cent of the state's geographic area (3.413 million hectares) (Anonymous, 2022). The Anand Agricultural University aims to promote the use of modern agricultural technologies that are location-specific, cost-effective, and readily accepted by farmers. Agriculture research and development plays a crucial role in addressing key societal issues, including sustainability, nutritional

security, climate change, and energy conservation. Over time, agricultural research has expanded its scope to become more multidisciplinary, inclusive, and integrative. The university places a strong emphasis on broadening its research activity to help farmers in the state double their income by overcoming production constraints. Anand Agricultural University is well-positioned to meet the needs of farmers in the region, conducting research in areas such as soil and water management, organic farming, post-harvest technology, animal husbandry, biotechnology, climate change, soil health, food quality, and seed production. An institution dedicated to leveraging scientific and innovative approaches to advance societal prosperity and enhance farmer welfare since its inception. Keeping these things in view, the researcher has decided to develop the scale to measure attitude of farmers towards Anand Agricultural University.

METHODOLOGY

Attitude refers to the degree of the positive or negative effect associated with some psychological object (Thurstone, 1946). In

this study, an attempt has been made to develop a scale, which can scientifically measure the attitude of farmers towards Anand Agricultural University. Among the techniques available for the development of the scale, Thurston's equal appearing interval scale (1928) and the Likert's summated rating scale (1932) are quite well known. However, both the methods suffer from limitations, the first one in getting a discriminating response and the second one in the selection of items. Thus, the technique chosen to develop the attitude scale was 'Scale Product Method' which combines Thurston's technique of equal appearing interval scale for selection of the items and Likert's techniques of summated rating for ascertaining the response on the scale as proposed by Eysenck & Crown (1949). To create a reliable and valid attitude scale, the Scale Product Method was applied (Chauhan et al., 2016). A systematic procedure was followed for the scale construction as followed by Kumar et al., (2016); Gupta et al., (2022); Vijayan et al., (2022); Sherin et al., (2023). The steps followed to develop the scale were standard steps ranging from item selection, judges ratings, determination of scale and quartile value, reliability and validity testing and finally categorisation/weight assigning.

RESULTS AND DISCUSSION

The first step in developing an attitude scale is selecting statements or items. 33 statements related to farmers' feelings towards Anand Agricultural University were collected from literature, advisors, experts, and extension personnel. These statements were edited according to Thurston and Chave's, Likert's and Edward's criteria, resulting in the selection of 26 non-ambiguous statements for the scale. A panel of 50 judges consisting of extension educationists and social science experts from Anand Agricultural University and other universities were selected to rate each statement on a five-point equal appearing interval continuum from 'Strongly agree' to 'Strongly disagree.' Judges were visited personally and provided with instructions for rating the statements.

Determination of scale and quartile value

Based on the judgment of the 50 judges for each statement, the median value (S value) of the distribution and the quartile (Q value) for the statement were calculated for each statement. Then the interquartile range was worked out by taking the difference between C_{75} (Q_3) and C_{25} (Q_1), that means $Q = C_{75} - C_{25}$ for the each statement. Formulas of Median value (S value) and quartile (Q value):

$$S = L + \frac{0.50 - \sum Pb}{P_w} \times i$$

Where, S = Scale value, L = The lower limit of the interval in which the median falls, $\sum Pb$ = The sum of the proportion below the interval in which the median falls, P_w = The proportion within the interval in which the median falls, i = The width of the interval and is assumed to be equal to 1 (one).

$$C_{25} = L + \frac{0.25 - \sum Pb}{P_w} \times i$$

Where, C_{25} = The median or scale value of the statement, L = The Lower limit of the interval in which the 25th centile falls, P_b = The

sum of the proportion below the interval in which the 25th centile falls, P_w = The proportion within the interval in which the 25th centile falls, i = The width of the interval and is assumed to be equal to 1 (one).

$$C_{75} = L + \frac{0.75 - \sum Pb}{P_w} \times i$$

Where, C_{75} = The median or scale value of the statement, L = The Lower limit of the interval in which the 75th centile falls, P_b = The sum of the proportion below the interval in which the 75th centile falls, P_w = The proportion within the interval in which the 75th centile falls, i = The width of the interval and is assumed to be equal to 1.0 (one).

$$Q = C_{75} - C_{25}$$

The final statement for the attitude scale

Statements were selected for the attitude scale based on the degree of agreement or disagreement among judges. Only statements with median values (S value) greater than Q values were chosen, but if some statements had similar scale values, those with the lowest Q values were selected. Based on these criteria, 14 statements were selected to form the attitude scale.

Establishing reliability and validity of the scale

Fourteen statements were selected for the final attitude scale and arranged randomly to prevent response biases that could affect reliability and validity. Eleven statements reflected a favorable attitude, while three indicated an unfavorable attitude. The five-point Likert continuum, which includes strongly agreed, agree, undecided, disagree, and strongly disagree, was used to represent agreement and disagreement with the statements. For favorable statements, weights of 5, 4, 3, 2, and 1 were assigned, while weights of 1, 2, 3, 4, and 5 were assigned for unfavorable statements. The weights of Likert's and Thurstone's techniques were combined, and an individual's total score was the sum of the product.

To ensure consistency in results, a reliable scale produces the same outcomes when applied to the same sample. Split-half method was used in this study. The 14 statements were split into two halves with 7 odd-numbered and 7 even-numbered statements and given to 20 respondents. Each half was treated as a separate scale, and the subscales were correlated, resulting in a reliability coefficient of 0.827 using Rulon's formula. The scale was found to be highly reliable.

$$\text{Rulon's Formula: } r_{tt} = 1 - \frac{\sigma^2 d}{\sigma^2 t}$$

Where,

$$\sigma^2 d = \frac{\sum d^2 - \frac{(\sum d)^2}{20}}{20} \quad ; \quad \sigma^2 t = \frac{\sum t^2 - \frac{(\sum t)^2}{20}}{20}$$

Where, R_{tt} = Coefficient of reliability, $\sigma^2 d$ = Variances of differences, $\sigma^2 t$ = Variance of total score

The validity of the scale was examined for content validity. The content was selected by discussing it with 20 specialists of extension and academicians of Anand Agricultural University. Thus, the present scale was also satisfied the content validity.

Table 1. The scale to measure the attitude of farmers towards Anand Agricultural University

S.No.	Statements	Scale Value (S)	Interquartile Value (Q)
1	AAU is a lighthouse for farmers to resolve agricultural problems.	1.30	0.97
2	AAU brings desirable changes in the thought process of farmers.	1.72	1.02
3	AAU helps farmers to become self-reliant.	1.58	1.03
4	AAU helps farmers in developing a scientific point of view.	1.46	1.12
5	Training given by the scientists of AAU is most practical to adopt.	1.69	1.19
6	AAU is beneficial to only resourceful farmers. (-)	2.50	1.94
7	AAU is a powerhouse to understand innovative farm ideas.	1.83	1.12
8	The association with AAU helps farmers to learn scientific managerial abilities.	1.70	1.02
9	AAU scientists are not wisdom-oriented to inculcate farming skills amongst the farmers. (-)	2.28	2.25
10	AAU is failed to magnetize the new generation towards farming. (-)	2.31	2.02
11	AAU scientists to improve my farming occupation.	1.59	1.11
12	Farm technologies developed by AAU are more advantageous.	1.54	1.06
13	AAU is the ultimate source to solve farmers' problems.	1.75	1.02
14	Publication of AAU farm literature are worthwhile to solve farmer's field problems.	1.39	1.14

Administering the scale

The final scale measures the attitude of farmers towards Anand Agricultural University using 14 statements on a five-point continuum from 'Strongly agree' to 'Strongly disagree' with weighted score of 5,4,3,2 and 1 for positive and reverse to negative statements. Respondents received a score ranging from 14 to 70. Using an arbitrary classification method, respondents were categorized into five categories.

S.No.	Categories	Score
1	Strongly unfavorable	Up to 14
2	Unfavorable	14.01 to 28
3	Neutral	28.01 to 42
4	Favorable	42.01 to 56
5	Strongly favorable	Above 56.00

CONCLUSION

The scale's development and standardisation aim to promote research into the behavioural aspects of Anand Agricultural University. Scale product method was used to develop the attitude scale, wherein 33 statements were initially drafted. After the refinement made by experts and criteria, 26 statements were retained. Further, based on the S value and Q value, the statements were refined to 14 (11 positive statements and 3 negative statements). The developed tool has a reliability coefficient of 0.827, which may be described as highly consistent and thus usable in a variety of scenarios. These findings establish the utility of the scale in measuring farmer attitudes in future studies. As such, researchers may consider utilizing this scale to measure farmer attitudes towards similar institutions or domains.

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Construction of Scale to Measure Women Farmers' Attitude towards Climate Resilient Dairy Farming Practices

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ARTICLE INFO

Keywords: Attitude, Scale, Climate resilient dairy farming practices, Women dairy farmers

<http://doi.org/10.48165/IJEE.2023.59327>

Conflict of Interest: None

ABSTRACT

Understanding farmers' attitude is instrumental in initiating/formulating any strategy to promote the adoption of technology. A scale was developed to analyze the attitude of women farmers towards climate-resilient dairy farming practices. A list of 50 statements comprising both positive and negative statements were collated and refined based on Edward's 14 principles and 35 statements were retained for administering to women farmers from non-sampling area for further analysis. Finally, "t" value for each statement, and found that 17 statements were having "t" value greater than 1.75. The 17 statements were retained for the final scale and administered for reliability and validity testing. Cronbach alpha coefficient of 0.786 confirmed the internal consistency of the developed scale. The content validity of the scale was ascertained based on the judgment of the experts. The final developed scale can be used to measure the attitude of women farmers on climate-resilient dairy farming practices in the present context and beyond the study area with modifications.

INTRODUCTION

Inter-Governmental Panel on Climate Change (IPCC, 2014), in the year 2014, reported that agriculture sector has been severely impacted by climate change which in turn poses major threat to food security and livelihood of millions of people across the world. Major risks include an increase in diseases in crops, fishery and animal husbandry (Sarkar et al., 2010). Livestock play a major role in the agricultural sector in developing nations, and the livestock sector contributes 40 per cent to the agricultural GDP (Gross Domestic Product). Global demand for foods of animal origin is growing and it is apparent that the livestock sector will need to expand (FAO, 2009). Livestock are adversely affected by the detrimental effects of extreme weather. Climatic extremes and seasonal fluctuations in herbage quantity and quality will affect the well-being of livestock, and will lead to declines in production and reproduction efficiency (Sejian, 2013). Climate change is a

major threat to the sustainability of livestock systems globally. Consequently, adaptation to, and mitigation of the detrimental effects of extreme climates has played a major role in combating the climatic impact on livestock (Sejian et al., 2015). The difficulty livestock facing is weather extremes, e.g., intense heat waves, floods and droughts. In addition to production losses, extreme events also result in livestock death (Gaughan & Smith, 2015). Dairy farming is vulnerable to climate change through increased temperatures and changes in rainfall patterns. These factors adversely affect feed and water availability, animal health, breeds and in turn milk production. Warmer and drier conditions increase the likelihood of heat stress in cattle. Heat stress adversely affects productive and reproductive performance in dairy animals (Van den Bossche & Coetzer, 2008).

Dairying is one of the important enterprises, which supports the rural households by providing gainful employment and steady income. Women in India play a predominant role in agricultural

production (Bhati et al., 2023) and women's involvement in livestock management is a longstanding tradition. There is considerable evidence to show that livestock and management related activities continue to be predominately rural women's responsibility and domain. Women generally are responsible for the feeding, grazing, fodder collection, milking, processing, dung management, while men who manage the finances generally sale of milk and milk products (Sethi, 2010). They constitute 71 per cent of the labour force in livestock farming. In India, about 75 million women are engaged as against 15 million men in dairying (Thakur & Chander, 2006). Increasing demand for milk and milk products in recent years intensifies dairy farming as profitable enterprise for women (Mohapatra et al., 2012).

A multi-pronged strategy should be adopted by extension agencies to prepare farmers for fight against the adverse effects of climate change. Changing their attitudes towards adoption various practices available is one of the important strategies (Bharat et al., 2021). Understanding the attitude of farmers will provide an important information in developing policy planning (Saji et al., 2023). Keeping the vital role played by women in the dairy farming, it is imperative to understand the attitude of women dairy farmers towards climate resilient dairy farming practices

METHODOLOGY

An attempt was made to measure the attitude of women dairy farmers towards climate resilient dairy farming practices. Likert's Summated Rating method was used to construct a scale for the purpose. Likert scale is a subject-centered/individual differences among respondents with respect to their possession or standing on a particular attribute or aspect (Ramya et al., 2019). The methodology followed by Kumar et al., (2016); Gupta et al., (2022), Vijayan et al., (2022) were followed. Likert scales with a five or seven point continuum can generate adequate variance for examining the relationships among items and scales, and create adequate internal consistency (Lissitz, 1975) and in this paper we went ahead with five point continuum.

Item analysis was performed with the responses from 60 women dairy farmers (random selection) from Uchana and Budha Khara villages around Karnal city which were from non-sampling area. To proceed further with item analysis an exhaustive list of statements that would measure the attitude were collected from literature, self-experience and by consulting experts, researchers and other relevant professionals of extension education and climate resilient dairy farming. A total of 50 statements were collected for the construction of scale and the statements were refined on the 14-point criteria given by Edwards (1957) for construction of scale statements and accordingly 15 statements were eliminated after screening and 35 statements were retained for item analysis.

RESULTS AND DISCUSSION

Base on the opinion of experts, a total of 35 items which were relevant to the construct were retained. Finally, the 35 statements were administered to 60 women farmers from a non-sampling area and responses for each item were collected on a five-point continuum i.e., Strongly agree, Agree, Undecided, Disagree

and Strongly disagree with scores 5, 4, 3, 2 and 1 respectively. Scoring was given in reverse order for the negative statements. Scores of all the respondents were summed up to get a total score and then respondents were arranged in descending order. For calculation of *t* – values the top 25 per cent and lowest 25 per cent of the respondents were selected as criterion groups. The *t*-value for each statement was calculated (Table 1) by using following formula to distinguish between respondents having high and less favorable attitude towards climate resilient dairy farming practices.

$$t = \frac{\bar{x}_H - \bar{x}_L}{\sqrt{\frac{\Sigma(x_H - \bar{x}_H)^2 + \Sigma(x_L - \bar{x}_L)^2}{n(n-1)}}$$

Where,

$\bar{x}_H$ = Mean score of a given statement for the high group

$\bar{x}_L$ = Mean score of a given statement for the lower group

$$\Sigma(x_H - \bar{x}_H)^2 = \Sigma x_H^2 - \frac{(\Sigma x_H)^2}{n}$$

$$\Sigma(x_L - \bar{x}_L)^2 = \Sigma x_L^2 - \frac{(\Sigma x_L)^2}{n}$$

n = number of respondents

The 't' value indicates a measure of extent to which a given statement differentiates between high score and low score groups. As a crude and approximate rule of thumb, we may regard any 't' value equal to or greater than 1.75 as indicating that the average response of high and low groups to a statement differs significantly. Through item analysis It was found that 17 statements were having "t" values greater than equal to 1.75 which indicated that these statements were having capacity to differentiate between favorable attitude and unfavorable attitude. Therefore, these 17 statements were included in the final developed scale (Table 1). Statements with negative value (statement number 18, 19, 30 and 35) were also dropped from the final scale as these statements expressed in opposite direction. Reliability and validity of the final scale was established through appropriate procedures.

Reliability refers to the consistency between multiple measurements of a variable. Cronbach alpha (Internal consistency) coefficient was used to determine the reliability of the measuring instrument. Cronbach alfa coefficient was calculated using SPSS tool and the coefficient was found to be 0.786 which was good enough to prove that the scale is a reliable one. The ideal value of Cronbach alpha value in research is more than or equal to 0.7 and in some cases a Cronbach coefficient of 0.6 and more is also considered good enough to prove the reliability of the measuring instrument (Nunnally & Bernstein, 1994). Calculated Cronbach alpha coefficient of the developed scale was found to be 0.786 which was good enough to prove that the developed scale was a reliable one.

A scale is said to be valid, if it measures what it is supposed to measure. It is the extent to which a scale accurately represents the concept or construct of the interest. The content validity is the sampling adequacy or representative nature of the content in scale to the content of the universe. Content validity of the present scale was ensured by collecting statements from relevant literature and by consulting experts.

Table 1. Scale to measure the attitude of farmers towards climate resilient dairy farming practices with their respective 't' values

S.No.	Statement	t -value
1.	Climate resilient dairy farming practices can only be followed by resource rich farmers.	2.218
2.	Climate variation is a normal phenomenon and there is no need to be much concerned about the same.	3.207
3.	Animals have innate capacity to adapt to changing climate and there is no need to follow a specific climate resilient practice.	2.268
4.	Climate resilient practices increase cost of production while profits from increased milk production are minimal.	4.563
5.	Gender is a major concern for adoption climate resilient dairy farming practices.	4.000
6.	Climate resilient dairy farming practices put additional burden on women farmers.	5.330
7.	Though women spend much of the time in dairy farming, when it comes to decision making regarding management of animals men have upper hand.	2.88
8.	Lower socio-economic position of women is hindering adoption of climate resilient practices in dairy farming.	3.118
9.	More women centric trainings should be conducted for better adoption of the practices.	2.477
10.	Preparation of milk primary milk products like khoa, ghee, paneer etc is utmost necessary to enhance the shelf life of milk.	4.486
11.	Value addition of milk will be a potential source of income as climate change is posing a threat to the livelihoods of women.	3.928
12.	Indigenous breeds are comparatively more resistant to changing climate, but, their lower milk productivity may little influence in improving adaptive capacity.	1.870
13.	Dairy animals should have innate resistance to adverse impacts of climate change and adopting climate resilient practices will not help.	2.594
14.	Climate change is just a seasonal variation and no need to take extra care for animals as they themselves can adapt to it.	2.522
15.	One needs to have some expertise in identifying the symptoms of impact of climate change on dairy animals.	4.000
16.	Emphasis should be given to promote climate resilient dairy farming practices made of locally available low-cost resources.	3.162
17.	Frontline demonstration of the climate resilient dairy farming practices may improve its adoption.	3.162

CONCLUSION

In conclusion, it is crucial for extension organizations and policy makers to study the attitude of women dairy farmers towards climate-resilient dairy farming practices. The participation of women in the agricultural workforce is significant and necessary for achieving gender equality in the sector. Additionally, climate change poses a significant threat to dairy farming, and farmers need to adopt climate-resilient practices to adapt to changing conditions. By understanding the attitudes of women dairy farmers towards these practices, extension organizations and policy makers can design interventions that are more gender-sensitive and effective. This will not only benefit the farmers themselves but also contribute to the overall sustainability of the dairy farming industry.

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Constraint Analysis by Faculty of SAUs for Strengthening Organizational Climate in Karnataka

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ARTICLE INFO

Keywords: Organisational climate, Faculty perception, Job satisfaction, Workplace relation, Motivation

<http://doi.org/10.48165/IJEE.2023.59328>

Conflict of Interest: None

ABSTRACT

The study aimed to evaluate the perception of faculty members towards the organizational climate by evaluating the constraints and finding the suggestions in three colleges, namely UAS Dharwad, UHS Bagalkot, and KVAFSU Bidar, during the academic year 2020-2021 in Karnataka. The researchers used a pre-set scale consisting of 32 items that represented six organizational climate characteristics, viz. communication, supervision, decision-making, motivation, guidance, and organization management. A total of 135 faculty members participated in the study, and personal interviews were conducted to collect the data. The results revealed that the majority of faculty members faced challenges such as poor workplace relations, lack of motivation and appreciation for their achievements, improper communication of work-related information, and lack of guidance from superiors in difficult situations that hampered the organizational climate. To foster a cordial climate within the organization, faculty members suggested fostering friendly relationships among faculty and building trust, the head's encouragement for good deeds, reward and incentive programs, and weekly faculty group meetings were suggested to increase motivation and appreciation for achievements.

INTRODUCTION

Organizational climate refers to the collective perceptions of organizational policies, practices, and procedures, both formal and informal, that affect employee satisfaction (Borah, 2019). Murugesan & Kannan (2014) noted that positive employee satisfaction with the organizational climate can lead to improved organizational outcomes, such as effectiveness, productivity, organizational commitment, and co-workers' cohesion. Rajandeeep (2017) emphasized that faculty members' actions, beliefs about their responsibilities, and overall value of their work within and outside of the organization significantly impact their work quality and outcomes (Harmsen et al., 2019). The organizational climate can also serve as a tool to address issues such as poor job motivation, interpersonal conflicts, power struggles, and

management relationships (Garbyal et al., 2018). As such, it can be considered a powerful tool for managing and improving organizational performance (Sidhu et al., 2014).

Organizations are complex social systems composed of individuals with various roles, interdependencies, and shared objectives (Prasantha, 2017). The organizational environment shapes employee behaviour, influencing their motivation and work satisfaction. The organizational climate of State Agricultural Universities (SAUs) requires in-depth examination due to the unique role and duties of faculty members as teachers, scientists, and extension workers (Aysen, 2018). Several models have been proposed to understand organizational climate, such as Likert's (1967) six components viz. leadership, motivation, communication, decisions, goals and control. Litwin and Stringer's (1968) seven dimensions viz. conformity, responsibility, standards, rewards,

organizational clarity, warmth and support, and leadership. Research has also been conducted to explore the organizational environment using different dimensions, such as the twelve dimensions viz. orientation, interpersonal relationship, supervision, problems, management of mistakes, conflict management, communication, decision making, trust, risk taking, innovation and change Pareek et al., (1981). Therefore, a comprehensive analysis of the organizational environment in SAUs is needed to identify critical dimensions and improve working conditions and productivity (Patil, 2017).

To improve working conditions and productivity in the agricultural education system, an in-depth examination of the organisational climate of these institutions is required (Sayanika, 2013). This assessment would allow SAUs that have been structured, as well as other entities outside of the ICAR system, to identify critical dimensions of organisational climate and bridge the gap between the current and expected organisational climate (Jayasingh et al., 2022). Critical analysis of organizational climate is especially important for SAUs since faculty members take on multiple roles beyond just being teachers, scientists, or extension workers (Win et al., 2020). The organisational climate affects individual motivation and job satisfaction, which ultimately impacts individual performance (Tripathy et al., 2022).

Therefore, the current study was conducted to examine Constraints encountered by faculty of three state agricultural universities representing the north, east, and west zones of the Karnataka state. The primary objective of this research was to investigate the constraints perceived by the faculties of SAUs with the goal of suggesting some remedial measures to improve the working conditions and productivity of these institutions.

METHODOLOGY

The study specifically focused on three universities in the state of Karnataka, namely the University of Agricultural Science, Dharwad, University of Horticultural Science, Bagalkot, and Karnataka Veterinary Animal and Fisheries Science University (KVAFSU), Bidar. These universities were selected with the intention of comparing organizations that cover three aspects of farming, including agriculture, horticulture, and veterinary. The research design is a crucial aspect of the research methodology. The study aimed to determine how faculty at SAUs perceived the organizational climate. To achieve this objective, an ex-post facto research design was employed. The Registrar's offices at the individual universities were contacted to obtain a list of faculty members employed at these universities. The random sampling technique was utilized to select 45 faculty members from each of the three universities. A total of 135 faculty members were included in the sample size. The distribution of sample respondents was based on their level of experience.

Bottom of Form

A draft questionnaire was developed with the study's objectives and data requirements in mind. The questionnaire was pretested with the assistance of experts, and modifications were made in response to the pre-test findings. Respondents were provided with questionnaires and self-addressed envelopes to return

the completed questionnaires to the researcher. For identifying the problems, some of the statements regarding the problems that are frequently faced by the Teachers were provided under four-point continuum via., 'To a Great extent', 'To a moderate extent', 'To a least extent' and 'Not at all a problem' with the scores of 4, 3, 2 and 1 assigned to them respectively. Appropriate ranks were allotted to them on the basis of mean of total sum of scores for each of the problem statements where high score indicates great extent of the problem and vice-versa.

The statements containing the suggestions that are regularly suggested by teachers were given to mark under four-point continuum as 'needs great attention', 'needs moderate attention', 'needs least attention' and 'does not need any attention' with a scores of 4, 3, 2 and 1 respectively. Later the mean scores for each statement by all the teachers were calculated and the statement showing high mean score was regarded as the suggestion that needs greater attention. Similarly, all the statements were ranked based on the mean scores acquired.

RESULTS AND DISCUSSION

The results in Table 1 represent the constraints encountered by faculty members of state agricultural universities. The table shows the mean score of each constraint, rounded to two decimal places. It gives a clearer picture of the relative severity of the constraints. The highest mean score was observed for the constraint of poor cordial atmosphere inside the organization, with a score of 3.63. This implies that faculty members face challenges in their work due to a lack of a friendly and supportive environment within the organization. A positive work environment is essential for the well-being of employees and can significantly impact their job satisfaction, productivity, and overall performance. Therefore, addressing this constraint should be a top priority for the management of these universities. The second highest constraint identified by the faculty members was the lack of motivation and appreciation for their success, with a mean score of 3.53. This indicates that the faculty members feel undervalued and underappreciated for their efforts and achievements, which can lead to a lack of motivation and disengagement from their work. Providing regular feedback, recognition, and opportunities for growth and development can help boost their morale and job satisfaction.

The third constraint identified was related to the communication of work-related information, with a mean score of 2.42. This indicates that faculty members face challenges in accessing and sharing relevant information that impacts their work. Effective communication is crucial for the smooth functioning of any

Table 1. Constraints encountered by faculty of state agricultural universities

Constraints	Mean Score
Poor cordial atmosphere inside organization.	3.63
Lack of motivation and appreciation for success of faculty.	3.53
Information related to work is not properly communicated	2.42
Superior is not guiding faculty in problematic situations.	1.28
Discrimination between subordinates and superiors.	1.21

organization, and the management should take measures to ensure that the faculty members have access to the information they need to perform their duties efficiently. The fourth and fifth constraints identified were the lack of guidance from superiors in problematic situations and discrimination between subordinates and superiors, respectively, with mean scores of 1.28 and 1.21. These constraints imply that the faculty members feel unsupported and treated unfairly by their superiors, which can lead to low job satisfaction and a lack of trust in the management. Addressing these constraints requires a cultural shift towards a more supportive and inclusive work environment that values diversity and equity.

In conclusion, the survey results highlight several constraints faced by faculty members of state agricultural universities, including poor cordial atmosphere, lack of motivation and appreciation, communication-related issues, lack of guidance, and discrimination. Addressing these constraints requires a multi-faceted approach that involves creating a positive work environment, providing regular feedback and recognition, improving communication channels, and fostering a culture of inclusion and equity. These measures can help boost job satisfaction, productivity, and performance among faculty members and contribute to the overall success of these universities. The results yielded from the investigation were in supportive to that of Slathia et al., (2012) & Fazely (2016).

Table 2 provides a list of suggestions given by faculty members of state agricultural universities to address the constraints they face in their work. The table presents five categories of suggestions, along with their mean scores. The first category of suggestions is to promote a cordial atmosphere inside the organization. This category includes two suggestions, namely building trust between faculty members and creating a friendly relationship between faculty members, with mean scores of 3.22 and 3.46, respectively. These suggestions reflect the importance of creating a positive work environment where faculty members feel supported and valued. Building trust and fostering friendly relationships can improve communication, collaboration, and teamwork, leading to increased job satisfaction and productivity.

The second category of suggestions is to strengthen motivation and appreciation for the success of faculty members. This category

includes two suggestions, namely providing motivation by the head for good work and offering reward and incentive facilities for faculty motivation, with mean scores of 2.73 and 3.30, respectively. These suggestions highlight the need for recognizing and rewarding faculty members for their hard work and achievements. Providing motivation and incentives can boost morale and job satisfaction among faculty members, leading to increased productivity and performance. The third category of suggestions is to favour the communication of work-related information. This category includes one suggestion, namely organizing weekly group meetings between superiors and subordinates, with a mean score of 3.45. This suggestion emphasizes the importance of effective communication in the workplace. Organizing regular group meetings can help facilitate the sharing of information and ideas, leading to better decision-making and problem-solving.

The fourth category of suggestions is to provide guidance to faculty members in problematic situations. This category includes two suggestions, namely allowing subordinates to speak freely with their superiors about their problems and improving teamwork in the workplace, with mean scores of 3.33 and 2.23, respectively. These suggestions highlight the need for a supportive and collaborative work environment where faculty members feel comfortable sharing their concerns and working together to solve problems. The fifth and final category of suggestions is to create an atmosphere of equal treatment for superiors and subordinates. This category includes two suggestions, namely considering all the suggestions of subordinates and encouraging superiors to support their subordinates, with mean scores of 3.45 and 2.32, respectively. These suggestions emphasize the importance of creating a culture of inclusion and equity in the workplace, where everyone's opinions and contributions are valued and respected.

In conclusion, the suggestions provided by faculty members of state agricultural universities highlight the need for creating a positive work environment that fosters trust, communication, motivation, and collaboration. The suggestions can be implemented by the management of these universities to address the constraints faced by faculty members and improve their job satisfaction and performance. By creating a supportive and inclusive work environment, state agricultural universities can attract and retain

Table 2. Suggestions enlisted by faculty of state agricultural universities

S.No.	Suggestions	Mean Score
1.	To promote cordial atmosphere inside organization	
A.	Build trust between faculty	3.22
B.	Create friendly relationship between faculty members	3.46
2.	To strengthen motivation and appreciation for success of faculty	
A.	Motivation by head for good work	2.73
B.	Reward and incentive facilities for faculty motivation	3.30
3.	To favour communication of work-related Information	
A.	Weekly group meetings between superior and subordinate	3.45
4.	For guiding of faculty in problematic situations by the superior	
A.	Subordinate free to speak their problems with superiors	3.33
B.	Improve team work in work place	2.23
5.	To create an atmosphere of equally treating superiors and subordinates	
A.	Consider all the suggestions of subordinates	3.45
B.	Encouragement by superior to their subordinates	2.32

talented faculty members, ultimately leading to the success of these institutions. The results yielded from the investigation were in supportive to that of Kusumalatha (2018).

CONCLUSION

In conclusion, the study conducted an investigation into the perceptions of faculty members regarding the organizational climate at state agricultural universities in India. The study found that faculty members face various challenges in their work environment, including poor communication, lack of motivation and appreciation for their success, discrimination between superiors and subordinates, and inadequate guidance from superiors in problematic situations. The study identified several suggestions to improve the organizational climate, including building trust and creating friendly relationships between faculty members, providing motivation for good work, improving communication through weekly group meetings, encouraging subordinates to speak freely with superiors, improving teamwork, and treating superiors and subordinates equally.

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Purchasing Behaviour of Farmers for Bio-fungicide in Meerut District of Uttar Pradesh

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ARTICLE INFO

Keywords: Bio-fungicide, Rank based quotient, Garrett ranking, Factors, Satisfaction

<http://doi.org/10.48165/IJEE.2023.59329>

Conflict of Interest: None

ABSTRACT

In this study, an attempt was made to examine the variables affecting farmers' satisfaction with bio fungicide use, the variables affecting their buying behaviour for the product and constraints faced by the farmers in usage of bio-fungicides. A total of 100 farmers were selected on the basis of snowball sampling. RBQ mean was calculated to find out the most influencing factors for purchasing of bio fungicide by the farmers. Garrett's standard procedure was adopted to determine the significance of a number of different factors as expressed by respondents in the use of bio-fungicides. It was found that the retailers influence, quality, price of positives and the opinion leaders with implant agency were the important factors that affect the purchasing decision of farmers. Further, a substantial percentage of farmers in the research area were quite satisfied with the bio-fungicide's efficacy, followed by its relative quality and history of widespread usage.

INTRODUCTION

The bio-fungicide is created of useful fungi and microorganism that colonize and attack plant germs, therefore meddlesome with the diseases they cause. Bio-pesticide was discovered in Japan in the early 20th century and first became a commercial product in France in 1938 (Mullaney, 2011). Microorganisms (microbial pesticides) and naturally occurring substances with the capacity to manage plant diseases are collectively referred to as "bio fungicides" (Abbey et al., 2019). The term "bio-fungicides" refers to substances used to treat plant diseases that are made through microorganisms and their by-products (Francis & Keinath, 2010). The majority of the formulations in this category are thought to be ecologically pure because of their biological origins and extremely low active ingredient concentrations. Additionally to being barely harmful, these products have a variety of impacts on different diseases, boost plants' resilience to harmful elements, and seem to be less expensive (Khakimov et al., 2020).

As of 2018, the North Yankee Bio-fungicide market had USD 496.9 million and is anticipated to succeed in USD 1046.2 million

by 2024, with a CAGR of 13.2 per term (Research and Markets Report, 2019). The market for bio-fungicides in Asia Pacific is expected to grow rapidly during the monsoon season. Due to the growing demand for food crops, especially cereals and grains and increased awareness of the benefits of agrochemicals derived from farmers also increases the demand for bio-fungicides in Asia Pacific. Government support for funding and awareness programs to educate farmers about the harmful effects of chemical-based fungicides is estimated to further the popularity of bio-fungicides in Asia Pacific.

Fan et al., (2015) studied that understanding of farmers' behaviour in pesticide use is essential for promoting sustainable pest control and protecting the health of farmers and the environment. Vegetable and fruit growers had higher levels of education and knowledge than grain growers, but the first ones were less willing to reduce pesticide use for fear of lower profits and a lack of reliance on government and pesticide dealers. Liu et al., (2016) found that vegetable growers used lower levels of bio pesticide and 68.63 per cent of them would prefer to use bio pesticide if they differed slightly from pesticides in the production

process. Naginbhai (2017) found that farmers these days rely heavily on chemical inputs to increase agricultural production and have little interest in the use of organic inputs due to lack of awareness and unavailability of natural products in the local market. It is therefore necessary for an hour to inform the farming community about inputs. Ravi Kumar et al., (2015) pointed out that education, land grabbing size and the linking of the marketing agency were the most important factors influencing the acceptance of the use of bio pesticides. Partial budget estimates suggest the use of bio-pesticides, rice fungicides, growing turmeric and sugarcane is economically viable. High prices are a major barrier to the adoption of bio products quoted by farmers.

METHODOLOGY

For the purpose of this study, descriptive research design was considered. It comprises of survey and fact finding enquiries of different kinds. Farmers' primary data was gathered using pre-planned schedules. The study area was Meerut, district of Uttar Pradesh state as it has leading research and production centre for bio-agents located in Uttar Pradesh. A multistage sampling was adopted for the study. Uttar Pradesh state was selected on the basis of judgmental sampling (highest production area of the Sugarcane). Meerut district was selected on the basis of judgmental sampling (Potential consumption area of the bio-fungicide). Sardhana tehsil of Meerut district was selected on the basis of judgmental sampling (highest production of bio-fungicide area with usage of product). A total of 10 potential villages suggested by directorate of biocontrol S.V.P. Agriculture University. Ten farmers were selected from each villages based on snowball sampling method and hence, a total of 100 farmers were covered.

Various aspects affecting the performance of the bio-fungicide related were questioned to the farmers and the most effective feature was determined using the Rank Based Quotient mean method (Nisha & Vimalraj Kumar, 2019).

$$RBQ = \frac{\sum_{i=1}^n \frac{fi(n+1-i) \cdot 100}{Nn}}{Nn}$$

Where, fi= Number of respondents who recorded a certain element under its rank

N = Number of respondents,

n = Number of factors identified

A five point Likert Scaling method was used to study the level of satisfaction of farmers using bio-fungicides. In this way, sample respondents were asked to indicate by five points (Rensis Likert, 1932) whether they were very satisfied, satisfied, neutral, dissatisfied and very dissatisfied (Joshi et al., 2015). Rank Based Quotient (RBQ) was used by Gupta et al., (2013); Das et al., (2014); Yadav et al., (2018); Gireesh et al., (2019) & Gireesh et al., (2023) in their study to analyse the adoption and discontinuation of agricultural ponds.

Garrett's standard procedure was adopted to determine the significance of a number of different factors as expressed by respondents in the use of bio-fungicides. According to this method, respondents were asked to rank each element, and the results of these rankings were then transformed into score values using the subsequent method (Dhanavandan, 2016):

$$\text{Percent position} = \frac{100 (R_{ij} - 0.5)}{N_j}$$

Where, R_{ij} = Rank given for the i^{th} variable by j^{th} respondents
 N_j = Number of variables ranked by j^{th} respondents

RESULTS AND DISCUSSION

This study was designed to analyse the factors influencing purchasing behaviour for bio-fungicide in the study area, to assess factors influencing satisfaction level of farmers for bio-fungicide and constraints faced by the farmers in usage of bio-fungicides. The findings of the study are presented in Tables and relevant interpretations were drawn using the primary data collected from farmers and analysed using measurement models.

Factors influencing purchasing behaviour for bio fungicide usage

Table 1 depicts the factors influencing the modification of the reception of bio-fungicides depends on a variety of economic conditions. Equal significance of these items was categorized using RBQ Meaning as the discovery of bio-fungicide. The study revealed that the factors such as retailers influence, quality and price had positive influences on purchasing of bio-fungicides with mean value of 93.67, 92 and 89, respectively. The opinion leaders with the implant agency was an important factor with a positive impact and increased the chances of acquisition by 81. The factors such as brand image and packaging had positive effects on purchase of bio-fungicides, while media has least effect on adoption.

The results were supported by study of Sharma et al., (2020), in their study the buying behaviour of farmers concerning about agrochemicals use on rice crop in Punjab was analysed. The result of their study shows that half of the farmers favoured their peer farmers experience as their information source for agrochemicals, while less than half farmers preferred dealers recommendations. Whereas 16 per cent obtained information via demonstrations, out of which four per cent of the respondents referred that extension specialists forget the details of agrochemicals.

Factors influencing satisfaction level of farmers for bio-fungicide

Likert Scaling approach was used to study the satisfaction level of farmers using bio-fungicides. In this approach, the sample

Table 1. Analysis of factors determinant in purchasing of bio-fungicides

S.No.	Factors	Mean	Rank
1	Retailers influence	93.67	I
2	Quality	92.00	II
3	Price	89.00	III
4	Opinion Leaders	81.00	IV
5	Ready availability	77.00	V
6	Brand image	50.67	VI
7	Packaging	48.67	VII
8	Effective & ease of use	48.33	VIII
9	Advertisements	43.67	IX
10	Media	43.33	X

Source: Researcher's compilation from primary data

respondents were asked to indicate on a five point scale (Rensis Likert, 1932) whether they were highly satisfied, satisfied, neutral, dissatisfied and highly dissatisfied with the various attributes of bio-pesticides and fungicides. The responses were recorded and the scores were added to obtain the mean score towards the satisfaction level of the sample respondents. The score for each factor responses is given in the Table 2. Table 2 shows that the majority of farmers in the research area were quite pleased with the bio-fungicide's efficiency, followed by the product's general quality and continuous usage history. Conversely, equal percentages of the farmers were not satisfied with the price of the products. The result infers that the availability of product is not in line with its performance.

Table 2. Degree of satisfaction of farmers indicated by a score

S.No.	Factors	Score
1	Effectiveness	72.50
2	Overall quality	68.75
3	Regular usage experience	65.00
4	First use experience	63.75
5	Price of product	60.00
6	Availability of product	42.50

The results are supported by the research of Sahar et al., (2020), where it was found that the respondents were generally pleased with the response in terms of the play's technical information, the play's message's applicability, and the play's linguistic style. They liked how the street play was presented, how it addressed agricultural issues, and how it came at the right time.

Constraints faced by the farmers in usage of bio-fungicides

To study the constraints faced by the farmers in usage of bio-fungicide, six major factors were identified and farmers were asked to rank the factors according to their severity. The Garrett score of each factor was calculated and ranks were given (Table 3).

It was noticed from the Table 3, the lack of technical support was the major constraints faced by the farmers was ranked first. Storage and slow results were the other constraints and they were ranked second and third, respectively. Naik et al., (2022) in their study analysed the constraints faced by the farmers in adopting CRA technologies through Garrett's Ranking Method. The results shows that in socio-personal category of constraints, the major problem was inability of farmers to take risk which was given as rank I. In financial constraints the major constraints was inadequate institutional financial support which was given as rank I.

Table 3. Constraints faced by farmers in usage of bio-fungicides

S.No.	Factors	Garrett Score	Ranks
1	Lack of technical support	66.60	I
2	Storage	64.00	II
3	Slow results	62.53	III
4	Adequate unavailability	55.93	IV
5	Products are very expensive	39.37	V
6	Bad smell	33.47	VI

Source: Researcher's compilation from primary data

CONCLUSION

The study concluded that majority of the farmers (33%) who had >4 hectares of land uses bio-fungicide in the study area. Educational status and land holding size of farmers had positive influences on adoption of bio-fungicide by 86.47 per cent and 39.76 per cent, respectively. The contact of farmers with extension agency were the important factor positively influences and increases the probability of adoption by 57.66 per cent, whereas the land quality index has the least effect on adoption. A substantial percentage of farmers in the research area were quite satisfied with the bio-fungicide's efficacy, followed by its relative quality and history of widespread usage. Conversely, equal percentages of the farmers were not satisfied with the price of the products. The result infers that the availability of product is not in line with its performance. The major constraints faced by the farmers using bio-fungicide were reported to be adequate unavailability followed by lack of technical support.

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Analysis of Constraints Affecting Beneficiaries under *Pradhan Mantri Krishi Sinchayee Yojana* in Odisha

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ARTICLE INFO

Keywords: PMKSY, Garrett's ranking, Farmers, Constraints

<http://doi.org/10.48165/IJEE.2023.59330>

Conflict of Interest: None

ABSTRACT

The study was conducted in 2021 in the Jharsuguda district of Odisha to identify the constraints affecting beneficiaries under the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY). The study used a random sampling procedure and collected data through personal interviews with 60 respondents. Garrett's ranking technique was employed to analyze the constraints as perceived by farmers. The findings revealed that medium and large landholding farmers availed the maximum limit of subsidy, and non-availability of spare parts in the local area, tedious procedures to obtain the benefit of PMKSY, and frequent equipment repairs were the major challenges hindering the performance of beneficiaries under PMKSY. Therefore, key stakeholders must take suitable steps to remove the identified constraints. It is imperative to address these challenges to improve the performance of farmers in Odisha.

INTRODUCTION

Agriculture is not only a crucial contributor to the Indian economy but also shapes the fabric of society, especially in developing countries like India. In the past, subsistence farming was the norm, and farmers produced crops mainly for self-sufficiency in terms of food production. However, this was insufficient to feed the entire nation (Wani et al., 2016). To overcome this challenge, the green revolution began in the 1960s, which involved the adoption of high-yielding varieties, fertilizers, and irrigation. The green revolution led to significant improvements in crop production in India, but much of it was based on over-exploitation of natural resources (Malhotra, 2017). Water, being the "elixir of life," is the most critical natural resource. Although the planet is covered by 70 per cent water, its usage for human beings is meager (Rasouliazar, 2011). Low and uneven distribution of rainfall, rapid industrialization, and a growing population have contributed to a shortage of water for agriculture (Yadav et al., 2020). The availability of water for irrigation depends on various hydro-meteorological factors, and effective utilization of available

water is essential for sustainable agriculture (Kaur & Sharma, 2022). Modern cultivation practices and technological interventions are necessary for improving and supervising water use. The Pradhan Mantri Krishi Sinchai Yojana (PMKSY), an agriculture irrigation scheme, is the latest catchphrase of the central government. Its aim is to achieve "Per Drop More Crop" by promoting micro-irrigation. The adoption of micro-irrigation, such as drip and sprinkler systems, is expected to save water and improve crop yields. By 2016, the area covered by micro-irrigation in India was 81.46.172 ha, with 9.05.802 ha in Karnataka (Anon, 2016).

Proper utilization of available water for irrigation is crucial, but it remains a major challenge. The lack of water availability has led to the over-extraction of groundwater resources and the development of inefficient irrigation practices (Mukherjee et al., 2022). Therefore, it is essential to adopt modern cultivation practices and technological interventions to improve water-use efficiency in agriculture. Water being a valuable resource for farming, every drop of water available in the distribution system must be used effectively to enhance overall farm production. PMKSY aims to achieve this by providing financial assistance to farmers for the

development of irrigation facilities, including micro-irrigation, which has proven to be an efficient method of water use. The adoption of micro-irrigation systems, such as drip and sprinkler systems, has led to a significant improvement in water-use efficiency and increased crop yields (Satapathy et al., 2022). However, there has always been constraints in adoption of modern technologies and many authors like Gupta et al., (2013); Das et al., (2014); Paul et al., (2015); Gireesh et al., (2019); Yadav et al., (2019); Kobba et al., (2020) attempted to analyse the constraints in different setting. Although, it is also essential to adopt water management strategies such as rainwater harvesting and re-use of treated wastewater in agriculture to ensure sustainable water use, it is essential to look into the constraint part also. In conclusion, the adoption of modern cultivation practices and technological interventions, along with the implementation of water management strategies, is essential for achieving sustainable agriculture and ensuring food security in India.

METHODOLOGY

The study was conducted in the Jharsuguda district of Odisha, which was chosen purposively due to its high irrigation area. Four blocks were selected based on the funds allotted and utilized for micro-irrigation under the *Pradhan Mantri Krishi Sinchayee Yojana* (PMKSY), with two having the highest fund utilization i.e., Laikera and Orient and two having the lowest i.e., Badmal and Brajarajnagar. Ten villages were selected randomly from the district, and six beneficiary farmers were selected randomly from each village, making a total sample size of 60. A structured, pretested interview schedule was used to collect relevant information from PMKSY beneficiary farmers. The interview aimed to gather information related to the problems faced by the beneficiaries under PMKSY in Odisha. Constraints were identified, and farmers were asked to rank the problems proposed to them. The Garrett Ranking Technique is a method for assigning numerical scores to the orders of constraints. It is advantageous over simple frequency distribution because it arranges the constraints based on their severity from the respondents' point of view. This means that two or more constraints with the same number of respondents may be given different ranks. To convert ranks into percentages using Garrett's method, the formula is as follows:

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

Where, R_{ij} = rank given for i^{th} constraint by j^{th} individual; N_j = number of constraints ranked by j^{th} individual.

Firstly, the percent position of each rank will be converted to scores using the table provided by Garrett & Woodworth

(1969). These scores will then be summed for each factor, and the resulting total will be divided by the number of respondents to calculate the mean score for each factor. Next, the mean scores for all constraints will be arranged in descending order to determine their relative importance.

RESULTS AND DISCUSSION

Garrett ranking technique was used to analyse various challenges affecting the beneficiaries of *Pradhan Mantri Krishi Sinchayee Yojana* by the respondents. The respondents were asked to rank the ten factors identified for the purpose of this studies as 1, 2, 3, 4, 5, 6, 7 in order to know their preference in the selection of constraint. The calculated percentage position for the rank 1, 2, 3....7 and their correspondent Garrett table as show in Table 1, For factors, the total score is calculated by multiplying the number of respondents ranking that factor as 1, 2, 3.... and 7 with the respective Garrett table values (Garrett & Woodworth, 1969).

The ranking of constraints associated with Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) presented in Table 2 sheds light on the factors perceived as significant constraints by farmers. The analysis of the table suggests that medium and large land-holding farmers availing the maximum limit of subsidy, followed by non-availability of spare parts, frequent equipment repair, and the tedious procedure to obtain the benefits of PMKSY are the most significant constraints perceived by farmers. These findings are important as they indicate that small farmers are at a disadvantage due to the subsidy allocation process, and there is a need to simplify the application process and ensure that farmers receive timely maintenance and repair services.

In contrast, inadequate publicity and low awareness about PMKSY, and high initial costs for the installation of micro-irrigation systems were perceived as relatively less significant constraints. Although policymakers should increase awareness about PMKSY

Table 1. Percentage positions and their corresponding Garrett Table values

Rank	Percent position	Table value
1.	$100(1-0.5)/7$	7.14
2.	$100(2-0.5)/7$	21.42
3.	$100(3-0.5)/7$	35.71
4.	$100(4-0.5)/7$	50.00
5.	$100(5-0.5)/7$	64.28
6.	$100(6-0.5)/7$	78.57
7.	$100(7-0.5)/7$	92.85

Table 2. Constraint associated with *Pradhan Mantri Krishi Sinchayee Yojana*

S.No.	Factors	Total score	Average score	Final ranks
1	Non-availability of spare parts in local area	3562	59.36	II
2	Frequent repair of equipment	3446	57.43	IV
3	Delay in the process and short listing of application	3241	54.01	V
4	Tedious procedure to obtain benefit of Pradhan Mantri Krishi Sinchayee Yojana	3484	58.06	III
5	Inadequate publicity and low level of awareness about Pradhan Mantri Krishi Sinchayee Yojana	2471	41.18	VI
6	Medium and large land holding farmers avail maximum limit of subsidy is 45 per cent.	3568	59.46	I
7	High initial cost for installation of micro irrigation system	2463	41.05	VII

through effective publicity campaigns, the findings suggest that this constraint should receive less priority compared to others. Furthermore, the fact that the high initial cost of installation was perceived as the least significant constraint is a positive development, indicating that farmers are willing to invest in adopting micro-irrigation systems. However, policymakers should continue to explore ways to reduce the cost of installation to encourage more farmers to adopt this technology. Overall, the study highlights the need to address the constraints associated with PMKSY to ensure that the scheme's benefits reach all farmers equitably. The findings of the study get the support by Barse et al., (2013) & Bhuriya et al., (2015).

CONCLUSION

The study's findings indicate that medium and large land-holding farmers availing the maximum limit of subsidy, followed by non-availability of spare parts, frequent equipment repair, and the tedious procedure to obtain the benefits of PMKSY are the most significant constraints perceived by farmers. These constraints are particularly disadvantageous to small farmers, highlighting the need to simplify the application process and ensure that farmers receive timely maintenance and repair services. Overall, the study underscores the importance of addressing the constraints associated with PMKSY to ensure that the scheme's benefits reach all farmers, particularly small farmers. Policymakers should prioritize addressing the constraints highlighted in this study to promote the sustainable development of agriculture and enhance farm productivity.

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Constraints Perceived by Dealers and Households for Execution and Adoption of Pradhan Mantri Ujjwala Yojana

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ARTICLE INFO

Keywords: Adoption, Bihar, Constraints, Dealers, Execution, Household, PMUY, Women

<http://doi.org/10.48165/IJEE.2023.59331>

Conflict of Interest: None

ABSTRACT

Considering the perception of the LPG dealers and households towards *Pradhan Mantri Ujjwala Yojana*, the current study was carried out in the Samastipur district of Bihar in 2022. A total of 110 respondents i.e., 100 women households and 10 LPG dealers were taken for the study from 4 villages of 2 blocks under Samastipur district. 21 specific constraints perceived by households and 18 specific constraints perceived by dealers were categorized into 4 broad constraints, viz., social, cultural, economic, and physical constraints. Analysis was performed by using Garrett's ranking method, and specific constraints were ranked accordingly. Garrett's mean scores of specific constraints ranged 29.38 to 73.41 for social constraints, 30.15 to 69.03 for cultural constraints, 27.73 to 71.77 for economic constraints, and 29.50 to 70.60 for physical constraints as perceived by households. The mean score of constraints perceived by dealers were 30.4 to 71.3 for social constraints, 31.5 to 73.5 for cultural constraints, 26.5 to 70.5 for economic constraints, and 34.5 to 66.7 for physical constraints. The paper may provides a better insight into the grassroots level constraints for implementation and acceptance of *Pradhan Mantri Ujjwala Yojana* in rural villages of India.

INTRODUCTION

Cooking is one of the chores that captures most of the time in the day-to-day life of Indian women. The practice of cooking in traditional *chulha* has detrimental health effects due to inhaling pollutants released during the combustion of solid fuels like firewood, cow dung cake, crop residue and coal (Jaiswal et al., 2022). It can adversely affect the respiratory system of women and young children because they spend maximum time at home. To get rid of household air pollution (Sidhu et al., 2017) Pradhan Mantri Ujjwala Yojana' (PMUY) was launched as largest flagship scheme, 'on 1st May 2016 in Ballia district of Uttar Pradesh, intending to provide clean cooking fuel such as Liquefied Petroleum Gas (LPG) to the underprivileged and deprived households using traditional cooking fuels (National Portal of India, n.d.). The scheme

achieved 8 Crore LPG connections before the targeted period. In 2022 additional allocation was sanctioned for 1.6 Crore new LPG connections under 'Ujjwala Yojana 2.0' (Ministry of Petroleum and Natural Gas, n.d.). Even though PMUY achieved the milestone for providing new connections, numerous factors are affecting the adoption and continuation of the same. In the financial year 2015-16 to 2016-17, increases in new customers were from 10.2 per cent to 16.2 per cent, while consumption rose from 9 per cent to 9.8 per cent only (The Wire, 2017). Many families had enrolled under PMUY (Gould et al., 2020), but never returned to refill their LPG cylinders once (Jha, 2017; Kar et al., 2019; Mani et al., 2020). A state like Bihar has 88.70 per cent population residing in rural areas while nearly half (49.16%) population is still illiterate (Census, 2011). So, factors like high refilling cost, low socio-economic status, and lack of awareness are prime indicators for the

discontinuance of the scheme (Patil et al., 2021; Swain & Mishra, 2019; Cabiyo et al., 2020). Swain & Mishra (2019) reported that many households face various social, economic, cultural and environmental constraints to shifting towards cleaner energies. Sahani et al., (2020) identified six constraints viz., Production, Economic, Post-harvest and Marketing, Social and Institutional by the farmers in adoption of groundnut cultivation technology. In the research, constraints perceived by both dealers and households were categorized into four broad constraints, viz., Social constraint, Cultural constraint, Economic constraint, and Physical constraint. The study was carried out to prioritize the perceived constraints confronted by dealers and households for smooth execution and adoption of PMUY in the study locale.

METHODOLOGY

The study was conducted in 2022 by using an exploratory research design. State Bihar ranked third in the number of beneficiaries covered under PMUY followed by UP and West Bengal was selected purposively for the study (Bank Bazaar, 2022). For data collection, Samastipur district was selected. Samastipur district consists of 20 blocks, out of that, Pusa and Kalyanpur blocks were selected. Two villages were selected from each of the blocks i.e. 4 villages and 25 women respondents from each village and 5 dealers from each block were included in the final sampling. A total of 100 women respondents and 10 dealers were finalized for the study. To determine the constraints perceived by the respondents and dealers, a semi-structured interview schedule was prepared. Primary data was collected through personal interviews and open discussion methods with respondents.

Individual constraints under four broad constraints were ranked by using Garrett's ranking method through MS Excel (Version, 2007). Each of the constraints obtained a certain mean value and ranked accordingly. Singh et al., (2021) also used Garrett's ranking method to determine (Personal, Infrastructural, and Organizational) constraints faced by the students in the usage of ICT initiatives. Standard formula was used for calculation purpose.

RESULTS AND DISCUSSION

Constraints faced by beneficiaries

Easy availability of conventional fuels was most significant among social constraints, with a mean score (73.41). It could be concluded that beneficiaries from the rural area easily access conventional fuels like firewood, cow dung cake, agriculture residues and kerosene oil. So they could not motivate towards the scheme. The result is in line with (CAG Report, 2019). "Unaware of the interest-free loan provided by gas companies for new connections" was perceived as the second most important constraint, with a mean score (58.80). Generally, respondents were unaware of the yojana and it was difficult for them to access the information regarding loans available for it (Patil et al., 2021). In the following order Lengthy application process (54.67), Long distance of the dealer location (46.17), Unable to consult the dealer about LPG connection and subsidy" (37.57) were the constraints. Illiterate respondents assumed that application for a new LPG connection was time-consuming and lengthy. There were fewer gas agencies in the study locale, so distance matters a lot for respondents to regular contact with dealers and respondents were not comfortable

Table 1. Garrett's ranking score for various constraints perceived by households

S.No.	Social constraints (Range: 23-77)	Mean score (x)	Rank
i.	Easy availability of conventional fuels	73.41	1
ii.	Unaware of the interest-free loan provided by gas companies for new connections	58.80	2
iii.	Lengthy application process	54.67	3
iv.	Long distance of dealer location	46.17	4
v.	Unable to consult the dealer about LPG connection and subsidy	37.57	5
vi.	Limited doorstep delivery	29.38	6
Cultural constraints (Range: 27-73)			
i.	Large cooking pots unfit on cooking stove	69.03	1
ii.	Time is taken to prepare cooked feed for cattle	54.87	2
iii.	Excessive consumption of gas during winter to boil water	45.95	3
iv.	Differ in the taste of cooking food in LPG stove over chulha	30.15	4
Economic constraints (Range: 23-77)			
i.	High refilling cost	71.77	1
ii.	Arranging money for immediate refilling when cylinder is empty	61.89	2
iii.	Subsidy amount doesn't credit in account timely	53.73	3
iv.	Regular maintenance of gas stove	46.48	4
v.	Transportation cost to dealer location	38.40	5
vi.	Extra money charged by agents during refilling	27.73	6
Physical constraints (Range: 25-75)			
i.	Lack of proper infrastructure in kitchen to install stove	70.60	1
ii.	Chance of explosion of cylinder in kutcha houses	59.40	2
iii.	Backache or leg pain during long cooking period	50.20	3
iv.	Carrying heavy LPG cylinder from dealer location to home location	40.30	4
v.	Depend on male members to reinstall new LPG tank	29.50	5

talking with dealers about their problems. Devi & Jain (2012) stated that lack of education and support from family, poor attendance, and lack of motivation were major social constraints among the rural women of Rajasthan.

A large cooking pots unfit on the cooking stove (69.03) was the prime cultural constraint. Joint families residing in the study area experienced difficulties when preparing food. The standard stove in the scheme was up to medium container capacity but could not use large utensils. Time is taken to prepare cooked feed for cattle (54.87), excessive consumption of gas during winter to boil water (45.95) were important because most families had livestock, and depend upon hot water for daily usage, and gas cannot fulfill the demand compared to conventional fuels (Patil et al., 2021). Smoked food items give an aroma and better taste when cooked over firewood and coal (Lakshmi, 2020) supports the findings.

Among economic constraints; High refilling cost (71.77), arranging money for immediate refilling when cylinder is empty (61.89), subsidy amount doesn't credit in account timely (53.73), regular maintenance of gas stove" (46.48) and transportation cost to dealer location scored (38.40) were major constraints. Even though the central government provided cash assistance of Rs. 1600 for a new connection, the refilling cost of the cylinder increased to Rs. 1132. Cabiyo et al., (2020) confined that due to low control over the money refill gap was usually from 3 to 10 days or more. Patil (2021) reported that respondents unwillingly used chulha due to a non-regular and inadequate income and women were dependent upon the earning member of the family for refilling. Sahoo et al., (2023) reported that unavailability of a loan during the proper time also create economic constraint among organic turmeric farmers in Odisha. Respondents cited, since COVID-19 they were purchasing LPG cylinders at actual cost without getting any subsidy amount.

Respondents perceived lack of proper infrastructure in the kitchen to install stove (70.60), chance of cylinder explosion in kutchra houses (59.40), backache or leg pain during the long cooking period (50.20), carrying heavy LPG cylinder from dealer location to home location (40.30) were important physical constraints.

Constraints perceived by LPG dealers

It is apparent from Table 2 that the socio economic condition of poor families (71.3), improper documents for new connection (50.7) and lack of exact data regarding the beneficiaries (47.6) were social constraints. Sawshilya (2018) reported that in the absence of authenticated data on the BPL population, identifying poor households for allotment of free LPG connection was a big challenge. The education level of the respondents was crucial for adopting and using these fuels (Behera et al., 2015).

Free availability of solid fuels for traditional chulha (73.5) ranked as the most important cultural constraint. Many rural households in these countries still use these cooking fuels (Ekholm et al., 2010). In India, around 63 per cent of rural households use firewood and 23 per cent depend on crop residue and cow dung cake for cooking (Census of India, 2011b). Almost every family prepared dung cake from livestock waste so the sellers dominated the study locale. Most respondents had no personal bank accounts, and it was difficult to transfer the benefit of subsidy money directly. Large-scale irregularities, negligence on the part of the administration and illegal collection of money from women beneficiaries reduces participation of women in training programmes (Sawshilya, 2018). Jaiswal et al., (2022) found that some cultural factors like traditional cooking practices and the slow cooking process in chulha when the women were at work checked the durability of the scheme.

Table 2. Garrett's ranking score for various constraints perceived by dealers

S.No.	Social constraints (Range: 27-73)	Mean score (x)	Rank
i.	Socio-economic condition of poor families	71.3	1
ii.	Improper documents for new connection	50.7	2
iii.	Lack of exact data regarding the beneficiaries	47.6	3
iv.	Communication with illiterate beneficiaries	30.4	4
Cultural constraints (Range: 25-75)			
i.	Free availability of solid fuels for traditional chulha	73.5	1
ii.	Dominance of cow dung sellers and users in the locality	55	2
iii.	Less number of Bank account holders among beneficiaries	46.5	3
iv.	Poor attention and response of rural women during training programme	43.5	4
v.	Value system of the beneficiaries	31.5	5
Economic constraints (Range: 25-75)			
i.	Difficult to recover EMI amount from beneficiaries	70.5	1
ii.	Selling of LPG cylinders by beneficiaries in open market	63.5	2
iii.	Transportation & accessibility cost of LPG cylinders	49	3
iv.	Credit system prevailed in rural areas	40.5	4
v.	Transaction and record keeping for the entire logistics system	26.5	5
Physical constraints (Range: 27-73)			
i.	Stretch far beyond the catchment areas to enroll beneficiaries	66.7	1
ii.	Poor road connectivity to households for delivery of cylinder	52.4	2
iii.	Supplying LPG cylinder in summer	46.4	3
iv.	Bottling of small cooking gas cylinder	34.5	4

Difficult to recover EMI amount from beneficiaries (70.5) was the dealers' first important constraint. Oil companies provided interest-free loan assistance and recovery through subsidy amounts during refilling, but poor beneficiaries did not refill their cylinder for the second time (CAG Report, 2019). Dealers bore the transportation cost from go down to consumer location, discouraging them from smooth execution of the scheme in rural areas (Patil et al., 2021). Purchasing cylinders with credit and paying for the next refill was troublesome for dealers.

Stretch far beyond their catchment areas to enroll beneficiaries (66.7) ranked first among physical. It wasn't easy to enroll all beneficiaries by motivating them. Dealers could not provide home delivery service in remote areas due to unavailable all-weather road connectivity. Due to the high temperature, there was a chance of an explosion so; special care was taken during the delivery of the cylinders. Dealers Though LPG companies were providing small LPG cylinders of 5 kg capacity the price was higher per kg of gas limiting the adoption.

CONCLUSION

Surprisingly PMUY is breaking its records by successfully issuing new LPG connections to adult women under BPL since 2016. Also, it is important to examine the loopholes underlying for execution and adoption of LPG at both dealers and households level. An effort was made to pinpoint the practical constraints perceived by the respondents. Constraints such as easy availability of conventional fuels and the high refilling cost of LPG Cylinders ranked top among the respondents. Free availability of solid fuels for traditional *chulha* and socio-economic condition of poor families were top-ranked constraints for the execution of PMUY. Government and policymakers must take appropriate action to minimize the constraints mentioned above for the long life of such an extensive scheme.

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Report on Indian Society of Extension Education National Seminar-2023 “Evolving Extension Science towards Secondary Agriculture for Sustainable Development” held at University of Agricultural Sciences, Bangalore, India during 22-24 June, 2023

Amidst the emerging dynamics of market and policy reforms by the Government, secondary agriculture has the potential to offer solutions to challenges in agriculture. To address the challenge of identifying and suggesting extension science for transition to secondary agriculture to attain sustainable development, the national seminar on *Evolving Extension Science towards Secondary Agriculture for Sustainable Development* was organized on the occasion of 60th anniversary of ISEE, New Delhi at the University of Agricultural Sciences, Bangalore by the Indian Society of Extension Education, New Delhi, UAS, Bangalore, Karnataka Chapter of ISEE in collaboration with several state and national level organisations concerned with secondary agriculture.

The National Seminar-2023 inaugurated by Hon’ble Susri Shoba Karandlaje, Union Minister of State for Agriculture and Farmers Welfare where need was expressed to think on reaching international markets to empower small and marginal farmers and coordination among all farm universities and line departments. The seminar covered ten major themes relating to secondary agriculture and allied aspects of extension education and provided a platform for deliberations on the achievements and a way forward by more than 550 scientists and delegates along with 100 farmers and 37 exhibitors during three-day deliberations divided into 35 sessions wherein 35 lead papers were presented by invited speakers. The participants represented 25 states, 63 universities, and 17 ICAR institutes. A total of 777 abstracts were received which were published in the form of book of abstracts containing 488 pages. The major take home emerged from presentations and discussions have been grouped under five broad heads:

Leveraging social media and ICT interventions

- Keeping in view the advancements in digital technologies, public extension systems should harness the power of drones, machine learning, artificial intelligence, low-cost sensor networks, block chain/ RFID

technologies for traceability, social media analytics-based extension, high resolution remote sensing imageries, 3d printing etc. for dissemination of agricultural technologies to the farming community.

- Digital extension services, especially from ICAR/SAUs/ state department line departments should be aligned with the Agri-stack to serve as a foundation to build innovative agri-focused solutions leveraging emerging technologies. Farmers’ education on the services available in government apps along with the methodology of using these apps need to be prioritized with suitable support of manual guide and videos.
- Social media need to be used and promoted as an essential tool for farmers and agribusinesses to connect with consumers, access to new markets and customers and enable them to sell and promote their products online.
- There is need to address the challenges like access to technology and internet connectivity, digital literacy and affordability of ICT tools and services, policymakers, private sector players, and development agencies need to work together to bridge these gaps and ensure equitable access and unlock the potential of ICT in agri-entrepreneurship, contributing to sustainable agricultural development and rural economic growth.

Entrepreneurship Development and Human Resource Development

- The government policies and programmes to promote agriculture entrepreneurship like start up India, stand up India etc., need to be popularized at a greater level. The key areas of HRD with regard to agricultural enterprises need to be focused and strengthened. As Farmer-led innovations have potential of agri-preneurship development and contribute to sustainable development by promoting environmentally friendly farming practices, need more focus and institutionalization. KVKs may facilitate registering the patents of technologies and

innovations developed by the farmers, certification of food products, seeking FPO / Agro-license and quality control license for value added products and provide backstopping to other KVKs and share their experiences.

- Empowerment of farmers and secondary agriculture can be achieved by establishment of structured extension service in processing sector. Extension service providers need to have skill for value chain analysis and need to educate farmers about storage facilities, finance management, facilitation services, and pro-active extension system so that small and medium level enterprises at village level may be created.
- The sustainable processing methods can enhance the nutritional and health benefits simultaneously providing value addition, technological innovation, diversification, export potential and market expansion consequently leading to economic development and food security.
- More emphasis should be given to partnership extension model, FPO partnership model, PPP model, convergence model, community based extension model, A2N model, livelihood security model, multimedia model, digital farm school, *Dhanyamahotsav* model, linking farmers to market and school children extension model. There is a need to link the farmers with agro based companies and promote direct marketing.
- Extension Research need utilize next generation methodologies like meta-analysis, RCT and DID, DCE, SEM, FUZZY theory, grounded theory, Artificial intelligence, Big data etc., Capacity building programmes should be organized for scientists and line department officers in emerging subject matter areas. The role of human resource development in facilitating technology adoption and digital transformation in agricultural entrepreneurship, the impact of digital literacy training, access to information and communication technologies, and the use of e-commerce platforms and entrepreneurial success analysis are key researchable issues.
- Entrepreneurship development to be considered as an essential component of extension educational activity, two levels of training/ capacity building activities including cognitive skills and the psychomotor skills on production of marketable product, operation maintenance etc. are to be taught. The students are to be oriented on Ideation, selection of potential enterprises, SWOT analysis and preparation of business proposals with value chain and financial requirements.

Innovative Extension Science Methodologies

- Establishing platforms for networking mentorship, and collaboration will foster a culture of continuous learning, innovation, and support among agricultural entrepreneurs. Encouraging of environmentally conscious entrepreneurship, resource conservation, and climate-smart farming techniques will contribute to long-

term sustainability and resilience in the agricultural sector.

- Encouragement of PPP) will enrich technology development, commercialization and transfer and investment requirement for the growth of secondary agriculture, where, the Government should be the facilitator, rather than a controller with minimum bureaucratic hurdles. Establishment of food processing units near agricultural production areas need to be facilitated. Migration of skilled and talented workforce may be addressed by strengthening infrastructure at grassroots' level.
- The curricula at SAUs should include secondary agriculture, bio processing technologies and agribusiness courses to have the right human resources to manage secondary and primary agriculture. In the process SAUs should offer diploma/certificate programmes as for the demand of secondary agricultural sector.
- Develop robust market linkages and improve infrastructure for transportation, cold storage units, warehouses, and processing centers to reduce postharvest losses and ensure the availability of quality produce throughout the year. Strengthen market information systems to help farmers make informed decisions.
- KVKs should actively collaborate with research institutions and industry partners to identify and disseminate the latest technologies relevant to secondary agriculture
- Engagement in market intelligence activities to identify emerging trends, consumer preferences, and market demands for value-added agricultural products has potential to facilitate market linkages for farmers and processors, connecting them with potential buyers, exporters, and value chain stakeholders.
- Assistance in branding and marketing strategies, institutional credit, low-cost skilling contextualized to local needs, knowledge-based exposure of farm communities, incubation facilities, specialized enterprise centric extension services at rural level on fast-track basis in secondary agriculture and processing be given the priority sector status. Establishing Information, Innovation and Incubation Centre' (i3C) at a suitable location, will give a big boost to entrepreneurship development in secondary agriculture.

Policy initiatives and Institutional Role

- Establishment of "Krishi Nyayalaya" for speedy disposal of issues related to agriculture and allied enterprises.
- Institutional framework can be created to support the promotion advocacy and connection between secondary and tertiary sectors of business. Unification of farm universities and allied sciences with multidisciplinary

approach for strengthening Teaching-Research-Extension for the benefit of all stakeholders. Creation of convergence platform with state line departments for strengthening extension education and extension service delivery mechanism and Establishment of All India Coordinated Research Project in agricultural extension is the need of the hour.

- Systematic analysis of the influence of policies related to ease of doing business, taxation, land acquisition, intellectual property rights, and sector specific regulations on entrepreneurial activities and outcomes need to be prioritized involving social science disciplines for widening the horizons of extension research under the umbrella of multidisciplinary research.
- Policymakers should simplify loan procedures, develop specialized financial products, and promote alternative financing mechanisms such as microcredit schemes and venture capital funding for secondary agriculture.

Gender Mainstreaming

- Extension approaches should be gender sensitive and check points should be followed while implementing extension methods for farm women for effective output. Women farmers should be encouraged in decision-making processes through the formation of women's farmer groups, exploration of gender dynamics in agricultural entrepreneurship and barriers and opportunities for women entrepreneurs.
- Farmer should make use of various government schemes like PMFME, Sampada yojana and more emphasis should be given on women capacity building programmes especially for nutritional and health benefits to the health conscious consumer
- Governments and other stakeholders should work towards creating an enabling environment for women farmers. This can be achieved through policy interventions, such as gender-responsive budgeting, and by addressing social and cultural barriers that limit women's participation in agriculture and rural development.

The ISEE Awards

Various awards instituted by the Indian Society of Extension Education were conferred to the extension professionals/educationists in recognition of their meritorious works & services to the following recipients:

Life Time Achievement Award

- Dr. U S Gautam, President ISEE & DDG (Extension), ICAR, New Delhi
- Dr. S V Suresha, Vice chancellor, UAS, Bangalore

Dr. D. K. Mishra Memorial Award

- Dr R.N. Padaria, Joint Director, IARI, New Delhi

Dr. G. S. Vidyarthi Memorial Award

- Dr. Y N Shivalingaiah, Professor and Head, UAS, Bengaluru

Dr. K. N. Singh Memorial Award

- Dr S S. Dolli, Professor and Head, UAS, Dharwad

Dr. O P Dahama Memorial Award

- Dr. Souvik Ghosh, Professor, Viswa Bharati, West Bengal

Dr Y P Singh Memorial Award

- Dr Basavaprabhu Jirli, Director, CMDR, GOI. Dharwad.

Best KVK Scientist Award

- Dr S.K Badodiya
- Dr Ritesh Dube
- Dr Rahul Kumar Singh
- Dr. Mandeep Sharma
- Dr. Shiva Shantanu Singh
- Dr Noorjehan A.K.A. Hanif
- Dr. J.B. Dobaria
- Dr Upesh Kumar

ISEE Fellow Award

- Dr. Bhanu P. Mishra
- Dr. Amulya Kumar Mohanty
- Dr. M.L Meena
- Dr. Subhdeep Roy
- Dr. K. Ravi Shankar
- Dr. R. Venkattakumar
- Dr. Nagaratna Biradar
- Dr. J. B. Patel
- Dr. B. L. Manjunath

Young Scientist Award

- Dr. Kamini Bisht
- Dr. Aparna Roy
- Dr. P. Mooventhan
- Dr. Sanjit Maiti
- Dr R. Vinay Kumar
- Dr. Itigi Prabhakar
- Dr. V. Jyothi
- Dr. C. M. Savitha
- Dr. H. M. Vinaya Kumar

General impressions

The national level seminar was organized with a focus on secondary agriculture promotion and evolving policy for better extension management. There was an overwhelming participation from students, scientists, NGOs, FPOs and farmers. There was a multifaceted collaboration with institutions like NABARD, APEDA, ATARI-KVKs, KAPPEC, MANAGE, CFTRI, KMF, AICRP, IFFCO and CoE on Millets which brought vibrant colours to the seminar.

The presence of Dr. Ashok Dalwai, CEO, National Rainfed Area Authority, MOA & FW, GoI and Dr. P.

Chandrashekara, DG, MANAGE, Hyderabad in the inaugural programme and the august presence of Sh. Cheluvarayaswamy, Hon'ble Minister for Agriculture, Govt. of Karnataka and Dr. S.V. Suresha, Hon'ble Vice Chancellor, UAS Bangalore in the valedictory programme motivated the achievers who were bestowed with various ISEE Awards. Reputed scientists, academicians, educationists and researchers presented their professional works in plenary and technical sessions of the seminar which provided the lead for the future endeavors of the extension professionals. The presence of Dr. P. Das (Former DDG) Dr. A. K. Singh (Former DDG), Dr. V. V. Sadamate (former advisor, Planning commission) Directors of ICAR-ATARIs namely; V. Venkatsubramanian, Anjani Kumar, S. K. Dubey, S. R. K.

Singh, A.K. Mohanty, S.K. Roy, Parvender, Sheikh Meera; the two ADGs (Ext); Dr. M. M. Adhikary, Dr. G. Eswarappa, Dr. Veerbhadaria, Dr Gangadharappa and many others helped to shape the seminar proceedings smooth.

Important issues for professional improvement were deliberated in the Annual General Body Meeting held on 22.06.2023 evening and it took the decisions that would further strengthen the ISEE functioning. The seminar was attended by students, researchers, academicians, scientists, extension professionals, NGOs, FPOs, financial institutions, research organizations and policy makers, etc. and in overall the national seminar provided an excellent platform for extension professional congregation and professional engagements who came from all over the country.

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- The **METHODOLOGY** describes what was done- experimental model or field study. It should be an exhaustive one (in logical order, sufficient details to reproduce the procedure) without tables and figures (approximately 300- 400 words). The subheadings must be avoided as far as possible in methodology. It should be written in simple past tense. Where the methods are well known, the citation of standard work is sufficient. All modifications of procedures must be explained. Experimental materials and statistical models should be described clearly and fully. Calculations and the validity of deductions made from them should be checked and validated. Units of measurement, symbols, and standard abbreviations should conform to international standards. Metric measurements are preferred, and dosages should be expressed entirely in metric units (SI units). Give the meaning of all symbols immediately after the equation in which they are first used.
- The **RESULTS AND DISCUSSION** should preferably be combined to avoid repetition. **Results** present the data, the facts- what you found/ calculated/ discovered/ observed. It should be written in simple past tense to report your observations on experiment/ fieldwork, its comparison/contrast. Only the salient results need to be presented instead of writing the whole tabular/ graphical data in text. Too many paragraphs are discouraged; one concept must be dealt with at one place and time in one paragraph. The **Discussion** shows the relationship among the facts, it puts results in context of previous researches, and the emphasis must be on presenting results in relation to established knowledge. The discussion should contain trends, relationships, generalizations, any exception, outlying data, agreement/ disagreement with previous researches with reasons. The discussion should be written in present tense. IJEE does not appreciate more than three subheadings in Results and Discussion. Avoid making too many tables just for the number's sake, do not give socio-personal profile table and text till it is utmost necessary and has some bearing on the other part of the research.
 - Results should be presented in tabular form and graphs where ever feasible but not both. The colour figures and plates during printing in black and white may lose information. Mean results with the relevant standard errors should be presented rather than detailed data. The data should be so arranged that the tables would fit in the normal layout of the page. Self-explanatory tables should be typed on separate sheets and carry appropriate titles. The titles of tables/figures should not be more than 12 words.

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