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EDITORIAL

At the New Delhi G20 summit, G20 leaders vowed to boost global food security and nutrition through research cooperation on resilient grains, also pledged to invest in agriculture to enhance productivity, reduce food waste, and build sustainable, climate-resilient food system, whereas, severe rain battered parts of Turkey, Brazil, Spain, China, and the United States, disrupting local services and creating barriers to accessing food and clean water. Rice prices reached a 15-year high in August, 2023 due to India's ban on overseas sales of non-basmati rice. In between IFFPRI organized second seminar of the CGIAR Policy Seminar Series on Strengthening Food Systems to explore how such schemes could be taken forward in order to help build greater resilience within food systems. There seems a potential solution in regenerative agriculture and to empower eaters through access, affordability and healthy choices, although, a projected 600 million people will still be undernourished for which, countries need to embrace localized solutions and extension system need to gear up.

The current issue (October-December, 2023) contains 33 manuscripts including three research tools, three research notes, and twenty seven full-length research papers from cross-sectional authors and content. the measuring tools include; organic poultry farming knowledge test among tribal, gender disparity index in tea gardens and household food and nutritional security index. The manuscripts on farmers' challenges in adopting soil health card, awareness and determinants of farmers participation in e-marketing and determinants for adopting ICTs by livestock farmers made the 'research note' section. The perception of participatory management behaviour, evidences of empowering women in aquaculture, measuring kvk-led fisheries extension efforts, cost and return analysis, indicators for assessing research-extension-farmers linkage in fisheries , knowledge level of maize growers, hybrid rice growers and good management practices in litchi, contribution of women in scientific publications, trends in area production and productivity, assessment of livelihood security and factors effecting food security, effectiveness of video and training on different aspects, use of kinesthetic learning activity, study of operation greens, aspirations of students, e readiness assessment of the NARS, factors of fish purchase, adoption pattern of farm machinery, study on ZBNF and ARYA programme, Gender Differences in Attitude of University Students towards Gender Roles were covered in 'Research Article' section. As usual, the data is regularly being fed to international indexing agencies leading to the indexing of the Indian Journal of Extension Education at various platforms. Now the journal is a legally registered copyrighted material in favour of the Indian Society of Extension Education, New Delhi.

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. The editorial team also congratulates the President ISEE and whole of the executive team as well as the organizers for successful organizing the ISEE National Seminar-2023 at UAS, Bangalore.

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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Superiors' Participatory Management Behaviour: Perception of Agriculture Officers in Banking Sector

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ABSTRACT

The quality of the superior-subordinate relationship can significantly impact various aspects of participatory management behaviour. The study was conducted in 2022 to assess the superiors' behaviour as perceived by a randomly selected 180 agriculture officers working in public sector banks in the state of West Bengal. Superiors' behaviour was assessed based on the four domains; motivation, communication, coordination, and empathy which included 20 aspects on which responses of the selected agriculture officers were obtained on a 5-point continuum scale. Superiors' behavioural characteristics were derived by mean perception score. Superiors' motivating nature was found to be most admired by the respondents. Using ANOVA and post hoc tests, significant differences were identified between the groups of agriculture officers categorised based on the job experience in the banks with respect to various dimensions of superiors' behaviour. Respondents with experience of >10 years perceived overall superiors' behaviour lowly (68.49) as compared to the other two groups with experience of up to five years (75.86) and >5-10 years (75.27), respectively. Such differences based on experience need to be addressed to create a more cohesive and thriving work environment for the agriculture officers in the banking sector to provide better financial assistance to the farmers.

INTRODUCTION

Participative management is an advanced concept in the modern management world, particularly within the Indian context. It involves soliciting employees' opinions and inputs regarding decision-making and policy formulation within the organisation. Participatory management represents a paradigm shift from a top-down approach to a more self-driven and self-sustained approach. The participatory management is to empower employees and enhance their understanding of problems, allowing them to explore and generate potential solutions through democratic spirit and active participation and known as the third managerial revolution. The first revolution was the establishment of the hierarchical structure, while the second revolution was the separation of management

from ownership and the invention of management professionalisation. Developing competencies and understanding the organization and its employees are essential to maintain a competitive advantage (Vakola et al., 2007; Bengtson et al., 2011). Participatory management is essentially a method of empowering employees or subordinates by providing information, expertise, authority, and rewards to the lower layer of an organisation (Miah & Bird, 2007). Allowing employees to engage in decision-making has been demonstrated in several studies to boost motivation, job performance, and organisational growth (Bhuiyan, 2010).

Most organisations have a well-established hierarchical system; thus, employees are classified as superior and subordinates. The leadership qualities of the immediate supervisors have a direct bearing on the productivity of the employees, which in turn

determines the efficiency in providing required services to the client system (Ponnusamy et al., 2014). The superior-subordinate relationship becomes vital for the proper implementation of participative management. With the growing acceptance that employees often have something valuable to contribute beyond the expected levels of their standard work in a participative management framework, superiors and/or managers need to expand their understanding of the principles, techniques and approaches involved in management (Kumar et al., 2022). In an era where traditional hierarchical structures are replaced with collaborative models, the behaviour of the superior holds significance. No longer confined to command-and-control paradigms, modern managers are expected to engage, inspire, and empower their teams. The dichotomy of superior-subordinate interactions has evolved from rigid directives to inclusive dialogues, where open communication and approachability foster an environment conducive to innovation and growth. As such, understanding the nuances of superior behaviour becomes imperative for organisations striving to thrive in this dynamic landscape.

Agriculture being diverse and full of contradictions (Alston & Pardey, 2014) has a larger implication for financial inclusion (Chattopadhyay, 2011). With the dual expertise of agriculture and finance, Agricultural Field Officers (AFOs) in the banking sector stand as an imperative asset. The duties of the AFO include promoting rural financing, disbursement of agri-loans, review of agri-loans, reporting to higher authorities, collaboration with NABARD and RRBs. Participative management behaviour will empower AFOs to efficiently perform these duties and enable them to respond swiftly to emerging financial challenges in the agricultural sector for sustainable agricultural development. Thus, a positive superior-subordinate relationship will set the tone for participative management culture in banks by empowering and motivating employees to actively contribute to the decision-making process. Against this backdrop, present study was undertaken.

METHODOLOGY

The study was conducted in West Bengal, where a simple random sample of 180 agriculture officers working in the public sector banks with varied job duration in two randomly selected districts using simple random sampling, namely, Birbhum and Murshidabad, were chosen as respondents. The respondents were further categorised depending on their years of services in the banks for delineating significant differences amongst the groups of respondents based on job experience; accordingly it was found that, there were 56 respondents working up to 5 years, 79 respondents for >5 to 10 years, and 45 respondents for >10 years. A questionnaire was developed for the present study following Burhanuddin (2013) and the perception of respondents about their superiors' behaviour was measured based on four domains, namely, motivation, communication, cooperation, and empathy. Motivation considered the superiors' abilities to influence, build confidence, reward, and encourages subordinates. Superiors' communication behaviour was measured in terms of group discussion, individual interaction, upward communication, information, and clarification of the roles of subordinates. The cooperation dimension included group ideas, cooperative attitude, cooperative teamwork, including

subordinates in decision-making and setting organisation goals. Empathy was operationalised as showing trust and confidence, satisfaction with achievements, friendly interaction, and understanding the job-related problems of the subordinates. Responses were obtained on a total of 20 items under four dimensions on a five-point continuum scale ranging from strongly agree (5) to strongly disagree (1) for the positive statements and reverse for negative statements. Collected data were compiled and analysed using SPSS v27 software. Descriptive statistics like mean, standard deviation (SD), and coefficient of variation (COV) 'were used to measure the central tendency of the population. The index values for each of the four dimensions and overall superiors' behaviour were calculated as follows:

Superiors Behaviour Index (SBI_i) was calculated as given below:

$$SBI_i = \Sigma(MI_i + CI_i + COI_i + EI_i)$$

Where, *i* indicates number of respondents, *MI_i* (Motivation index) = $\Sigma M_{ij} / \Sigma j$, *j* (=1,2, ...) denotes motivation items, *CI_i* (Communication index) = $\Sigma C_{ik} / \Sigma k$, *k* (=1,2, ...) denotes communication items, *COI_i* (Coordination index) = $\Sigma CO_{il} / \Sigma l$, *l* (=1,2, ...) denotes coordination items, *EI_i* (Empathy index) = $\Sigma E_{im} / \Sigma m$, *m* (=1,2, ...) denotes empathy items.

The ANOVA and post hoc tests were applied to find out the significant differences between perceptions of three groups of agriculture officers on four dimensions and overall superiors' behaviour.

RESULTS AND DISCUSSION

A comprehensive analysis of perceptions of agriculture officers working in public sector banks regarding different facets of their superiors' behaviour indicates differential opinions (Table 1). The superiors were successful in fostering a supportive and motivating work environment in the bank for most of the agriculture officers as evident from the responses of the respondents. The study indicated that the superiors were successful in exerting influence in a voluntary and honest manner. Additionally, respondents also acknowledged their superiors' ability to create confidence in them. Most respondents held a positive perception of their superiors' ability to encourage in implementation of decisions and to inspire group members to strive for high-performance goals as indicated by mean perception scores. However, motivating subordinates through rewards was less favourable that needed attention of the management in banking organisations.

The communication domain was studied with a set of five statements. The findings highlighted the importance of effective communication between superiors and subordinates to inculcate participatory management behaviour in the banking sector. It was evident that superiors actively engaged in providing work-related information and discussed office-related work with their subordinates. It was evident that superiors maintained a clear flow of information within the bank by ensuring that subordinates understood their roles and by effectively passing information both downward and upward throughout the organisation. The study also indicated that there were areas that can be improved in terms of effectively communicating with subordinates individually to address their specific individual as well as shared concerns.

Table 1. Perceptions of the agriculture officers on different aspects of their superiors' behaviour

S.No.	Items	Mean	SD	COV
	Motivation			
1.	Influence subordinates voluntarily	3.73	0.97	26.01
2.	Influence subordinates honestly	3.88	0.98	25.26
3.	Tries to create subordinates' confidence in superior	3.73	1.05	28.15
4.	Motivate subordinates through rewards	3.61	0.92	25.48
5.	Encourage subordinates to implement the decisions	3.78	1.02	26.98
6.	Encourage group members to strive for high-performance goals	3.73	1.12	30.03
	Overall motivation	3.74	0.82	21.93
	Communication			
7.	Group discussion with subordinates about related office works	3.79	1.01	26.65
8.	Interact with each subordinate individually	3.37	1.23	36.50
9.	Upward and downward information flow accurately	3.71	0.96	25.88
10.	Provide information about work-related topics	3.89	0.86	22.11
11.	Make subordinates understand their role in accomplishing organisational goals	3.67	1.12	30.52
	Overall communication	3.69	0.84	22.76
	Cooperation			
12.	Get group ideas to find solutions for organisational problem	3.74	0.97	25.94
13.	Show a co-operative attitude with subordinates	3.66	1.15	31.42
14.	Indicate cooperative teamwork	3.94	0.87	22.08
15.	Involve all subordinates in the decision-making process	3.30	1.24	37.58
16.	Involve all members in proposing organisational goals	3.67	1.15	31.34
	Overall cooperation	3.66	0.96	26.23
	Empathy			
17.	Show trust and confidence in subordinates	3.88	0.99	25.52
18.	Show high satisfaction on the achievements of subordinates	3.53	1.03	29.18
19.	Friendly interaction with subordinates	3.73	1.08	28.95
20.	Know well the job problems faced by subordinates	3.42	1.25	36.55
	Overall empathy	3.64	0.89	24.45
	Overall Superiors' behaviour	3.69	0.83	22.49

The culmination of the findings further revealed that the respondents highly appreciated the superior's emphasis on fostering cooperative teamwork and utilising a participatory approach in problem-solving within the banking organisations. It was also evident that the superiors emphasised the importance of collaboration and teamwork with the subordinates to work cooperatively (mean perception score 3.94). Furthermore, these findings underscored the prevailing recognition among participants regarding the superiors' encouragement for active participation from all members in setting organisational goals. However, there was a need for closer attention to involving subordinates in the decision-making process as the respondents were divided regarding this characteristic. The study also revealed that respondents believed that their superiors had established a positive, supportive, and cordial relationship with them, fostering trust and confidence in their abilities. Superiors also acknowledged and appreciated the accomplishments of their subordinates, creating a positive and motivating work environment. However, there were opportunities for superiors to further enhance their understanding of job problems faced by the subordinates and provide support to them to overcome the challenges.

The overall perceptions of selected agriculture officers in the banks on four dimensions of superiors' behaviour showed similar outcomes. The findings indicated a positive perception of different dimensions of superiors' behaviour among respondents, with

motivation standing out. While some variability existed in the perception, it was relatively consistent across the dimensions. The mean perception scores varied between 3.64 to 3.74 with overall perception of superiors' behaviour score as 3.69 with a coefficient of variation of about 22.50%. The findings indicated that the superiors in the study area were successful in fostering a supportive and motivating work environment in the bank. They were perceived as influential, and capable of creating confidence in their subordinates. However, there were areas that can be improved, such as motivation through rewards. Effective communication between superiors and subordinates was crucial. According to Mittal & Randhawa (2021), it was not possible to have good personal and professional relationships without effective information exchange. So, effective communication of information with coworkers/ colleagues was crucial and permanent challenge to the success of any organization. The findings of present study also suggests that the superiors had emphasised teamwork, collaboration, and inclusive decision-making, although there was room for improvement in involving bank's agriculture officers in the decision-making process and helping them to overcome the job-related problems. Further, the study indicated a positive perception of superiors' behaviour and their efforts to create a positive work environment in the banking sector, but there were areas that could be strengthened to enhance support and understanding for subordinates. Rao et al., (2021) mentioned four

different behavioural styles of a leader - a high task/low relationship behaviour, a high task/high relationship behaviour, a high relationship/low task behaviour, and a low relationship/low task behaviour following the managerial grid of Blake et al., (1962). According to their study, out of four styles following the situational leadership model. i.e., Telling, Selling, Participating and Delegating, professionals from the National Agricultural Research and Education System were found to have selling style of leadership followed by a telling style. Selling was viewed as trying to persuade on tasks and this still required much of the leader's time, but the focus now also includes developing a relationship with the employee spending more time listening and offering advice.

Comparative perceptions of groups of respondents

Table 2 represents index scores for various dimensions of superiors' behaviour perceived by bank employees (subordinates) across different experience groups. Whereas, Figure 1 illustrates the relative contribution of the dimensions on overall index scores as well as relative contributions of various dimensions of superiors' behaviour. The respondents with >5-10 years of experience in banking service perceived that their superiors had a relatively higher motivation index of 77.97. Therefore, the motivating ability of the superior was appreciated mostly by respondents with >5-10 years of experience followed by respondents with up to 5

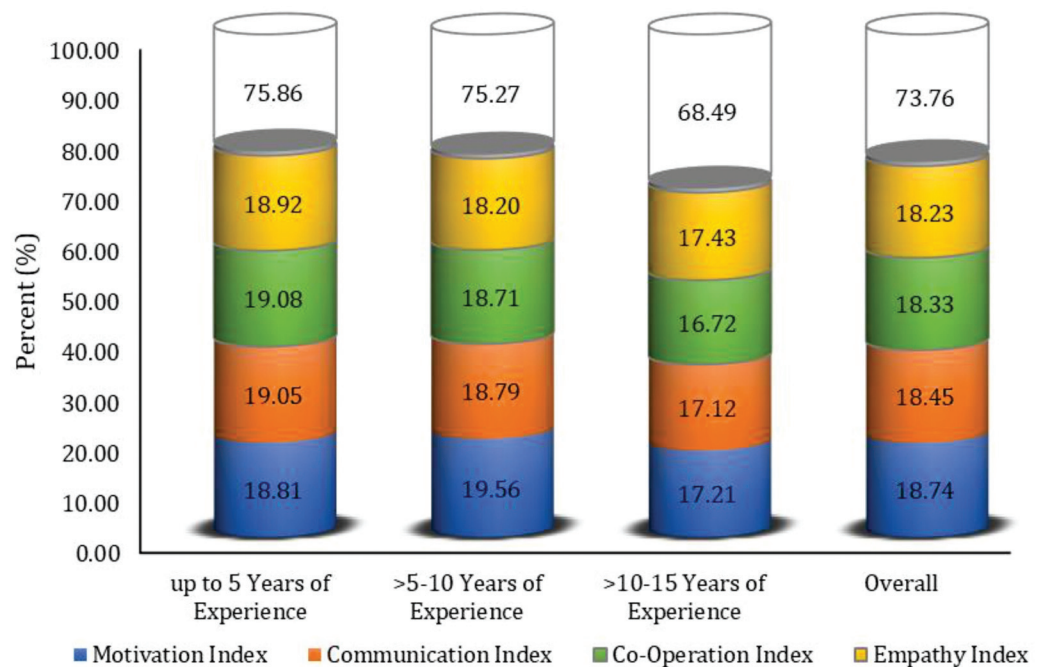
years of experience. Respondents' perception about the remaining three domains of superior' behaviour and overall superiors' behaviour was inversely proportional to their experience. The ability of superiors to motivate their subordinates was notably acknowledged by respondents who possessed more than 5-10 years of experience, closely trailed by respondents with up to 5 years of experience. Interestingly, as respondents' experience levels increased, their perceptions regarding the other three dimensions of superior behaviour viz. communication, cooperation, and empathy followed an inverse relationship, suggesting a potential decline in the perceived effectiveness of superiors' behaviour in these dimensions over extended periods of service. Similarly, the overall perception of superiors' behaviour exhibited a parallel trend. The impact of superiors' behaviour on employees lessens as respondents accumulate more experience. This nuanced pattern highlights the dynamic interplay between experience and perception of overall superiors' behaviour. It also emphasises the importance of maintaining consistent and effective superiors' behaviour in the dimensions of communication, cooperation, and empathy to counteract the potential decline in the performance of the subordinates over time.

It was evident from the study that, respondents across diverse experience groups, whether considered individually or collectively, share similar perceptions regarding the distinct characteristics of

Table 2. Indices with respect to different dimensions of superiors' behaviour across three groups of respondents

Domains	Work experience (Years)			Overall
	up to 5	>5-10	>10-15	
Motivation index (MI)	75.24	77.97	68.89	74.85
Communication index (CI)	76.21	74.89	68.53	73.71
Cooperation index (COI)	76.36	74.58	66.93	73.22
Empathy index (EI)	75.71	72.53	69.78	72.83
Superiors' behaviour index (SBI)	75.86	75.27	68.49	73.76

Figure 1. Overall superiors' behaviour and relative contributions of its dimensions



their superiors. This consistent pattern was evident in the nearly equivalent contributions of these four distinct behaviour dimensions to the overall perception of superiors' conduct (Figure 1). It could be observed that respondents from different experience groups individually, as well as together, had perceived those four distinct characteristics of superior had an almost similar contribution to the overall superiors' behaviour. The contribution ranged from 16.72 per cent to 19.56 per cent.

Test of significance of differential perceptions of respondents

To take a deeper look in the difference of perceptions among the groups of respondents the one-way ANOVA was performed. The findings of the analysis are tabulated in Table 3. It was suggested that, there were significant differences exist among the groups of bank officials (based on experience) in the perception of motivation ($F=4.608$; $p=0.011$), communication ($F=3.014$; $p=0.052$), cooperation ($F=3.437$; $p=0.034$), and overall superiors' behaviour ($F=3.120$; $p=0.047$), while there was no significant difference in perceptions of regarding empathy domain of superiors' behaviour ($F=1.395$; $p=0.251$). In order to precisely determine

which pair of groups of respondents differed from each other, post hoc tests were conducted for the domains like motivation, communication, cooperation, and overall superiors' behaviour having significant F test statistics.

The post hoc tests revealed significant differences. As evident from Table 4, significant variations were observed in the motivation and cooperation domains. Specifically, there was a significant difference in perceptions between the groups of respondents with >5-10 years of experience and >10-15 years of experience ($p=0.011$) with respect to motivation domain. And in case of the cooperation domain, the significant difference was observed between respondents with up to 5 years of experience and the respondents with more than 10 years of experience ($p=0.049$). Additionally, a notable difference at 10% level of significance was observed for communication domain between two extreme experience categories of respondents ($p=0.073$). Regarding the overall superiors' behaviour, respondents with high experience showed a variation with the remaining two groups ($p=0.083$ and 0.089). Figure 2 indicates no significant differences in mean perception scores of three groups in terms of commonality in alphabets.

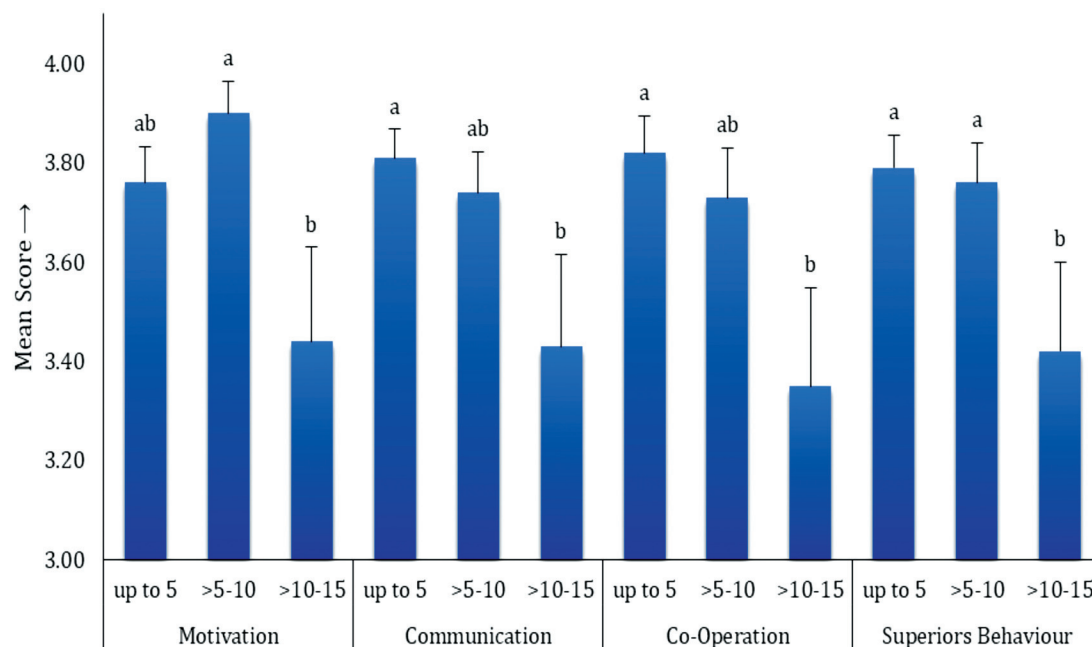
Table 3. The differences between the groups of respondents regarding perceptions of superiors' behaviour

Particulars		Sum of squares	df	Mean square	F	Sig.
Motivation	Between Groups	5.971	2	2.985	4.608	0.011
	Within Groups	114.678	177	0.648		
	Total	120.649	179			
Communication	Between Groups	4.166	2	2.083	3.014	0.052
	Within Groups	122.317	177	0.691		
	Total	126.482	179			
Co-operation	Between Groups	6.191	2	3.095	3.437	0.034
	Within Groups	159.417	177	0.901		
	Total	165.608	179			
Empathy	Between Groups	2.230	2	1.115	1.395	0.251
	Within Groups	141.532	177	0.800		
	Total	143.763	179			
Superiors behaviour	Between Groups	4.189	2	2.095	3.120	0.047
	Within Groups	118.844	177	0.671		
	Total	123.033	179			

Table 4. Post hoc tests depicting significant differences between the groups of respondents with respect to perceived domains and overall superiors' behaviour

Variable	Experience category (yrs.)		Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
	(I)	(J)				Lower bound	Upper bound
Motivation	up to 5	>5-10	-0.136	0.141	0.626	-0.483	0.211
	up to 5	>10-15	0.319	0.161	0.144	-0.079	0.717
	>5-10	>10-15	0.455	0.150	0.011	0.084	0.826
Communication	up to 5	>5-10	0.066	0.145	0.901	-0.292	0.425
	up to 5	>10-15	0.384	0.166	0.073	-0.027	0.795
	>5-10	>10-15	0.318	0.155	0.126	-0.066	0.701
Co-operation	up to 5	>5-10	0.089	0.166	0.867	-0.321	0.498
	up to 5	>10-15	0.471	0.190	0.049	0.002	0.940
	>5-10	>10-15	0.382	0.177	0.100	-0.055	0.820
Superiors behaviour	up to 5	>5-10	0.030	0.143	0.979	-0.324	0.383
	up to 5	>10-15	0.368	0.164	0.083	-0.037	0.773
	>5-10	>10-15	0.339	0.153	0.089	-0.039	0.717

Figure 2. Mean perception scores of three groups of respondents regarding superiors' behaviour and its domains



Overall superiors' behaviour was perceived moderately with an index of 73.76 that was derived based on motivation, communication, cooperation, and empathy, each contributing to overall perception almost equally. Motivation by the superiors was valued maximum by the subordinates as most of the respondents appreciated the superiors' motivating nature (mean score 3.74). The relationship between supervisors and subordinates is crucial for organisational performance (Robins, 2005); in this context, a favourable perception of agriculture officers on superior's behaviour as revealed in the present study may influence the organisational effectiveness of the banks. Donaldson-Feilder et al., (2011) highlighted positive leadership as having a stimulating effect on the motivation and participation of employees. Communication ability of the superior is equally important in influencing subordinates' attitudes (Gatling et al., 2017; Swain et al., 2018; Van Quaquebeke & Felps, 2018; Men, 2021) that is found favourably perceived by the bank's agriculture officers in the present study. Therefore, superiors in banks must establish a foundation of trust with their employees to foster a positive work environment and enhance employee satisfaction (Dutta & Sharma, 2016).

CONCLUSION

Superiors were successful in fostering a supportive and motivating work environment, exerting influence voluntarily and honestly, and creating confidence in subordinates in the public sector banks as perceived by the agriculture officers. Communication between superiors and subordinates was generally effective, with superiors actively engaging in providing work-related information and discussing office-related matters. The cooperative nature of superiors was also apparent, with an emphasis on teamwork and the involvement of subordinates in decision-making processes. Thus, it is worth concluding from the present study that the respondent agriculture officers working in the banks have been

working with motivating and supportive superiors exercising the participatory management behaviour that would have a facilitating effect in their performance to provide financial assistance to the farmers for improved farming. Therefore, policies should aim to cultivate positive relationships, support open communication, and provide incentives for collaboration to promote effective participatory management in the banking industry.

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Empowering Women in Aquaculture- Evidences from Jagatsinghpur, Odisha

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ABSTRACT

Empowerment levels of women involved in aquaculture-related vocations were measured using the Women Empowerment in Aquaculture Index (WEAI) in Jagatsinghpur, Odisha during 2022-23. Ninety-eight women belonging to 9 randomly chosen women self-help groups were studied using a structured interview schedule. Regression analysis indicated that 53.9 per cent variation in the women empowerment level was attributed to annual income, information source utilization, social participation, participation in extension activity, training, and innovativeness. The empowerment level of 9 SHGs varied from 61-95 per cent, with considerable differences between the domains- access to and control over resources and services, participation in social and economic activities, ability to make independent decisions, control over income usage, knowledge on aquaculture, and attitude towards aquaculture. Non-availability of bigger size fingerlings, lack of financial support from Govt. organizations, and lack of knowledge regarding recommended practices were among the constraints that limit women's participation in aquaculture.

INTRODUCTION

Aquaculture plays a vital role in addressing global food security challenges and fostering economic growth, particularly in developing nations. The growth in fish production aligns with an overall expansion in fish consumption. Fish consumption has risen by approximately 3 per cent annually since the 1960s, surpassing the growth of other animal protein sources. This trend is evident in both developed and developing countries (FAO, 2020b). Notably, women have increasingly become active participants in the aquaculture sector, engaging as both producers and entrepreneurs. This involvement not only promotes gender equality but also brings positive socio-economic outcomes to households and communities. In Indonesia, women collaboratively make aquaculture decisions with their male partners (Sari et al., 2017). While women's roles vary across countries, cultures, and technologies, their participation along the aquaculture value chain remains significant (Kruijsen et al., 2018; Gonzalez et al., 2021). Therefore, approaches to empower women in this field will differ based on

the country, such as India, where distinct strategies may be required. To ensure sustained empowerment, the establishment of Self-Help Groups (SHGs) has emerged as an effective tactic. Empowering women through SHGs in aquaculture demonstrates promising outcomes, enhancing their resource access, decision-making authority and overall livelihoods. This strategy not only bolsters individual women's livelihoods but also contributes to broader community development, aligning with Sustainable Development Goals (SDGs). The Government of Odisha has recognized fish farming as a promising venture for women Self-Help Groups (SHGs). In September 2018, they launched an inter-departmental scheme named "Fish Farming in Gram Panchayat Tanks by Women SHGs." To incentivize SHGs' participation, a significant policy modification was introduced, prioritizing the leasing of Gram Panchayat tanks to women SHGs for duration of 3-5 years. The government offered financial support of Rs. 90,000 per hectare to SHGs, covering 60 per cent of the operational expenses (totalling Rs. 1.5 lakhs/ha/crop) for fish production. This assistance enabled SHGs to adopt modern fish farming techniques, leading to enhanced

fish yield and higher annual income (Jaysankar et al., 2022). During the span of 1987 to 2016, the Central Institute of Freshwater Aquaculture (CIFA), located in Bhubaneswar, executed several technology transfer projects. These projects either exclusively benefited women in agriculture or included a considerable number of women as beneficiaries (De et al., 2020). Literature on women's contribution to aquaculture and their level of empowerment as a consequence of getting involved in aquaculture is scarce. Measuring and quantifying empowerment of women has also received less research attention (Nain et al., 2010). It is imperative to gauge empowerment so that interventions are made to ensure gender mainstreaming in aquaculture. The present study attempts to quantify empowerment level of women SHGs involved in aquaculture; how empowerment is influenced by socio-economic factors and the constraints that hinder women's involvement in aquaculture.

METHODOLOGY

One of the 30 districts in Odisha, Jagatsinghpur, was purposively chosen for the study. All eight blocks-Tirtol, Balikuda, Naugaon, Biridi, Erasama, Raghunathpur, Jagatsinghpur, and Kujangawere surveyed. Two SHGs were selected at random from Tirtol, the biggest block and one from each of the remaining seven blocks. A structured interview schedule that included socio-personal and socioeconomic characteristics as well as an index to measure the degree of empowerment among women involved in aquaculture was used to interview all the members of the nine SHGs (n=98). Data were gathered between 2022 and 2023. The level of women's empowerment in aquaculture was measured using the Women Empowerment in Aquaculture Index (WEAI) developed by De et al., (2023). This index comprises six domains, namely access to and control over resources and services, participation in social and economic activities, ability to make independent decisions, control over income usage, knowledge on aquaculture, and attitude towards aquaculture. Raj et al., (2022) assessed empowerment in cassava cultivation using 5 Domains of Empowerment (5DE) viz., agricultural production decision-making, access to productive resources, control over use of income, community leadership and time allocation. Additionally, the study assessed different constraints faced by rural women in practicing fish farming. These constraints were ranked based on their severity, as indicated by SHG members during interview. By employing Henry Garrett's Ranking Technique, the rankings assigned by respondents were examined. The respondents' rankings were transformed into scores using a standard formula proposed by Garrett (1979).

RESULTS AND DISCUSSION

In relation to the socio-demographic characteristics of the Women Self-Help Groups (WSHGs), a majority of 59.9 per cent fall within the age range of 30 to 50 years. Regarding education, 28.6 per cent of the members had successfully completed their matriculation. Within the group, 22.4 per cent of female members belong to the SC/ST and OBC categories. Among the members, 39.5 per cent are part of joint families. Moreover, 62.6 per cent of individuals have less than 5 years of experience in fish farming. Notably, 87.8 per cent members have taken part in various training

programmes focused on aquaculture. Concerning their annual income, 53.1 per cent of members were able to generate a moderate level of income from farming and other sources, ranging between (Rs. 95,312-2,30,994). In terms of their innovativeness, 42.9 per cent of respondents expressed their willingness to adopt new fish farming technologies.

Association between socio-personal/economic variables with the level of empowerment was carried out and the following variables such as participation in extension activity, training and innovativeness with 'r' person correlation coefficient value 0.338, 0.543 and 0.523 respectively were found to be significant at 1% level of significance. The findings revealed that women who are innovative and actively participate in different extension activities and training programmes were more empowered than others. Additionally, the variable "social participation" exhibited a significant association at a 5% level of significance with an 'r' Pearson correlation coefficient value of 0.246 in relation to the level of empowerment. Similarly Yadav & Ghosh (2023) reported 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.

Results given in Table 1, reveals that all of the selected independent variables together determined 53.9 per cent variation in level of empowerment. Out of the 13 attributes regression coefficients of six attributes namely annual income, information source utilization, social participation, participation in extension activity, Training and innovativeness were found to be positively significant. For each of these attributes, a one-unit increase corresponded to empowerment level changes of 0.175, 0.212, 0.384, 0.424, 0.384, and 0.398 units, respectively. Roy and Ghosh (2022) reported that regression coefficients of four attributes such as family size, use of personal cosmopolite information sources, use of mass media source and knowledge level were found to be positively significant with perceived marketing system effectiveness (MSE). These findings are in line with the findings of Banerjee et al., (2022) and Chandra et al., (2023).

Table 2 presents a comprehensive overview of women's empowerment levels in aquaculture, segmented across different domains and Self-Help Groups (SHGs). Among the listed SHGs, Trinath Matsya Utpadak Gosti leads with the highest Women's Empowerment in Aquaculture Index (WEAI) score of (19.16) followed by Maa Manisa SHG with a score of (17.50) and Maa Durga SHG with a score of (16.66) in terms of accessing and controlling resources and services. These top-performing SHGs have effectively established collaborations with local organizations, government bodies and stakeholders like Krishi Vigyan Kendra (KVK) Jagatsinghpur and the District Fisheries Office. This collaborative approach has resulted in increased resource access, knowledge sharing, and enhanced service provision in the aquaculture sector. In the aspect of participation in social and economic activities, Trinath Matsya Utpadak Gosti achieves the highest score of (14.18) followed by Gorekhgadi SHG (8.08) which showcasing their strong leadership and group dynamics that actively encourage engagement in various economic and social

Table 1. Multiple regression analysis of socio-personal/economic variables with the level of empowerment

Variables	Regression coefficient	Standard error	Standardized Coefficients β	't' value	P value
(Constant)	92.420	8.246	-	11.208	0.000
Age	0.592	2.260	0.021	0.262	0.794
Education	0.480	0.597	0.070	0.804	0.424
caste	-0.806	0.871	-0.074	-0.925	0.358
Family type	1.459	1.687	0.081	0.865	0.389
Family size	1.111	1.134	0.083	0.980	0.330
Experience	-0.738	3.024	-0.020	-0.244	0.808
Land area	-1.189	1.088	-0.094	-1.093	0.278
Annual income	2.292E-5*	0.000	0.175	2.127	0.036
Information Source Utilization	0.628*	0.294	0.212	2.134	0.036
Social participation	7.501**	2.083	0.384	3.600	0.001
Participation in Extension activity	1.173**	0.311	0.424	3.773	0.000
Training	3.650**	0.830	0.384	4.398	0.000
Innovativeness	3.278**	0.775	0.398	4.228	0.000

R square = 0.539, F value = 7.565, **Significant at the 0.01 level, *Significant at the 0.05 level

Table 2. Comparison of empowerment level of 9 women SHGs

Domains	Gorekhgadi SHG (n=14)	Baba Trinath SHG (n=14)	Trinath Matsya Utpadak Gosti (n=10)	Tarak-eswar Matsya Utpatak Gosti (n=10)	Jay Hanuman SHG (n=10)	Maa Manisa SHG (n=10)	Bajara-ngabali SHG (n=10)	Maa Durga SHG (n=10)	Baba Shiv Shambhu SHG (n=10)
Access to and control over resources and services	11.90	10.51	19.16	3.88	5.55	17.50	8.33	16.66	8.05
Participation in social and economic activities	8.08	6.03	14.18	2.45	1.90	6.95	7.36	7.36	6.95
Ability to decide independently	7.05	6.07	3.25	4.50	3.12	3.12	4.00	5.25	4.87
Control over use of income	36.50	27.38	27.5	33.33	40.55	33.61	45.83	34.72	40.55
Knowledge on aquaculture	3.29	4.12	4.07	2.46	3.23	3.23	2.84	1.53	2.46
Attitude towards aquaculture	28.27	21.42	17.08	15.16	12.83	27.25	21.33	15.16	14.91
Overall WEAI (%)	95.09	75.53	85.24	61.78	67.18	91.66	89.69	80.68	77.79

endeavours. Gorekhgadi SHG secures the highest score of (7.05) in the ability to decide independently domain, while both Jay Hanuman and Maa Manisa SHGs exhibit lower scores of (3.12). This difference can be attributed to the supportive atmosphere within Gorekhgadi SHG, where strong unity among members fosters an environment conducive to decision-making. Concerning control over income utilization, Bajarangabali SHG obtained a high score (45.83), while Baba Trinath SHG trails behind with (27.38), indicating diverse income-generating activities within Bajarangabali SHG that facilitate greater control over income allocation. In terms of knowledge about aquaculture, Baba Trinath SHG claims the highest score of (4.12), closely followed by Trinath Matsya Utpadak Gosti with a score of (4.07). On the other hand, Maa Durga SHG scores the lowest with (1.53). This discrepancy arises from Baba Trinath SHG's active participation in extension activities and training programs related to aquaculture. Lastly, attitudes toward aquaculture demonstrate that Gorekhgadi SHG shines with a score of (28.27), while Jay Hanuman SHG records the lowest score of (12.83). The positive attitude of Gorekhgadi SHG members can be attributed to the strong support they receive from their society for aquaculture activities. The Overall Women's

Empowerment in Aquaculture Index (OWEAI), a comprehensive measure combining scores across all domains, ranks "Gorekhgadi SHG" at the forefront with the highest score of (95.09%), followed by "Maa Manisa SHG" at (91.66%) and "Bajarangabali SHG" at (89.69%) among the listed SHGs. De et al., (2023) in his study reported that the district Khordha had the highest overall empowerment (79.8%), followed by Puri (74%) and Kendrapara (69.2%). Roy et al., (2022) had constructed an empowerment index for SHG women and applied the same on 290 SHG members of North 24 Praganas, West Bengal and worked out the empowerment score that ranges from 0.6-0.8. SHG group leaders in rural West Bengal are true examples of empowerment. The investigator's assessment underscores the significant impact of collaboration, leadership, and supportive environments in fostering women's empowerment in the aquaculture sector, as indicated by the Overall Women's Empowerment in Aquaculture Index (OWEAI) score.

Non-availability of bigger size fingerlings was ranked as (I), while, lack of financial support from Govt. organizations was ranked (II) and lack of knowledge regarding recommended practices is ranked (III) the corresponding Garrett mean scores for these

Table 3. Constraints encountered by the rural women in practicing aquaculture

S.No.	Constraints	Garrett mean score	Ranks
1	Non-availability of bigger size fingerlings	68.87	I
2	Disease outbreak	32.95	XIV
3	Lack of knowledge regarding the recommended practices	60.46	III
4	Seasonality of pond	44.11	XI
5	High cost of feed	58.72	IV
6	High cost of fertilizer	32.90	XV
7	Lack of financial support from the Govt. organisations	65.88	II
8	Poaching & Poisoning	50.32	VIII
9	Lack of family support and encouragement	41.06	XII
10	Inadequate time after household work	39.30	XIII
11	Lack of need based training programme	52.95	VI
12	Lack of farm and home visit by the extension workers	47.46	IX
13	Lack of facility for soil and water testing	51.75	VII
14	Lack of water management during flood	45.44	X
15	Lack of fishery input supplier in the locality	57.73	V

constraints were 68.87, 65.88, and 60.46 respectively. De and Pandey (2014) reported that Lack of access to credit and finance was the major constraints to women's participation in aquaculture. Mohanty et al., (2020) reported barriers to women's engagement in aquaculture as a lack of literacy. Women still face significant economic, social and cultural barriers that affect their participation in aquaculture, their access to, and control over assets and resources, and the income and benefits derived from these activities (Johnson et al., 2016; Kruijssen et al., 2018; Morgan et al., 2017; Phillips et al., 2016; Ramirez & Ruben, 2015). As reported by Githukia et al., (2020), access to productive resources is a major constraint among women in aquaculture in Kenya, which also limits their ability to access loans due to lack of collateral. Likewise, Agbebi et al., (2016) noted that women in Rwanda face constraints in accessing technical skills in fish production systems.

CONCLUSION

Empowerment level of women in aquaculture in Jagatsinghpur, Odisha has been quantified. Empowerment levels among 9 Women Self-Help Groups (WSHG), varies from 61 per cent to 95 per cent, across 6 domains of WEAI. Socio-economic variables like participation in extension activities, training and innovativeness and social participation has had positive correlation with women empowerment level. Variables like annual income, information source utilization, social participation, participation in extension activity, Training and innovativeness significantly affects the empowerment level with coefficient of determination worked out as 0.539. Government initiatives aimed at enhancing women's participation in aquaculture through several interventions are resulting in positive outcomes. These findings underline the importance of tailored policies to overcome challenges and promote women's active role in aquaculture for sustainable development.

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Measuring KVK-led Fisheries Extension Efforts in Haryana and Punjab: Insights and Interventions

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ABSTRACT

KVKs have proved to be dynamic agents of agricultural development but their role and potential contribution for fisheries development is less known. This study, conducted in 2023, quantifies fisheries extension efforts of all 22 KVKs in Punjab and 19 KVKs in Haryana. The study relied on secondary data sourced from annual reports of ATARI-Ludhiana, ATARI-Jodhpur, ICAR-KVK portal, individual KVK websites as well as primary data collected from KVK-SMS in all districts using a structured online survey, besides field visits to few KVKs. A novel methodology, the KVK-Fisheries Extension Intensity Index (FEII) consisting of 5 dimensions (human resource, infrastructure, budget, fisheries extension activities, and digital outreach), was used to quantify the KVKs' extension effort. The average FEI scores were 33 per cent for Haryana KVKs and 36 per cent for Punjab KVKs with none of the 41 KVKs having *high* FEI (>66%), clearly indicating inadequate attention to fisheries by KVKs. Nearly two-thirds of KVKs in Punjab (68%) and in Haryana (58%) had *moderate* FEI scores. The absence of fisheries SMS and fisheries infrastructure in all, but 5 KVKs in the two states were primary reasons for poor extension effort which needs speedy redressal.

INTRODUCTION

Public extension has been recognised as a crucial element in agriculture development (Babu et al., 2013). Provision of quality extension services has been demonstrated to improve agricultural productivity and farm income (Agholor et al., 2013). Extension services can strengthen the resilience of farmers by improving access to knowledge and inputs (Davis et al., 2014). ICAR has initiated frontline extension approaches namely National Demonstration (1964), Operational Research Project (1974), Krishi Vigyan Kendra (1974), and Lab to Land program (1979) which were clubbed together into KVK system in 1992 (Sahoo et al., 2021). The birth of KVKs itself was a result of ICAR's realisation

to integrate research, education, and extension organically within the NARES (Venkatasubramanian et al., 2010). The robust network of district level KVKs, established across the country to refine and disseminate agricultural innovations, helped amplify production and profit through OFTs, FLDs and capacity development at field level (NILERD, 2018; IFPRI, 2019). KVKs provide multidisciplinary and broad-based technological interventions enabling farmers to manage their farms sustainably in an integrated manner (Sinha et al., 2021).

In the crop sector, it is amply documented that KVKs have a significant impact on the economic welfare of farming households and are positively empowered, though the extent of impact is said to vary (IFPRI, 2019; Rani et al., 2021). Many have reasoned that

the positive impact was the result of enhanced knowledge and skill sets leading to improved technology adoption and income due to KVKs activities (Dubey et al., 2016; Sandhu & Dhaliwal, 2016; Singh & Tanwar, 2020; Kumar et al., 2022). KVKs have proven to be one of the finest solutions for improving knowledge, attitude, and skill level among rural India's farming community (Gorfad et al., 2018). Particularly, KVKs' training and demonstration has played a key role in the adoption-diffusion process due to comprehensive understanding by farmers (Singh et al., 2018). However, the state of know-how on the role and contribution of KVKs in fisheries sector is scanty, as underscored by Subramannian (2013); Ananth et al. (2014); Singh & Tanwar (2020); Geetha (2022) & Deboshmita (2022). This is rather surprising in a scenario where fisheries development is considered a sunrise sector with huge untapped growth potential (Takar & Gurjar, 2020; Chrispin et al., 2022). Also, few case studies have demonstrated the potential role of KVKs in strengthening fisheries development at the district level (Deboshmita, 2022; Geetha, 2022). Vast salt-affected areas in Haryana (2.32 lakh ha) and Punjab (1.51 lakh ha) have become unsuitable for crop farming, yet they are prospective resources for both fresh and salt water fish culture (CIFE, 2012; Ansal & Singh, 2019). With a weakened extension system due to half the vacant positions in State Fisheries Departments of Haryana (55%) and Punjab (56%), importance of KVKs as source of do-how and know-how in districts for fisheries development gains traction. Thus, this study was undertaken to assess the present state of fisheries extension activities by KVKs in Haryana and Punjab, and identify gaps to further strengthen and upscale their efforts.

METHODOLOGY

The inland states of Haryana and Punjab were selected due to their vast untapped potential for inland saline aquaculture, and the paucity of studies on fisheries extension. During 2019-20, Punjab and Haryana produced 1.51 and 1.91 lakh tonnes of fish respectively (Handbook of Fisheries Statistics, 2020). Punjab has 23 districts with 22 KVKs and Haryana has 22 districts with 18 KVKs as per ICAR-KVK Portal. Besides, the state funded KVKs in Palwal, Karnal, Panchkula and Nuh districts in Haryana have not been included in the ICAR directory. KVKs of Haryana come under the jurisdiction of ATARI- Jodhpur and Punjab KVKs come under ATARI-Ludhiana.

The study uses the novel methodological framework, KVK-Fisheries Extension Intensity Index (FEII), inspired from the widely used project management tool Logical Framework Analysis, that has been adapted and validated in the context of assessing KVKs extension efforts in West Bengal, Bihar, Andhra Pradesh, and Tamil Nadu (Deboshmita, 2022; Geetha, 2022; Ananthan et al., 2021). FEII uses the inputs-outputs-outcomes framework and a set of measurable indicators to assess the *inputs* (human resource, working environment, infrastructure and budget) that fuels KVK activities as well as *outputs* (OFTs, FLDs, Trainings and digital outreach) of KVKs, while leaving out outcomes and impact that becomes discernible in the medium and long term. KVK-FEII consists of 5 dimensions with differential weights namely human

resource (30%), infrastructure (15%), budget (10%), fisheries extension activities (35%) and digital outreach (10%).

The study covered 41 of 44 KVKs (22 in Punjab and 19 in Haryana) present and functional as of December 2022 in the two states. Relevant secondary data available from annual reports of both ATARIs, ICAR-KVK portal, websites of individual KVKs were compiled and tabulated. Primary data was collected from KVK-SMS representing all the districts through a structured online survey. Google Forms were sent to all the KVK-SMS through respective ATARIs and responses were received from 48 SMS (54.4%) in Haryana and 55 SMS (47%) in Punjab. The primary responses were obtained on a 3-point Likert scale. At least one response from each of the KVK was ensured as the FEII was calculated for each KVK. The responses were coded and analysed using descriptive as well as inferential statistical tools. The first author also visited a few KVKs in each state to gain a first-hand understanding of KVKs' activities. To get the FEII scores, the responses of SMS belonging to the same KVK, if more than one, were pooled and considered as a single response. Arc-GIS software was used to generate spatial maps for each state representing district wise KVK-FEII scores.

RESULTS AND DISCUSSION

Profile of KVKs

First KVK in Haryana was established in 1976 in district Karnal under ICAR-NDRI, while in Punjab, the first KVK was established in district Gurdaspur in 1982. Majority of KVKs in Haryana (36%) were established during 1985-1994 and in Punjab (45%) during 2005-2014. With the Prime Minister's announcement in 2015 that there should be atleast one KVK in each district, considerable progress has been achieved (Figure 1).

In Haryana, there are 22 districts and 22 KVKs, 18 KVKs are ICAR funded and 4 are state funded. The four-state funded KVKs are in Palwal, Karnal, Panchkula and Nuh district. Karnal has 2 KVKs one under State Agricultural University (SAU) and other under ICAR-NDRI Karnal. One district, Charkhi Dadri doesn't have a KVK yet as it was carved out from Bhiwani district in 2016. Out of 22 KVKs, majority (82%) of them in Haryana are under the SAU (Chaudhary Charan Singh Haryana

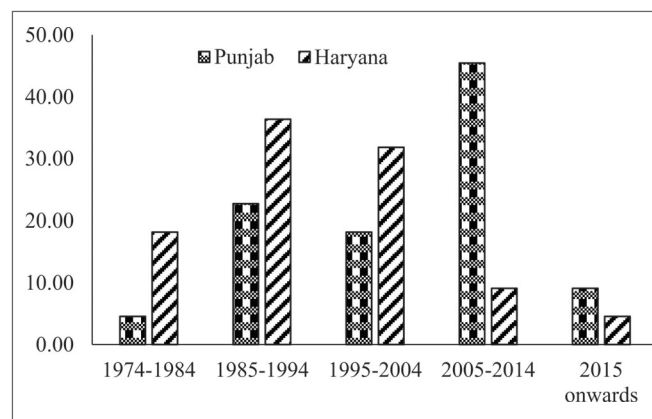


Figure 1. Year of Establishment of KVKs

Agricultural University, Hisar), 9 per cent under ICAR institutes (IARI and NDRI) and 9 per cent under NGOs (Bhagwat Bhakti Ashram, Rampura, and Society for Creation of Heaven on Earth).

In Punjab out of 23 districts, only one district doesn't have a KVK (Malerkotla, carved out from Sangrur district in 2021). Except one KVK which is under ICAR-Central Institute of Post-Harvest Engineering & Technology, rest of them (95.5%) are under the two SAUs (Punjab Agriculture University, and GADVASU, Ludhiana). This is a skewed distribution as compared to most states and the country as well wherein about 50-60% KVKs are under the SAUs and the rest are under either ICAR institutes or the NGOs (Deboshmita, 2022).

Infrastructure facilities and human resource status

KVKs are expected to have adequate infrastructure and physical facilities for accomplishing their mandated activities. Except for a few KVKs, most of them have basic infrastructure namely administrative building, farmers' hostel, staff quarters, vehicles, and soil water testing lab. However, it was found that only 2 KVKs (10.52%) in Haryana and 3 KVKs in Punjab (13.63%) have fisheries related infrastructure. Pennobalishwamy et al. (2018) suggested that development of physical facilities will help in promoting extension work and sustainable development in agriculture and allied sectors.

The accomplishment of KVKs mandated activities is greatly determined by the deployed human resource. The staff strength sanctioned to each KVK is 16, which includes 1 senior scientist and Head (Programme Coordinator), 6 Subject Matter Specialists (SMS), 1 Farm Manager, 3 Programme Assistants, 2 Administrative staff, 2 Drivers and 2 Supporting Staff. Regular capacity building of KVK professionals is crucial to increase the vibrancy and visibility of the KVK system. It was found that only 204 (67%) were in position out of sanctioned 304 staff in 19 KVKs of Haryana. Staff position in Punjab KVKs was much better with only 20 per cent vacancy i.e., 282 out of 352 were in position in 22 KVKs. SMS are the key resource persons in KVKs for carrying out effective extension services. It was observed that 26 (22.81%) of SMS posts were vacant in Haryana and 15 (11.36%) posts were vacant in Punjab, considerably better compared to other staff. SMS vacancies were more in the districts of Fazilka (6), Hisar (4), Panipat (4) and Kaithal (4). Mukherjee and Maity (2015) argued that in India large numbers of positions in the public extension system are vacant, resulting in overload for extension personnel and thus, lowering their efficiency. More alarmingly, only two KVKs (10.5%) in Haryana i.e., Karnal and Panchkula have Fisheries SMS in position, and only three KVKs (13.6%) in Punjab i.e., Tarn Taran, Barnala and Mohali (SAS Nagar) have Fisheries SMS. Bashir et al., (2016) reported that only about 5 per cent of the SMS working in KVKs in Tamil Nadu and Kerala have specialization in fisheries. Only 17 per cent of KVKs in Andhra Pradesh and 13% of KVKs in Tamil Nadu reported fisheries related extension activities which was attributed to the presence of fisheries SMS (Geetha, 2022). This highlights the importance of fisheries SMS in districts with high fisheries potential.

Budget and digital outreach

Budgetary provisions, especially operational budget, are the lifeline for KVKs. ATARIs provide this based on an assessment of the budgetary demands. A novel revolving fund facility is available for KVKs which gives them much needed operational flexibility. ICAR/Host Institute provides one-time seed money to each KVK, which is supplemented by income earned by the KVKs through sale of farm produce and services provision. A substantial amount of revenue generated by KVKs is available for spending / reinvestment in order to generate further revenue and recoup costs. About 16 KVKs in Haryana and 17 KVKs in Punjab have revolving funds of more than Rs. 20 lakhs, indicating a healthy fiscal scenario and giving a leverage to carry out need based extension activities.

In the era of digital and information revolution, the public extension providers are expected to have an informative website as a minimum. The presence and adequacy of KVKs individual websites were assessed for all the KVKs in both states. The specific indicators were availability of individual websites, website in state language, information on staff contact, infrastructure available, training and extension activities, and regular updation. It was observed that though 95 per cent of KVKs in Haryana have their own website, none of them were in Hindi. On the other hand, 63 per cent KVKs in Punjab have their own websites and 41 per cent of websites were in Punjabi as well. About 84 per cent of KVK websites in Haryana and 59 per cent KVK websites in Punjab had information about their respective training and extension activities. Updation was found to be very poor especially in Haryana with only 11 per cent of KVKs and 45.4 per cent in Punjab updating regularly. Deboshmita (2022) also reported that most of the KVKs in West Bengal and Bihar don't update their websites regularly.

Fisheries extension activities

Under this dimension, KVKs were assessed with regard to conduct (type and number) of OFTs, FLDs, training related to fisheries, and organization of fisheries related exhibitions/farmers meet. Besides, they were also assessed for availability and development of technical / extension literature related to fisheries. The average Fisheries Extension activities scores were found to be very low: an average of 3.48 out of 35 in Haryana and 5.59 in Punjab. FLDs, OFTs and training related to fisheries were conducted by only those KVKs in which fisheries SMS were in position in both states. The low scores indicate that KVKs are not focusing on fisheries at present. Absence of fisheries SMS and or related infrastructure in the KVKs are found to be primary reasons. Studies by Deboshmita (2022) & Geetha (2022) also present a similar portrait. In contrast, KVK of Ernakulam district in Kerala which is under the jurisdiction of ICAR-Central Marine Fisheries Research Institute has played a crucial role in standardising the shrimp farming and popularizing it in the district (Subramannian, 2013).

FEII scores of KVKs in Haryana and Punjab

Table 1 highlights district wise scores for different dimensions of FEII. Panchkula (19.06) followed by Karnal (17.71) and Sirsa

Table 1. Fisheries extension intensity index scores for districts in Haryana (n=19)

Districts	Human resource (30)	Infrastructure (15)	Budget (10)	Fisheries extension activities (35)	Social media (10)	Total score (100)
Karnal	17.71	9.00	7.00	7.33	7.67	48.71
Sirsa	15.88	8.00	6.00	3.75	7.00	40.63
Jhajjar	10.56	13.00	6.00	4.50	6.00	40.06
Panchkula	19.06	6.00	1.50	5.81	5.75	38.12
Sonipat	12.40	8.00	7.00	2.00	6.50	35.90
Yamunanagar	11.17	6.00	6.50	5.74	5.00	34.40
Rewari	9.09	8.00	5.67	4.90	6.60	34.26
Mahendragarh	11.44	8.00	6.50	2.56	5.75	34.25
Faridabad	13.08	6.00	6.00	2.08	7.00	34.16
Rohtak	11.16	6.00	6.80	5.45	4.67	34.08
Kurukshetra	8.48	8.00	7.00	4.25	6.00	33.73
Panipat	7.50	8.00	6.80	3.80	6.00	32.10
Fatehabad	10.21	6.00	7.00	0.00	6.00	29.21
Kaithal	6.38	8.00	5.33	3.00	5.67	28.38
Gurgaon	9.02	8.00	5.00	4.75	1.33	28.10
Bhiwani	7.98	8.00	5.67	1.17	3.67	26.48
Ambala	11.65	6.00	2.00	2.50	3.50	25.65
Hisar	4.46	8.00	6.00	2.50	4.17	25.13
Jind	6.58	8.00	5.00	0.00	1.50	21.08
Average	10.73	7.68	5.72	3.48	5.25	32.86

Table 2. Fisheries extension intensity index scores for districts in Punjab (n=22)

Districts	Human resource (30)	Infrastructure (15)	Budget (10)	Fisheries extension activities (35)	Social media (10)	Total score (100)
Barnala	17.08	6.00	9.00	29.50	2.00	63.58
Tarn Taran	13.71	6.50	2.50	24.75	9.00	56.46
Hoshiarpur	12.71	8.00	10.00	5.75	8.00	44.46
Ludhiana	11.63	7.50	10.00	2.97	8.25	40.35
Ropar	12.94	7.00	10.00	1.25	8.50	39.69
Moga	14.44	7.50	8.75	5.25	3.50	39.44
Jalandhar	13.04	7.50	8.75	4.87	4.50	38.66
Faridkot	15.02	8.00	9.17	4.17	2.00	38.36
Sangrur	8.29	11.00	7.50	4.17	7.00	37.96
Muktsar	12.88	6.50	10.00	2.25	5.50	37.13
Patiala	12.47	7.50	9.17	3.08	4.33	36.56
Ferozepur	12.75	7.50	10.00	0.50	5.00	35.75
Bathinda	10.81	7.50	8.12	2.63	6.00	35.07
Mohali	16.94	3.50	3.50	10.25	0.00	34.19
Amritsar	11.54	5.50	7.50	1.75	7.5	33.80
Kapurthala	12.94	10.00	5.00	2.00	2.00	31.94
Gurdaspur	13.61	7.00	8.33	0.56	1.33	30.83
Nawanshahar	8.88	7.50	5.00	1.50	7.50	30.38
Fatehgarh Sahib	9.34	6.50	6.00	1.87	4.80	28.51
Mansa	10.15	5.50	6.87	3.06	1.75	27.33
Fazilka	6.00	4.00	5.00	7.00	2.00	24.00
Pathankot	8.33	3.00	0.83	3.75	0.67	16.59
Average	12.07	6.84	7.32	5.59	4.60	36.41

(15.00) scored high for human resource and working environment dimension. This was due to the presence of fisheries SMS. Jhajjar scored higher for infrastructure dimension, which may be attributed to presence of fisheries demo units along with other basic infrastructure. The scores of different district KVKs were found to be in the range of 5-7 except for Panchkula (1.50) and Ambala

(2.00), where the scores were found to be low. The lower score for Ambala KVK may be attributed to its host institute's (NGO) interest. Most of the KVKs scored low for fisheries extension activities dimension, attributed to a large extent to the lack of fisheries SMS and fisheries related infrastructure. Surprisingly, KVK Gurgaon (1.33) which is under ICAR-IARI, and KVK Jind

(1.50) obtained lowest scores for social media usage indicator. About 59 per cent of KVKs obtained a medium score of FEII, the rest had low scores. The FEII score for Karnal was highest 48.47, this can be due to the presence of fisheries SMS and availability of fisheries related infrastructure. None of the KVKs in Haryana scored high for FEI, thus indicating the need to support them for intensifying fisheries development efforts. Thus, it could be concluded that for Haryana the very low average scores for human capital (10.73), fisheries extension activities (3.48) and social media (5.25) dimensions led to poor overall FEII score (32.86). Geetha (2022) reported that the average FEII score for Tamil Nadu KVKs was 39.2 per cent and for Andhra Pradesh KVKs was 33.7 per cent which compares with Haryana. This only underscores the overall dismal scenario of KVK-led fisheries extension at present in most states, with the exception of states like West Bengal that have a moderately high FEII score of 48.76.

Table 2 highlights district wise scores for different dimensions of FEII. Barnala (17.08) followed by Mohali (SAS Nagar) (16.94) and Faridkot (15.02) scored high for human resource and working environment dimension. Sangrur scored the highest (11) for infrastructure dimension. The score of budget dimension was found to be low for Pathankot (0.83), Tarn Taran (2.50) and Mohali (SAS Nagar) (3.50). Except Barnala (29.50) and Tarn Taran (24.75), other KVKs scored low for fisheries extension activities, due to the lack of Fisheries SMS and fisheries related infrastructure. KVK Mohali (0), Mansa (1.75), Barnala (2) and Faridkot (2) scored very poorly on social media indicators. About 68 per cent of KVKs have a medium score of FEII, the rest have low scores. The FEII score for Barnala was highest (63.58) as a result of fisheries SMS and fisheries related infrastructure in the KVK that has led to noticeable extension activities. None of the KVKs in Punjab scored high (>66) on FEII, indicating the need to redress the existing gap to intensify fisheries development efforts. Again, it could be seen that the average scores for human resource (12.07), fisheries extension activities (6.84) and social media (4.60) dimensions were low leading to lower FEII score (36.41) in Punjab. Deboshmita (2022) reported that the average FEII score of KVKs in Bihar was 36.78 per cent, almost similar to Punjab, Haryana, Tamil Nadu, and Andhra Pradesh.

CONCLUSION

The evidence, in the form of poor KVK-FEII scores for both states and for the majority of KVKs, clearly demonstrates that fisheries has not yet become one of the priority areas of KVKs. This calls for reconsidering the cadre strength of KVKs by appointing fisheries SMS in identified districts with considerable fisheries potential, besides making immediate steps to fill vacant SMS positions. In districts with full strength of SMS, animal science or agricultural extension SMS may be trained to conduct fisheries extension activities as an interim measure. Fisheries demonstration units should be created in districts with high fisheries potential and adequate budgets should be provided for the same. A one-time catch-up grant for revamping each KVK website, making it bilingual and building the capacity of SMS and other KVK staff in effective social media usage will provide a visible impetus to usher in a KVK-led fisheries development in the state.

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Cost and Return Analysis of Tomato Cultivation in Haryana

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ABSTRACT

The study was carried out in Yamuna Nagar, Kurukshetra, and Karnal districts of Haryana during 2021-22. A total of 210 tomato growers were interviewed to collect data to study the thorough cost and return analysis of tomato cultivation. Tomato cultivation was a profitable venture for farmers with a BC ratio of 1: 1.86. The per hectare cost of cultivation was worked out to be Rs. 305701.14 of which major contributors were rental value of land (24.96%), picking/harvesting charges (15.44%), transportation (11.61%) and nursery raising/seed (5.74%). The gross return, return over variable cost and net return per hectare were Rs. 569528.28, 412210.72, and 263827.14 on an overall basis. The production cost per quintal of tomato was computed to be Rs. 707.23 per quintal. It was suggested that farmers should take tomato cultivation with a business and market-oriented approach to compete with the challenges of the glut situation and opt cooperative approach in the production and selling of crops to avail maximum profit by reducing the cost of inputs and transportation and ultimately improving bargaining and negotiating power for better price availing.

INTRODUCTION

Tomato (*Solanum lycopersicon*) is one of the most regularly utilized vegetable in the world, acting as a fundamental element in raw, cooked, and processed cuisines. After China, India is the world's second largest tomato grower. The fruits and vegetables sector offers numerous opportunities enabling farmers to boost their income and possesses a capacity to propel the agriculture sector's overall growth to greater heights. In view of the sensitivity and perishability of tomatoes, producers need to pay meticulous attention to each and every step during the cultivation process, and negligence in any operation might result in substantial post-harvest losses and crop deterioration. Tomato is a labor-intensive crop and needs labor in field operations like transplanting, manual weeding, earthing up, harvesting/picking and post-harvest management, which further helps in providing employment opportunities. In terms of production costs, seed and labor costs

are major contributors (Agarwal & Banerjee, 2019). The tomato crops encounter challenge of wastage and quality deterioration due to large gap in demand and supply. The major problems faced by vegetable growers are high prices of hybrid seeds, fertilizers and chemicals (Kumar et al., 2020). To reduce transportation cost and post-harvest losses, provision of better marketing facilities at village or major tomato producing blocks will be a great help (Kumari et al., 2022). Despite substantial efforts and significant investments, tomato cultivation has been repeatedly hampered by erratic production, disappointing yields, and recurrent swings in prices, causing hampered yield potential and poor livelihood status of tomato producers. Kisan rail facilitated transport will help in improving return by reducing losses and intermediaries' interference (Dubey et al., 2023). Cost and return analysis estimate are crucial for decision making at numerous phases of production and selling for farmers, researchers, policymakers, and government agencies.

(Nain et al., 2019) It will also aid in providing useful information for enhancing agricultural and marketing efficiency. Further, it will help in evaluating the financial viability of cultivation practices, profitability improvement, input optimization and maximizing returns on investment and ultimately sustainability in tomato cultivation. In light of this, the current study was carried out with the objective of evaluating the cost and return analysis of tomato cultivation in Haryana.

METHODOLOGY

The current study was conducted in the Kurukshetra, Karnal, and Yamuna Nagar districts of Haryana, since the aforementioned districts account for a substantial amount of the state's tomato area and production. Yamuna Nagar was chosen for the current research on the basis of its maximum production in 2019-2020. Karnal and Kurukshetra districts have been selected for their proximity to Yamuna Nagar, and together they represent an extensive tomato producing belt in Haryana, accounting for 20.96 per cent of total area and 27.35 per cent of total tomato output in the state. One block from each district was purposively chosen based on their closeness, and together they formed a large pocket of tomato area and production. Five villages were conveniently picked from each block, and 14 farmers were randomly selected from each village, generating a sample of 70 farmers from each district. As a result, 210 tomato producers were interviewed in order to get the necessary information. The primary data was collected using survey schedule to study cost and return analysis of tomato cultivation. For this, the data regarding details of expenditure on various operations involved in tomato cultivation like seed, nursery raising, fertilizers, plant protection chemicals, manure, land preparation, transplanting, irrigation, manual weeding, harvesting, transportation, rental value of land, packaging and labour charges were calculated and analysed to determine total of variable and fixed cost. Statistical tools like averages and percentages were used to analyse and interpret the results. Variable cost is calculated by adding total working capital and interest on working capital. Interest on working capital was calculated at annual interest rate of 9 percent, but as tomato is a six-month crop so, it was calculated at interest rate of 4.5 per cent. Transportation cost, packaging, risk factor, management charges and rental value of land were added to calculate fixed cost. Variable cost and fixed cost were added to approximate the total cost of cultivation. Production per hectare was multiplied with the average price received by tomato growers to determine gross return and to calculate net return and return over variable cost, the total cost and variable cost were subtracted from gross return. Cost of production was determined by dividing total cost by production per hectare. B:C ratio was used to show relationship between investment and return from one hectare of land which was calculated by dividing gross return with total cost.

RESULTS AND DISCUSSION

The thorough analysis of cost and return structure of tomato cultivation was presented in Table 1 and 2. The data presented in Table 1 disclosed that the total cost of cultivation of tomato per hectare in Kurukshetra, Karnal and Yamuna Nagar districts were found to be Rs. 301831.93, 304672.25 and 310599.23, respectively.

The average total cost of cultivation of tomato for all three districts was found to be Rs. 305701.14 per hectare, out of which 51.46 per cent was variable cost and 48.54 per cent was fixed cost. Major items that contributed to variable cost were picking/harvesting, nursery raising, plant protection chemicals, fertilizers, earthing up and FYM/poultry manure with a share of 15.44, 5.74, 5.06, 3.70, 3.22 and 3.18 per cent of total cost of cultivation, respectively. Major contributors to fixed cost were rental value of land and transportation charges with a share of 24.96 and 11.61 per cent of the total cultivation cost, respectively.

The high cost of picking was due to labour intensive nature of tomato cultivation and labour scarcity. It was also observed in the study area that peak harvesting/picking season and the schedule of MGNREGP (Mahatma Gandhi Rural Employment Program) clashes which resulted in labour scarcity that led to high labour cost. Kondal (2017) also reported this in his study conducted in Telangana that the problem of labour scarcity had increased after implementation of MGNREGP which leads to high labour cost. Further, he suggested that government should implement the MGNREGP in agricultural lean season in order to reduce problem of labour scarcity and labour cost.

The high cost of nursery raising/seed was caused by direct purchasing of seedlings from market due to which growers had to pay more price which was found 0.80-1.5 rupee per seedling. Tomato is a perishable crop and attracts insect pest and diseases easily which resulted into high cost of plant protection chemicals. The high cost of transportation was due to distant market as majority of tomato growers sold their produce in Azadpur Mandi of New Delhi and other market of Saharanpur, Dehradun, and Chandigarh. The results were in line with Mango et al., (2015) & Kushwaha et al., (2018), which stated that major contributors of the total cost of cultivation were human labour (35.88%), rental value of land (15.19%), manure and fertilizers (12.98%), plant protection chemicals (6.40%) and seed (4.41%). Sai et al., (2022) also observed that labour cost (50.00 percent of total cultivation) was major contributor in variable cost due to labour-oriented nature of tomato cultivation followed by plant protection (8.30%), fertilizers (7.25%) and seed/seedling (6.31%), respectively.

Return analysis of per hectare tomato cultivation

Returns from tomato cultivation were presented in Table 2. The data presented in Table 2 disclosed that average production per hectare in Kurukshetra, Karnal, Yamuna Nagar and overall was 424.24, 432.12, 440.40 and 432.25 quintal per hectare, respectively. The gross return per hectare in Kurukshetra, Karnal and Yamuna Nagar was found to be Rs. 557442.87, 569780.47 and 581429.29, respectively. Overall gross return per hectare was amounted to be Rs. 569528.28 and return over variable cost was Rs. 412210.72 per hectare. Net return per hectare of tomato cultivation was worked out to be Rs. 255610.94, 265108.22, 270830.06 and 263827.14 in Kurukshetra, Karnal, Yamuna Nagar and overall, respectively. The results are consistent with the findings of Kumar et al., (2016).

The average price received by tomato growers on overall basis was Rs.1317.59 per quintal. The average cost of production was Rs. 711.46, 705.06, 705.27 and 707.23 per quintal of tomato

Table 1. Costs of cultivation of tomato in(Rs. /ha)

S.No.	Particulars	Kurukshetra		Karnal		Yamuna Nagar		Overall	
		Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
1	Nursery raising/seed (g)	140.85	17071.12(5.66)	135.91	17987.13(5.90)	138.38	17541.92(5.65)	138.38	17533.39(5.74)
2	Preparatory tillage (Units)	4.7	4767.58(1.58)	4.6	4574.98(1.50)	4.8	4938.23(1.59)	4.7	4760.26(1.56)
3	Ridging (Units)		6141.16(2.03)		6093.57(2.00)		6218.93(2.00)		6151.22(2.01)
4	Transplanting (Units)	16	7742.59(2.57)	15	7797.08(2.56)	17	7686.47(2.47)	16	7742.04(2.53)
5	F.Y.M./ Poultry manure (tons)	8.15	9540.97(3.16)	8.4	9709.42(3.19)	8.75	9959.34(3.21)	8.43	9736.57(3.18)
	a. Nitrogenous (kg)	185.33	1196.98(0.40)	182.85	1096.44(0.36)	181.09	1114.44(0.36)	183.09	1135.95(0.37)
	b. Phosphatic (kg)	70.6	1754.23(0.58)	74.84	1895.22(0.62)	73.25	1844.77(0.59)	72.90	1831.41(0.60)
	c. Potassic (kg)	58.07	1579.80(0.52)	61.95	1512.48(0.50)	60.01	1534.02(0.49)	60.01	1542.10(0.50)
	d. Zinc (kg)	12.36	311.06(0.10)	14.83	353.36(0.12)	17.3	436.38(0.14)	14.83	366.93(0.12)
	e. Sulphur (kg)	14.83	1502.22(0.50)	12.36	1254.97(0.41)	17.19	1677.72(0.54)	14.79	1478.30(0.48)
	f. Boron (kg)	8.51	1093.64(0.36)	9	1149.02(0.38)	9.85	1217.72(0.39)	9.12	1153.46(0.38)
	g. Gypsum (kg)	298.29	2652.33(0.88)	305.35	2719.44(0.89)	310.64	2932.43(0.94)	304.76	2768.07(0.91)
	h. Mycorrhiza (kg)	9.88	940.43(0.31)	11.37	1219.38(0.40)	9.35	974.84(0.31)	10.20	1044.89(0.34)
6	Total fertilizer (a-h)		11030.69(3.65)		11200.31(3.68)		11732.32(3.78)		11321.11(3.70)
7	Fertilizer and weedicide application (Units)		1901.21(0.63)		1881.45(0.62)		1971.53(0.63)		1918.06(0.63)
8	Irrigation (Units)	11.96	9038.77(2.99)	10.94	9000.68(2.95)	12.36	9288.85(2.99)	11.75	9109.44(2.98)
9	Weeding (Units)								
	a. Manual		9091.83(3.01)		9105.10(2.99)		9096.75(2.93)		9097.89(2.98)
	b. Chemical		669.35(0.22)		637.22(0.21)		680.28(0.22)		662.28(0.22)
11	Earthing up (Units)		9793.15(3.24)		9920.93(3.26)		9850.10(3.17)		9854.73(3.22)
12	Plant protection chemicals		14938.65(4.95)		15555.89(5.11)		15903.30(5.12)		15465.94(5.06)
13	Picking/Harvesting		46396.66(15.37)		46865.07(15.38)		48308.80(15.55)		47190.18(15.44)
	Total working capital (1-13)		148123.73(49.07)		150328.83(49.34)		153176.80(49.32)		150543.12(49.25)
14	Interest on working capital @ 4.5 per cent per annum		6665.57(2.21)		6764.80(2.22)		6892.96(2.22)		6774.44(2.22)
A	Variable cost (1-14)		154789.29(51.28)		157093.63(51.56)		160069.76(51.54)		157317.56(51.46)
15	Transportation		35176.47(11.65)		34932.07(11.47)		36356.71(11.71)		35488.41(11.61)
16	Packaging charges		5055.88(1.68)		5130.43(1.68)		5158.54(1.66)		5114.95(1.67)
17	Management charges @ 10%		15478.93(5.13)		15709.36(5.16)		16006.98(5.15)		15731.76(5.15)
18	Risk factor @ 10 per cent		15478.93(5.13)		15709.36(5.16)		16006.98(5.15)		15731.76(5.15)
19	Rental value of land		75852.43(25.13)		76097.40(24.98)		77000.28(24.79)		76316.70(24.96)
B	Fixed cost (15-19)		147042.64(48.72)		147578.63(48.44)		150529.47(48.46)		148383.58(48.54)
20	Total cost (A+B)		301831.93(100)		304672.25(100)		310599.23(100)		305701.14(100)

Note: Figures in the parentheses represent percentage to respective total cost

Table 2. Returns from per hectare tomato cultivation

S.No.	Particulars	Kurukshetra	Karnal	Yamuna Nagar	Overall
1	Production (Quintal)	424.24	432.12	440.40	432.25
2	Price (Rs./quintal)	1313.98	1318.57	1320.23	1317.59
3	Gross return (Units)	557442.87	569780.47	581429.29	569528.28
4	Return over variable cost (Units)	402653.58	412686.84	421359.53	412210.72
5	Net return (Units)	255610.94	265108.22	270830.06	263827.14
6	Cost of production (Rs./quintal)	711.46	705.06	705.27	707.23
7	B:C Ratio	1: 1.85	1: 1.87	1: 1.87	1: 1.86

production in Kurukshetra, Karnal, Yamuna Nagar and overall, respectively. The B:C ratio was determined to be 1.85, 1.87, 1.87 and 1.86 implying that the tomato producer obtained a return of 1.85, 1.87, 1.87 and 1.86 rupees on a one-rupee investment in Kurukshetra, Karnal, Yamuna Nagar and overall, respectively and it is evident that tomato farming is a profitable venture in study area. The results were in line with Shende & Meshram (2015); Kushwaha et al., (2018) & Tambe et al., (2018). Samshunnahar et al., (2016); Kondal (2017); Vanitha et al., (2018); Gaikwad et al., (2020) & Sai et al., (2022) also concluded that tomato cultivation is profitable venture for the tomato growers.

CONCLUSION

Tomato cultivation is a profitable venture for farmers as indicated by the higher returns on per rupee investment of 1.86 due to its wide demand and short life period. Major constraints in tomato farming were high cost of labor, transportation, plant protection chemicals and seeds or nursery raising. It is suggested to build processing units and cold storage facilities with facility of sorting, grading and packaging in the major tomato producing belts to face challenges of glut situation during high production periods and reduction of post-harvest losses and spoilages of tomato. The government should take initiative to build processing units, cold storage units and refrigerated vehicles for transportation in the major tomato producing belts to save tomato growers from poor price in glut situation during period of higher production, reducing post-harvest losses and spoilage and also improving export capacity of the country.

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Identification of Indicators for Assessing Research-Extension-Farmers Linkage in Fisheries Sectors of Tripura

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ABSTRACT

The study was conducted in Tripura from 2019 to 2022 to identify different indicators for linkage between research-extension-farmers in fisheries sectors. For selecting relevant indicators that are responsible for establishing linkage among the researchers, extension personnel, and farmers, different published documents, reports, and secondary sources were reviewed for the study. The indicators identified for establishing linkage were pooled and a comprehensive list of indicators was prepared. There were 53 indicators that were kept under different categories in the pooled list using the three-point continuum; Most Relevant (MR), Relevant (R), and Not Relevant (NR). After obtaining the judges' opinions, the relevancy score for each indicator was worked out using the relevancy percentage. The 24 indicators having an average relevancy percentage of more than 75 were finally selected for the study. Conducting need-based training (92.78%, I), Regular contact with farmers (92.12%, II), and Assessing the outcome and impact of training attended (91.35%, III) were few of the important indicators identified in the study.

INTRODUCTION

Being an integral part of the Indian economy, agriculture provides access to entrepreneurial opportunities to many people and acts as a stable means of income to many farmers. Most Indian farmers, today struggle with issues including increased debt, decreased financial inclusion (Arunkumar et al., 2023), weak bargaining power, and a lack of insurance options (Nain et al., 2016; Kumar et al., 2021). Indian farming community is dominated by 86.21 per cent of the country's total land holdings which are owned by small and marginal farmers (Gorai et al., 2022). Agricultural advisory services are also proved to be important tools, which provide critical and scientific farming information in a timely manner, which in turn help in livelihood development and farmers' welfare especially, in rural places (Lahiri et al., 2020). It is quite usual to

have knowledge and information about the elements that affect the acceptance of new practises in agriculture. However, there haven't been many attempts to create quantitative models that can anticipate adoption for those organising relevant research, extension, development, and policy intervention in agricultural sectors (Kuehne et al., 2017). Typically, extension planning, implementation, and evaluation activities do not include the marginalised and impoverished farmers (Adugna, 2013). This can be one of the reasons for the information and communication gap between the farmers and extension personnel. The three primary pillars of the agricultural system (research, extension, and farmers) depend heavily on one another for their efficiency (Sewnet et al., 2016). Effective extension programmes can be created by taking into account the information that farmers need, how they find that information, and the sources they rely on (Joshi, 2021). It may

be possible to combine many sectoral plans and create cogent cross-sectoral policy by understanding the connections between various aims in order to seek synergies (Mainali et al., 2018). Agricultural production and productivity will suffer if the connections between the players in the agricultural knowledge system are inadequate since this would impede information flow from researchers to extension personnel or from extension personnel to farmers (Adesoji & Tunde, 2012). Strong coordination and linkage between research and farmers can't be made without highly trained and competent extension personnel (Adugna, 2013).

The main means of communicating the pertinent information to the farmers and other stakeholders is through indicators. The identification of the most efficient indicators is, therefore, extremely important in the context of the existing linkages among research-extension-farmers and information gap. When linkages are successful, stakeholders can benefit from having appropriate understanding about the socioeconomic environment for effective use of technology and innovation (Urhibo, 2021). Indicators are the instruments used to evaluate the condition, status, or trend of a certain system. Indicators are variables that help to measure changes in a given situation. It gives qualitative and quantitative details to objectives (Chandana et al., 2022). For the present study, indicator has been operationally defined as a function, programme, event, condition that describes or measures changes in the respondents' perceptions of changes over time in the connections between researchers, extension personnel and farmers.

METHODOLOGY

The study was conducted during the year 2019-2022 to identify different indicators for assessing research-extension-farmers linkage in fisheries sector. Tripura state was selected for the study since the state has the highest per capita fish consumption and significantly high demand for fish. The ex post facto was deployed in several districts of Tripura to identify the indicators that are responsible for the extent of linkage among the researchers, extension personnel and fish farmers. For selecting the indicators, a list of indicators that may be responsible for establishing linkage among researchers, extension personnel and farmers was essential. Relevant indicators from different published documents, reports and secondary sources were also reviewed for the study. The following procedure was followed to prepare the list of indicators. To enumerate the possible indicators, the relevant stakeholders were contacted with the help of an open-ended questionnaire/schedule and were requested to indicate the factors, functions, events, conditions, etc., which contributed for establishing linkage among them. The indicators identified for establishing linkage were pooled and a comprehensive list of indicators responsible for establishing linkage among researchers, extension personnel and farmers was obtained. There were 53 indicators which were kept under different categories in the pooled list using the three-point continuum: Most Relevant (MR), Relevant (R) and Not Relevant

(NR). In order to select relevant indicators, judges' opinions were obtained. The selected 53 indicators were first edited with the help of experts. The list of indicators was sent to 62 experts out of which 38 responded. The judges considered for this purpose were researchers from ICAR (Tripura Centre), faculty from CAU, extension experts from Krishi Vigyan Kendras (KVK) and Department of Fisheries.

After obtaining judges opinion, the relevancy score for each indicator was worked out using the relevancy percentage. Relevancy percentage was calculated by summing up the scores of Most Relevant (MR), Relevant (R) and Not Relevant (NR) categories, which was then converted into percentage as was followed by Saravanan (2009).

The indicators having average relevancy percentage of more than 75 per cent were selected and 24 indicators were finally selected for the study.

RESULTS AND DISCUSSIONS

Identifying indicators for assessing research-extension-farmers linkage

Out of 53 indicators which were kept under different categories in the pooled list using the three-point continuum; Most Relevant (MR), Relevant (R) and Not Relevant (NR) were converted into percentage as was followed by Saravanan (2009). Table1 shows the major indicators which were responsible for establishing linkage among researchers, extension personnel and fish farmers; 24 indicators having relevancy percentage of 75 or more were selected and listed in the table. Indicators for assessing research-extension-farmers linkage were grouped under seven different domains namely, organizational related indicators, extension related indicators, IT related indicators, training related indicators, input related indicators, programme related indicators and finance related indicators. Relevancy percentages were calculated and were ranked as per their scores obtained.

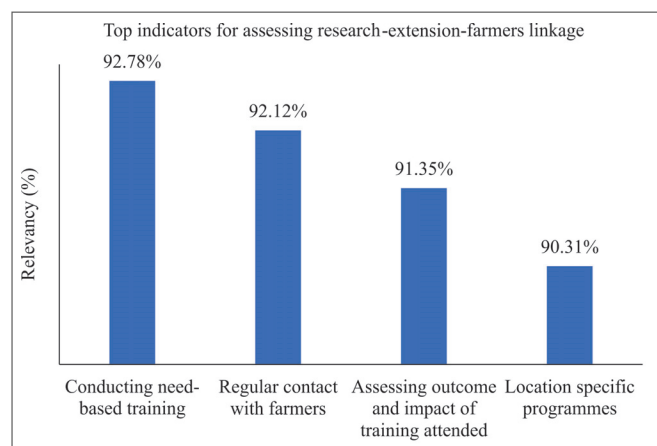
Figure 1 indicates the top indicators which were perceived to play significant roles in assessing Research-Extension-Farmers Linkage. It was found that '*Conducting need-based training*' (92.78%, I) was the main indicator for assessing the existing linkage among researchers, extension personnel and farmers. Depending on geographical locations, availability of natural resources and prevalence of certain farming systems, the needs of the farmers may differ. Moreover, farmers basically feel the need to acquire knowledge, skills on proper fish culture techniques and various means to increase their productions through integrated farming, composite farming, etc. Training for farmers should be need based and region specific and relevant training programmes should be organised to boost the fish production and enhance their income thereby improving the livelihood of the farmers. For instance, formulation of Strategic Research and Extension Plan (SREP) of ATMA is significantly essential with the help of research

$$\text{Relevancy percentage} = \frac{\text{Number of most relevant responses} \times 2 + \text{Number of relevant responses} \times 1}{\text{Maximum possible score (n} \times 2)} \times 100$$

Where, n = number of respondents (38)

Table 1. Relevancy percentage of the selected indicators for assessing research-extension-farmers linkage

S.No.	Indicators for assessing research-extension-farmers linkage	Relevancy (%)	Rank
Organizational related indicators			
1	Regular contact with extension organizations	89.20	VI
2	Regular contact with farmers	92.12	II
3	Having a committee for planning and monitoring	79.32	XVII
4	Regular review of extension activities	76.55	XXI
Extension related indicators			
5	Interface meeting with researchers, extension personnel and farmers	77.98	XIX
6	Participatory technology development	87.67	VIII
7	Location specific programmes	90.31	IV
8	Conducting regular village meetings	78.18	XVIII
9	Conducting regular demonstration	77.67	XX
10	Publication of extension literature success stories of farmers	76.33	XXII
IT related indicators			
11	Use of Smartphones	89.65	V
12	Use of Social media platforms	85.86	XI
13	Use of internet/e-mail	76.24	XXIII
Training related indicators			
14	Conducting need-based training	92.78	I
15	Assessment of Training needs	88.37	VII
16	Assessing outcome and impact of training attended	91.35	III
17	Conducting collaborative training	81.06	XIV
Input related indicators			
18	Adopting single window system	79.54	XVI
19	Supply of quality inputs	87.15	IX
Programme related indicators			
20	Involvement of rural youth	83.65	XII
21	Programme for development of weaker section	86.78	X
22	Promoting indigenous knowledge/practice/technologies of farmers	81.65	XIII
Finance related indicators			
23	Providing subsidies	75.90	XXIV
24	Awareness on availing financial benefits from different organizations	80.04	XV

**Figure 1.** Indicators with greater than 90% relevancy percentage for assessing Research-Extension-Farmers Linkage

institutes and other relevant stakeholders to assess the training needs of the farmers. Accordingly, the experts are to be identified from the College, ICAR, KVKs, Department of Fisheries, NGO, etc. to redesign the training.

Therefore, assessment of training needs is very crucial for identifying farmers' interest and needs. Similar findings were also

reported in studies conducted by Sajeev et al., (2012) & Rahman et al., (2018). 'Regular contact with farmers' (92.12%, II) was also found to be a significant indicator for assessing the linkage mechanisms since regular communication with farmers by researchers and extension personnel is essential to build good rapport, to monitor and supervise farm related issues and to share and receive information and feedback for effectively and timely dissemination of farm information. Effective transfer of knowledge from extension personnel to farmer is found to be a very essential form of extension activity (Lukuyu et al., 2012; Niu & Ragasa, 2018; Sekiya et al., 2015). Identification of potential adopters among the farming community is very important for which regular visits must be made in collaboration with other stakeholders. Therefore, development of extension and support services like Matsya Seva Kendras is very essential to increase the frequency of contacts with the farmers. Apart from the above indicators, 'Assessing the outcome and impact of training attended' (91.35%, III) was also perceived as one of the most significant indicators to identify the status of linkage among researchers, extension personnel and farmers. Different training and demonstration programmes are generally kept untracked after the completion of the event thereby widening the information gap among the stockholders involved. To identify the adoption rate, constraints

and issues faced by farmers, drawbacks of the technologies, limitations of the training conducted and strategies to improve the efficacy of the training programmes, study on the outcomes and impacts of the training programmes is very essential. This finding is in line with the other findings reported by Gautam et al., (2017); Ragasa et al., (2022). A team of experienced and knowledgeable scientists, faculties and extension personnel should be formed to study and access the training programmes. 'Location specific programmes' (90.31%, IV) is another important indicator which implies the selection of appropriate and relevant extension activities and programmes suited for a particular region or place. Since social and institutional contexts of a country or region may vary, extension services providers should also create institutions and organizations which are more favourable for innovation adoption within a particular social system (Suvedi et al., 2017). Public organisations like KVKs should be encouraged to focus on conducting more On-Farm Trials (OFT) to work on location-specific programmes. Among the IT related indicators, 'Use of Smartphones' (89.65%, V) is a crucial indicator at present time which acts as an important tool for information sharing and communication between different stakeholders. Extension provides information and services that may be incompatible with certain farming systems and which may involve complex interactions and communication flows between different stakeholders. This information gap can be minimised by the use of different recent ICT and other communication tools (Nord, 2022; Meijer et al., 2015). 'Regular contact with extension organizations' (89.20%, VI); 'Assessment of Training needs' (88.37%, VII), etc. are some of the significant indicators which signify the extent of linkage among different stakeholders. Findings by Girma & Kuma (2022) indicate the importance of market/ input/ finance oriented extension service to improve the welfare of the farmers. Borah et al., 2019 stated the importance of conducting regular demonstrations, conducting regular village meetings and publication of different leaflets/magazines in different regional languages which are intended for the use by the farming community in a way easily understandable by them.

CONCLUSION

Poor monitoring and evaluation, improper top-down management structure, political interference, less coordination among stakeholders, weak accountability and inadequate funding are few factors which can hinder the linkage mechanism as a whole. Linkage needs to be improved so that farmers could connect freely with researchers and extension personnel, thereby improving the bottom-top approach system of communication. Conducting need-based training, regular contact with farmers and assessing outcome and impact of training programmes are few of the major aspects for assessing the linkage. Therefore, there is a need to develop strong coordination and cooperation among different stakeholders to provide farmers with efficient extension services. Apart from producing more farm publications in local languages, efforts should also be given on the usage of ICT tools and different social media platforms for information sharing and exchange. This would enhance the feedback mechanisms from the farmers and provide timely and more effective communication with different stakeholders.

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Knowledge Level and Adoption Behaviour of Maize Growers in Selected Districts of Nagaland, India

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ABSTRACT

The paper examined the knowledge level and adoption behaviour of maize growers in Nagaland. Altogether, 120 respondents were selected following proportionate random sampling from 8 villages from four blocks of two districts. Two indices, namely, knowledge and adoption indices were developed. The maize growers had inadequate knowledge of improved cultivation practices of maize. Respondents had inadequate adoption index. The variables- age, marital status, and family size had having statistically significant relationship at 5% with knowledge level. Simultaneously, income from maize cultivation, informal information, mass media, social participation, and experience in maize cultivation established a statistically significant relationship at 1% with the knowledge level. Similarly, marital status, education, and informal sources of information established a statistically significant relationship at 5% with the adoption level, and annual income was found to be statistically significant at 1% with the adoption level. It is recommended that all the stakeholders and extension systems take the initiative to improve maize cultivation in Nagaland, which will accelerate the socio-economic up-scaling of the study community. Concerned authorities may also carry out frequent capacity development and technology transfer drives for improvement.

INTRODUCTION

Adoption of innovations or modern technologies in the farming sector is one of the most promising alternatives to maximize the productivity (Duflo et al., 2011; Mason & Smale, 2013), up-scale the farmer's income (Varshney et al., 2019) and better livelihood (Benjontoshi & Patra, 2021). The adoption of innovations or modern technologies in the farming sector had direct influence on the growth and development of the agricultural sector and economy of the country. Further, the crop's sustainable performance is desirable to address the issues of food security, nutrition security, global warming, and climate change (Patra & Babu, 2017; Gamlin et al., 2021; Patra & Babu, 2023). Adoption of technology or innovation in the production process is a decision of individual

farmers. Farmers' knowledge about the technology or innovation is a pre-requisite to bringing it in the adoption process or innovation-decision process. The time span for adoption can be reduced by up-scaling the knowledge level of the intended adopter through better extension service, apart from the relative advantages attached to the technology or innovation. Despite India's largest agricultural extension system, 60 per cent of farmers yet not come under any form of extension service in 2002 (NSSO, 2005), and the condition is worst in the North-eastern part of the country.

Nagaland, a state of NER of India, was taken for the study. Entire NER is growing maize for food, feed and economic reason. Globally, maize is regarded as the "Queen of cereals" and "Miracle crop" because of its high genetic yield potential. Globally, it is being grown in more than 100 countries and is one of the principal

crops in America, Africa and Asia. In spite of wide adaptability, maize cannot withstand frost at any stage of its growth (Reddy, 2004). The crop cannot withstand waterlogged conditions. It can be preferably grown on soil with a pH ranging from 5.0-7.0 but requires a moderate pH of 6.0-7.0. The optimum temperature for growing maize is around 30°C and can be grown within a temperature range of 10-40°C. Maize is also cultivated on a wide range of soil but requires well-drained, well-aerated, deep loam and silt loam with adequate organic matter and available nutrients for its cultivation.

The climatic condition of the NER is very much favourable for maize cultivation. The climatic condition of the region ranges from subtropical, tropical to temperate, and the topography is mainly hilly. It is grown primarily as a pure or mixed crop under *jhum* or shifting cultivation. As instance, In Nagaland, most (97.08%) of the French bean grower were also growing maize (Benjongtoshi & Patra, 2021a). However, large scale cultivation is becoming popular among farmers. In mixed cropping under shifting cultivation in the NER, maize yield varies from 0.30-1.70qt/ha. In Nagaland, the area and production of maize were recorded at 69,130 ha and 1,37,160 MT, respectively (Govt. of Nagaland, 2020).

METHODOLOGY

There are 12 districts in Nagaland. Out of these districts, Dimapur and Peren were purposively selected for the study because maize is one of the most important crops in these districts. The area and production of maize under the Dimapur district are 6,770 ha and 13,473 MT and under the Peren district are 3,100 ha and 6,149 MT, respectively (Govt. of Nagaland, 2020). Medziphema, Niuland, Peren and Jalukie blocks were purposively selected, and a list of all maize-growing villages under the selected blocks was prepared. Out of these, two villages with a maximum number of growers were purposively selected from each block making eight villages. A list of all households engaged in maize cultivation for each village was prepared, and 120 maize growers were selected based on the proportionate random sampling method.

To evaluate the level of knowledge, 15 aspects, and 47 issues relevant to improved cultivation practices were included in the interview schedule. The scoring was done as fully knowledge-rich with a score of 2, partially knowledge-rich with a score of 1 and no knowledge with a score of 0. To measure the adoption level of the respondents regarding the recommended maize cultivation practices, all the 15 aspects with 47 issues (as mentioned under the knowledge test) were included in the test. The scoring was done as: fully adopted with a score of 2, partially adopted with a score of 1 and not adopted with a score of 0. The maximum achievable score in both cases was 94 (47 x 2). A knowledge as well as adoption index was developed

$$\text{Adoption / knowledge index} = \frac{\text{Total score achieved}}{\text{Total achievable score}} \times 100$$

The respondents were further categorised under low, medium and high categories based on mean and standard deviation from the score obtained. Further, a relationship study was conducted between socio-economic status versus knowledge and the adoption level of respondents through the Pearson correlation method.

RESULTS AND DISCUSSION

Knowledge level of maize growers on improved practices

Table 1 reveals that 90 per cent of the respondents lacked knowledge about land preparation and selection of suitable soil for maize cultivation. 100 per cent of the respondents had acquired complete knowledge about local cultivars. In contrast, 52.50 per cent of the respondents knew hybrid varieties 100.00 per cent of the respondents had acquired knowledge about the normal seed rate, while only 32.50 per cent of the respondents knew about recommended hybrid seed rate, 14.17 per cent of the respondents knew about seed treatment, 95.00 per cent of the respondents lacked an understanding of recommended spacing, 100.00 per cent of the respondents knew about sowing time during the *kharif* season, 41.67 per cent of the respondents knew about the *rabi* season, and 100.00 per cent of the respondents had known the recommended depth of sowing. 100.00 per cent of the respondents knew about the broadcasting and dibbling method, most (94.17%) of the respondents lacked knowledge of the drilling method of sowing, and 100 per cent of the respondents lacked knowledge of sowing the seed behind the plough, 100.00 per cent of the respondents lacked knowledge of recommended NPK dose/requirement. In comparison, around 25.84 per cent of the respondents knew about the recommended dose of FYM. 84.17 per cent of the respondents knew about recommended water management in the seedling stage whereas 76.67 per cent lacked knowledge of recommended water management in the knee-high, flowering and grain-filling stages. 100.00 per cent of the respondents had complete knowledge about weed management, while most (97.50% and 98.34%) of the respondents were unaware about Simazin/Atrazin and 2-4-D, respectively.

All the respondents had a lack of knowledge of maize stem borer and pink borer, whereas most (97.50%) of them had a lack of knowledge of earworm and shoot fly management, while around 89.17 per cent and 50.00 per cent of the respondents knew armyworm and termite management, respectively. Patra & Lianzami (2021) also reported a lack of knowledge regarding insect and disease management of chow-chow in Mizoram. It was also found that around 90.00 per cent of the respondents had a lack of knowledge of diseases and their management. For instance, damage to plants during the harvesting of king chilli and yield loss during the harvesting was also reported by Patra et al., (2019). Around 90.00 per cent of the respondents knew about harvesting and, around 45.00 per cent of the respondents had knowledge of storage and packaging practices.

Status of adoption of improved practices by maize growers

It was found that around 4.79 per cent of the respondents had completely adopted the land preparation methods (Table 2). Another 4.17 per cent of the respondents had partially adopted of growing maize in well-drained sandy loam soil. It was also revealed that none of the respondents had adopted the concept of optimum pH for maize cultivation and was unaware of it. It was also found that 0.83 per cent of the respondents had fully adopted hybrid varieties. Most (90.80%) of the respondents had partially adopted the normal seed rate. It was also observed that 0.83 per

Table 1. Knowledge level on improved maize cultivation practices

S.No. Aspects along with recommended practices of maize cultivation	Knowledge level		
	Fully (%)	Partially (%)	No knowledge (%)
1. Land preparation			
(i) Well prepared flat beds	8.33	8.33	83.33
(ii) 1 deep ploughing	3.33	6.67	90.00
(iii) 2-4 harrowing	3.33	4.17	92.50
(iv) Provide Ridge and furrow for proper drainage	3.33	7.50	89.17
2. Suitable soil			
(i) Well drained sandy loam	0.00	10.83	89.17
(ii) Thrives well in pH 5.5-8.0	0.00	1.67	98.33
3. Varieties			
(i) Local cultivar	100.00	0.00	0.00
(ii) Hybrid-Ganga safed, HQPM-1	7.50	45.00	47.50
4. Seed rate			
(i) Normal seed rate -6-8 kg/acre	1.67	98.33	0.00
(ii) Hybrid 7-9 kg/acre	0.00	32.50	67.50
5. Seed treatment			
(i) Seed treatment with thiram / captan @ 4g/kg seeds	0.00	14.17	85.83
6. Spacing			
(i) 70 cm R-R and 25cm P-P	0.00	5.00	95.00
7. Sowing time			
(i) <i>Kharif</i> - summer	16.67	83.33	0.00
(ii) <i>Rabi</i> - Mid oct to Mid Nov	2.50	39.17	58.33
(iii) Depth of sowing: 4-6 cm	65.00	35.00	0.00
8. Method of sowing			
(i) Broadcasting	93.33	5.00	1.67
(ii) Drilling	0.00	5.83	94.17
(iii) Dibbling	100.00	0.00	0.00
(iv) Sowing the seed behind the plough	0.00	0.00	100.00
9. Nutrient requirement/acre			
(i) FYM or Compost: 2 t/acre	1.67	24.17	74.17
(ii) N:40-50 kg/acre	0.00	2.50	97.50
(iii) P: 25 kg/acre	0.00	0.00	100.00
(iv) K: 12.5-16 kg/acre	0.00	2.50	97.50
10. Water management			
(i) Seedling stage	70.00	14.17	15.83
(ii) Irrigation at knee high stage	1.67	21.67	76.67
(iii) Flowering	0.83	22.50	76.67
(iv) Grain filling stage	0.83	5.83	76.67
11. Weed management			
(i) As soon as the weed appears	91.67	8.33	0.00
(ii) Hand hoeing and hand weeding.	96.70	3.33	0.00
(iii) simazine or atrazine @ 0.5 ai/acre	0.00	2.50	97.50
(iv) 2,4-D@0.5-0.8 kg ai/acre	0.00	1.67	98.33
12. Insect pest management			
(i) Maize stem borer	0.00	0.00	100.00
(ii) Army worm	0.00	89.17	10.83
(iii) Ear worm	0.00	1.67	98.33
(iv) Shoot fly	0.00	2.50	97.50
(v) Pink borer	0.00	0.00	100.00
(vi) Termites	2.50	47.50	50.00
13. Diseases control			
(i) Leaf blight	0.00	0.00	100.00
(ii) Downy mildew	0.00	4.17	96.00
(iii) Maydis leaf blight	0.00	0.00	100.00
(iv) Soft rot	0.00	1.67	98.33
(v) Common rust	0.00	14.17	85.83
(vi) Smut	0.00	1.67	98.33
(vii) Charcoal rot	4.17	9.17	86.67

Table 1 contd...

S.No. Aspects along with recommended practices of maize cultivation	Knowledge level		
	Fully (%)	Partially (%)	No knowledge (%)
14. Harvesting method			
(i) Cob shed turns brownish	95.83	4.17	0.00
(ii) Grain become hard, containing 20% moisture	68.33	26.67	5.00
(iii) For fodder- milking or sub-dough stage	58.30	24.20	17.50
15. Storage practices			
(i) Stored by drying seed to 12% moisture content and	0.00	75.83	24.17
(ii) packing in 700 gauge polythene bags	1.67	14.17	84.17

Table 2. Adoption behaviour on improved maize cultivation practices

Aspects along with recommended practices of maize cultivation	Adoption level		
	Fully (%)	Partially (%)	Not adopted (%)
1. Land preparation			
(i) Well prepared flat beds	9.17	0.00	90.83
(ii) 1 deep ploughing	3.33	5.74	90.83
(iii) 2-4 harrowing	3.33	5.74	90.83
(iv) Provide Ridge and furrow for proper drainage	3.33	5.74	90.83
2. Suitable soil			
(i) Well drained sandy loam.	0.00	4.17	95.80
(ii) Thrives well in pH 5.5-8.0	0.00	0.00	100.00
3. Varieties			
(i) Local cultivar	100.00	0.00	0.00
(ii) Hybrid- Ganga safed, HQPM-1	6.67	2.50	90.83
4. Seed rate			
(i) Normal seed rate -6-8 kg/acre	0.83	90.83	8.33
(ii) Hybrid 7-9 kg/acre	0.83	7.50	91.67
5. Seed treatment			
(i) Seed treatment with thiram or captan @ 4g/kg Maize seeds	0.00	0.00	100.00
6. Spacing			
(i) 70 cm R-R and 25 cm P-P	0.00	1.67	98.33
7. Sowing time			
(i) Kharif- summer	5.83	93.33	0.83
(ii) Rabi- Mid oct to Mid Nov	0.00	0.83	99.17
(iii) Depth of sowing: 4-6 cm	7.50	90.83	1.67
8. Method of sowing			
(i) Broadcasting	0.00	0.83	99.17
(ii) Drilling	0.00	0.00	100.00
(iii) Dibbling	99.17	0.83	0.00
(iv) Sowing the seed behind the plough	0.00	0.00	100.00
9. Nutrient requirement/acre			
(i) FYM or Compost: 2 t/acre	0.83	7.50	91.67
(ii) N: 40-50 kg/acre	0.00	0.00	100.00
(iii) P: 25 kg/acre	0.00	0.00	100.00
(iv) K: 12.5-16 kg/acre	0.00	0.00	100.00
10. Water management			
(i) Seedling stage	4.17	3.33	92.50
(ii) Irrigation at knee high stage	0.00	5.00	95.00
(iii) Flowering	0.00	2.50	97.50
(iv) Grain filling stage	0.00	2.50	97.50
11. Weed management			
(i) As soon as the weed appears	13.33	86.67	0.00
(ii) Hand hoeing and hand weeding	60.00	40.00	0.00
(iii) simazine or atrazine @ 0.5 ai/acre	0.00	0.00	100.00
(iv) 2,4-D@0.5-0.8 kg ai/acre	0.00	0.00	100.00

Table 2 contd....

Aspects along with recommended practices of maize cultivation	Adoption level		
	Fully (%)	Partially (%)	Not adopted (%)
12. Insect pest management			
(i) Maize stem borer	0.00	0.00	100.00
(ii) Army worm	0.00	0.00	100.00
(iii) Ear worm	0.00	0.00	100.00
(iv) Shoot fly	0.00	0.00	100.00
(v) Pink borer	0.00	0.00	100.00
(vi) Termites	0.00	0.00	100.00
13. Diseases control			
(i) Leaf blight	0.00	0.00	100.00
(ii) Downy mildew	0.00	0.00	100.00
(iii) Maydis leaf blight	0.00	0.00	100.00
(iv) Soft rot	0.00	0.00	100.00
(v) Common rust	0.00	0.00	100.00
(vi) Smut	0.00	0.00	100.00
(vii) Charcoal rot	0.00	0.00	100.00
14. Harvesting method			
(i) Cob shed turns brownish	85.83	14.17	0.00
(ii) Grain become hard, containing 20% moisture	53.33	30.00	16.67
(iii) For fodder- milking or sub-dough stage	10.83	3.33	85.83
15. Storage practices			
(i) stored by drying seed to 12% moisture content and	0.00	3.33	96.67
(ii) packing in 700 gauge polythene bags	0.00	0.00	100.00

cent and 7.50 per cent of the respondents had fully and partially adopted the recommended seed rate for hybrid maize, and the remaining were not adopted the same. It was revealed that none of the respondents had adopted seed treatment. Only 1.67 per cent of the respondents had partially adopted recommended spacing. Another 5.83 per cent of the respondents had full adoption of recommended sowing time during *kharif* (summer), while 93.33 per cent of the respondents had partially followed the practice. The study also observed that 99.17 per cent of the respondents had never followed the recommended sowing time during the *rabi* season. Most (99.17%) of the respondents had fully adopted dibbling method of sowing.

The study reveals that only 0.83 per cent of the respondents had fully adopted the FYM application. It was found that only 4.17 per cent of the respondents had fully adopted water management at the seedling stage. Most (95.00%) of the respondents had never adopted water management on knee height, flowering and grain filling stage. Around 86.67 per cent of the respondents had partially adopted weed management as soon as the weed appeared. Another 60 per cent had fully adopted hand hoeing and hand weeding, none of the respondents had adopted the application

of NPK, chemical control for weed management, recommended insect pest and disease management on maize cultivation and storage method (in 700-gauge polythene). Only traditional practices like manual handpicking and removal were followed to control the insect pests in the field. The majority (85.83%) of the respondents had full adoption of the harvesting method when the cob shed turned brownish. In contrast, 14.17 per cent had partial adoption of this method. The majority (55.33%) of the respondents had fully followed the harvesting of the maize at the grain-hardened stage with containing sufficient moisture, another 10.83 per cent of the respondents had fully adopted the harvesting method for fodder purposes,

Table 3 shows the distribution of respondents based on their overall knowledge and adoption level. The mean value of the knowledge index was 24.60 (i.e., less than 1/5th of the maximum index value) with SD of 3.70. Based on the overall knowledge score, 72.50 per cent of the respondents were under the category of medium knowledge level, The average of adoption index was 16.20 (i.e., less than 1/5th of the maximum index value) with SD of 2.70. The study reveals that 89.17 per cent of the respondents had a medium level of adoption. Concerning adoption, Chandran

Table 3. Overall knowledge and adoption level

S.No.	Categories	Knowledge			Adoption		
		Percentage	*Mean#	SD	Percentage	*Mean#	SD
1.	Low level (< mean-SD)	9.17			0.83		
2.	Medium level (mean-SD to mean + SD)	72.50	24.60	3.70	89.17	16.20	2.70
3.	High level (> mean + SD)	18.33			10.00		

*Maximum achievable Index=100.00; #Maximum achievable score=94 (47 × 2)

Table 4. Relationship between independent variables and the dependent variables

Variables (Unit)	Knowledge Value of 'r'	Adoption Value of 'r'
Age (Years)	-0.184*	-0.005 NS
Marital status (married=1; unmarried=0)	-0.196*	0.203*
Family size (Numbers)	0.189*	0.051 NS
Education {Actual year(s) of education}	0.107 NS	-0.213*
Total land holding (Acre)	0.048NS	0.109 NS
Total land holding under maize (Acre)	0.141 NS	0.007 NS
Annual income (Rs.)	-0.082 NS	-0.283**
Income from maize (Rs.)	0.388**	0.074 NS
Training exposure (Not attended=0; Attended=1...n)	0.007 NS	0.129 NS
Formal information (Score)	0.403**	0.070 NS
Informal information (Score)	0.265**	0.182*
Mass media exposure (Score)	0.372**	0.099 NS
Social participation (Score)	0.247**	-0.013 NS
Experience in maize cultivation (Years)	-0.319**	-0.044 NS

*=Significant at 5%; **=significant at 5%; NS=Non significant

& Chakravarty (2022) also reported on the low level of adoption by farmers practicing integrated farming systems. Therefore, it can be concluded that the knowledge and adoption level of the study community (maize growers under the investigation) had extremely inadequate and in a pitiful state. The universally accepted concept is that knowledge about the innovation is a prerequisite for the adoption of the same innovation (Rogers, 2003). Inadequacy of knowledge about improved cultivation practices has a direct reflection on the adoption level. Therefore, an improvement in the knowledge level of respondents on improved cultivation practices is needed for the adoption of improved cultivation practices/ technologies in the production system.

Table 4 shows that independent variables- education, total landholding, landholding under maize, annual income and training exposure established a non-significant relationship with knowledge level. On the other hand, correlation values between age, marital status and family size were established to have a statistically significant (at 5%) relationship. Patra et al., (2020) viewed that income from the cultivation of crops has a direct and positive influence on the modernization of cultivation. Income from maize, formal information, informal information, mass media, social participation and experience in maize cultivation established a statistically significant relationship with knowledge level. Concerning social participation, IWMP performed moderately in social participation and inclusion (Ao & Patra, 2018). The findings have partial agreement with the results of Nain et al., (2007); Kumari et al., (2022). Acharya et al., (2023); and age, family size, total land holding, landholding under maize, income from maize cultivation, training exposure, formal source of information, mass media, social participation, experience in maize cultivation, and attitude were not established as statistically significant relationship to adoption level. It also indicates that the variables- marital status and informal source of information established a statistically significant relationship (at 5%), while annual income established a statistically significant relationship at 1% to adoption level. Varshney et al., (2019a) viewed that the level of education directly influences the act upon innovation by the intended adoption. This study also established a positively significant relationship between education and the adoption index.

CONCLUSION

This paper explored that the overall knowledge and adoption levels of the maize growers were in a pitiful state. Respondents are somehow knowledgeable about weed management, irrigation management, sowing method, and proper time of harvesting, and huge inadequacy was observed in the remaining aspects. In spite of, maize being a primary crop of the state of Nagaland, the status of adoption of improved technologies in maize cultivation was immensely lagged behind. Socio-economic status of the respondents had a non-significant influence on the knowledge and adoption levels of improved technologies. But the universally accepted trend is socio-economic status has a direct and significant relation with knowledge level and adoption behaviour. Therefore, all the stakeholders take the initiative to improve maize cultivation in Nagaland, which will accelerate the socio-economic up-scaling of the respondents and also bring the adoption of innovations in maize cultivation. Concerned stakeholders may also carry out a technology transfer drive for improvement.

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Contribution of Women in Scientific Publications – A Comparative Study Before and After COVID-19

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ABSTRACT

Emerging evidence shows that women authors are not well represented in publications resulting in gender gaps in publications. 548 original research papers published between 2019 to 2021 in three journals selected randomly from the list of quarterly published journals from India under the *Science Citation Index Expanded (SCIE)* core collection. According to the gender-wise contributions in scientific publications, there was a significant disparity between authors (male and female). Among national-level publications, the percentage of female authors in science journals published in 2019 and 2020, before the COVID-19 pandemic was 20.25 per cent, while their contribution to science journals published during COVID-19 reduced to 17.80 per cent. The contribution of women authors in science journals was decreased by 2.47 per cent during the COVID-19 pandemic. There was a significant divergence between the average number of authors and the average number of female authors in each issue.

INTRODUCTION

Women are increasingly opting for careers in the fields of science, technology, mathematics, and medicine (Agarwal, 2021). Today, scientific innovations are progressing at an ever-increasing rate. Gender inequality in STEM (Science Technology Engineering and Math) in developing nations encompasses a range of interconnected factors, such as familial, social, cultural, and institutional aspects, which cannot be overlooked. The consequence of this under-representation of women scientists in STEM fields is a scarcity of female role models and limited mentoring prospects for girls (Fathima et al., 2020). In the majority of science, technology, engineering, and math (STEM) institutions of higher learning, women represent less than 20 per cent of the all professor positions (Sahoo, 2021).

Another study by the UK's Intellectual Property Office [Gender profiles in worldwide patenting: An analysis of female inventorship (2019 edition)] noted that women inventors account

for just under 13 per cent of patent applications globally. Furthermore, this gender gap is progressively expanding. Notably, when comparing women to men with comparable publication records, women received a slight advantage of 0.8 per cent in terms of citation counts (Huang et al., 2020). In a study by Garg et al., (2019) on content analysis of agriculture science journal (Gujarat Journal of Extension Education) based on research area, respondents, source of articles & type of authorship, found that as compared to the mere ten percent of the articles on farm women, nearly 68 per cent articles published were on farmers. It has been observed that women comprise only 30 per cent of the total authors of scholarly articles. To address this gender disparity in authorship, it is crucial to implement gender-responsive planning and management strategies. Achieving gender equality in scientific research is a new, dynamic, exciting and interesting area of research (Bhagat & Vijayaraghavan, 2019). The gender imbalance in the education world has been historically evident and continues till today.

The COVID-19 pandemic resulted in lockdowns across the country, which led to the emergence of telecommuting and online classes. Individuals who were previously active were confined to their homes due to sudden lockdown measures. Consequently, both their physical and mental well-being have been negatively affected (Yadav et al., 2023). A considerable number of people possess a moderate understanding of the challenges arising from the Covid-19 pandemic (Kaur et al., 2021). Additionally, the pandemic has significantly impacted the dynamics of the academic and research community, particularly among female researchers and authors who now face the difficulty of finding a balance between remote work and domestic responsibilities, including full-time childcare duties. Women, whose empowerment is of utmost importance for the progress of the society on the whole, are the indispensable other half. According to Singh et al., (2016), women deserve increased attention of agricultural extension services in every developing nation. Participation of women in economic activities is now emerging as a universal phenomenon. The COVID-19 pandemic has enabled us to highlight the fact that women have been less involved in scientific research involving COVID-19 and have held less prestigious author positions than their male colleagues. The slowdown in their publications should be taken into account, especially when analyzing academic applications for which the number of published articles is still a determining factor. This will ensure that this does not negatively affect the development of their academic career, summarizes Gayet-Ageron (2021).

The present study is observance of the following objective- Analyzing the contribution of women researchers to scientific publications and comparing the difference in their contribution before and during COVID-19.

METHODOLOGY

The study was exploratory in nature; collected data from the current contribution status of women in scientific publications and this data proved to be helpful in finding results progressively. With the exploratory method, the contribution of women in scientific publications was analyzed. The study made a thorough analysis of science journals available online. With the objective to cover the journals with a larger number of per year publications, the analysis is based on National Journals of Science which published four issues in a year. Three journals were randomly selected for study from the list of quarterly published journals from India under *Science Citation Index Expanded (SCIE)* Core Collection coming under *Web of Science* Coverage from *Group – 2 of UGC Care List and National Academy of Agriculture Sciences (NAAS)*. It was done to ensure the inclusion of quality publications in the study. Since UGC care-listed and NAAS-rated journals are widely sought after for publication of research, nationally, owing to their regular maintenance of quality and acceptance in job selections and subsequent promotions, the journals for the study were selected from this category.

The data were secured by three Journals of Science from the year 2019 to 2021 namely *Proceedings of the National Academy of Sciences, India Section A: Physical Sciences* (Electronic ISSN: 2250-1762 and Publisher: The National Academy of Sciences, India), *Agricultural Research* (Online ISSN: 2249-7218, Publisher:

National Academy of Agricultural Sciences) and *Journal of Indian Society of Soil Science* (Online ISSN: 0974-0228 and Publisher: Indian Society of Soil Science). All issues of each Journal from the year 2019 to 2021 were considered for the analysis. This period provided reliable data to present trends before and during the COVID-19 pandemic, therefore, this methodology assisted in achieving the objective of examining the impact of the COVID-19 pandemic on the participation of women authors in scientific publications. The thorough analysis included original research papers published in Journals of Science, excluding books, thesis, dissertations, editorials and non-research pieces. 548 original articles were analyzed for the study. The gender of the authors was mainly identified by examining their names. For authors whose name was gender neutral or whose gender was not identifiable as might be in the case of some South Indian and International authors, gender information was searched online. The information of 12 authors could not be traced properly regarding their gender, so they were not included in the study.

RESULTS AND DISCUSSION

Female contributors in science journals before and during COVID-19

It is clear from Figure 1 that there was a difference among authors (Male & Female) according to the gender wise contribution in scientific publications. Among national level publications, the percentage of female authors in science journals published before the COVID-19 pandemic was 20.25 per cent while their contribution during COVID-19 was 17.80 per cent with a decrease by 2.45 per cent. Gender inequity in science and education, especially in senior positions, is a widespread problem. The causes are poorly understood due to lack of enough studies, but there are other factors including historical sex ratios, discrimination, and gender-based behavioral differences. True to the leaky pipeline label, number drops significantly when women's participation reaches a higher level in science field, several studies indicate that women are often excluded from study groups and classes and face sexist remarks and sexual harassment in laboratory settings. These un-supportive academic environments can significantly contribute

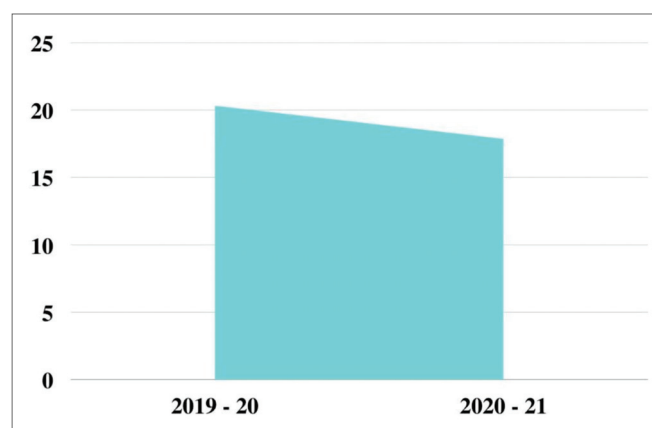


Figure 1. Distribution of female contributors in science journals before and during COVID-19

to the under-representation of women in science. The problem is related to the retention of women after education, after entering their fields. This is especially true in the context of the large number of female researchers who, after earning their doctoral degrees, either do not pursue a career in science or takes a break in employment after starting a job. This is evident in the significant disparity between the percentage of women who possess doctoral degrees and the percentage of women scientists holding postdoctoral positions, which is notably lower. In many cultures, caring for children, the elderly, or persons with disabilities is an activity entirely entrusted to women. In case of women in the field of science, they address the challenges arising from balancing family and professional responsibilities by deferring motherhood, leaving their scientific careers, sacrificing personal time, opting for less ambitious and more manageable career paths, or choosing not to have children (Dizaho, 2016). A significant proportion of scientists have a limited number of publications, possibly attributed to factors such as the high costs associated with publishing, insufficient skills in publishing among scientists, and the absence of specific guidelines mandating a minimum number of articles to be published annually within the university (Veldandi et al., 2023). In the study, the participation of women in science journals decreased by 2.45 per cent. The reasons for the slight decrease in the number of female authors in scientific publications during pandemic may be that scientific studies are done in the laboratories (accessing which could have been more difficult for female scientists in the pandemic) and scientific studies have more number of contributors i.e. research work is done in teams.

Authorship status of female authors

Decisions regarding authorship should be made in a thoughtful and strategic manner. The primary decision when collaborating is to choose between conducting research independently or as part of a team, and subsequently, to select from various types of team research. The Table 1 layouts that the number of women authors in science journals published at National level publications has decreased. The percentage contribution of female authors as researcher in the year 2019 was 23.20 per cent, which has increased to 23.95 per cent in 2020 itself then decreased by 20.34 per cent in 2021. Similar to the researcher's category, there was a shift in the percentage of female authors in supervisor category. In the year 2019, the female authors as 'Other contributors' were 19.09 per cent which came down to 16.5 per cent in 2021. Research indicates that women, particularly those in underrepresented STEM fields, have lower representation in academic literature. However, the impact of this under-representation is reduced when women

assume leadership positions in research, as evidenced by their role as corresponding authors. When women take on the role of corresponding authors, they tend to publish manuscripts with a higher number of female authors, have a greater likelihood of collaborating with female co-authors, and include more female authors overall. The figures clarified reduction in the number of female corresponding authors in selected journals. Similar to the trend observed among various categories of researchers, the percentage of female corresponding authors has also changed. The data of the study indicates the massive gender gap in authorship when it comes to prominent positions in a research paper. Across all the three years, in every authorship category, the contribution of women in the journals is nearly a quarter of that of the men. This raises big concerns for the future of women academicians and researchers.

It is recognized that male researchers generally engage in collaborations to a greater extent than their female counterparts (Fox, 2017; Kwiek & Roszka, 2020). Furthermore, studies indicate that women in academia are less engaged in global collaborative initiatives compared to their male counterparts (De Kleijn et al., 2020, Kwiek & Roszka, 2020). Another notable result showed that female academics are less likely to collaborate with international articles than male academics (De Kleijn et al., 2020). Study conducted by Bendels et al., (2018) revealed that the under-representation of women in high-impact academic journals is primarily attributed to their lower rate of submitting manuscripts for publication, rather than the rejection of their submitted work. Collaborative research and publications are known to generate more impactful and effective outcomes, yet women's participation in these collaborations is comparatively less. Women get fewer citations than men. Citations increase with the number of co-authors and the number of citations also decreases due to the lack of network and collaboration with women. Based on a study assessing merit-based decisions by prospective hiring faculty, it was found that a female applicant for science laboratory manager positions had a lower likelihood of being hired compared to a similar male applicant. The report "Beyond Bias and Barriers" (2007) extensively examined the existing literature on gender, bias, and academic careers, and its findings indicated that subtle bias persistently impacts women's career progression in the field of education. Men spend significantly less time in supervised research, are less likely to overestimate their time allocation to the demands of assigned tasks, and author more published journal articles per 100 hours of research time than their female counterparts. Collectively, these findings suggest that gender inequality manifests as differences in time-to-credit payments beginning in the first year of doctoral training. One potential reason for the under-representation of female authors could be the higher likelihood of men being more successful in negotiating for prestigious positions within the authorship hierarchy during informal team discussions. However, currently, there is a lack of specific research focused on studying these interactions among authors. Generally, men tend to engage in more interactions and self-promotion of their achievements compared to women. Another possibility is the existence of bias favoring women during the review process. Consequently, when men occupy esteemed positions, papers of

Table 1. Authorship status of female authors in national science journals

Years	Authorship category			
	Researcher (%)	Supervisor (%)	Corresponding author (%)	Other contributors (%)
2019	23.20	19.16	20.99	19.09
2020	23.95	19.23	21.87	18.45
2021	20.34	16.66	15.60	16.95

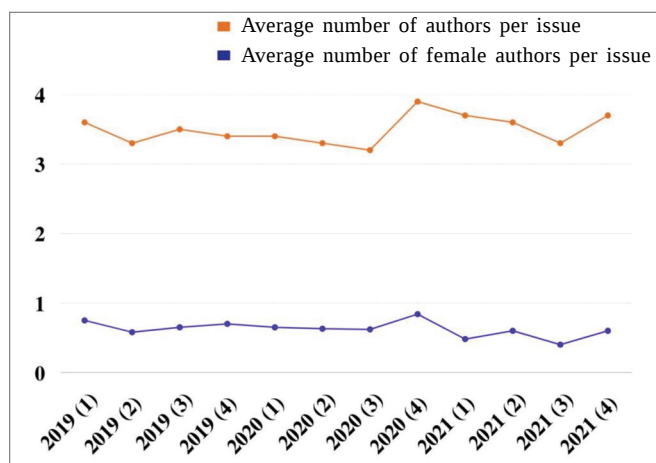


Figure 2. Distribution of average number of authors per addition

similar quality may face lower acceptance rates. This bias could result in an under-representation of women in journals that do not employ gender-blind reviews. Despite claims based on correlation data suggesting that gender bias no longer contributes to gender inequality, controlled laboratory and field experiments consistently reveal that bias negatively impacts women's decisions. In the context of the pandemic, it may take place that most of the women may not had been able to do research work properly because of the excess of household responsibilities due to staying at home after the lockdown. Research work in science is often done by teams, so even during pandemic; there was a smaller number of female authors in science journals indicating that their male counterparts done more work at that time.

Average number of authors per edition

As mentioned earlier, there was a significant disparity between the number of female authors and male authors in scientific publications. Consequently, the average number of female authors per issue was considerably lower than the overall average number of authors. This clearly illustrates that the participation of female authors in national scientific publications was significantly lower compared to their male counterparts. Moreover, the average number of female authors is notably lower than the average number of authors overall. During the pandemic there was a slight decrease seen in their percentage, the reason for this may also be that their number is very less. The Figure 2 also points that this comparatively low percentage seen in female contributors is not seasonal, i.e. the issue number of the journal has no impact over the number of female contributors.

CONCLUSION

There was a slight decrease in the proportion of female authors during the COVID-19 pandemic in comparison to the preceding two years, although in both time periods, i.e. pre and post COVID-19, women participation in scientific publications was found to be alarmingly lower than men. However, gender disparities are growing on prominent authorship positions like supervisor, researcher, corresponding author etc. Academic journals tend to have a higher average number of authors per issue, but the

average number of female authors remains relatively low. The under-representation of women as authors in academic publications has an impact on the representation of female faculty members, particularly in esteemed authorship positions. The journals may encourage women authors to submit their research papers, may be through special issues, ensuring proper review, and implementing equality in the editorial process.

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Trends in Area Production and Productivity of Sesame in Bundelkhand Region of Uttar Pradesh

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ABSTRACT

Sesame seeds are often referred to as *seeds of immortality*. Due to the root system, the crop does well under drought stress, making the Bundelkhand region more suitable for growing sesame than other districts in Uttar Pradesh. The coefficient of Variation and the Cuddy-Della-Valle Index were computed to determine the degree of instability. The relative importance of acreage and yield to the expansion of sesame production was determined by calculating the area effect, yield effect, and interaction effect. Results showed that in Jalaun, both the sesame area and production increased at a compound annual growth rate of 0.17 per cent and 0.20 per cent, respectively, while in other districts of Bundelkhand, they remained relatively stable or declined. On the other hand, it was found that productivity was falling across the seven districts of the region. According to the CDVI values, Chitrakoot had the highest variability in area (125.45) while Jalaun had the highest variability in production (181.7) as well as productivity (53.45). In the whole Bundelkhand, the strongest interaction effect between area and yield growth was found.

INTRODUCTION

The use of vegetable oils in both the food and industrial sectors has skyrocketed in recent years. India is now one of the world's largest importers of vegetable oils despite being the world's fifth-largest producer of oilseed crops (Reddy, 2013). Oilseeds are the second-most important crop in India. It accounts for 15.7 per cent of the gross cultivated area and 11 per cent of the total agricultural output value (Sri et al., 2022; Singh et al., 2019; Meena et al., 2023). Seven of the nine oilseed crops grown in the country are used for human consumption (soybean, groundnut, mustard, sunflower, sesame, safflower, and Niger), while the other two are used for industrial purposes (castor and linseed). The Indian ecological zone is the original home of most oilseeds. About of 5,500 years ago, the Indian subcontinent became the first place in the world where sesame was cultivated. The oilseeds crops have

shown the significant growth in area and production during last three decades (Reddy & Immanuelraj, 2017). Sesame is considered to be the most valuable oilseed crop. Sesame seeds are held in high regard and are sometimes referred to as “the seeds of immortality” due to their high antioxidant content.

The estimated global area, production, and yield of sesame in 2018–19 were 128.21 million hectare, 65.49 million tones, and 510.8 kg ha⁻¹, respectively, reflecting the crop's significant role in human nutrition and the livelihood of millions around the world (FAO, 2019). Sudan has the largest area of 42.43 million hectares dedicated to the cultivation of sesame, followed by Myanmar (15.05 million hectares) and India (14.19 million hectares) (FAO, 2019). The top producers of sesame are Sudan, Myanmar, and India. As compared to Nigeria, Ethiopia, Tanzania, and Burkina Faso, India has the lowest productivity. While the average yield in India is only 485.4 kg ha⁻¹, Nigeria's is 818.4 kg ha⁻¹, making

for a stark comparison (FAO, 2019). The total amount of sesame produced in India in 2019 is projected to be 399.16 million metric tonnes. Uttar Pradesh, with a total production of 99.76 million tonnes, accounted for 25 per cent of India's total output; this was followed by Madhya Pradesh (82.34 million tonnes), Rajasthan (78.08 million tonnes), and Gujarat (65.65 million tonnes), each of which accounted for 20 per cent. Eighty-two per cent of the country's output came from these four states. As a whole, the yield estimates for each state were as follows: Gujarat: 565 kg ha⁻¹; Rajasthan: 289 kg ha⁻¹; Madhya Pradesh: 262 kg ha⁻¹; and Uttar Pradesh: 239 kg ha⁻¹. An estimated 485.4 kg ha⁻¹ was the average yield across the country (Directorate of Economics & Statistics, 2019).

The highest estimated yield in Uttar Pradesh was recorded in Unnao (798 kg ha⁻¹), while the lowest was in Mahoba (120 kg ha⁻¹). Jhansi, with the most land and the highest estimated yield, made up nearly 17 per cent of the state's total harvest. Estimates put the global sesame harvest at 99.76 million metric tonnes, with a yield per hectare of 239 kg ha⁻¹ (Directorate of Economics & Statistics, 2019). The current study attempts to analyse the relative contribution of area, yield, and interaction effects in the expansion of sesame in Bundelkhand, the major sesame producing districts in UP, taking these factors into account.

METHODOLOGY

This study is based on secondary information collected from various sources. The information was compiled from the Uttar Pradesh Department of Economics and Statistics, the Food and Agriculture Organization's Agricultural Statistics at a Glance 2019, and the FAO's Directorate of Economic and Statistical Research. Area, output, and harvest size for sesame in Bundelkhand have all been tracked for the past 30 years (1989-2019). The estimated changes in sesame area, production, and productivity were analysed using compound growth rates for the given time period, revealing some interesting trends. Explicit calculations of growth rates were derived in order to analyse whether a given variable tends to rise, fall, or stay about the same over time. The compound growth rate (CGR) is the rate of change of "Yt" per unit of time expressed as a function of the magnitude of "Yt" itself, and it was mathematically expressed as:

$$CGR = [(t) (dYt/dt)] = [(Yt+1 - Yt)/Yt] \quad \dots (1)$$

The compound growth rate of Yt was calculated in percentage form by multiplying the above expression by 100. Many different types of growth functions, such as linear exponential, modified exponential, Cobb-Douglas, etc., have been developed and were used in scientific inquiry. The following is the mathematical form of the log-linear function (also called the exponential function) that is employed:

$$Yt = Ae^{bt} \quad \dots (2)$$

Instability was measured by using co-efficient of variation, Cuddy-Della Valle Index and Coppock's index to assess the variability in the production, area and yield of sesame, as followed by Sandeep et al., (2016) & Boyal et al., (2015). The standard deviation as percentage of means called as co-efficient of variation.

$$CV = \sigma/\mu \times 100$$

Where, CV = Co-efficient of variation

σ = Quantified in units of the variable's standard deviation

μ = Determining the average of a variable

To estimate the contribution of area, productivity and interaction of the two in total production, the following additive scheme of decomposition was used:

$$P = A_0 (Y_n - Y_0) + Y_0 (A_n - A_0) + \Delta A \Delta Y$$

$$1 = [(Y \Delta A)/P] + [(A \Delta Y)/P] + [(\Delta A \Delta Y)/P]$$

Where, P = Change in production

A₀ = Zone in the Foundational Year

A_n = Zone in current year

Y₀ = Base Year Yield

Y_n = Current Year's Yield

ΔA = Variation in region (A_n - A₀)

ΔY = Variation in yield (Y_n - Y₀).

RESULTS AND DISCUSSION

Growth in sesame area, production and productivity

Sesame's area, production, and productivity in Bundelkhand were evaluated by fitting the compound growth trend equations. From 1989-2019, the amount of land used for growing sesame has increased in Bundelkhand from 27.46 thousand hectares to 219.44 thousand. A positive and statistically significant 0.07 per cent compound growth rate over time indicates a static growth rate supported by the findings of Debnath et al., (2015). When looking at the area planted with sesame on a district-by-district basis, it has showed an upward trend in the compound growth rate. From 1989 to 2019, Bundelkhand's sesame harvest increased from 33.55 million tones to 504.08 million tones, a compound growth rate of 0.09 per cent. Bundelkhand's sesame harvest slowed to a crawl this year. According to a breakdown of production growth by municipality, from 1989 to 2019, all regions saw an increase in output. From 1989 to 2019, Bundelkhand's average sesame yield per hectare rose from 1.22 to 2.29 tones. Growth trend analysis for sesame crop indicates a 0.02 per cent compound annual growth rate in yield from 1989 to 2019. When broken down by state, yield growth rates are positive in all but one district: Jhansi, where they are -0.009 per cent. All regions have experienced substantial expansion. Between 1989 and 2019, the Jalaun district saw a significant increase in population.

Instability in sesame area, production and productivity

Table 2 provides information for the entire period (1989-2019) and for individual districts on the fluctuations in Bundelkhand's sesame area, production, and yield. Bundelkhand saw the most variation in production compared to land area and crop yield over the 29-year study period. Differences in CDVI between production, area, and yield were 79.61, 53.54, and 27.15, respectively. According to district-by-district analyses, Chitrakoot's CDVI value of 125.45 is the highest, followed by the CDVI value of 181.87 for its area of production. In terms of yield, however, the 70.80 CDVI value observed in the Mahoba district represents the greatest instability. The consistent returns from growing sesame suggest that it is a major cash crop in all of Bundelkhand's

Table 1. Growth in area, production and productivity of sesame in Bundelkhand (1989-2019)

Sesame	Particulars	Jhansi	Lalitpur	Jalaun	Banda	Hamirpur	Mahoba	Chitrakoot	Total
Area	Beginning year area (000' ha)	6098	6397	454	1402	8144	4512	454	27461
	End year area (000' ha)	80152	7152	4622	11546	41913	31321	1134	219440
	No. of observation	30	30	30	30	30	30	30	30
	Coefficient	0.00017	0.0016	0.00025	0.0004	0.00038	0.0004	0.002	
	R ² (%)	0.64*	0.31*	0.49*	0.40*	0.58*	0.63*	0.24*	0.66*
	Growth rate (%)	0.092	0.038	0.172	0.075	0.05	0.06	0.032	0.074
Production	Beginning year production (000' tonnes)	604	582	57	178	1458	450	26	3355
	End year production (000' tonnes)	6092	880	12572	3048	9221	18385	210	50408
	No. of observation	30	30	30	30	30	30	30	30
	Coefficient	0.00041	0.0043	0.0013	0.0017	0.0015	0.0015	0.009	0.00024
	R ² (%)	0.42*	0.20*	0.54*	0.32*	0.48*	0.40*	0.20*	0.56*
	Growth rate (%)	0.082	0.014	0.204	0.10	0.06	0.13	0.074	0.097
Yield	Beginning year yield (q ha ⁻¹)	0.99	0.91	1.27	1.27	1.79	0.99	0.57	1.22
	End year yield (q ha ⁻¹)	0.76	1.23	2.71	2.63	2.20	5.86	1.85	2.29
	No. of observation	30	30	30	30	30	30	30	30
	Coefficient	4.76	4.44	3.78	5.95	6.37	3.18	12.02	9.77
	R ² (%)	0.25*	0.088	0.16*	0.27*	0.14*	0.122*	0.43*	0.42*
	Growth rate (%)	-0.009	0.010	0.026	0.02	0.007	0.06	0.041	0.021

(*significant at 1% level and **significant at 5% level)

Table 2. Instability in area, production and productivity of sesame in Bundelkhand region (1989-2019)

Particulars		Districts							Bundelkhand (Total)
		Jhansi	Lalitpur	Jalaun	Banda	Hamirpur	Mahoba	Chitrakoot	
Area	CV	108.63	46.38	93.57	145.30	95.46	91.21	143.90	91.824
	CDVI	65.16*	38.53*	68.11*	112.55*	61.87*	55.48*	125.45*	53.54*
	Instability	High	High	High	High	High	High	High	High
Production	CV	146.37	83.80	110.44	190.60	127.10	154.53	203.34	120.02
	CDVI	111.47*	74.95*	74.90*	157.18*	91.65*	119.70*	181.87*	79.61*
	Instability	High	High	High	High	High	High	High	High
Yield	CV	50.26	38.29	58.32	51.02	34.93	75.56	43.66	35.65
	CDVI	43.53	36.56*	53.45*	43.59*	32.39*	70.80	32.96*	27.15*
	Instability	High	High	High	High	High	High	High	High

(*significant at 1% level and **significant at 5% level)

Table 3. Relative contribution of area and yield in the growth of sesame in Bundelkhand region (1989-2019)

Particulars	Districts							
	Jhansi	Lalitpur	Jalaun	Banda	Hamirpur	Mahoba	Chitrakoot	Bundelkhand (Total)
Area effect $\Delta A.Y0$ (%)	133.5	23.08	46.65	45.00	77.90	14.80	21.00	49.90
Yield effect $\Delta Y.A0$ (%)	-2.5	68.79	0.5	6.67	4.3	12.3	31.5	6.4
Interaction effect $\Delta A.\Delta Y$ (%)	-31	8.13	52	48.33	17.8	72.9	47.5	43.7

districts. Study period was characterized by high levels of area and production instability supported by the findings of Nayak (2021). Changes in the cropping pattern of sesame crop in all the districts of Bundelkhand may have been caused by the introduction of the programme green revolution, technological advancement, and the availability of high yielding varieties during the study period from 1989 to 2019. Similarly, in case of legumes the instability was attributed to adoption gap (Nain et al., 2014) as such the efforts for adoption of technologies might have effected positively.

Relative contribution of area and yield in the growth of sesame

For the time period 1989–2019 and district wise, separately, the study conducted a decomposition analysis to determine the area, yield, and their interaction effect on growth of sesame production in Bundelkhand. A summary of the findings is shown in Table 3. According to the data, in Bundelkhand, the area effect was 49.90 per cent, the yield effect was 6.40 per cent, and the interaction effect was 43.70. This indicates that the increase in

Bundelkhand's sesame output was due to a combination of factors, including both land area and yield; similar findings were reported by Kumar et al., (2020) and Kalia et al., (2021). Analysis by district indicates that during the study period, area had a positive effect on sesame production in the Jhansi district by 133.5 per cent, while yield had a negative effect. Comparatively, during the study period, the area and yield of the sesame crop produced were found to be positively correlated in the other Bundelkhand districts (Lalitpur, Jalaun, Banda, Hamirpur, Chitrakoot & Mahoba).

CONCLUSION

Sesame crop area increased at an annual growth rate of 0.007 per cent in Bundelkhand, but district-by-district analysis revealed a stagnant growth trend throughout the study period whereas yearly growth rate of 0.02 per cent in productivity. All Bundelkhand districts except Jhansi (-0.009%) showed a rising trend in productivity and Bundelkhand as a whole was experiencing a significant uptick in production. In Bundelkhand, the production instability (79.61%) was found to be higher than the area instability (53.154%) and the yield instability (27.15%). Decomposition analysis showed that the interaction effect was crucial to the development of sesame in Bundelkhand between 1989 and 2019. Reduced yields can be attributed to a lack of HYV seed input, seed replacement and the reluctance of farmers to implement improved agronomic practices requiring cutting-edge technology, as well as the careful identification of problem areas to optimize the output.

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Assessment of Livelihood Security and Constraints Encountered by Small and Marginal Cotton Growers

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Informed consent of the participants

ABSTRACT

The study examines the constraints faced by cotton growers in achieving livelihood security in the Guntur district of Andhra Pradesh, India. The investigation used a Livelihood Security (LS) index comprising seven elements, including food security, economic security, health security, educational security, social security, institutional security, and infrastructural security. Data were collected from 120 cotton farmers using structured interviews, and statistical analysis was employed to assess the level of livelihood security and identify constraints. The findings indicate that a substantial proportion of farmers have medium to high levels of livelihood security, but certain challenges persist. Among the constraints, lack of knowledge of technical skills and relevant technologies, low market prices for products and inadequate knowledge of marketing stand out as significant obstacles. Addressing these challenges can contribute to enhancing the overall well-being and livelihood security of cotton growers in the region.

INTRODUCTION

Livelihood is the means of earning a living to meet basic needs, often associated with poverty and vulnerability. It involves capacities, resources, and activities for subsistence. Livelihoods focus on obtaining resources to achieve survival and well-being goals, reducing vulnerability (Young et al., 2002). During achieving livelihood security by the household, certain problems or constraints come in the way. These may differ from person to person and region to region. These may be related to various aspects like related to credit facilities, during the marketing process, technical guidance or may be some related to infrastructure setup. So an attempt was made to enumerate the various constraints faced by cotton growers of the Guntur district of Andhra Pradesh in achieving livelihood security. No such study regarding constraints faced by cotton growers to achieve livelihood security had been conducted in the Guntur district. Therefore, it becomes necessary to find out the problems faced by farmers.

METHODOLOGY

The investigation was conducted in the Guntur district of Andhra Pradesh. The district comprises 18 blocks namely Thullur, Tadikonda, Medikonduru, Phirangipuram Guntur, Prathipadu, Pedhanandipadu, Kakumanu, Vatticherukuru, Ponnur, Chebrolu, Pedakakani, Duggirala, Thenali, Kollipara, Mangalagiri and Tadepalle. Out of which, the Ponnur and Tadikonda 2 blocks were selected randomly. Using a straightforward random selection procedure, three villages were randomly chosen from each of the two blocks. Each village produced a number of 10 marginal and 10 small farmers. For the experiment, a total of 120 farmers were chosen. Using a set schedule that had been evaluated in advance, data were gathered through in-person interviews. Numerous statistical techniques were used to analyze the data. A Livelihood Security (LS) index established by Lal et al., (2017) was used to assess the family of cotton growers' level of livelihood security. In this manuscript, the Livelihood Security (LS) index consists of

seven elements: food security, economic security, health security, educational security, social security, institutional security, and infrastructural security. These elements were selected through a literature review, and their weights were determined with input from 32 knowledgeable judges. The judges ranked the seven indicators from 1 to 7, and the rankings were converted into weightage using the Alfares methodology (Alfares & Duffuaa, 2009).

The following formula was used to determine the standardized scores for each sub-indicator in this study:

$$Z \text{ Ind } i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}$$

Where, X_i , $X_{\max}$ and $X_{\min}$ - Were the original values for indicator i ,
 $Z \text{ Ind } i$ = value of standardized indicator i

The Garret ranking method (1969) was employed to evaluate the obstacles to obtain livelihood security. It includes economical, communicational, technical and miscellaneous-related constraints;

- Thus, the respondents' order of merit was transformed into a % position using the following formula:

$$\% \text{ position} = \frac{100 (R_{ij} - 0.50)}{N_j}$$

- The terms N_j and R_{ij} , respectively, stand for the quantity of constraints ranked by the j^{th} individual and the position assigned by the j^{th} individual to the i^{th} constraint.
- To translate the % position for each rank so acquired into scores, Garrett (1969)'s table was consulted.
- For each constraint, the mean scores were computed, and the corresponding rank was then determined.

RESULTS AND DISCUSSION

Livelihood security

Table 1 shows that among the small and marginal cotton growers surveyed, a significant proportion (69.17%) had a medium level of food security. Additionally, (20.00%) and (10.83%) of cotton growers reported low and high levels of food security, respectively. These findings revealed that 80.00% of the respondents in the study area had medium to high levels of food security, indicating a relatively favourable food security situation among them. The agricultural based commodities like paddy, bhendi, cucumber and brinjal crops grown by them and food distribution systems providing rice, red gram and sugar, enhancing the food security among small and marginal cotton growers in the study area.

A majority of cotton growers (64.17%) reported having a medium level of economic security. Overall, 85.84% of cotton farmers in the study area fell into the low and medium levels of economic security. These findings indicate a significant need to enhance economic activities among cotton growers in the study area to improve their economic security. A significant proportion of cotton growers in the study area (43.34%) reported having a high level of health security. According to the conclusions, most cotton growers showed a high level of health security, indicating the significance of health awareness and proactive health practices among cotton growers in the study area. Most of the cotton growers (65.00%) reported having a medium level of educational security. The results suggest that the level of educational security among cotton growers was lacking. Almost 87.00% of cotton growers had medium and low levels of educational security, indicating a need to improve educational facilities and opportunities in the study area. Enhancing educational access and quality can contribute significantly to increasing the livelihood security of these individuals. A majority of cotton growers (56.67%) reported having a medium level of social security. It can be inferred that around 25.00% of the selected cotton growers feel "socially secure," while approximately 75.00% reported feeling "socially insecure." This suggests that a significant proportion of cotton growers in the study area face social vulnerabilities and challenges that impact their overall livelihood security. A significant proportion of cotton growers (66.67%) reported having a medium level of institutional security. The findings underscore the need to focus on bolstering institutional support and engagement, cotton growers can benefit from improved livelihood security and better access to resources and services. A majority of cotton growers (70.83%) reported having a medium level of infrastructural security. The findings highlight the majority of cotton growers believed that having sufficient infrastructure provisions positively impacts their well-being and livelihood security.

These research findings are consistent with the outcomes reported in earlier investigations carried out by Parmanand (2012); Dhakade (2019) & Jhamb (2020). These prior studies also revealed that the majority of respondents possessed a medium level of food security, economic security, educational security, social security, institutional security, and infrastructure security. Moreover, they indicated a high level of health security among the respondents.

The values in Table 2 clearly demonstrate how cotton growers are categorized into three groups based on their overall livelihood security: low, medium, and high. The overall Livelihood Security score for each cotton grower was determined by considering scores from different domains of livelihood security. A majority (60.84%)

Table 1. The current status of different indicators of livelihood security of cotton growers

Category	Indicators of livelihood security						
	Food security (%)	Economic security (%)	Health security (%)	Educational security (%)	Social security (%)	Institutional security (%)	Infrastructural security (%)
Low	20.00	21.66	18.33	22.50	17.50	11.67	19.17
Medium	69.17	64.17	38.33	65.00	56.67	66.67	70.83
High	10.83	14.17	43.34	12.50	25.83	21.66	10.00
Mean Score	0.707	0.549	0.609	0.518	0.588	0.531	0.641

Table 2. Overall livelihood security of small and marginal cotton growers

Overall livelihood security level	Frequency	Percentage	Mean
Low (< 0.484)	25	20.83	0.594
Medium (0.484-0.704)	73	60.84	
High (> 0.704)	22	18.33	
Total	120	100.00	

were classified as having medium Livelihood Security, and 81.67 per cent of respondents lived in medium to high levels of livelihood security in the selected area. In terms of their living standards, this is a good sign. These research findings are consistent with the conclusions made by previous studies conducted by Parmanand (2012); Roy et al., (2012); Saha (2018); Mahadik & Sawant (2012); Sathwika et al., (2019); Dhakade (2019) & Jhamb (2020) which also noted that most respondents had a medium level of overall livelihood security. The study indicates that a substantial number of cotton growers enjoy a medium to high level of livelihood security, suggesting an encouraging sign for their well-being and quality of life. However, it also highlights the importance of continued efforts to address the livelihood security concerns of those in the low category to further enhance overall well-being in the selected area.

As seen in Figure 1, various indicators supported the livelihood security of cotton growers in the research area. From the security score for each indicator, it was discovered that out of the 7 sub-indicators, food security had the greatest index value of 0.707 due to the predominant focus on cultivating agricultural commodities such as paddy and brinjal among cotton growers and due to the presence of an efficient food distribution system in the research

area and educational security had the lowest index value of 0.518. Due to the prevalence of low literacy levels among cotton growers within the research area. Dhakade (2019) came to a similar conclusion that food security had the greatest index value of 0.725, whereas Lal et al., (2015) discovered a different conclusion that educational security had the highest index value of 0.560.

Perceived constraints by the cotton growers

Table 3 presents the data on technical constraints perceived by the respondents, along with their corresponding rank patterns. Among the five constraints identified by the respondents, the highest rank was assigned to the constraint “Lack of knowledge of technical skills and relevant technologies to increase crop output” with a (mean score - 67.33). This result suggests that a significant number of respondents were not adequately informed about the latest advancements in agricultural production techniques and technologies, which could potentially enhance their crop yields and overall agricultural output, thereby leading to better financial returns. The remaining constraints were listed by the cotton growers in order of decreasing importance.

Among economic constraints experienced the foremost rank was assigned to the constraint “Products with low market prices” with a (mean score - 72.74). This result highlights a crucial issue faced by the respondents, where the costs of agricultural inputs have significantly increased over time, leading to higher cost of production; however, in contrast, the prices of various agricultural products have not risen proportionately, resulting in substantial losses for the respondents in their agricultural endeavours. The second rank was attributed to the constraint of “huge expenses regarding farming inputs such as seeds, fertilizers, pesticides, and other essential resources”. This suggests that the financial burden

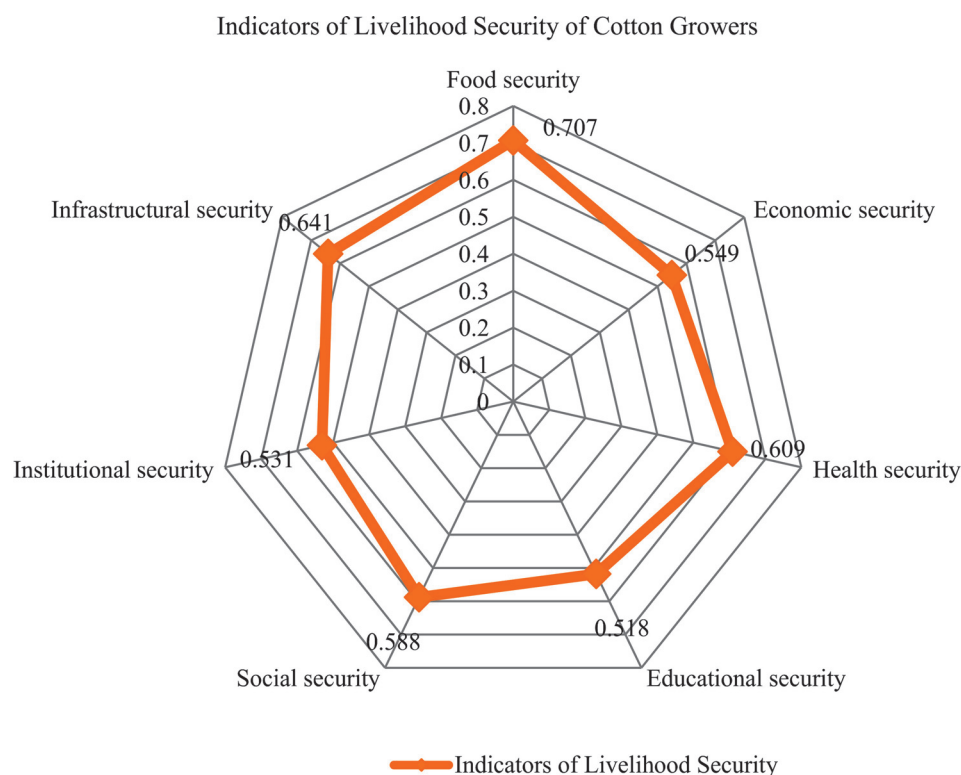
Figure 1. Mean score of different indicators of livelihood security of cotton growers

Table 3. Constraints encountered by the cotton growers

S.No.	Statement	Mean	Rank
Technical Constraints			
1.	Lack of knowledge of technical skills and relevant technologies to increase crop output.	67.33	I
2.	Lack of knowledge of the programmes and subsidies for agriculture and animal husbandry.	54.00	II
3.	Lack of proper supervision or training of workers before any new initiatives are launched.	48.62	III
4.	Lack of knowledge about scientific crop management techniques including avoiding fertilizer, pesticides, and insecticides, as well as preparing the soil for cultivation.	42.71	IV
5.	Absence of agricultural equipment such as tools and machines.	31.67	V
Economic Constraints			
1.	Products with low market prices.	72.74	I
2.	Huge expenses regarding farming inputs. (Like seeds, fertilizers, pesticides, etc.,)	62.57	II
3.	Lack of credit available to the farmers.	58.76	III
4.	In case of a delay getting insurance if crops are damaged or livestock loses.	41.85	IV
5.	Labourers' high wages.	37.09	V
6.	Lack of employment opportunities within the village during the off-season.	26.75	VI
Communicational Constraints			
1.	Lack of knowledge of the marketing of the products.	68.05	I
2.	Farmers don't participate enough in various initiatives like kishanmela, demonstrations, training, community gatherings, etc.	55.72	II
3.	Absence of extension workers for disseminating newly acquired information about emerging technology.	43.18	III
4.	Field issues have not received sufficient attention during discussions by the scientists and higher authorities during KrishiGoshti.	33.38	IV
Miscellaneous Constraints			
1.	Repeated failures of the crops.	72.79	I
2.	Higher interest rates are paid for taking a loan from institutions that lend money.	63.63	II
3.	When taking out a loan or debt from the bank, the bank employees reacted improperly or incorrectly.	57.37	III
4.	Farm inputs like seeds, feeds, fodder, insecticides, etc. are scarce or unavailable.	42.73	IV
5.	Lack of reliable irrigation sources.	36.37	V
6.	Farmer's unwillingness to know any new livelihood practice.	27.29	VI

of investing in these inputs has been a significant challenge for the respondents, impacting their ability to achieve livelihood security. The remaining economic constraints were ranked in descending order of perceived importance by the respondents.

Among the communicational constraints experienced top-ranked constraint, with the highest (mean score - 68.05), was "Lack of knowledge of marketing the products". This result indicates that a majority number of respondents faced challenges in understanding effective marketing strategies for their products. Insufficient knowledge in this area may have hindered their ability to reach broader markets, secure fair prices, and maximize their returns, impacting their overall livelihood security. On the other hand, the last ranked constraint was "Field issues have not received sufficient attention during discussions by the scientists and higher authorities during KrishiGoshti". Despite being an important constraint perceived by the respondents, it received the lowest rank. This suggests that there might be a lack of attention or emphasis on addressing practical on-field issues faced by farmers during agricultural conferences or discussions led by scientists and higher authorities.

Among miscellaneous constraint, "repeated failures of the crops" with a (mean score of 72.79) was most serious. Agriculture's heavy reliance on nature exposes farmers to numerous unforeseen calamities, leading to substantial and unexpected losses. As a result, their livelihoods are at risk due to these uncontrollable factors. Following this, other constraints were identified by

respondents in descending order of importance. However, the last rank was assigned to the constraint of the "Farmer's unwillingness to know any new livelihood practice". While challenges in adopting new practices may exist, it appears to be of relatively lesser concern compared to the formidable issue of crop failures and their devastating consequences on the farmers' livelihood security. The constraint analysis by Yadav et al., (2019); Gireesh et al., (2019); Kobba et al., (2020).

CONCLUSION

The study reveals a positive picture of livelihood security among small and marginal cotton growers in the study area, with a majority having medium to high levels of food, economic, health, institutional, and infrastructural security. However, challenges in educational and social security warrant attention to further improve overall well-being. The findings emphasize the significance of agricultural-based communities and effective food distribution systems in enhancing food security and the need to enhance economic activities and educational opportunities among cotton growers. Addressing technical, economic, communicational, and miscellaneous constraints will play a crucial role in sustaining livelihood security and prosperity in the selected area. Overall, the study provides valuable insights for policymakers and stakeholders to develop targeted interventions and support systems to uplift the livelihoods of cotton growers and promote sustainable development in the region.

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Effectiveness of Video on Knowledge Gain Regarding Sugarcane Cultivation Practices among the Farmers

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ABSTRACT

Information and communication technology in agriculture provides solutions to agricultural challenges. The study was conducted in Athani taluk of Belagavi District in Karnataka state during 2020-21. 'Before-After' without control group experimental design was used to determine the effectiveness of video on knowledge gain regarding sugarcane cultivation practices among farmers. Video developed on "Sugarcane cultivation practices" was the subject matter selected for the study and tested for their effectiveness and acted as treatment for the study. 50 Sugarcane growers were selected for the treatment randomly. The results revealed that highest mean difference 3.72 was observed in case of integrated disease management, followed by integrated pest management (3.62) and weed management (2.38). The farming experience, land holding, achievement motivation, risk orientation, scientific orientation and cosmopolitanism were found to be positive and significantly related with knowledge gain. Therefore, efforts should be taken up to disseminate knowledge about recommended scientific farming practices by using information and communication technology tools especially video to educate farmers and thereby maximizing their benefits. Hence "Video" might be helpful for making the 'sugarcane grower' into 'resource rich farmers'

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is an important commercial crop of the world and is cultivated in about seventy five countries, the leading countries being Brazil, India, China and Thailand. The sugar industry plays an important role in the agricultural economy of India. Today, sugarcane cultivation and sugar industry stands as supporting pillars of Indian economy. India occupies the second rank in production of sugarcane in the world. The area under sugarcane in India is 46.02 lakh hectares during the year 2019-20 and production of 370.50 million tonnes and yield is 80497 kg/ha. India's annual consumption of sugar is around 28.00 million tonnes. (Anonymous, 2019-20). Karnataka is blessed with a favourable climatic conditions for the cultivation

of sugarcane, hence the area under sugarcane has expanded to 6.91 lakh ha with a production of 381.81 lakh tonnes and productivity of 89000 kg/ha (Anonymous, 2019-20). The leading sugarcane growing districts are Belagavi, Bagalkote, Mandya and Kalaburagi. Belagavi being one of the leading sugarcane growing district in Karnataka has an area of 2.21 lakh ha under sugarcane with production of 15.33 lakh tonnes and productivity of 102 t/ha (Anonymous, 2017-18).

Agriculture continues to be the occupation and way of life for more than half of Indian population even today, making single largest contribution to the GDP of our nation. Sustainable prosperity of the farmers and the agricultural labourers holds the key for improving the overall human resource development scenario in the country. Indian agriculture had been on traditional lines till the first

waves of green revolution in the late 1960s. The green revolution gave a sudden boost to the production and productivity by making India self sufficient. Though India has achieved self sufficiency in food grain production, we cannot be complacent with the increasing population. There is a need to increase production and productivity of agriculture. Hence, the Indian farmers need to be updated with the latest knowledge about new techniques of farming, new cultivars, farm machinery, market and trade situation, etc. The extension personnel of the department of agriculture disseminated the technologies and messages to the farmers through various extension methods. But these approaches have not been able to reach the majority of the farmers spread across the country as the ratio between farmer and extension worker is 1000:1 (Chitra & Shankaraiah, 2012). This gap remains a challenge for extension system even today. To reach 120 million farmers spread over more than 500 districts is an uphill task. The diversity of agro-ecological situations adds to this challenge further. Farmers' needs are much more diversified and the knowledge required to address them is beyond the capacity of the grass root level extension functionaries. In this context, Video plays an important role in reaching the unreached, supplement and reinforce the extension efforts. Keeping this in view, the present study was conducted with a specific objective to effectiveness of video on knowledge gain regarding sugarcane cultivation practices among farmers.

METHODOLOGY

The experimental study was conducted in Athani taluk of Belagavi District in Karnataka state. 'Before-After' without control group experimental design was used to determine the effectiveness of video on knowledge gain regarding sugarcane cultivation practices among farmers. Video developed on "Sugarcane cultivation practices" was the subject matter selected for the study. Video acted as treatments for the study. Based on the highest area under sugarcane cultivation Ugar Khurd village from Athani taluk of Belagavi district was randomly selected for the study. 50 Sugarcane growers were selected for treatment on the basis of random sampling. The effectiveness was studied in terms of knowledge gain for video by conducting pre test and post test. The standardized interview schedule as suggested by Kumar et al., (2016) was used for data collection which was done through personal interview technique. Collected data were tabulated and analyzed using mean, paired 't' test, correlation and other statistical tools.

RESULTS AND DISCUSSION

The Table 1 depicts the gain in knowledge level of sugarcane growers on sugarcane cultivation practices due to Video exposure. The paired 't' test was calculated to find out the mean difference before and after the treatments. The knowledge gain on soil and land preparation was 2.22 after the Video exposure. The mean score before the treatment was 1.32 and it was increased to 3.54 after the treatment. The paired 't' value is 18.69 which is significant at 1 per cent level. The mean knowledge gain on planting season and varieties was 2.18 after the Video exposure. The mean score before the treatment was 1.76 and it was increased to 3.94 after the treatment. The paired 't' value is 19.91 which is significant at 1 per cent level. The mean knowledge gain on seed setts was 2.26

after the Video exposure. The mean score before the treatment was 1.54 and it was increased to 3.80 after the treatment. The paired 't' value is 26.65 which is significant at 1 per cent level. The mean knowledge gain on organic manure was 2.24 after the Video exposure. The mean score before the treatment was 1.04 and it was increased to 3.28 after the treatment. The paired 't' value is 24.13 which is significant at 1 per cent level. The mean knowledge gain on chemical fertilizer was 1.96 after the Video exposure. The mean score before the treatment was 1.84 and it was increased to 3.80 after the treatment. The paired 't' value is 39.87 which is significant at 1 per cent level. The mean knowledge gain on green leaf manure was 1.66 after the Video exposure. The mean score before the treatment was 0.78 and it was increased to 2.44 after the treatment. The paired 't' value is 22.60 which is significant at 1 per cent level. The mean knowledge gain on micronutrients was 2.26 after the Video exposure. The mean score before the treatment was 0.88 and it was increased to 3.14 after the treatment. The paired 't' value is 22.10 which is significant at 1 per cent level. The mean knowledge gain on irrigation was 2.24 after the Video exposure. The mean score before the treatment was 1.42 and it was increased to 3.66 after the treatment. The paired 't' value is 18.71 which is significant at 1 per cent level. The mean knowledge gain on inter cultivation was 1.98 after the Video exposure. The mean score before the treatment was 0.98 and it was increased to 2.96 after the treatment. The paired 't' value is 21.40 which is significant at 1 per cent level. The mean knowledge gain on weed management was 2.38 after the Video exposure. The mean score before the treatment was 1.38 and it was increased to 3.76 after the treatment. The paired 't' value is 34.32 which is significant at 1 per cent level. The mean knowledge gain on integrated pest management was 3.62 after the Video exposure. The mean score before the treatment was 2.66 and it was increased to 6.28 after the treatment. The paired 't' value is 25.92 which is significant at 1 per cent level. The mean knowledge gain on integrated disease management was 3.72 after the Video exposure. The mean score before the treatment was 3.68 and it was increased to 7.40 after the treatment. The paired 't' value is 27.13 which is significant at 1 per cent level. The mean knowledge gain on harvesting was 1.32 after the Video exposure. The mean score before the treatment was 1.24 and it was increased to 2.56 after the treatment. The paired 't' value is 15.04 which is significant at 1 per cent level.

It is observed in Table 1 that highest mean differences 3.72 was observed in case of integrated disease management, followed by integrated pest management (3.62) and weed management (2.38). The fact that under Video treatment the sugarcane cultivation practices focused more on integrated pest management and integrated disease management practices which resulted in the high knowledge gain of farmers. Further, in sugarcane crop, pest and disease management is very important for the farmers to follow in order to get good yield and farmers are most accustomed to the Video and they view regularly and hence the result. The crucial factor in cultivation is the weed management or otherwise it will reduce the yield drastically. Hence, the farmers were motivated to get more knowledge on the quantity of herbicides to be used. The study supported by the results of Dechamma (2015) & Sowjanya (2017).

Table 1. Knowledge gain of farmers on exposure to video on sugarcane cultivation practices

S.No.	Sugarcane cultivation practices	Scores	Video		Paired 't' value
			Mean Knowledge gain		
			Mean	SD	
1	Soil and land preparation	4	2.22	0.03	18.69**
2	Planting season and varieties	5	2.18	-0.34	19.91**
3	Seed setts	5	2.26	-0.16	26.65**
4	Organic manure	4	2.24	-0.10	24.13**
5	Chemical fertilizer	5	1.96	-0.06	39.87**
6	Green leaf manure	3	1.66	0.08	22.60**
7	Micronutrients	6	2.26	0.05	22.10**
8	Irrigation	7	2.24	0.27	18.71**
9	Inter cultivation	3	1.98	-0.42	21.40**
10	Weed management	4	2.38	-0.17	34.32**
11	Integrated pest management	8	3.62	0.01	25.92**
12	Integrated disease management	10	3.72	-0.47	27.13**
13	Harvesting	3	1.32	0.11	15.04**
Mean Knowledge gain			30.00		49.08**

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

The data regarding the overall knowledge gained as a result of exposure to video format are presented in Table 1. The computed 't' value was positive and significant at 0.01 level of significance for gain in knowledge. Hence, it can be concluded that there was a positive and significant difference in the knowledge levels of respondents before and after exposure to the treatments. The mean knowledge score of video of the respondents before exposure was 20.52 and after exposure it was 50.52, thus there was mean knowledge gain of 30.00. This might be due to their need and interest towards scientific practices, validity of information and the contents in the vernacular language (Kannada). The present finding supports the 'axiom' one picture worth a thousand words and the visual literacy is given priority as one could see and learn thereby integrate all sensory experiences. Thus, the text, photos, videos and audios in the MCD combinedly attracted and created interest among the respondents and it was found to be the most effective in ensuring knowledge gain of the farmers. These findings were in accordance with the results obtained by Kadian & Gupta (2006) who stated that as compared to "lecture only", "audio only" and "literature only" educational methods, the Video Compact Disc (VCD) found to be most effective for imparting knowledge related to dairy calf management practices. Similarly these results are in concordance with the findings of Radhakrishnan (2000) who inferred that the distribution of respondents based on knowledge gain, showed that majority (82.00 per cent) of the respondents was in high category after exposure to Instructor Controlled Interactive Video. Similarly Vidya & Manivannan (2010) also pointed out that Video presentation had produced remarkable impact on gain in knowledge of the technology disseminated. Marshall (2002) established that people remember only 10 per cent of what they read, 20 per cent of what they hear, 30 per cent of what they see and 50 per cent of what they hear and see. With the advent of such technologies which combines images, texts and audio all in one can make the percentage even higher than 50 per cent. Learners can see it in their comfort zone and time convenient for them. Further Bansal and Joshi (2014) reported in their study

that 73 per cent students found learning anytime, anywhere convenient.

Relationship between selected socio-economic characters with knowledge gain

It is apparent from Table 2 that the variables such as farming experience, land holding, achievement motivation, risk orientation, scientific orientation and cosmopolitaness were found to be positive and significant relationship with knowledge gain at 0.05 per cent level. Other variables viz., age, education, extension participation, extension contact, mass media exposure, innovative proneness, economic motivation and management orientation had a non significant relationship with knowledge gain of the respondents. Farming experience was found to be positive and significant relationship with knowledge gain. The possible reason might be that farmers are involved in farming activities for a long time, they

Table 2. Relationship of socio-economic characteristics with knowledge gain after exposure to Video format

S.No.	Variables	Video (T_2)
1	Age	-0.125 ^{NS}
2	Education	0.122 ^{NS}
3	Farming experience	0.323*
4	Land holding	0.302*
5	Extension participation	0.177 ^{NS}
6	Extension contact	0.265 ^{NS}
7	Mass media exposure	0.159 ^{NS}
8	Innovative proneness	0.033 ^{NS}
9	Achievement motivation	0.308*
10	Economic motivation	-0.131 ^{NS}
11	Risk orientation	0.288*
12	Management orientation	-0.039 ^{NS}
13	Scientific orientation	0.326 *
14	Cosmopolitaness	0.295 *

*Significant at the 0.05% level, **Significant at the 0.01% level, NS- Non significant

try to know more about new technologies with interest, thus farming experience has high significance. The findings are in agreement with the findings of Dechamma (2015); Vandana (2016) & Mohanakumar (2018). Land holding had found positively and significantly correlated with knowledge gain. The probable reason for this kind of results may be that farmers with larger holdings will have more opportunities and potentialities to try and adopt large number of technological innovations. As a result, it is quite possible that farmers with larger holdings evince keen interest to know about new farm practices and be more receptive to such ideas, thus leading to better acquisition of knowledge. Therefore, size of land holdings might have shown positive and significant relationship with knowledge gain. The findings are in agreement with the findings of Dechamma (2015) & Mohanakumar (2018). Achievement motivation was found to be significantly related, the reason might be that the interest of the individual to decide and complete the tasks in certain directions, which in turn helps in achieving the desired crop yield and income. These findings are in agreement with the findings of Chandra & Reddy (2004). The relationship between risk orientation and knowledge gain was found to be significant. Risk orientation is expressed as the degree to which a farmer is oriented to take risk and has courage to face uncertainties in sugarcane cultivation. Those who have this particular trait normally will have better knowledge. This might be the possible reason for significant relationship between knowledge gain and risk orientation. These findings are in agreement with the findings of Anandaraja (2002); Senthil Kumar (2003); Dechamma (2015); Kumar et al., (2020). Scientific orientation had positive and significant relationship with knowledge gain of sugarcane cultivation practices. The possible reason might be that sugarcane cultivation practices with scientific orientation could be more receptive to the latest technologies, employ scientific methods on making the decisions as well as, acquire and adopt efficient factors of management of enterprise. The findings are supported by the results of Priyanka (2016). The significance of cosmopolitanism is might be due to the fact that the farmers who make frequent visits to outside places will be exposed to new ideas, technologies and awareness. The farmers who have higher exposures to different mass media have better opportunities to get exposed to new ideas, hence mass media is significantly related. The finding was in conformity with the findings of Nain & Chandel (2012); Dechamma (2015); Ghanghas et al., (2015); Priyanka (2016) & Sowjanya (2017).

CONCLUSION

The videos have the potential to improve awareness, knowledge acquisition and technology adoption. There was a significant gain in knowledge from before to after exposure mean scores which inferred that the informative videos had significant effect on the knowledge gain on sugarcane cultivation practices. By proving that an image is worth a thousand words, seeing the images makes the information clearer and more complete, which helps to create lasting impressions in the minds of the respondents. Therefore, efforts should be taken up by the extension agents to disseminate knowledge about recommended scientific farming practices by using information and communication technology

tools especially Video to educate farmers and there by maximizing their benefits. Hence "Video" might be helpful for making the 'sugarcane grower' into 'resource rich farmers'

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Innovations in Teaching: A Case of Using Kinesthetic Learning Activity for Teaching Physics

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ABSTRACT

The paper evaluates the advantage of the role of Kinesthetic Learning Activity (KLA) method in understanding basic concepts of physics over traditional methods. This study was conducted during the year 2022-23. The topic “Photo-electric effect” of grade 12 was selected for KLA from feedback of 20 teachers and literature study. A sample of 50 students from two schools in Kolkata was taught the topic traditionally. Later the Kinesthetic learning activities were conducted in the classroom and school field. The data of pre KLA and post KLA were collected and analyzed using various statistical tools using SPSS software. The calculated value of *t* in paired *t*-test was 21.289 with *p* values 0.000 which clearly showed differences in pre and post-KLA and were highly significant. Ninety percent of the respondent students showed high satisfaction with KLA. Major improvement in post-KLA score was observed which increased from an average value of 8.00 to an average value of 15.12. Thus it is concluded that KLA was very effective in teaching the target topic. The learning from this study may be applicable across the disciplines including the field of agriculture extension to make an effective understanding of abstract topics in informal settings also.

INTRODUCTION

Kinesthetic learning activity (KLA) is an innovative participatory teaching tool in pedagogy which physically engages student in learning. In the schools in India the pedagogy of teaching Physics is more of a lecture method delivery with limited experiments on board Feinstein & Waddington (2020); Sivilotti & Pike (2007). The current study mainly researches one such innovation, using the kinesthetic learning activity (KLA). Kinesthetic learning activity (KLA) is defined as “any activity which physically engages students in the learning process” (Begel et al., 2004). KLAs are sometimes referred to in literature as simulation role play or analogical modeling role play. KLAs can address many of the shortcomings of the traditional classroom by raising the level of engagement during instruction, and can reenergize

a class; these activities engage learning preferences which improves learning outcomes for all students. KLAs can positively affect the culture of interaction in the classroom, encouraging student participation and collaboration (Whitworth et al., 2014). There is evidence to suggest kinesthetic learning may prove especially beneficial to at-risk students (Richards et al., 2017). KLAs draw new ideas in the minds of the students, and serve as useful formative assessment tools for instructors, thus helping in monitoring the learning process. Finally, these activities also induce great deal of excitement and enthusiasm into the classroom and the topics dealt are etched in the memory with clarity and depth (Meng & Rentschler, 2018). There are a number of topics in Physics in the secondary and the senior secondary level which becomes very difficult for the children to conceptualize as they cannot relate to the topic. The framework elaborated by Bloom

and his collaborators consisted of six major cognitive skills: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation (Anderson et al., 2001). It is expected that the Kinesthetic learning activities will help students comprehend the topic better; hence learning outcome for the application, analysis and synthesis can be evaluated with a positive trend.

KLAs has been effectively used in computer science courses (Bonwell, 1996), but very few research on other courses has been conducted. This paper aims to answer the question if there is any remarkable difference in understanding the basic concepts of Physics which cannot be demonstrated or experimented at the school level when applying the contemporary and traditional lecture method with that of the KLA method (Robinett, 2011; Whitworth et al., 2014).

METHODOLOGY

Firstly, the gray areas of the topics which were difficult for the children to understand in the secondary and higher secondary level in different schools were identified. For this, 20 High school Physics teachers were asked to identify topics in Grade 12 which were difficult for the children to conceptualize in Physics. Based on their feedback and literature survey (Morrow et al., 2014; Richards & Etkina, 2013; Richards, 2019; Richards, 2020) the topic “Photo- electric effect” was zeroed down. Second step was to teach the topic “Photo- electric effect” to a sample of 50 students from two different schools in the traditional way. Third step was to frame a multiple-choice question based testing process with 18 questions covering all six major cognitive skills based on Blooms taxonomy: Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation (Anderson et al., 2001). Fourth step was to administer the pre KLA test on the sample of students and collect the data through a Google form. In the fifth step different kinesthetic learning activities were framed and explained pictorially to the class to introduce the topics “Photo- electric effect” in a play way method. In the sixth step the kinesthetic learning activities were conducted in the classroom and in the school field on the same sample of students.

It was done in multiple small steps. In the first step 10 students performed the activity, while the remaining sample observed. In the second step another group of 10 students

performed the next activity, while the others observed. Thus different groups of the students performed different Kinesthetic learning activity. After the KLA was performed, the students made hypotheses and discussed them and made further conclusions. Then 5 short answer questions were further added to the previous 18 multiple-choice questions based testing process and was administered on the sample of students post kinesthetic learning activity and the data on post KLA was collected. Finally, the data was statistically analyzed in SPSS software using tools like pair t test to study the effectiveness of the KLA.

RESULTS AND DISCUSSION

Degree of satisfaction

The degree of satisfaction was divided into four categories: low, medium, high and very high. As evident from the pie chart majority of the respondents (90%), showed high satisfaction followed by medium satisfaction (6%), whereas only 4 per cent of the respondents showed low satisfaction from inclusion of kinesthetic learning activity in teaching method of Physics. Among the high degree satisfaction, 62 per cent of respondents showed very high satisfaction, while 28 per cent respondents showed moderately high satisfaction from this method of study. Overall the degree of satisfaction from the respondent was very high after performing the Kinesthetic learning activity to teach Photoelectric effect in School curriculum (Figure 1).

Effect of KLA on Scoring of the students

The Figure 2 shows students’ score pre KLA and post KLA based on 18 questions administered, where blue line indicates the

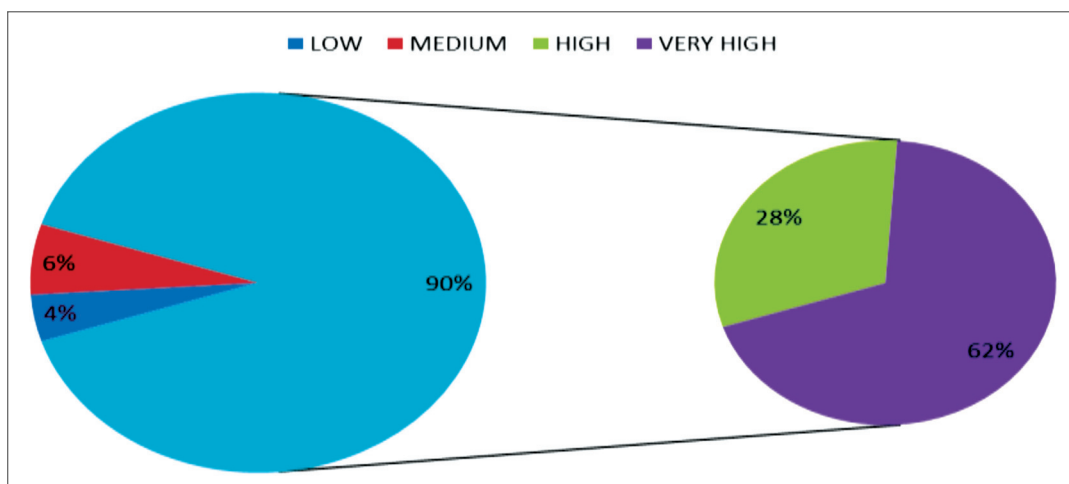
Table 1. Paired sample statistics n=(N-1)

		Mean	Std deviation	Std error Mean
Pair 1	Pre marks	8.00	1.708	0.244
	Post marks	15.12	1.481	0.212

Table 2. Paired samples Correlation n=(N-1)

		Correlation	Sig
Pair 1	Pre-post marks	-0.074	0.613

Figure 1. Degree of satisfaction of Kinesthetic learning activity in teaching Method



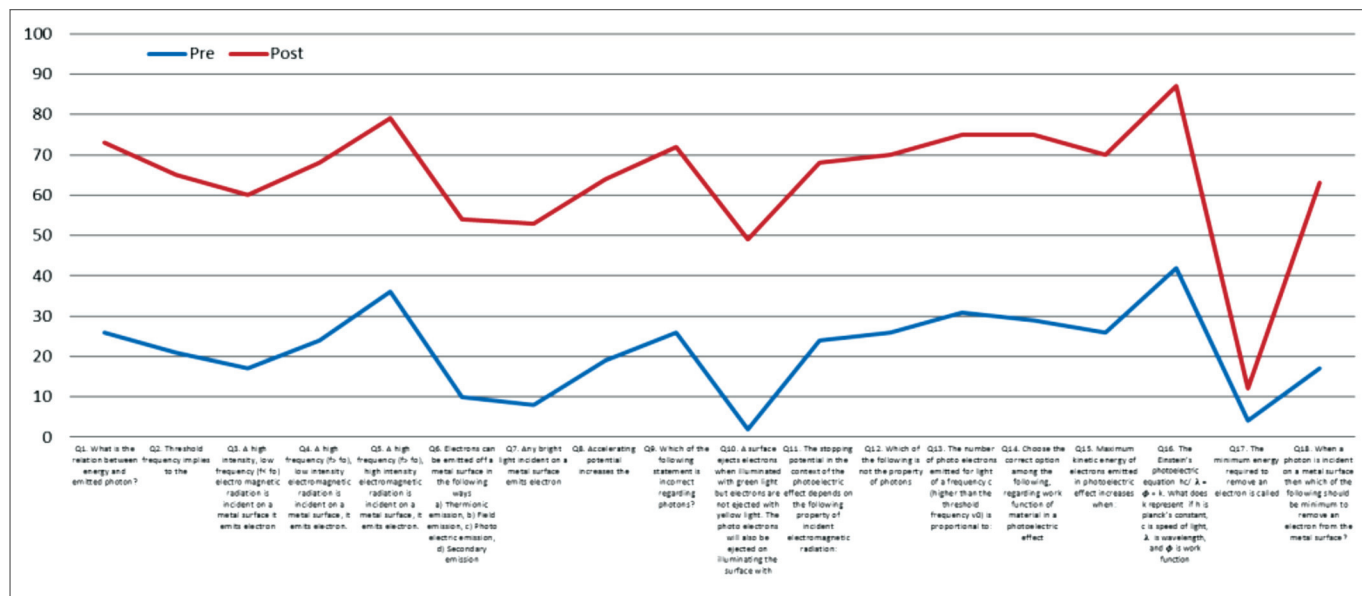


Figure 2. Pre and Post KLA scoring by the students

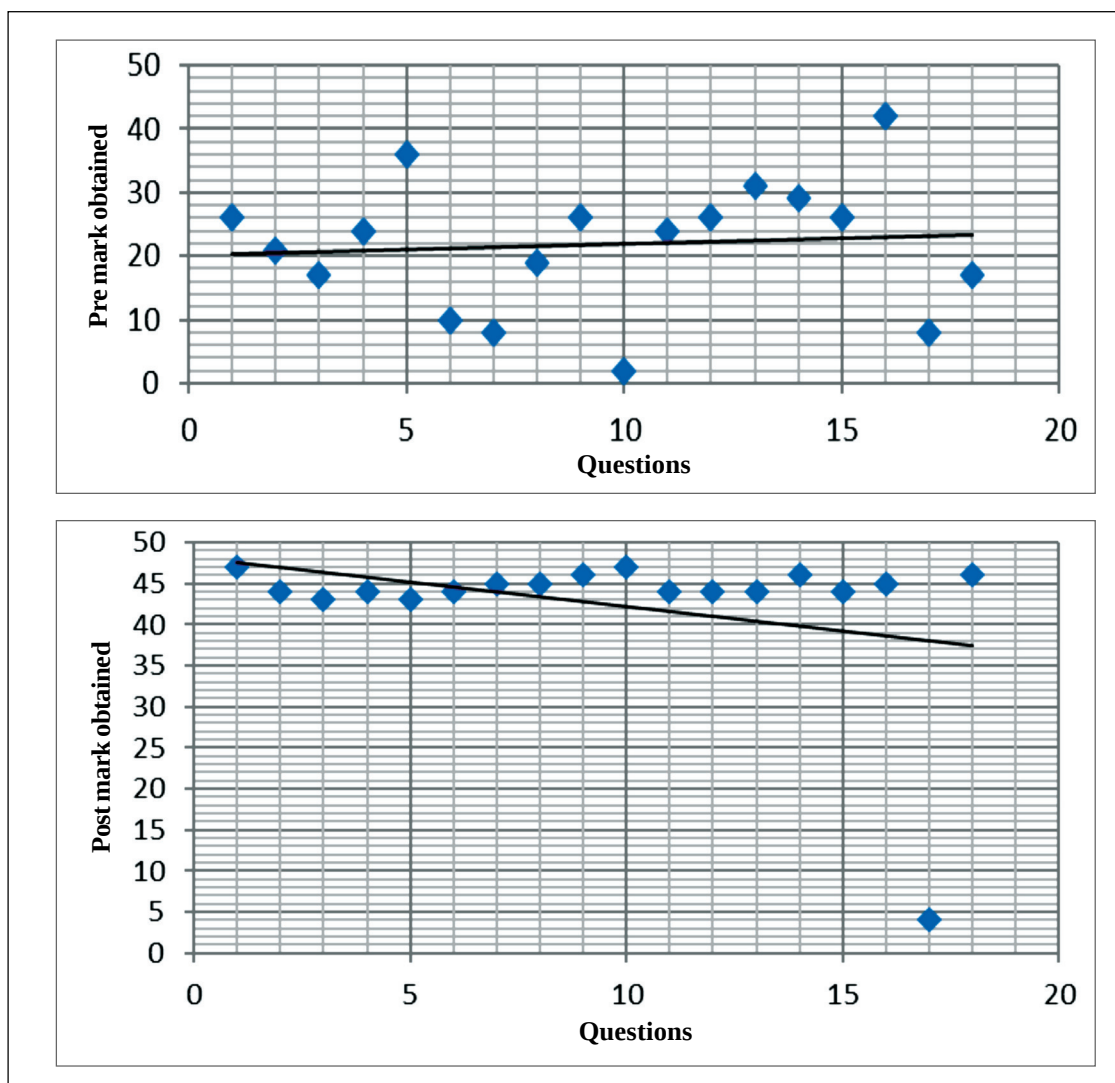


Figure 3. Pre and Post KLA marks obtained by the students

Table 3. Paired Samples Correlations n=(N-1)

	Paired differences							
	Mean	Std. deviation	Std. error mean	95% CI of the difference		t test result	degrees of freedom	sig
				Lower	Upper			
Pre-post marks obtained	-7.122	2.342	0.335	-7.797	-6.450	-21.289	48	0.000

pre KLA Score and redline indicates the post KLA Score. The pre KLA score is low whereas post KLA shows sharp rise in the students score. The score being high post Kinesthetic Learning Activity clearly explains that this was an innovative method of teaching learning process leading to higher scores ultimately better learning.

Effect of KLA on marks of the students

The Figure 3 shows pre KLA and post KLA marks obtained by the students in Photo Electric Effect with respect to consolidation of marks. It is seen that the pre KLA score obtained by the students is scattered in the lower region, while the post KLA score for all the students was in the higher region. Thus it is evident that *kinesthetic learning activity (KLA)* is very effective in teaching Photo Electric Effect to the Physics student.

The data was analyzed using the Paired t est. First, the data was entered into SPSS software and after that it was analyzed. The null hypothesis (Ho) was that the difference between pre kinesthetic and post kinesthetic is zero. The calculated value of t was tested by using p value at 5% level of significance. The calculated value of t was 21.289 with p value 0.000. It shows that pre and post kinesthetic differences were highly significant. However, pre and post marks obtained by the students were weekly and negatively correlated ($r=-0.074$, $p>0.05$), This interactive nature of KLAs makes it a valuable tool for “content-related” exercises and understanding ambiguous topics in a play way method. The KLA method of teaching can also be used to address social challenges faced by any classroom or society. This innovative method of teaching can be further researched and adapted in the field of agricultural extension for the training of extension personnel, researchers, line department officials and farmers.

CONCLUSION

The data collected and analyzed using graphical and statistical method clearly shows the advantage of using kinesthetic learning activity in teaching Physics to the student. The calculated value of t is 21.289 with p value 0.000 shows that differences in pre and post kinesthetic are highly significant. The degree of satisfaction calculated also showed most of the participants were highly satisfied (90%). Further the high (28%) and very high (62%) level of satisfaction states clearly that degree of satisfaction from the respondent is very high. The impact of students score pre KLA and post KLA clearly explains that the score is higher post KLA. It is seen that the pre KLA score obtained by the students is scattered in the lower region, while the post KLA score for all the students is in the higher region. From the above discussions we

can conclude that *kinesthetic learning activity (KLA)* is highly effective in teaching Photo Electric Effect which has been identified as a difficult concept in Physics in School curriculum. This research has shown that the effect of KLA makes a significant contribution to general and conceptual understanding of the concepts of Physics based on the Photoelectric effect. Thus the innovations in teaching Physics in School Curriculum using Kinesthetic Learning Activity should be introduced in the school curriculum.

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Knowledge Enhancement of Landless and Marginal Farmers through Entrepreneurship Training on Goat Farming

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ABSTRACT

The study focused on assessing the cognitive effectiveness of entrepreneurial development training on goat rearing for landless and marginal farmers in Maharashtra's Beed district carried out during 2020-21. A group of Twenty-five farmers were selected based on WhatsApp messages sent to registered KVK groups and a newspaper announcement. The training covered housing, disease management, improved goat breeding, feeding, feed preparation, and marketing intelligence. It was found that education level, socio-economic status, scientific interest, land ownership, social engagement, and marketing skills positively influenced knowledge acquisition. The trainee's knowledge gained to the tune of 172 per cent more in seven days of training compared to the benchmark. Goat production and management including wildlife corridor preservation and promoting local vegetation through controlled grazing were key aspects. The study emphasized the importance of goat-rearing training for farmers in the Beed district, showcasing substantial knowledge gains and identifying factors affecting participants' learning outcomes.

INTRODUCTION

Without a change in the people, there is nothing in extension, and without cooperation from the people, there can be no little but positive change. The primary objective of the study was to determine the impact of training on the knowledge gained on market intelligence among landless and marginal farmers following the completion of a seven days training programme. Rai et al., (2004) undertook a study on goat rearing can indeed be helpful for entrepreneurship development, particularly for small and landless farmers because of its features like low investment and quick returns, shorter reproduction cycle allowing farmers to see returns on investment relatively quickly. Goats are known for their adaptability and can thrive in harsh environments, including lands that may not be suitable for other forms of agriculture (Gaur et al., 2008). The study enables us to determine the effect of training on the knowledge gained on market intelligence among landless and

marginal farmers. Goat farming provides multiple sources of income. Farmers can earn from selling goats for meat, milk, and fiber (e.g., mohair, cashmere). Additionally, they can sell breeding stock and goat manure for organic farming. Goats can offer nutritional benefits to poor.

METHODOLOGY

The study conducted was an experimental model focused on assessing the effectiveness of a seven-day training program on goat rearing among 25 landless and marginal farmers from various villages in Beed district of Maharashtra. The training program was carried out under the STRY (Strengthening Rural Youth through Enterprise) initiative in January 2021. The training program employed various teaching methods to ensure maximum engagement and learning for the participants. Initially, a lecture-based approach was used followed by interactive sessions and group discussions. Additionally, audio-visual aids, including videos showcasing

previous success stories were employed to enhance the learning experience.

To assess the farmer's initial knowledge and understanding, a comprehensive questionnaire with 20 questions as suggested by Kumar et al., (2016) was developed by subject matter experts. Each question had a scoring system, where 1 mark was assigned for correct responses and 0 mark for incorrect one. This questionnaire was an integral part of the training program and was administered both before and after the training sessions. The pretest and post-test knowledge scores of the trainees were recorded to evaluate the impact of the training programme. The difference between these scores was calculated to measure the overall knowledge gain attributed to the training. The primary aim of the analysis was to assess the additional knowledge gain among the participants as a result of the training program. The study followed a structured experimental model that included the selection of participants, a well-structured training program, the development of a comprehensive questionnaire and the assessment of knowledge gain through pre- and post-test scores. The aim of the training programme was to determine the effectiveness of the training program in enhancing the knowledge and skills of landless and marginal farmers in the field of goat rearing. The study's findings are based on the observed changes in knowledge levels before and after the training sessions.

RESULTS AND DISCUSSION

The study provided insights into the trainee's background information and the impact of goat rearing training. Here are the salient findings:

Trainees' background information

A substantial 64 per cent of participants were in the age range of 25 to 40 years of the entire sample spanning from 25 to 49 years. In terms of education 56 per cent of participants had reached the matriculation level while 28 per cent had completed primary education. Additionally, 16 per cent of participants demonstrated basic literacy skills. There was no illiterate participant. These results align with similar findings from previous studies by (Surendar et al., 2012; Singh et al., 2020). In the realm of experience in goat rearing, the majority (40%) had an experience between 21 to 40 years followed by 32 per cent having an experience of 40 years. Only 12 per cent of participants fell into the 11 to 20 years range and 16 per cent had up to 10 years of experience. About the number of training programmes attended, 56 per cent of participants had attended 1 to 2 training programme while 24 per cent had attended 2 to 5 trainings. A smaller group (20%) had attended more than 5 training programs (Sharma et al., 2018).

As it is evident from the Table 1, the average knowledge score has jumped from 2.5 to 6.8 showing the gain in knowledge of 172 per cent. This remarkable gain can be attributed to trainee's favorable background and skillful organization of training. It also highlights the trainer's expertise and understanding trainee's need.

In Table 2, the study examined the correlation between various independent variables and the dependent variable i.e. marketing intelligence. The significant findings of the training also correlate

Table 1. Knowledge gain of trainees

Particulars	Before training	After training	Knowledge gain (%)
Knowledge score range	1-3	3-8	172
Total score	63	171	
Average score	2.5	6.8	

Table 2. Zero order correlation co-efficient with knowledge gain

S.No.	Independent variables	'r' value	p value
1.	Age	0.000	1.000
2.	Education	0.436*	0.030
3.	Experience in agriculture	0.457*	0.022
4.	Family type	-0.441*	0.028
5.	Socio-economic status	-0.433*	0.031
6.	No. of trainings attended	0.464*	0.020
7.	Land holdings	0.480*	0.015
8.	Social participation	0.395*	0.041
9.	Scientific orientation	0.371*	0.048

*Significant at 0.05 probability level

with what has been reported by Hundel et al., (2016). They had also reported that education exhibited a positive and significant correlation ($r = 0.436$, $p = 0.030$) with marketing intelligence. Higher education levels were associated with better marketing intelligence (Kadam et al., 2010). The experience in agriculture had a positive and significant correlation ($r = 0.457$, $p = 0.022$) with marketing intelligence. More experience in agriculture was linked to higher levels of marketing intelligence. Similar findings were also reported by (Kumari, 2014). The family type showed a negative and significant correlation ($r = -0.441$, $p = 0.028$) with marketing intelligence. The joint family respondents were more comfortable with starting entrepreneurial activities due to family and financial support (Rao et al., 2009). The socio-economic status had a negative and significant correlation ($r = -0.433$, $p = 0.031$) with marketing intelligence. The higher socio-economic status was associated with lower marketing intelligence (Patel et al., 2010). The number of trainings attended exhibited a positive correlation ($r = 0.464$, $p = 0.020$) with marketing intelligence. Those who participated in more agricultural trainings had higher levels of marketing intelligence (Sharma et al., 2006). The land holdings showed a positive and significant correlation ($r = 0.480$, $p = 0.015$) with marketing intelligence. The individuals with larger landholdings had better marketing intelligence, possibly due to higher levels of income and market contacts (Birgit et al., 2018). The social participation exhibited a positive and significant correlation ($r = 0.395$, $p = 0.041$) with marketing intelligence. The active participation in social activities related to agriculture was linked to higher marketing intelligence (Razzaq et al., 2011). The scientific orientation had a positive correlation ($r = 0.371$, $p = 0.048$) with marketing intelligence. The individuals with strong scientific knowledge related to agriculture had better marketing intelligence. Similar findings were also reported by (Tsiouni et al., 2022).

In gist, the study revealed that several factors significantly influenced an individual's marketing intelligence. This included education, experience in agriculture, family type, socio-economic

status, the number of trainings attended, land holdings, social participation and scientific orientation. The higher education and more experience in agriculture was associated with better marketing intelligence. The joint family respondents were more likely to engage in entrepreneurial activities. Interestingly, individuals with higher socio-economic status tended to have lower marketing intelligence. The variables like attending more agricultural trainings, larger land holdings, active social participation and possessing scientific knowledge were also linked to higher marketing intelligence. The findings highlight the importance of education, practical experience and community involvement in enhancing marketing intelligence (Soodan et al., 2020).

Table 3 depicted that the regression analysis involved nine independent variables and the R-squared value of 0.6812 indicates that these variables collectively explain 68.12 per cent of the variation in marketing intelligence. Among the nine independent variables, education, type of family, number of trainings attended, social participation and scientific orientation showed significant results at the 0.05 and 0.01 per cent levels (Singh et al., 2020). Education has a positive coefficient of 0.08 indicating that higher levels of education are associated with better marketing intelligence. This highlights the importance of investing in education for improved marketing strategies in agriculture. This variable has a positive coefficient of 0.061, suggesting that attending more training sessions leads to increase in marketing intelligence. The continuous learning and skill development are crucial for better marketing practices (Nain & Bhagat, 2005; Singh et al., 2018).

Table 3. Regression co-efficient

S.No.	Variables	Coefficients	SE (b)	t value
1.	Age	-0.012	0.011	-1.091
2.	Education	0.08*	0.031	2.581
3.	Experience in agriculture	0.003	0.007	0.429
4.	Type of family	-0.047*	0.016	-2.938
5.	Socio-economic status	-0.079	0.068	-1.162
6.	Number of trainings attended	0.061*	0.022	2.773
7.	Landholding (ha)	-0.205	0.325	-0.631
8.	Social participation	0.245*	0.084	2.917
9.	Scientific orientation	0.023*	0.010	2.300

It was observed that the number of trainings attended had a coefficient of 0.061 in the regression model. This indicated that for each one-unit increase in the number of trainings attended, marketing intelligence was expected to increase by 0.061 units. These finding supported the observations made by (Subha Laxmi et al., 2022). The social participation has a positive coefficient of 0.245, indicating that actively engaging in social activities related to agriculture positively impacts marketing intelligence. Networking and collaboration within the agricultural community are beneficial for marketing knowledge. scientific orientation has a positive coefficient of 0.023, emphasizing that a stronger scientific orientation towards farming is associated with better marketing intelligence. The evidence-based practices are important in agricultural marketing strategies. The scientific orientation had a coefficient of 0.023 in the regression model. This indicated that for each one-unit increase in scientific orientation, marketing intelligence

Table 4. Analysis of variance

Source of variation	df	Sum of squares	Mean squares	F-calculated	Significance
Regression	9	5.450	0.606	3.562	0.01467
Residual	15	2.550	0.170		
Total	24	8.000			

R- square value: 0.6812, Multiple R-value: 0.8254

was expected to increase by 0.023 units. In essence, a stronger scientific orientation towards farming was associated with better marketing intelligence (Roy & Tiwari, 2016).

The study's findings were confirmed by other researchers adding credibility to the relationships identified. The results can guide policymakers, educators, and agricultural professionals in devising strategies to enhance marketing skills, knowledge dissemination and social engagement in agriculture. The text also briefly mentions the training needs of a group of trainees in goat rearing. It highlights that expertise in areas like disease management in kids, breed improvement, feeding management, and general entrepreneurial management skills is crucial for success in commercial goat rearing. Overall, the study underscores the importance of education, continuous learning, social engagement and scientific orientation in improving marketing intelligence in agriculture and provides valuable insights for stakeholders in the field.

Discovered a clear need among all trainees for comprehensive guidance in various aspects of commercial goat rearing production technology through a detailed investigation. This requirement was unanimously acknowledged by the trainees themselves. Notably, disease management in goats emerged as the top priority, ranking first in importance among the participants. This finding underscores the significance of expertise in managing goat health. The improved breeds of goats also ranked high in terms of training needs highlighting the importance of breeding practices. Additionally, feeding management and care giving were identified as crucial areas requiring attention. These results align with the notion that effective management skills are essential for success in entrepreneurship (Kumar et al., 2003; Singh et al 2014; Singh et al., 2016; Nain et al., 2019). Overall, our observations provided valuable insights into the specific training needs of the participants as summarized in Table 5.

CONCLUSION

The training impact depends on several factors. The trainees background, trainer's expertise, smooth and meticulous organization of training, trainees need and urge for knowledge gain contribute

Table 5. Training needs of participants

S.No.	Particulars	Average mean score	Rank
1.	Disease management in goat	21	I
2.	Improved breeds of goats	18	II
3.	Feed preparation	12	IV
4.	Feeding management and take care	16	III
5.	Marketing intelligence	10	V

heavily for positive impact. The scope of the enterprise, economic relevance, ease in adoptability, environmental factors also add to the necessity of training and its successful implementation. The impact assessment of any training, particularly enterprises oriented needs to be carefully arranged. This research article deals with the all the major factors that affects the success of training. It deals with all in house and on field activities that fructify in a successful training. The methodical assessment also sets the tone for advance planning of long durational, enterprise oriented, employment generative training programmes.

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Perception and Analysis of Existing Practices Associated with Risk of Brucellosis among Dairy Farmers

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ABSTRACT

The study to measure the perception and identify risky practices at the farm and household level on commercial dairy farms in six districts of Haryana and Punjab states was conducted during 2018-19. Dairy farmers' responses were obtained through an interview using a well-structured interview schedule. Univariate Logistic regression models were used to analyze the potential predictors for the risky behaviours of respondents. Binary logistic analysis revealed that Wald statistics values were significant at a 1% level for the explanatory variables viz., education while occupation and herd size were found significant at a 5% level. Half of the respondents (52.50%) had a high perception towards brucellosis disease risk. About one-third of the respondents (28.33%) of the respondents were found in the category of moderate perceptual level. Pearson chi-square indicates that there were significant associations for health status variables such as landholding, annual income, herd size, and milk production with the perception of respondents. Poor understanding of brucellosis, the presence of manifold risky practices, and incorrect perception of respondents need an urgent policy for the prevention and control of brucellosis in farm animals.

INTRODUCTION

India witnessed a rapid increase in milk production during the past two and half decades and holds the first position in the world (Sudhanshu, 2019). Dairying has considerable potential for generating additional income and provide employment through various sectors (Gupta et al., 2013; Singh et al., 2014; Singh et al., 2017; Verma et al., 2020). With the promotional policies of governments to fund the livestock and processing sectors, many entrepreneurs are choosing this enterprise (Jose et al., 2019). However, presence of Brucellosis as an endemic disease was reported in India by several researchers (Khurana et al., 2012;

Deka et al., 2020) which is recognized as one of the most serious problems affecting the sustainability of dairy farming in India. The Brucellosis is a serious threat and accounted for 95.60 per cent of the total losses occurring due to brucellosis in livestock populations (Singh et al., 2015). In dairy animals, brucellosis primarily affects sexually mature female animals and leads to abortion in the last trimester, retained foetal membrane, the birth of unthrifty calves, repeat breeding, and infertility. The aborted animals release the pathogen by vaginal, uterine discharge, and milk which becomes the carrier of disease and spread over the herd through ingestion of infected materials. Human beings are the accidental hosts of brucellosis. In humans, this disease results from inhalation of the

pathogen, or moves into by scratches in the skin. The use of unprocessed milk and milk products, and the handling of materials without any protection from infected animals lead to human infection. Due to these reasons, the person with frequent contact with farm animals in the endemic region is subjected to higher risk. Bovine brucellosis although has been eradicated in developed countries, it is still common in developing countries like India (McDermott et al., 2013). The presence of brucellosis in dairy farms of Haryana and Punjab state was studied by Chand and Chhabra (2013) and revealed overall herd prevalence was found to be 65.54 per cent (78/119). Whereas, state-wise herd prevalence of brucellosis was found 62.79 per cent (54/86) in Haryana and 72.72 per cent (24/33) in Punjab. The study aims to measure the perception and risk factors associated with Brucellosis among commercial dairy farmers of Haryana and Punjab states.

METHODOLOGY

This study was conducted in three districts of Haryana (Sirsa, Hisar and Karnal) and three districts of Punjab states (Ferozepur, Gurdaspur and Ludhiana). The data was collected by using a well-structured interview schedule. These districts were selected on the basis of highest cattle population, and researchers' convenience, but also represent the social and physical differences of both states. From each selected district 20 respondents were selected by snowball sampling method. The respondents were selected based on the criteria that they have at least 25 dairy animals. Thus, a total of 120 units were identified, selected and interviewed to get first-hand information on existing practices, risks, and perceptions of the respondent towards brucellosis for the present study. To identify the variables responsible for the risk of brucellosis several logit models were devised and tested (Lal et al., 2016). Although authors have presented the logit versions, probit forms were also tried thoroughly. However, as there was minute variation between them, only the logit is reported here comparing risky practices and non-risky practices of dairy farmers to identify significant variables for discrete dependent variables taking the binary value of either 0 or 1 (Lal et al., 2018). The dependent variable takes the value 1 with a probability to be non-risky (p), or the value 0 with probability to be risky (1-p). In this research, farmers were grouped as risky and non-risky based on their scale value, a score of 1 was given to non-risky and value 0 was given to risky. Statistical analysis tools; frequency, percentage, Univariate logistic regression model, and Pearson chi-square test were calculated by using SYSTAT VERSION 6.0.1 software to draw meaningful conclusions.

RESULTS AND DISCUSSION

Existing practices (Factors) associated with risk of Brucellosis

Initially, 11 predictive variables were taken but the final model was fitted with 5 factors. The five explanatory or predictive variables that are selected for the binary logistic regression model have been discussed based on the model output. The analysis asserted that 79.2 per cent was the overall percentage correctness of the total prediction for the risky practice of respondents toward brucellosis (Table 1). This empirical fact depicted that the variables predicted the model as Nagelkerke R square statistics indicated overall modest fit for the model was 0.297 or 29.70 per cent. Binary logistic analysis revealed the Wald statistics were significant at 1 percent level for the explanatory variables viz., education. Variables like occupation and herd size were significant at 5 per cent level. Variable family size was significant at 10 per cent level while age had not a significant relationship with the risk of following existing practices towards brucellosis even at 10 per cent level. The result revealed that age was not found to be statistically significant even at $P < 0.10$, with the Wald statistics value of 1.325. The reason may be for the non-significant relationship between age and risk of following existing practices towards brucellosis was knowledge of good hygienic practices. It does not depend on age of farmers while other variables like education, family size, occupation and herd size was found to be statistically significant at $P < 0.01$, $P < 0.10$, $P < 0.05$ and $P < 0.05$ with the Wald statistics value of 7.599, 3.606, 6.199 and 4.496, respectively.

Perception of commercial dairy farmers towards brucellosis disease risk

A critical look at Table 2 revealed that the majority of the respondents had positive perceptions about the 'Brucellosis Disease Risk'. Respondents strongly responded in favour of almost all the positive statements, like: (19) Willingness to vaccinate heifers (13) Vaccinating heifers on the recommendation of veterinary doctor (2) Family life at risk due to brucellosis in dairy animals; (5) Dairy animals infected by licking or eating the placenta of affected animals; (12) Making arrangements for vaccination of heifers against brucellosis; (10) News of brucellosis influenced to get vaccination in farm animals; (18) Vaccination of animal to prevent spreading the disease to other animals; (6) Probability of getting brucellosis infection were more if sleep inside the animal shed; (15) Following health instructions provided through various sources on brucellosis

Table 1. Binary logistic regression pertinent to existing practices of dairy farmers

Predictive variables	B	S.E.	Waldvalue	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
							Lower	Upper
Age	-.021	.018	1.325	1	.250	.980	.946	1.015
Education	.428	.155	7.599	1	.006***	1.534	1.132	2.080
Family size	.232	.122	3.606	1	.058*	1.261	.993	1.603
Occupation	.923	.371	6.199	1	.013**	2.517	1.217	5.206
Herd size	.028	.013	4.496	1	.034**	1.028	1.002	1.055
Constant	-5.819	1.766	10.854	1	.001	.003		

***Significant at 0.01 level of significant; **Significant at 0.05 level of significant; *Significant at 0.10 level of significant; S.E.=Standard Error; C.I.= Confidence Interval; df=Degree of freedom

(Table 2) with the chi-square value of 241.17, 208.50, 172.83, 140.83, 128.91, 120.00, 120.00, 105.67 and 100.17, respectively, which was found to be significant at 1% level. From this, we can conclude that there is a trend of positive response towards brucellosis disease risk, and a significantly more number of subjects are in agreement with the perception statements on brucellosis disease risk. In contrast, they strongly responded against the negative statements, like (24) distrust on veterinary doctor's advice to get brucellosis vaccination'; (1) do not bother for brucellosis in dairy animals; (3) If dairy animals get brucellosis, it would be not serious than other diseases; (20) unable to afford to get vaccination in dairy animals (Table 2) with the chi-square value of 78.17, 65.83, 54.00 and 44.67, respectively. From this, it is evident that a significantly more number of respondents are in disagreement with the negative perception statements on brucellosis risk. Whereas they positively responded for the negative statements like: (23) Veterinary doctors/clinic that gives the brucellosis vaccination is hard to reach at grassroot level; (21) Inadequate knowledge of brucellosis transmitted from animals to humans and vice-versa; (14) they don't know how to ask to doctor about brucellosis; (22) Non-availability of the vaccine in the market interfere the process of vaccination against brucellosis; (Table 2) with the chi-square value of 80.83 71.41, 19.91 and 18.58, respectively, which was found to be significant at 1% level. The findings of the study supported by Ntirandekura et al., (2018) who revealed that although respondents recognized brucellosis as a zoonotic disease, they consider it of less importance. However, they perceived the interactions between

humans, livestock and wildlife together with movements between borders to be potential risks for introduction of brucellosis in their communities. Kansime et al., (2014) conducted their study on Knowledge and perceptions of brucellosis in the pastoral communities adjacent to Lake Mburo National Park, Uganda revealed that majority of the respondents (99.30%) had ever heard about brucellosis which is commonly known as 'brucella' and perceived that brucellosis affects all age groups and all sexes and majority (66.20%) mentioned that the disease is not seasonal.

Overall perception towards brucellosis disease risk

Table 3 revealed that the maximum number of the respondents (52.50%) was having a high perceptual level, while only 19.17 per cent of the respondents were in the category of low perceptual level. However, 28.33 per cent of the respondents were found in the category of having moderate perceptual level. The results indicated that 97 respondents were having moderate to high perceptual level towards Brucellosis Disease Risk. That means respondents were much concerned for brucellosis disease. From this, we can conclude that there is a trend of positive response and concern for this disease among commercial dairy farmers and a significantly 80.83 per cent of respondents (with a minimum score of 79 in the 100 point scale) are having a moderate to high perceptual level towards brucellosis risk. Majority of the respondents had high perception of brucellosis disease risk due to severity of the disease. Verma et al., (2019) emphasized that educational module had significant relevance to overcome against brucellosis among commercial dairy farmers. The study conducted

Table 2. Chi-square values in respect of perception items

S.No.	Statements	χ^2
1	I do not bother for brucellosis in my dairy animals.	65.83**
2	My family life will be at risk due to brucellosis in the dairy animals of my farm.	172.83**
3	If my dairy animals get brucellosis, it would be not serious than other diseases.	54.00**
4	There may be a chance of getting brucellosis in the future if I consume uncooked milk and its products from the infected dairy animals.	41.83**
5	Dairy animals may be infected by licking or eating the placenta of affected animals.	140.83**
6	The probability of getting brucellosis infection will be more, when I will sleep inside the animal shed.	105.67**
7	When I avoid my animals licking my body, I may set a good example for others.	23.75**
8	Even if I don't vaccinate heifers against brucellosis, I think that the chances of infection will be less.	29.17**
9	I don't think my family member likely to get brucellosis	17.41**
10	News of brucellosis would influence me to get brucellosis vaccination in animals	120.00**
11	I shall access online resources which can serve as the most appropriate means of information being provided on brucellosis.	21.08**
12	I will make arrangements for vaccination of heifers against brucellosis, once I observe the symptoms in other animals.	128.91**
13	I would prefer to vaccinate heifers at my farm for brucellosis, if veterinary doctor recommend it.	208.50**
14	I don't know how to ask about brucellosis risk for my family.	19.91**
15	I would follow, if health instructions provided through various sources on brucellosis.	100.17**
16	I am sure that I can comprehend health advice from my veterinarian about brucellosis risk prevention.	38.67**
17	I think, by doing surveillance for brucellosis, future problems of heifers may be prevented.	21.25**
18	I would get brucellosis vaccination to prevent spreading the disease to other animals	120.00**
19	I am willing to vaccinate my farm heifers, if I am sure it would prevent brucellosis.	241.17**
20	I could not afford to get brucellosis vaccination in dairy animals.	44.67**
21	I have inadequate knowledge of diseases transmitted from animals to humans and vice-versa.	71.41**
22	Non-availability of vaccine in the market may likely to interfere with the process of vaccination against brucellosis.	18.58**
23	Veterinary doctors/clinic that gives the brucellosis vaccination is hard to reach in my locality.	80.83**
24	I do not trust a veterinary doctor's advice to get a brucellosis vaccination.	78.17**

*Significant at 5% level; **significant at 1%; (df=5-1=4). Table values of chi-square at 4 df were 9.49 and 13.28 at 5 and 1% level of significance, respectively.

Table 3. Overall perception level of respondents towards brucellosis disease risk (n=120)

S.No.	Perception level	Respondents	
		Freq- uency	Perce- tage
1.	Low perceptual level (<78.63)	23	19.17
2.	Moderate perceptual level (78.63 to 92.76)	34	28.33
3.	High perceptual level (>92.76)	63	52.50

by Mondal et al., (2022) reported that overall perception index was estimated to be 68, indicating that consumers have a favourable perception of milk consumption and dairy farming. The findings of Mangesho et al., (2017) revealed that pastoralists do not perceive the threats of zoonosis unless they have been able to link the biomedical realities, for example, from hospital or veterinary diagnosis with the visible or actual disease. The perceptions may also be muted by indigenous practices, which render the food safe, such as the use of herbs during cooking and eating of meat and milk.

Socio-personal and socio-economic variables influencing perception level of commercial dairy farmers towards brucellosis disease risk (n=120)

To find out that which socio-personal and socio-economic variables are influencing the perception level of the commercial dairy farmers towards brucellosis disease risk. For this Pearson chi-square values were calculated using SYSTAT VERSION 6.0.1 among different variables and perception level. By applying the

Pearson chi-square test it was found that there were no significant associations for socio-demographic factors or health status variables (Table 4) such as age, education, family size, and experience in commercial dairy farming with the perception level. The landholding, annual income, Herd size and Milk production was highly associated with perception of commercial dairy farmers towards brucellosis disease risk as the chi-square value, i.e. 22.182, 13.063, 11.438 and 17.778 was significant at 1%, 5% and 0.001% level with *P*-value of 0.000, 0.011, 0.022 and 0.001, respectively. So, it can be concluded that these socio-demographic variables and perception level was not independent. The study conducted by Mishra et al., (2021) revealed that perception and socio-demographic profile of respondents had positive correlation towards social media.

CONCLUSION

The studies revealed that majority of the respondents were not aware of brucellosis as zoonotic disease, burying aborted foetus with slaked lime and wash hands before and after milking. All the respondents engaged in at least one practice that is risky to them. The overall awareness of zoonotic diseases among commercial dairy farmers is abysmally poor. The perception of dairy farmers in the study area predisposes them to the risk of zoonotic diseases, thus presenting serious challenges to the development of nation. Awareness program should be started through public education on brucellosis and their preventive and control measures as a matter of urgency to make sure public well-being and safety.

Table 4. Relationship between socio-economic profile of the respondents and perception level

S.No.	Variables	Categories	Perception			df	χ^2 (P-value)
			Low	Medium	High		
1.	Age	Low	13 (10.83)	17 (14.17)	30 (25.00)	4	0.681(0.954)
		Medium	6 (5.00)	9 (7.50)	19 (15.83)		
		High	4 (3.33)	8 (6.67)	14 (11.67)		
2.	Education	Low	4 (3.33)	8 (6.67)	12 (10.00)	4	0.576(0.966)
		Medium	14 (11.67)	18 (15.00)	35 (29.16)		
		High	5 (4.17)	8 (6.67)	16 (13.33)		
3.	Family-size	Low	9 (7.50)	15 (12.50)	37 (30.83)	4	3.941(0.414)
		Medium	6 (5.00)	9 (7.50)	14 (11.67)		
		High	8 (6.67)	10 (8.33)	12 (10.00)		
4.	Land-holding (ha)	Low	3 (2.50)	3 (2.50)	4 (3.33)	4	22.182**(0.000)
		Medium	9 (7.50)	22 (18.33)	55 (45.84)		
		High	11 (9.17)	9 (7.50)	4 (3.33)		
5.	Annual Income (rupees)	Low	4 (3.33)	17 (14.17)	36 (30.00)	4	13.063**(0.011)
		Medium	15 (12.50)	10 (8.33)	18 (15.00)		
		High	4 (3.33)	7 (5.84)	9 (7.50)		
6.	Herd size	Low	7 (5.83)	10 (8.33)	35 (29.17)	4	11.438*(0.022)
		Medium	8 (6.67)	18 (15.00)	19 (15.83)		
		High	8 (6.67)	6 (5.00)	9 (7.50)		
7.	Milk production (litres/day)	Low	3 (2.50)	9 (7.50)	34 (28.33)	4	17.778**(0.001)
		Medium	14 (11.67)	13 (10.83)	14 (11.67)		
		High	6 (5.00)	12 (10.00)	15 (12.50)		
8.	Experience in commercial dairy farming (year)	Low	7 (5.83)	8 (6.67)	14 (11.67)	4	4.477(0.345)
		Medium	10 (8.33)	23 (19.17)	39 (32.50)		
		High	6 (5.00)	3 (2.50)	10 (8.33)		

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Factors Affecting Household Food Security in Bundelkhand Region of India

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ABSTRACT

This study assessed the food security status of the households and examined factors influencing food security within the surveyed households. A total of 240 samples were gathered from Lalitpur and Jhansi districts in the Bundelkhand region using a multistage random sampling technique during the period of August to September 2022. The Indicator approach and Binary Logistic Regression methods were used to analyze the data. The results show households belonging to the Jhansi district had a substantially higher level of food security in comparison to the Lalitpur district. The findings show that Socioeconomic and demographic characteristics of surveyed households have a significant role in determining the level of food security. Hence, the development of an appropriate policy to protect households from the adverse effects of natural disaster like drought and health- hazards like COVID-19 are suggested.

INTRODUCTION

Food insecurity is a pervasive global issue, with a particular pronounced present in emerging nations like India. Despite the country's ability to generate excess food, a significant portion of its population, arounds one-third, experiences severe poverty. Further, a substantial proportion of children, approximately one-half, suffer from various forms of malnutrition (Kannan et al., 2000). India has a significant increase in food grain production, with a fourfold jump from 50 million tonnes in 1950 to 219.3 million tonnes in 2007–2008 (Kumar, 2010). This growth occurred despite a threefold rise in population from 33 million to more than 100 million. Moreover, the issue of food security is a highly contested and debated topic among scholars working on development issues, and for policymakers to come out from hunger, malnutrition, poverty and unemployment. According to Sharma & Sharma (2008) & Jatav (2022), a household is considered to be food secure when it possesses the physical, economic, and social access to the necessary amount of food items including food grains, fruits, vegetable, meat, eggs and other nutritional product in terms of quantity, quality, and safety. Additionally, Mishra et

al., (2008) state that food security is achieved when the available food is culturally acceptable and when there is no significant risk of losing access to such food.

The determination of food security is contingent upon several criteria, which are included within the framework of four fundamental pillars i.e., food availability, food accessibility, food stability, and food utilization. The concept of food availability encompasses the domestic production of food grains within a given region. On the other hand, food accessibility pertains to the reliability of food availability, either through importing from surplus regions or by maintaining a reserve stock at the micro level, particularly during periods of man-made or natural disasters. It is important to note that food stability ensures that households consistently have access to an adequate food supply. Additionally, food utilization refers to the extent to which individuals or households are able to obtain sufficient energy and nutrition from their food consumption (Jatav et al., 2021a; Jatav, 2022). In totality, food security is a complex concept that encompasses several dimensions and is influenced by diverse factors, including social, economic, and demographic. Hence, the evaluation of

household's food security has significant importance for the formulation of food policy in the most backward region of India namely Bundelkhand region.

Various indicators of food security have been created and are commonly employed to assess its status. However, there is considerable ambiguity regarding the specific dimensions (availability, access, utilization, or stability), levels (ranging from global to individual), or components (quantity, quality, safety, cultural acceptability, and preferences) of food security that these indicators are intended to capture. The aims of this study is to provide clarification on indicators for the dimensions of food security at the household level, as well as to identify the drivers of food security in the Bundelkhand region using an indicator approach and the Binary Logistic Regression Analysis methods.

METHODOLOGY

The study was undertaken in the Bundelkhand region of Uttar Pradesh (UP) in India. Two districts of Bundelkhand region namely Lalitpur and Jhansi were selected due to the preponderance of drought in the region. Using multistage random sampling technique, a total 240 samples were collected from four villages. The Larauni and Madpura villages were selected from Mauranipur & Moth Development Blocks of Jhansi district, while Badanpur and Manikpur villages were randomly selected from the Talbehat & Mehroni Development Blocks of Lalitpur district to elicit households-level information on the determinants of food security.

To analyse data, an indicator approach was used to assess food security status of surveyed villages in the Bundelkhand region (Jatav, 2021; Chetri et al., 2023). As the study used differential data; hence, it is prerequisite to standardize the data before calculating the agricultural sustainability index (Mishra et al., 2023). To standardize indicators into a common range (0, 1) based on their functional link with food security, this study utilized the min-max approach (Iyengar and Sudarshan, 1982). Equations 1 and 2 were adopted for larger-better-type and smaller-worse-type indicators, respectively.

$$Z_{ij} = \frac{X_{ij} - \text{Min}(X_{ij})}{\text{Max}(X_{ij}) - \text{Min}(X_{ij})} \quad \dots (1)$$

$$Z_{ij} = \frac{\text{Max}(X_{ij}) - X_{ij}}{\text{Max}(X_{ij}) - \text{Min}(X_{ij})} \quad \dots (2)$$

$i = 1, 2, \dots, I$ and $j = 1, 2, \dots$

Where, Z_{ij} is the standardize value of i^{th} indicator in j^{th} household, X_{ij} is actual value of i^{th} indicator in j^{th} household; $\text{max}(X_{ij})$ and $\text{min}(X_{ij})$ are the maximum and minimum values of i^{th} indicator in the j^{th} household, respectively.

Finally, the food security index was first calculated for household, and then village level. An average of four component i.e., food availability, food accessibility, food stability and food utilization using equation 3 was taken to calculate food security index.

$$P_j = \frac{\sum_{i=1}^4 Z_{ij} \cdot W_i}{\sum_{i=1}^4 W_i} \quad \dots (3)$$

Moreover, the Binary Logistic Regression (BLR) model was adopted for identifying the key influencing determinants of food security in the surveyed households (Singh, 2020a; Jatav et al.,

2021a; Jatav & Singh, 2023). The logistic distribution function for the decision on food security measures can be specified as:

$$\text{Logit}(P) = \log\left(\frac{P}{1-P}\right) \quad \dots (4)$$

$$\text{Let } P_i = P_r\left(\frac{Y=1}{X=X_i}\right), \text{ then model can be written as} \quad \dots (5)$$

$$P_r\left(y - \frac{1}{x_i}\right) - \frac{\exp^{x' b}}{1 + \exp^{x' b}} = \log\left(\frac{P}{1-P}\right) = \text{Logit}(P_i) = \beta_0 + \beta_i \dots (6)$$

Where; P_i is a probability of household's food security status (we have used index value), X_i 's are independent variables, β_0 is the intercept and β_i is the regression coefficient of food security.

RESULTS AND DISCUSSION

Food Accessibility Index (FAI)

Table 1 shows the food accessibility index together with its corresponding indicators. The calculated food accessibility index reveals that households belonging to the Manikpur village of Lalitpur district exhibit comparatively lower access to resources for obtaining food, whilst households belonging to the Larauni village of Jhansi district have significantly higher level of food accessibility in comparison to the other surveyed villages. The findings from the cross-indicator analysis indicate that the highest access to local markets, access to daily needs goods, access to all seasonal roads, and access to midday meals were the main contributing factors for higher food accessibility in Larauni village compared with Manikpur village. The data reveals that about 62 per cent of households in Larauni village has the access to the local market, while only 41 per cent of households in Manikpur village have access to the local market. More than 72 per cent of households in Larauni village have access to necessary goods for daily consumption expenditure, while only 55 per cent of households in Manikpur village have access. Further, about 85 per cent of households in Larauni village have access to all seasonal roads, while only 58 per cent of households have access. Likewise, about 82 per cent of children get a midday meal in Larauni village, while only 78 per cent of children get a midday meal in Manikpur village.

Food Availability Index (FAI)

Table 1 shows a comprehensive overview of the village-wise food availability index. The findings indicate that households in Larauni village exhibit comparatively higher levels of food accessibility (i.e., a 0.603 index score) compared with households in Manikpur village (i.e., a 0.500 index score). The cross-indicator analysis reveals that relatively higher perceived farm productivity loss, consumption of supplement and low-cost food for children, food skips due to non-availability of food, and hunger but not eating food due to non-availability of food were the main influencing factors for lower food availability for households in Manikpur village compared with Larauni village.

Food Stability Index (FSBI)

According to the data shown in Table 1, it can be seen that households in Larauni village (i.e., 0.513 index score) exhibit a

Table 1. Index values of various sub-components for food security of surveyed villages

Indicators	Larauni	Madpura	Badanpur	Manikpur
Food Accessibility Index (FAI)				
Access of local market	0.620	0.550	0.480	0.410
Access of necessary goods in local market	0.720	0.680	0.650	0.550
Access of all seasonal roads	0.850	0.820	0.650	0.580
Price of food increases day-by-day	0.900	0.950	0.890	0.820
Wages are relatively less to food inflation	0.950	0.920	0.820	0.630
Access of Ration Card	0.910	0.925	0.930	0.920
Ration under PMGKY	0.950	0.935	0.940	0.953
Access of mid-day meal	0.820	0.853	0.860	0.790
Food accessibility index	0.840	0.829	0.778	0.707
Food Availability Index (FAI)				
Fertile agricultural land	0.250	0.400	0.370	0.462
Perceived that farm productivity declined	0.920	0.740	0.820	0.750
Supplement and low cost food to children	0.620	0.550	0.590	0.500
Adults skipped food due to non-availability food	0.490	0.320	0.450	0.290
Children skipped food due to non-availability food	0.590	0.480	0.550	0.450
Were you ever hungry, but didn't eat	0.750	0.520	0.650	0.550
Food availability index	0.603	0.502	0.572	0.500
Food Stability Index (FSBI)				
Increase use of chemical fertilizer	0.850	0.750	0.690	0.650
Diversification of cropping pattern	0.210	0.195	0.165	0.150
Irregularities in rainfall	0.950	0.920	0.890	0.750
Electricity connection	0.535	0.250	0.275	0.550
Awareness of food prices in local market	0.605	0.580	0.550	0.480
Awareness of minimum support price	0.450	0.410	0.380	0.330
Storage capacity for farm produce	0.225	0.200	0.195	0.145
Food stability index	0.513	0.444	0.417	0.402
Food Utilization Index (FUI)				
Aware of balance diet	0.450	0.390	0.370	0.350
Households afford balance food	0.290	0.250	0.210	0.190
Taking meat and eggs for balance diet	0.260	0.255	0.210	0.150
Weight loss due to not eating enough food	0.850	0.760	0.710	0.690
Cut the size of children's meal	0.880	0.810	0.790	0.720
Consultation with government officials on nutrition status	0.260	0.200	0.180	0.150
Attained nutrition diet programme	0.180	0.150	0.120	0.090
Food utilization index	0.453	0.402	0.370	0.334

Source: Field Survey Data (2022)

substantially higher level of food stability, as indicated by their index score. In contrast, households in Manikpur village demonstrate a comparatively lower level of food stability, with an index score of 0.402. The findings of the cross-indicator analysis indicate that several factors significantly influenced the level of food stability in Larauni village in comparison to Manikpur village. These factors include a higher availability of fertile land, the higher utilization of chemical fertilizer in agriculture, higher crop diversification rate, higher awareness of food prices in the local market, higher access to the minimum support price, and higher storage capacity in Larauni village compared with Manikpur village. In statistics term, about 28 per cent of households reported that they have fertile land suitable for wheat production with assured irrigation facilities, while households in Manikpur village have only 15.8 per cent fertile land. Further, about 85 per cent of households in Larauni village have used chemical fertilizer to

increase farm productivity, while the corresponding figure for the households in Manikpur village was only 65 per cent. Furthermore, about 21 per cent of households in Larauni village have diversified their cropping pattern in favour of low water intensive crops, while only 15 per cent of households in Manikpur village have diversified. Likewise, about 60 per cent of households in Larauni village were aware of food prices in the local market, while only 48 per cent of households in Manikpur village were aware of it. Nearly half of the households in Larauni village were aware of the minimum support price, while only 33 per cent of households in Manikpur village were aware of the minimum support price. Lastly, about 22.5 per cent of households in Larauni village have storage capacity to store farm produce, which results in higher farm returns, while only 15.5 per cent of households in Manikpur village have storage capacity. In totality, households in Larauni village have a more stable food system, while households in Manikpur village have a relatively less stable food system.

Food Utilization Index (FUI)

Table 1 shows the food utilization index pertaining to the households that were surveyed in different villages of Bundelkhand region. The food utilization indices, as determined by calculations, indicate that households in Larauni village exhibited a higher propensity to use their food resources in order to ensure food security, in comparison to households in Manikpur village. The findings of the cross-indicator analysis indicate that households in Larauni village exhibited higher awareness of importance of a balance diet, specifically in terms of incorporating meat and eggs to meet their nutritional needs. Additionally, these households were more likely to engage in consultation with government officials regarding balanced diets and actively participate in nutrition diet programs. These factors collectively contributed a higher level of food utilization in households belonging to the Larauni village, as compared to those in the Manikpur village. The study findings revealed that around 45 per cent of households in Larauni village were aware of a balanced diet, while only 35 per cent of households in Manikpur village were aware of it. Further, about 29 per cent of households were in a position to afford balanced food in Larauni village, while only 19 per cent of households in Manikpur village were in this position. Furthermore, about 26 per cent of households in Larauni village have consulted with nutrition experts on a balanced diet, while only 15 per cent of households in Manikpur village have consulted. Likewise, about 18 per cent of households in Larauni village have attended the nutrition diet program, while only 9 per cent of households in Manikpur village have attended.

Food Security Index (FSI)

Table 2 depicts the village-wise food security status of the surveyed village. The findings indicate that households in Larauni village of Jhansi district exhibited a higher level of food security,

Table 2. Village wise food security index

Components	Larauni	Madpura	Badanpur	Manikpur
Food accessibility index	0.840	0.829	0.778	0.707
Food availability index	0.603	0.502	0.572	0.500
Food stability index	0.513	0.444	0.417	0.402
Food utilization index	0.453	0.402	0.370	0.334
Food security index	0.602	0.544	0.534	0.486

Source: Field Survey Data (2022)

while households in Manikpur village of Lalitpur district had a comparatively lower level of food security. The cross-component analysis reveals that households in the Larauni village experience higher food security due to higher levels of food accessibility, availability, stability, and utilization. Conversely, households in Larauni village face lower food security as a result of lower levels of food accessibility, availability, stability, and utilization.

Factors affecting household's food security

Table 3 depicts factors affecting household's food security in the surveyed village. This study assumes that households have food security index score above from 0.500 was food secure, and households have food security index score below 0.500 was food insecure. The food security status was modelled as a binary variable where 1 = food secure (index value >0.500), and 0 = food insecure (index value <0.500). The overall predictive power of the model was high indicating that independent variables had significant impact in explaining the food security status of surveyed households. The Chi-square (95.21, $p < 0.005$). The results show that all the variables are positively associated with the food security status except household size. The age of individuals has a significant role in influencing the state of food security within households (Abdullah et al., 2019). The findings indicate a positive and statistically significant correlation between age and food security. The calculated odds ratio indicates that households with

Table 3. Factors affecting household's food security status

Independent Variables	Coefficient	Odds Ratio	P-value
Age (Age of head in number of years)	0.873	2.41	0.001*
Gender (Male =1; otherwise = 0)	0.214	2.37	0.008*
Education (Literate = 1; otherwise = 0)	0.095	1.15	0.005*
Household size (Number of households members)	-0.482	1.74	0.001*
Remittances (household receive remittances = 1; otherwise = 0)	0.866	4.21	0.000*
Employment (Head of Household is employed = 1; otherwise = 0)	0.192	3.15	0.003*
Livestock ownership (HHs own livestock = 1; otherwise = 0)	0.088	2.45	0.004*
Credit (HHs has access to institutional credit = 1; otherwise = 0)	0.817	1.15	0.009*
Market access (HHS has access to local market =1; otherwise =0)	0.659	1.93	0.001*
Food aid (HHs receive food aid = 1; otherwise 0)	0.832	2.29	0.005*
Drought (HHs perceived drought is responsible for crop loss =1; otherwise = 0)	0.067	3.45	0.010*
Constant	-0.087	0.91	0.000*
LR Chi ²		29.54	
Prob> Chi ²		0.0056	
Pseudo R ²		0.9521	
Log Likelihood		-88.842	
No. observation		240	

Source: Estimated from field survey data, 2022.

Note: *, **, and *** indicate 1, 5, 10% level of significance respectively.

elder members were more likely to be food secure compared to households with younger members. Also, education is a crucial factor that significantly influences the level of food security. It gives them knowledge and awareness and increases the chances of obtaining job (Rejula et al., 2017; Jatav, 2020). The findings indicate that there is 2.37 times higher probability that a household is food secure, if he/she literate than that of illiterate household. Remittances had always been remained one of the important source of income and external finances for many poor people across the developing countries (Jatav & Sanatan, 2022; Jatav & Kalu, 2023). Majority of the people (at least one member from each family) are outside of the home and doing jobs in different cities of India including Delhi and Mumbai. Every year they send a lot of money to home. The household were asked whether they receive remittance or not? The effect of remittances was found significant. Households receiving remittances were found relatively more food secure while those do not receive remittances were lacking food security. Further, if head of households employed and getting regular income were found food secure than that of others. Likewise, household owned livestock was found food secure compared with household have not owned any livestock. For instance, the calculated odds ratio show that there is a 2.45 times higher probability of food security than that of household does not owned any livestock. Credit, market access and food aid were also found positively related with food security status of surveyed households. Higher credit from institutional sources ensures regular supply of resources to meet food requirement. Likewise, access of market along with awareness of food price help to a household to get food at a reasonable rate and government schemes are adding to the food security (Vijayan et al., 2023). The Central Government started an ambitious scheme called *Pradhan Mantri Garib Kalyan Yojna* on March 2020. Under this scheme, free ration was started to provide eligible households. It played vital role in household's food security during COVID-19. The BLR results show that a household has received food aid is more likely food secure compared with household who doesn't received food aid. Lastly, perception on drought also helps to store food items to deal with natural disasters like drought as it is frequent in Bundelkhand region. The calculated odds ratio shows that there is a 3.45 times higher probability a household food secure vis-à-vis.

CONCLUSION

The findings indicate that households in Jhansi district has a substantially higher level of food security in comparison to those belonging to the Lalitpur district. Several factors influencing food security demonstrate a positive and statistically significant correlation between socioeconomic and demographic characteristics and food security of surveyed households. Hence, the present study suggests that the formulation of an appropriate strategy to protect household from adverse impacts of natural disasters like drought as it frequent in Bundelkhand region, and health-hazard like COVID-19.

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Factors for Value Realization of Tomato, Onion, and Potato (TOP) under Operation Greens Using DEMATEL Method

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Informed consent of the participants

ABSTRACT

Operation Greens Programme of the Government of India focuses on post-harvest management of Tomato, Onion, and Potato (TOP) crops, value chain development, and value realization of farmers' produce, which helps in enhancing livelihood security. The study conducted during 2022-2023 focused on factors determining the value realization of TOP crops under operation greens. The data were collected using a semi-structured interview schedule, with 90 farmers for each crop i.e., Tomato, Onion, and Potato. The government policy initiatives under Operation Greens were the most important factor, which mutually affected the socio-psychological, market intelligence, and input supply for TOP cultivation. About 42 per cent of respondents perceived Government policy under operation greens as important for value realization and 37.40 per cent of respondents perceived support from grassroots level extension agencies as important. Improving government policies followed for Operation Greens would result in the overall betterment of farmers and the agricultural sector of India.

INTRODUCTION

Around 52 per cent of the population of India is directly and indirectly associated in agriculture, contributing to 18.8 per cent of gross domestic product (Press Information Bureau, 2023). Currently the agricultural sector in the country is parallelly modernized with advancement in technology sector. However, post-harvest losses in fruits and vegetables continue to be a major issue, which is due to low capacity of food processing, approximately 2 per cent of fruits and vegetables (Ministry of Food Processing & Industries, 2022) and lack of infrastructure and poor economic condition of majority of the farmers. The other problems in the agricultural sector in India includes: non-realization of optimum price for farm produce by farmers due to damage of crops and deficit of strong marketing information system and price

volatility of crops (Gulati & Wardhan, 2021). Among the vegetables; tomato, onion, and potato are the top three commodities included in consumption basket consumed by Indian households (Kishore et al., 2022). The problem with vegetable commodities is that on production increases sharply, their prices collapse because lack of enough modern storage capacity in the country (Majunder & Cherala, 2021). The linkage between processing and organized retailing are very weak and small in India, which often results in farmer receiving less than 1/4th of what consumers pay for their produce in major cities. As about 85 per cent of farmers in India are small and marginal category, which means they have less land holdings and other resources making them more vulnerable to stressed situations (Likhi, 2020). Government of India has taken several steps through implementation of schemes like Mission for Integrated Development of Horticulture (MIDH), Scheme for

Integrated Cold Chain, Value Addition and Preservation Infrastructure under Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters (SAMPADA) scheme, Capital Investment Subsidy for Construction/Expansion / Modernization of Cold Storages and Storages for Horticulture Products to improve upon the situation of farmers. However, the results from these schemes does not show much improvement, so in 2018-2019, Operation Greens programme was launched by Government of India with the objectives; Enhancing value realization of TOP farmers by targeted interventions to strengthen TOP production clusters and their FPOs and linking them with the market; Price stabilization for producers and consumers by proper production planning in the TOP clusters and introduction of dual use varieties through convergence with the scheme implemented by Mission for Integrated Development of Horticulture (MIDH) and state governments; Reduction in post-harvest losses by creation of farm gate infrastructure, development of suitable agri-logistics, creation of appropriate storage capacity linking consumption centers; Increase in food processing capacities and value addition in TOP value chain by creating firm linkages with production clusters, and Setting up of market intelligence network to collect and collate real time data on demand and supply and price on regional and seasonal basis to moderate and check localized gluts of TOP crops. Hence, considering the view that farmers are unable to realize the value (in the form of income or livelihood betterment), the study on identification of key factors responsible for value realization of TOP crops under Operation Greens was taken up.

METHODOLOGY

The study with *exploratory research design* was conducted in Maharashtra, Gujarat, and Uttar Pradesh during 2022-2023. Two districts each from Maharashtra (Ahmednagar & Nashik), Gujarat (Anand & Kheda) and Uttar Pradesh (Meerut & Hapur) were selected purposively as per tomato, onion and potato clusters established by Government of India in 2018-2019. Cochran formula ($n_0 = Z^2 \cdot p \cdot q / e^2$) was used to calculate the essential sample size for the study. Where, n_0 is the sample size, Z^2 is the area under the acceptance region in a normal distribution ($1-\alpha$), e is the preferred level of precision, p is the estimated proportion of an attribute that is present in the population, and q is $1 - p$. The total

sample size for the study was 270, where 45 respondents were selected randomly from each cluster of villages in 6 districts (Ahmednagar, Nashik, Anand, Kheda, Meerut, Hapur) in the three selected states i.e., Maharashtra, Gujarat, UP, respectively. Decision Making Trial and Evaluation Laboratory (DEMATEL) method was adopted to identify influencing factors of value realization of TOP crops under Operation Greens.

After identification of factors for value realization of TOP crops under operation greens, these factors were administered to farmer respondents to know the importance of these factors from farmers' point of view. The data were collected on *Likert* type five-point continuum having i.e., Least important (1), less important (2), moderately important (3), Important (4) and Most important (5). The weighted mean score for each facilitating factor was worked out and ranking is done according to weighted mean score of each factor.

RESULTS AND DISCUSSION

The demographic profile of the respondents revealed that majority of the respondents (91.48%) was male and only 8.50 per cent were female and most of the respondents (59.62%) were between age group of 31-50 years and followed by more than 50 years (22.90%) and less than 30 years (17.40). All the selected respondents were engaged in agriculture as main occupation and majority (40.37%) of the respondents were having secondary level of education followed by illiterate (30.74%) and primary level education (22.59%); and only 6.29 per cent respondents were having senior secondary level of education. Findings are in line with Ranjit & Sharma (2021), & Bharti et al., (2022).

A perusal of the results (Table 1) regarding factors and their importance show that according to perceived degree of importance, favorable policy of government under operation greens (mean score = 4.325) was perceived to be most important factor followed by support from grassroot level extension agencies (mean score = 4.320), high market intelligence (mean score = 4.309), farmers' socio psychological factors (mean score = 4.270), and sufficient input support under operation greens (mean score = 4.200). Results have shown that the important values of the factors do not have much variation; therefore, it is very reasonable to have all the factors to be very important from the farmers' point of view (Li

Table 1. Factors determining value realization of TOP crops under Operation Greens

S.No.	Factors	Degree of importance (Mean Score)
1.	High knowledge of cultivation practices of TOP crops	3.956
2.	Ownership of large land	4.172
3.	Availability of high yielding varieties and other inputs	4.039
4.	High risk involved in TOP crops	3.825
5.	Sufficient credit /subsidy support under operation greens	4.152
6.	Sufficient input support under operation greens	4.200
7.	High market intelligence	4.309
8.	Easy availability of market and easy marketability	3.963
9.	Favorable policy of government under operation greens	4.325
10.	Attractive price for produce	3.621
11.	Support from grassroot level extension agencies	4.320
12.	Avenues for more value addition/food processing	4.015
13.	Farmers' socio psychological factors	4.270

& Wu, 2022). After the identification of important factors, it is not possible to improve all the factors with limited resources. So, in order to study more critically, five major factors were identified after discussion with farmer respondents, which included farmers socio-psychological factors, market intelligence of farmers regarding Tomato, Onion, and Potato crops and input support provided under Operation Greens, government policies followed under operation greens, support from grassroot level extension agency. After identification of key factors, the second interview schedule for applying DEMATEL was administered to experts in subject area to first prioritize the importance of key factors and then construct the causal relations among them. With this process, the key factors for improving the value realization of TOP crops under operation greens were identified to make improvements by observing causal relationship among these key factors.

To follow the procedure of DEMATEL method, the first survey data from 20 expert respondents were taken and mentioned in 5×5 non-negative matrices, as follows:

Table 2 depicts the direct and indirect effects of five factors. Finally, the threshold value used in step 4 computed the average of the elements in matrix T, which was found to be 1.1870 and the diagram of these five factors, is depicted in Figure 1.

Based on results from Table 2, the importance of the five factors was prioritized as D>C>E>B>A based on (r+c) values, where government policies under operation greens was the most important with the value of 12.163, while farmers' socio-

According to the procedure followed in methodology section, the average matrix A was constructed based on Eq. (1):

A =	0	2.35	2.80	1.65	2.45
	2.15	0	2.35	2.20	2.50
	2.25	2.40	0	2.65	2.00
	3.05	2.70	2.65	0	2.95
	2.20	2.80	2.35	2.65	0

In step 2, calculation of the normalized initial direct-relation matrix D, depicted below:

D =	0000	0.2070	0.2466	0.1453	0.2158
	0.1894	0000	0.2070	0.1938	0.2202
	0.1982	0.2114	0000	0.2334	0.1762
	0.2687	0.2378	0.2334	0000	0.2202
	0.1938	0.2466	0.2070	0.2334	0000

In Step 3, calculation of matrix T by the following formula:

T =	0.9877	1.2133	1.2323	1.0807	1.1515
	1.1505	1.0442	1.2071	1.1154	1.1570
	1.1688	1.2296	1.0474	1.1519	1.1376
	1.3509	1.3898	1.3788	1.0915	1.3014
	1.2265	1.3186	1.2825	1.2115	1.0480

$$X^1 = \begin{bmatrix} 0 & 2 & 3 & 3 & 3 \\ 1 & 0 & 2 & 2 & 2 \\ 0 & 3 & 0 & 1 & 3 \\ 3 & 2 & 3 & 0 & 2 \\ 3 & 2 & 3 & 2 & 0 \end{bmatrix} \quad X^2 = \begin{bmatrix} 0 & 1 & 2 & 2 & 3 \\ 3 & 0 & 2 & 1 & 2 \\ 3 & 2 & 0 & 1 & 3 \\ 3 & 3 & 3 & 0 & 3 \\ 2 & 2 & 3 & 1 & 0 \end{bmatrix} \quad X^3 = \begin{bmatrix} 0 & 1 & 3 & 2 & 4 \\ 2 & 0 & 2 & 1 & 2 \\ 1 & 2 & 0 & 2 & 2 \\ 2 & 2 & 3 & 0 & 2 \\ 2 & 3 & 2 & 2 & 0 \end{bmatrix} \quad X^4 = \begin{bmatrix} 0 & 2 & 2 & 1 & 2 \\ 3 & 0 & 1 & 2 & 2 \\ 1 & 2 & 0 & 2 & 2 \\ 3 & 4 & 3 & 0 & 3 \\ 3 & 2 & 2 & 3 & 0 \end{bmatrix}$$

$$X^5 = \begin{bmatrix} 0 & 2 & 3 & 1 & 2 \\ 2 & 0 & 3 & 3 & 2 \\ 3 & 1 & 0 & 3 & 3 \\ 4 & 3 & 4 & 0 & 4 \\ 2 & 3 & 2 & 2 & 0 \end{bmatrix} \quad X^6 = \begin{bmatrix} 0 & 2 & 3 & 2 & 3 \\ 2 & 0 & 4 & 3 & 1 \\ 4 & 1 & 0 & 3 & 3 \\ 4 & 1 & 2 & 0 & 3 \\ 4 & 1 & 2 & 3 & 0 \end{bmatrix} \quad X^7 = \begin{bmatrix} 0 & 3 & 2 & 1 & 2 \\ 4 & 0 & 1 & 2 & 3 \\ 2 & 1 & 0 & 3 & 1 \\ 3 & 4 & 3 & 0 & 4 \\ 1 & 2 & 4 & 4 & 0 \end{bmatrix} \quad X^8 = \begin{bmatrix} 0 & 2 & 3 & 1 & 2 \\ 2 & 0 & 3 & 3 & 1 \\ 3 & 1 & 0 & 3 & 3 \\ 4 & 3 & 4 & 0 & 4 \\ 2 & 3 & 2 & 2 & 0 \end{bmatrix}$$

$$X^9 = \begin{bmatrix} 0 & 1 & 4 & 2 & 1 \\ 2 & 0 & 3 & 1 & 4 \\ 1 & 3 & 0 & 4 & 2 \\ 4 & 2 & 1 & 0 & 4 \\ 1 & 2 & 3 & 2 & 0 \end{bmatrix} \quad X^{10} = \begin{bmatrix} 0 & 4 & 4 & 1 & 4 \\ 3 & 0 & 3 & 2 & 3 \\ 2 & 3 & 0 & 3 & 2 \\ 4 & 2 & 1 & 0 & 1 \\ 1 & 4 & 2 & 3 & 0 \end{bmatrix} \quad X^{11} = \begin{bmatrix} 0 & 3 & 4 & 2 & 3 \\ 3 & 0 & 3 & 4 & 4 \\ 4 & 3 & 0 & 3 & 2 \\ 2 & 4 & 3 & 0 & 4 \\ 3 & 4 & 2 & 4 & 0 \end{bmatrix} \quad X^{12} = \begin{bmatrix} 0 & 2 & 3 & 4 & 1 \\ 1 & 0 & 4 & 4 & 2 \\ 2 & 3 & 0 & 3 & 1 \\ 1 & 4 & 4 & 0 & 1 \\ 1 & 4 & 3 & 2 & 0 \end{bmatrix}$$

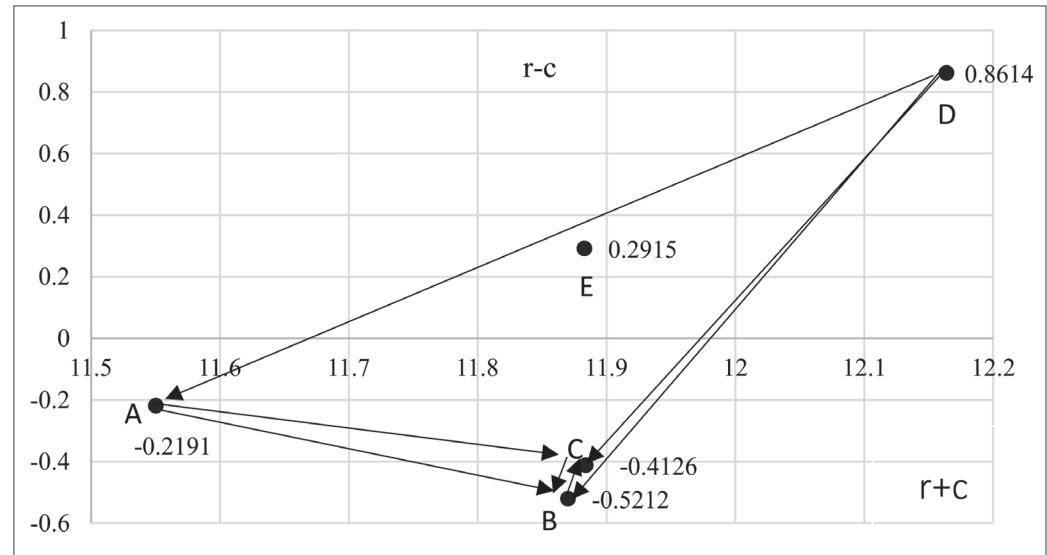
$$X^{13} = \begin{bmatrix} 0 & 3 & 4 & 1 & 3 \\ 1 & 0 & 1 & 2 & 2 \\ 2 & 1 & 0 & 3 & 2 \\ 3 & 1 & 3 & 0 & 3 \\ 2 & 4 & 2 & 3 & 0 \end{bmatrix} \quad X^{14} = \begin{bmatrix} 0 & 1 & 4 & 2 & 3 \\ 1 & 0 & 2 & 3 & 4 \\ 4 & 2 & 0 & 3 & 1 \\ 2 & 3 & 3 & 0 & 4 \\ 3 & 4 & 1 & 4 & 0 \end{bmatrix} \quad X^{15} = \begin{bmatrix} 0 & 1 & 4 & 2 & 3 \\ 2 & 0 & 3 & 1 & 4 \\ 2 & 4 & 0 & 4 & 2 \\ 4 & 3 & 2 & 0 & 4 \\ 1 & 3 & 1 & 2 & 0 \end{bmatrix} \quad X^{16} = \begin{bmatrix} 0 & 3 & 2 & 2 & 1 \\ 2 & 0 & 2 & 2 & 3 \\ 3 & 3 & 0 & 3 & 1 \\ 3 & 4 & 4 & 0 & 4 \\ 1 & 2 & 3 & 2 & 0 \end{bmatrix}$$

$$X^{17} = \begin{bmatrix} 0 & 4 & 3 & 1 & 4 \\ 2 & 0 & 1 & 1 & 2 \\ 3 & 2 & 0 & 1 & 2 \\ 3 & 3 & 1 & 0 & 3 \\ 2 & 4 & 2 & 3 & 0 \end{bmatrix} \quad X^{18} = \begin{bmatrix} 0 & 4 & 1 & 1 & 2 \\ 3 & 0 & 2 & 1 & 4 \\ 2 & 4 & 0 & 3 & 1 \\ 4 & 2 & 1 & 0 & 1 \\ 4 & 1 & 2 & 3 & 0 \end{bmatrix} \quad X^{19} = \begin{bmatrix} 0 & 2 & 1 & 2 & 1 \\ 2 & 0 & 4 & 4 & 1 \\ 1 & 3 & 0 & 2 & 3 \\ 1 & 2 & 4 & 0 & 1 \\ 3 & 2 & 4 & 2 & 0 \end{bmatrix} \quad X^{20} = \begin{bmatrix} 0 & 4 & 1 & 3 & 2 \\ 2 & 0 & 1 & 2 & 2 \\ 2 & 4 & 0 & 3 & 1 \\ 4 & 2 & 1 & 0 & 1 \\ 3 & 4 & 2 & 4 & 0 \end{bmatrix}$$

Table 2. Prioritization of factor dimensions of farmers

	Factor dimensions	r	c	r+c	r-c	Indicator
A	Farmers' socio-psychological factors	5.665	5.884	11.550	-0.219	Effect
B	Market intelligence for TOP crops	5.674	6.195	11.870	-0.521	Effect
C	Input supply under operation greens	5.735	6.148	11.883	-0.412	Effect
D	Government policies under operation greens	6.512	5.652	12.163	0.861	Cause
E	Support from grassroots level extension agency	6.087	5.795	11.882	0.291	Cause

Figure 1. Causal Relationship among the five key criteria



psychological factors were the least important factor with the value of 11.550. In contrast to importance (D) government policies under operation greens and (E) support from grassroots level extension agency were the net cause, whereas (A) farmers' socio-psychological factors, (B) Market intelligence for TOP crops, (C) Input supply under operation greens were observed as the net effects/receivers based on (r-c) values. As per results these key factors are interrelated and essential for value realization of TOP crops as they provide a framework for decision making at farm level and helps in mitigating the risks. Prioritizing these factors could lead to improved socio-economic status and farmers' satisfaction and sustainability. The findings are in line with studies done by Wei & Xia Wu (2022); Xia & Ruan (2020).

Figure 1 observed that factor (D) Government policies under operation greens is not affected by others but affects (A) Farmer socio-psychological factors, (B) Market intelligence for TOP crops, (C) Input supply under operation greens and likewise (A) Farmer socio psychological factor is only affected by (D) government policies under operation greens but affects (C) Input supply under operation greens and (B) Market intelligence for TOP crops.

Whereas, factor (B) Market intelligence for TOP crops and (C) Input supply under operation greens mutually affects each other. The factor (E) Support from grassroots level extension agency as factor (D) Government policies under operation greens is not affected by any other factor hence acts independently. In summary, it is worth mentioning that under operation greens much attention is paid to two causes (D, E) rather than (A, B, C) factors. The government policies under operation greens are a key factor of utmost importance because it is not only a cause but also did not affect by any other factor. The improvement in government policies under operation greens would result in better targeting of the scheme and achievement of the objectives along with the support from grassroots level extension agencies in promotion of the programme in large area and dissemination of technologies promoted under operation greens.

Results (Table 3) of perceived importance of respondents on factor dimensions revealed that 42.23 per cent respondents have perceived government policies under operation greens is most important factor followed by support from grassroots level extension agency (37.40%) whereas, 39.25 per cent respondents have

Table 3. Distribution of respondents based on their perceived importance

S.No	Factor dimensions	Least important	Less important	Undecided	Important	Most important
A	Farmers socio-psychological factors	30.00	39.25	8.51	5.92	16.29
B	Market intelligence for TOP crops	17.77	34.07	4.07	19.25	24.81
C	Input supply under operation greens	8.88	19.25	12.96	32.96	25.92
D	Government policies under operation greens	5.56	17.03	7.40	27.78	42.23
E	Support from grassroots level extension agency	8.14	21.48	2.23	30.74	37.40

perceived farmers socio-psychological factors as of less importance. In case of input supply under operation greens factor it is revealed that 32.96 per cent respondents perceived as important for them for TOP crops. Strengthening of government policies under operation greens could enhance the value realization as these policies affects the farmers and processors at every stage of decision making at farm. Creating well-structured market infrastructure and market intelligence system could build confidence among farmers regarding market and selling of their crops at optimum prices. The similar findings are reported by Patil & Kokate (2021).

CONCLUSION

A total of 13 factors were identified related to value realization of TOP crops under operation greens, five out of 13 factors were selected based on the importance scores as given by the respondents. The second study based on DEMATEL method was conducted with the help of 19 experts. Using DEMATEL method the importance of five key factors was determined along with causal relationship among themselves. The results revealed that government policies under operation greens were the most important factor. Though there are many factors, which were influenced by government policy under operation greens but no factor influencing government policies under operation greens was found. So, the improvement in government policies under operation greens would result in better targeting of the scheme and achievement of the objectives.

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Educational Aspirations among the Students of Manipur University, India

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ABSTRACT

Educational aspirations provide students valuable insights that can inform educational policies, improve career guidance, promote equitable opportunities leading to better educational outcomes, and increase success in students' future careers. This study examined the educational aspirations of students in 2021 at Manipur University, India. A structured interview schedule was designed, and data were collected from 160 students through stratified random sampling from five Schools of studies of the postgraduate students of the University. Students in the School of Human and Environmental Sciences showed the highest Achievement Likelihood of Educational Aspiration Index (ALEAI). Study reveals that the majority of the students wanted to pursue higher education. Students' primary career advice was found to be their interests. Students were also motivated about their career choice mainly by their parents' support, followed by the influence of TV, radio, social media, and other media. Students should also be encouraged and empowered to decide on and stand for their right career. The study suggests that it is necessary to review the influences, programmes, and different factors affecting students at all stages of their education.

INTRODUCTION

Students are the most promising segment of the population of a nation and their nourishment determines the development of the community and nation as a whole. Study suggests that about 70 per cent of young people are optimistic about their career prospects worldwide (Anonymous, 2017). Any person's achievement is mostly motivated by their aspirations. Many times, lower/ weaker ambitions are cited as one of the causes of anyone's inferior accomplishment, especially in children (Hari et al., 2022). Ambition is a form of self-development, and individual performance is affected by a desire to do well (Mali et al., 2015). It indicates what a person wants to be in his future life, irrespective of the limitations imposed by reality. Khanna (2009) defined aspiration as the fantasy of an individual regarding a future occupation or settlement. The ability to set goals and then pursue these goals

is sometimes referred to by educators as students' aspiration Ahmed et al., (2017). Schaefer and Meece (2009), opined that young people's goals have a significant impact on their life decisions. Academic aspiration refers to how realistically a person sets educational goals given their physical and mental attributes as well as their environment. Educational ambitions, which are sometimes characterized as idealistic or practical, are said to pertain to students' aims and plans within an academic context (Chow et al., 2012). The educational purposes that an individual sets for himself differ from one individual to another due to different factors can significantly influence how students want to pursue their education (Ghosh et al., 2021). Youth unemployment is a global concern, attributed among other things to a lack of appropriate skills. It has been determined that education that is skill-focused is an effective way to address the gap (Lekang et al., 2016; Modak et al., 2018). However, studying educational aspirations among

students provides valuable insights that can inform educational policies, improve career guidance services, and promote equitable opportunities, leading to better educational outcomes and increased success in students' future careers. National Education Policy, 2020 is a progressive shift towards a more scientific approach to education and if it is enforced in its true vision, the new education structure can be brought which aim to develop creative potential, skills, and analytical thinking which will be the need in the global job market (Arun et al., 2020).

Integrated modes of learning, which combine education with connections to business, hands-on learning, and the building of social capital in the entrepreneurial field (Lekang et al., 2017), appear to have an impact on how students evaluate, perceive, and make decisions about the field of possibilities as well as the direction of their lives after graduation (Yuan & Olivos, 2023). The study was carried during 2020–2021 to analyze the educational aspirations of the students of Manipur University. According to the 2011 population census, the total literacy rate of Manipur is 76.94 per cent, the number of unemployed youths in Manipur was 3,46,690 in 2018, which was registered in the state employment exchange as per records of the Directorate of Labour and Employment, and the Human Development Index (HDI) rank of Manipur is 15th (0.696).

METHODOLOGY

Manipur, a state in north east India, was purposefully selected due to the convenience of data collection and ease of communication with the respondents. Manipur University, being the main University of the state, was selected for the study as it has diverse group of students from different backgrounds. Primary data was collected from 160 Post Graduate Students of Manipur University using stratified random sampling methods from five Schools of studies, i.e., the School of Humanities (n=30), the School of Human and Environmental Sciences (n=30), the School of Social Sciences (n=50), the School of Life Sciences (n=24), and the School of Mathematical and Physical Sciences (n=26), through a semi-structured interview schedule.

Educational aspirations were measured using the Achievement Likelihood of Educational Aspiration Index (ALEAI) which was adopted by Haller & Miller (1963) and Bhanu (2006) were used with slight modification to find out the level of attainment among the students. Normalisation and the average score of confidence were used to find out the ALEAI. After normalisation, based on the respective ALEAI, scores between the ranges of 0 and 0.33 were regarded as low; scores between the ranges of above 0.33 and 0.67 were regarded as medium; and scores higher than 0.67 were regarded as high. The Mann-Whitney U test and the Kruskal-Wallis test were used to find relationships among different variables.

RESULTS AND DISCUSSION

Educational aspirations of students

From Table 1, it was found that the majority of the students (78.92%) wanted to pursue higher studies. The results showed that most respondents had aspirations towards higher education among different schools of studies: The School of Humanities (86.70%), the School of Mathematical and Physical Sciences (84.6%), the School of Life Sciences (80%), the School of Human and Environmental Sciences (73.3%), and the School of Social Sciences (70%). The reason being that students compete for higher job opportunities; higher studies indicate higher job opportunities. Moreover, some students also wanted to continue their studies due to family pressure and to gain higher social status. Currently, the majority of the students are encouraged by their parents to study. Students were attracted to several good career opportunities in a competitive world that demands higher educational qualifications.

Students were asked on the reasons for wanting to continue or discontinue education/pursuing higher studies, which is listed in Table 2. The majority of the youth were continuing their education to acquire a better career. Nowadays, youths are well aware of the importance of education. Some of the reasons were that they plan to study further because they like studying; higher studies would help improve their social status; and they feel higher studies would provide more and better job opportunities. A few reasons for students wanting to discontinue their studies due to their financial problems and family responsibilities: they are not interested in studying further; they have no financial support to pursue further studies; they are confident of their own capabilities and can do well in jobs without further education. Lekang et al., (2016) found out that a few students did not want to continue their studies because they were not interested in studying further and family responsibilities also make them work in order to support them.

From Table 3, it was found that parents support for education seems high for all five 'Schools of Study'. Jungen (2008) stated that students' educational choices had a big influence on their kids' job decisions. He also revealed that work ethics, family values, and gender stereotypes have been demonstrated to significantly influence employment choice. Relationships between different 'Schools of Studies' with different demographic variables, viz. Gender (Male, Female); Caste (UR, OBC, SC, ST); Year (1st Year, Final Year); Family type (Joint, Nuclear); Family size (5 or <5, >5); and family occupation (Farming & Allied Activities, Government Service, Private Service, Business), were presented in Table 4 with all five 'Schools of Studies'.

School of humanities

It was found that females had more intent on continuing their studies in the School of Humanities. Different variables like caste, family, occupation, and family type show no significant difference

Table 1. Students continuing higher studies

Response	Hum (n=30)	H&Env Sc. (n=30)	S Sc. (n=50)	L Sc. (n=24)	M&PhySc. (n=26)	Total (n=160)
No	13.3	26.7	30	20	15.4	21.08
Yes	86.7	73.3	70	80	84.6	78.92

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&PhySc.- School of Mathematical and Physical Sciences

Table 2. Reasons for continuing or discontinuing education/pursuing higher studies

Statement / Questions	Response (%)	Hum (n=26)	H & EnvSc (n=22)	S.Sc (n=35)	L.Sc (n=24)	M & Phy.Sc (n=22)
Reasons for continuation of studies/ pursuing higher studies						
I plan to study further because I like studying	DA	10.3	33.3	15.4	-	15
	NAND	10.3	4.2	7.7	-	25
	AG	80.2	62.5	76.9	100	60
I have to study due to my family's pressure	DA	69	62.5	53.9	100	95
	NAND	13.8	25.0	7.7	-	-
	AG	17.2	12.5	38.4	-	5
Higher studies would help improve my social status	DA	6.8	20.8	26.9	18.8	5
	NAND	20.7	16.7	-	12.5	10
	AG	72.4	62.5	73.1	68.8	85
I am opting for studies as I have no other better options to do	DA	65.5	62.5	50	93.8	70
	NAND	20.7	20.8	23.1	6.3	10
	AG	13.8	16.7	26.9	-	20
I feel higher studies would provide more and better job opportunities	DA	27.6	20.8	3.8	-	-
	NAND	20.7	16.7	-	-	40
	AG	57.7	62.5	96.1	100	60
Reasons for discontinuation of studies/ pursuing higher studies						
I am not interested in studies/ any further	DA	40	85.7	40	44.4	-
	NAND	30	14.3	20	22.2	50
	AG	30	-	40	33.3	50
No financial support to pursue further studies	DA	100	85.7	80	88.9	75
	NAND	-	14.3	-	-	25
	AG	-	-	20	11.1	-
There are no good schools/colleges in the nearby locality	DA	-	14.3	-	33.3	50
	NAND	25	71.4	30	66.7	20
	AG	75	14.3	70	-	30
Hardly anyone in our community study further	DA	-	42.9	50	11.1	-
	NAND	50	28.6	20	22.2	-
	AG	50	28.6	30	66.7	100
I am confident of my capabilities now and can do well in my job without further education	DA	75	42.9	10	30	50
	NAND	25	28.6	20	30	50
	AG	-	28.6	70	40	-

D-Disagree; NAND-Neither agree nor disagree; A-Agree

Table 3. Parents support to education

Parents support education (n=160)	Yes (%)	No (%)
Humanities	73	27
Human and Environmental Sciences	77	23
Social Sciences	57	43
Life Sciences	65	35
Mathematical and Physical Sciences	71	29

with continuing studies. Howard, 2003 also confirms that female students showed higher educational ambitions than male students.

Human and environmental sciences

Males had more intent on continuing their studies, and students of joint family type show a significantly higher interest in continuing their studies in the School of Human and Environmental Sciences. Other variables like caste, family occupation, and family type show no significant difference, indicating interest in further studies.

Table 4. Relationship between different School of Studies with different variables

Educational aspiration		Mean Rank	p-value
School of Humanities (n=30)	Male	12.21	0.037*
	Female	18.60	
Human & Environmental Sciences (n=30)	Male	18.87	0.036*
	Female	12.13	
	Joint	14.50	0.047*
	Nuclear	8.79	
Life Sciences (n=24)	Farming & Allied Activities	4.83	0.039*
	Service (Government)	7.00	
	Service (Private)	19.50	
	Business	6.20	

*p= p<0.05 there is a significant difference

School of life sciences

Students whose family member works in the private sector are more intent on continuing their studies in the School of Life Sciences. The reasons include family pressure, social status, and the fact that higher studies mean higher job opportunities.

School of social sciences

A significant difference was not found in any of the variables, which means they are more or less similar with reference to continuing the studies.

School of mathematical and physical sciences

In the School of Social Sciences, significant differences were also not found in any of the variables, which mean they were more or less similar with reference to continuing the studies.

Relationship among different demographic variables and all the other variables taken for the study viz. Gender (Male, Female); Caste (UR, OBC, SC, ST); Year (1st Year, Final Year); Family type (Joint, Nuclear); Family size (5 or <5, >5); Family occupation (Farming & Allied Activities, Government Service, Private Service, Business) were presented in Table 5. It demonstrates that students with working family members have much greater educational aspirations than students with working family members in the business sector. This suggests that students with family members who are employed in the private sector were more motivated to pursue their education since more education equals more employment chances. Moreover, they want to continue their studies due to family pressure and for higher social status also. There is more or less similarity in educational aspirations among students with other variables, viz., Gender (Male, Female); Caste (UR, OBC, SC, ST); Year (1st Year, Final Year); Family type (Joint, Nuclear); Family size (5 or <5, >5).

Different findings suggest that family education status, sex, annual family income, landholding size, and academic performance were positively correlated with aspiration (Daundkar et al., 2011). Makkar (2010) found that urban students have higher educational aspirations than students in rural areas. Daundkar et al., (2011) found that lower socioeconomic status is associated with bigger

goal disparities, or the distance between aspiration and performance, than higher socioeconomic status. Tiwary (1995) stated a tremendously significant difference in the level of aspiration of the different community categories, i.e., lower category people was superior in educational aspirations and upper category people were inferior to all. Positive correlations between participation outside of school and inside of it have been discovered by researchers. A high level of competition and a dearth of decent employment put individuals under strain. Numerous elements, such as attitude, interests, ambition, familial influences, and financial considerations, might affect a person's decision to pursue a career (Ojha, 2015 & Burns et al., 2023). Agricultural students have some plans to settle down in specific career after getting degree. Majority of the students aspired to settle themselves in suitable positions in any government departments. Remaining students were found to be interested in starting their own farms, expressed their desire to earn an income of more than Rs. 50,000 to Rs. 1,00,000 per month (Arunachalam et al., 2020).

From Table 6, it was found that the ALEA index among different students in the school of studies falls at a medium or high level of ALEAI. The overall average mean Achievement Likelihood of Educational Aspiration Index (ALEAI) is 0.7, which depicts that students in general are likely to have high confidence in attaining educational aspirations and are more positive towards education and continuing studies. Bakar et al., (2002) stated that the most of the students felt confident in obtaining an area for further educational instruction or information. Moreover, a significant difference was not found between Schools of Studies or between any of the variables towards Achievement Likelihood of Educational Aspiration (ALEA), i.e., students across streams have been more or less similarly positioned with reference to the likelihood of attaining their aspirations. Hari et al., (2022) also stated that aspiration is one of key factor influencing the youth's educational preference and, hence, should be examined in conjunction with other factors to allow more logical and scientific approaches.

CONCLUSION

A primary reason for continuing their studies is that they plan to study further because they aspire to do so. A majority of the students preferred a government job as their primary career aspiration. Job security is the major factor determining whether students across streams are more or less similarly positioned concerning the likelihood of attaining their aspirations. Understanding educational Education among students is important for understanding students' motivation and guiding educational planning. Addressing achievement gaps, career guidance, and counseling will help enhance student outcomes in achieving their educational goals. Studying the educational aspirations of students is essential for shaping effective educational

Table 5. Overall educational aspiration among all the students with different variables

Educational aspiration (n=160)	Mean rank	p-value
Farming and allied activities	22.42	0.049*
Service (Government)	35.17	
Service (Private)	54.06	
Business	34.97	

*p= p<0.05 there is a significant difference

Table 6. Achievement likelihood of educational aspiration index (ALEAI)

ALEA-Index	Hum (n=26)	H&Env Sc. (n=22)	S Sc. (n=35)	L. Sc. (n=24)	M&Phy.Sc (n=22)
Low (<0.33)	14	20	8	2	18
Medium (0.33-0.66)	38	26	36	13	25
High (>0.66)	48	54	56	85	57
Mean score	0.648	0.76	0.716	0.75	0.644
Overall mean score	0.703				

policies, providing appropriate guidance, and fostering a more inclusive and supportive education system. By understanding students' goals and challenges, academics and policymakers can work together to create an environment where all students can thrive and reach their full potential.

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E-readiness Assessment of National Agricultural Research in India

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ABSTRACT

The digital era has ushered in profound transformations across global industries, where the integration of information and communication technologies (ICTs) is crucial for growth, productivity, and sustainability. Agriculture, in particular, relies on this digital imperative to enhance food security, sustainability, and economic development. The National Agricultural Research System (NARS) plays a pivotal role in shaping the nation's agricultural progress addressing food security, productivity, climate change, and farmer livelihoods, the NARS must embrace digital advancements. The study was conducted at NARS of India, 660 scientists were selected from 102 ICAR institutes using multistage stratified random sampling techniques. E-readiness was measured based on a conceptual framework developed by Tugrul & Maru (2003) and the STOPE framework. The framework measures the dimensions like strategy, technology, organizational support, HR support, and e-culture. The result provides a comprehensive understanding of NARS's preparedness for digital transformation. While there are clear strengths in strategy, technology, and human resources support, areas requiring improvement, particularly organizational support and aspects of e-culture readiness, should be addressed with strategic initiatives.

INTRODUCTION

The digital era has ushered in transformative changes across industries and sectors worldwide. In an increasingly interconnected world, the adoption and integration of information and communication technologies (ICTs) are pivotal for driving growth, enhancing productivity, and achieving sustainable development goals. This digital imperative holds across various sectors, but perhaps none is more critical than agriculture, where the ability to leverage technology can significantly impact food security, sustainability, and economic development.

India, with its vast agricultural landscape and diverse agro-climatic zones, stands at the nexus of agricultural innovation and development. The National Agricultural Research System (NARS) of India, encompassing a multitude of research institutions and

universities, plays a central role in shaping agricultural innovation and development in the country. The NARS is entrusted with the monumental task of harnessing science and technology to address the multifaceted challenges facing Indian agriculture, including food security, agricultural productivity, climate change, and improve the livelihoods of millions of farmers. As India continues its journey towards agricultural modernization and sustainability, the readiness of the National Agricultural Research System to embrace digital advancements is of paramount importance.

The concept of "e-readiness" has gained prominence as a holistic assessment of an organization's preparedness to leverage ICTs to achieve its goals and objectives. E-readiness encompasses a spectrum of factors, including technological infrastructure, human capital, policy frameworks, and the willingness to adopt and adapt to digital solutions. According to the United Nations Development

Program (UNDP), “e-readiness assessments are meant to guide development efforts by providing benchmarks for comparison and gauging progress (Sergey, 2004). They help diagnose ICT problems, advocating required ICT changes, and develop sound ICT plans. Although most e-readiness assessment studies were performed at the country level, for different countries, it has been emphasized that the e-readiness of organizations in a country, is an integral part of the overall e-readiness of that country (Dawn, 2002). Keeping in view the above facts and their importance, the present study was conducted to study the E-readiness assessment of the National Agricultural Research System in India.

METHODOLOGY

The study was conducted at NARS of India, the Indian Council of Agricultural Research system was purposively selected for the study because it mainly focuses on agricultural research and development and many ICT interventions developed under this system. The study used the multistage simple random sampling framework. All 102 ICAR institutes were classified into 11 zones based on ICAR’s classification of Agricultural Technology Application Research Institute. And from each zone, randomly 3 institutes were selected considering subject matter divisions, small and big institutional criteria. A total of 33 institutes were selected and from the selected 33 institutes, 20 scientists were selected randomly. Hence, the total sample size was 660. Data were collected by personally interviewing the respondents as well as online through Google forms. E-readiness was measured based on a conceptual framework developed by Tugrul & Maru (2003) and the Strategy, Technology, Organisation, People and E-culture framework. The framework measures the dimensions like strategy, technology, organizational support, HR support, and e-culture in the organization having 79 items on a five-point continuum indicating the status of ICT/ICM in the organization. The respondents were classified into 5 categories least e-ready to very high e-ready based on frequency and percentage.

RESULTS AND DISCUSSION

Dimensions of E-readiness

Data in the Table 1 Strategy e-readiness indicate that notably, 38.48 per cent of respondents perceived a medium level of strategy e-readiness, followed by 24.24 per cent high level, 13.64 per cent low, 13.03 per cent of very high, and only 10.61 per cent perceived the least strategy e-readiness. These findings indicate that NARS has established strategies that position it within the medium to high e-ready category. The possible reason for these findings may be that NARS has developed and implemented different policies

for ICT use like, Information communication and dissemination system (ICDS) components in National Agricultural Innovation Project (2006), Open access and open data policy (2013), ICT Road map (2021) and many other policies and strategies for harnessing the potential of ICT. A medium to high readiness level in strategy is a positive indicator of NARS’s commitment to leveraging digital technologies for agricultural research and innovation. This also suggests that NARS has articulated clear and effective strategies for integrating digital technologies into its operations. These strategies can serve as a roadmap for aligning research goals with digital initiatives. To further enhance strategy e-readiness, NARS should ensure that these strategies remain dynamic and adaptable to evolving technological landscapes. Regular reviews and updates are essential to maintain alignment with the organization’s digital goals and changing external factors. These findings are in line with Rai (2013).

From Table 2 regarding technology readiness it can be said that a substantial 43.33 per cent of respondents perceived a medium level of technology e-readiness, followed by 23.33 per cent high level, 14.85 per cent lower level, 11.82 per cent at a very high level, and only 6.67 per cent at perceived least technology e-readiness. The medium to high readiness in technology indicates that NARS has invested in the necessary infrastructure and technological capabilities to support its digital initiatives. The possible reason might be that under the NAIP project, one component was strengthening ICAR as a catalyzing agent for the management of change in the Indian NARS. One sub-component was the information communication, and dissemination system (ICDS) in which different efforts were made to harness the transformative power of information and communication technology (ICT) to make public services more efficient in which different initiative was taken up to strengthen infrastructure and technology support to all ICAR institutes. It is a positive indication, as it suggests that the organization is equipped with the hardware, software, and connectivity needed for digital transformation (Lahiri et al., 2017). This level of readiness positions NARS well for harnessing the benefits of digital technologies in agricultural research. However, sustaining this readiness requires ongoing investments in technology. Regular updates, maintenance, and the integration of emerging technologies such as artificial intelligence, cloud computing, the internet of things, and many more are essential to ensure that NARS remains at the forefront of digital advancements. The same finding was reported by Rai (2013); Navani (2016) & Mwangi (2019).

The data in Table 3 represent organizational support e-readiness, and it can be said that the majority of respondents, 37.42 per cent perceived a medium level of organizational support

Table 1. Distribution of respondents based on Strategy e-Readiness

Categories	Score	Percentage
Least e-ready (R1)	(00 – ≤20)	10.61
Less e-ready (R2)	(>20 – ≤40)	13.64
Medium e-ready (R3)	(>40 – ≤60)	38.48
Highly e-ready (R4)	(>60 – ≤80)	24.24
Very Highly e-ready(R5)	(>80 – ≤100)	13.03
Total		100

Table 2. Distribution of respondents based on Technology e-Readiness

Categories	Score	Percentage
Least e-ready (R1)	(00 – ≤20)	6.67
Less e-ready (R2)	(>20 – ≤40)	14.85
Medium e-ready (R3)	(>40 – ≤60)	43.33
Highly e-ready (R4)	(>60 – ≤80)	23.33
Very Highly e-ready(R5)	(>80 – ≤100)	11.82
Total		100

Table 3. Distribution of respondents based on organizational support e-Readiness

Categories	Score	Percentage
Least e-ready (R1)	(00 – ≤20)	11.97
Less e-ready (R2)	(>20 – ≤40)	26.67
Medium e-ready (R3)	(>40 – ≤60)	37.42
Highly e-ready (R4)	(>60 – ≤80)	13.48
Very Highly e-ready(R5)	(>80 – ≤100)	10.45
Total		100

e-readiness, followed by 26.67 per cent lower level, 13.48 per cent high level interestingly, 11.97 per cent least e-ready, while only 10.45 per cent considered a very high level of organizational support e-readiness (Nirmalkar et al., 2022). Overall, it is at medium to less e-ready which reveals a gap between the medium to high readiness observed in other dimensions. The possible reason might be that in every NARS institute, there was establishment of an Agriculture research information system cell in 1994. Later, it known as the Agricultural Knowledge Management Unit which works at the IT cell and provides IT-related services. Medium level of e-readiness suggests that while NARS has made progress in terms of strategy and technology, it might be facing challenges in providing the necessary organizational support structures. Efforts should be directed toward creating an environment that fosters digital initiatives. This includes establishing clear roles and responsibilities for digital projects, providing training and development opportunities for staff, and ensuring adequate budget allocation for digital initiatives. A lack of support in these areas can hinder the effective implementation of digital strategies (Lahiri et al., 2020). These findings are supported by Navani (2016) & Mwangi (2019).

The data in Table 4 indicate that People/HR support e-readiness and it found notably that 36.97 per cent of respondents perceived a medium level of e-readiness in terms of People/HR support, followed by 27.58 per cent high level, 14.85 per cent lower level, 12.42 per cent very high level, and only 8.18 per cent perceived least People/HR support e-readiness. The medium to high e-readiness in People/HR Support is a promising sign. The possible reason for these findings is that ICAR regularly organizes different training and capacity-building programs under IASRI on various topics related to ICT like data management, e-governance systems, cyber-security, and application of advanced technology like machine learning and artificial intelligence. As well as ICAR-IASRI has also developed and implemented many ICT interventions related to e-HRM Like, E-office, ERP, CBP, FMS, etc. The medium

Table 4. Distribution of respondents based on People/HR support e-Readiness

Categories	Score	Percentage
Least e-ready (R1)	(00 – ≤20)	8.18
Less e-ready (R2)	(>20 – ≤40)	14.85
Medium e-ready (R3)	(>40 – ≤60)	36.97
Highly e-ready (R4)	(>60 – ≤80)	27.58
Very Highly e-ready(R5)	(>80 – ≤100)	12.42
Total		100

to high level of e-readiness suggests that NARS recognizes the importance of its human resources in digital transformation efforts and has likely implemented HR strategies and policies to support these initiatives. However, sustaining and further improving this readiness requires ongoing investment in skill development, training, and capacity development programmes, promoting a culture of continuous learning, and aligning HR practices with digital goals. An institution with below-average skills needs to upgrade itself so that it can meet the demand of the hour. Similar reports were made by Rai (2013); Navani (2016) & Mwangi (2019).

Regarding E-culture readiness the data presented in Table 5 indicate that a substantial 44.09 per cent of respondents perceived a highly e-ready level of E-culture, followed by 27.12 per cent medium level, 14.85 per cent very high level, 10.30 per cent lower level and only 3.64 per cent fell into the category of least e-ready. Overall it ranges from highly e-ready to medium e-ready. The possible reason for this finding is that the ICAR has implemented a number of digital solutions for office automation, reporting, and management systems for effective e-governance in the organization. Some of the major systems in this regard are e-office, PIMS, PERMISNET, ICAR-ERP, HYPM, FVMS, PMS, PGS, CBP, etc. which shows the great degree of e-governance in NARS and being a great instrumental in driving digital transformation. A highly e-ready culture typically embraces change, innovation, and digital fluency, which are essential for the successful adoption of new technologies. Efforts should be made to foster a culture of digital readiness consistently across the organization. This may involve promoting innovation, encouraging knowledge sharing, collaboration, development, and implementation of other important e-governance initiatives. These findings are supported by Navani (2016) & Mwangi (2019).

Table 5. Distribution of respondents based on E-culture Readiness

Categories	Score	Percentage
Least e-ready (R1)	(00 – ≤20)	3.64
Less e-ready (R2)	(>20 – ≤40)	10.30
Medium e-ready (R3)	(>40 – ≤60)	27.12
Highly e-ready (R4)	(>60 – ≤80)	44.09
Very Highly e-ready(R5)	(>80 – ≤100)	14.85
Total		100

Overall organizational e-readiness

The Table 6 indicates that notably, 33.94 per cent of respondents perceived a medium level of overall organizational e-readiness. Followed by 28.03 per cent high level, 14.85 per cent lower level, 14.24 per cent very high level, and only 8.94 per cent perceived as least e-ready in the context of overall organizational e-readiness. The assessment of overall e-readiness for NARS falls within the medium to highly e-ready range. This suggests that NARS has made significant progress in its journey toward digital transformation. It is likely that a combination of strategies, technological infrastructure, HR support, and elements of an e-ready culture contribute to this overall readiness. Moving forward, NARS should continue to assess and address the gaps in the less

Table 6. Distribution of respondents based on overall organisational e-Readiness

Categories	Score	Percentage
Least e-ready (R1)	(00 – ≤20)	8.94
Less e-ready (R2)	(>20 – ≤40)	14.85
Medium e-ready (R3)	(>40 – ≤60)	33.94
Highly e-ready (R4)	(>60 – ≤80)	28.03
Very Highly e-ready(R5)	(>80 – ≤100)	14.24
Total		100

e-ready areas, such as organizational support, to ensure a holistic and sustainable approach to e-readiness. However, achieving and maintaining this level of readiness requires ongoing commitment and strategic planning. It is essential that NARS continuously assesses and addresses the gaps, particularly in areas like organizational support and specific aspects of e-culture readiness. These findings are supported by Aydin & Tasci (2005); Rai (2013); Navani (2016); Mwangi (2019) & Syahputr (2021).

CONCLUSION

The assessment of e-readiness using the STOPE framework provided a comprehensive understanding of NARS's preparedness for digital transformation and NARS has made significant progress in its journey toward digital transformation. The NARS has established strategies within the medium to high e-ready category. The medium to high readiness in Technology indicates that NARS has invested in the necessary infrastructure and technological capabilities to support its digital initiatives. Organizational support at medium to less e-ready reveals a gap between the medium to high readiness observed in other dimensions. The medium to high e-readiness in People/HR Support is a promising sign. E-culture readiness ranged from highly e-ready to medium e-ready. Moving forward, NARS should continue to assess and address the gaps in the less e-ready areas, such as organizational support, to ensure a holistic and sustainable approach to e-readiness. However, achieving and maintaining this level of readiness requires ongoing commitment and strategic planning.

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Factors Influencing Fish Purchase and Consumption Behaviour of Koraga and Soliga Tribes, Karnataka, India

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ABSTRACT

The study carried out in 2021-2022 investigates fresh and dried fish consumption patterns and factors influencing fish purchase among Koragas and Soligas; two major tribes of Karnataka, India. 400 fish-consuming tribal households were surveyed and per capita fish consumption was estimated at 1.04 and 2.02 kg/person/month for Koragas and Soligas respectively. Mackerel and Sardine were the two most important species preferred by the Koragas while Tilapia and Catla were the preference among Soligas. Among the 15 factors studied; the ones that were ranked with the highest contribution towards the fish purchase of Koragas were the 'price of fish' (7.68) and the 'availability of favourite fish' (7.36). Soligas ranked the 'availability of favourite fish' (10.42) as the most contributing factor followed by 'convenience perception' (6.69). Increasing awareness about the health benefits of fish consumption and building the capacity of tribes to prepare culturally compatible fish-based products can aid in improving fish consumption. The results of the study will be of utility to health department officials and policymakers in planning strategies to increase fish consumption and alleviate malnutrition among these tribes.

INTRODUCTION

Fish as food is an important tool for ending global hunger, achieving food security and improving nutrition as envisaged in the United Nations 2030 Agenda for SDGs (Bennet et al., 2021). One of the healthiest foods; fish with its high levels of Omega-3 fatty acids and docosahexaenoic acid (DHA) is advised for all age groups; especially for expectant and nursing mothers and growing children (WHO, 2011). Low fat content, high-quality proteins, and plenty of micronutrients including vitamins and minerals make fish and seafood widely acknowledged as a crucial part of any balanced and healthy diet (Yaktine & Nesheim, 2007). Positive perception of consumers in terms of nutritional content and health benefits of fish is found significant (Verbeke et al., 2008). World food fish consumption recorded an increase to 20.2 kg per capita

in 2022 from 9.0 kg in 1961 thus helping 3.1 billion people to meet 20 per cent of their total animal protein intake from fish alone (FAO, 2022).

NSSO (2012) reports per capita fish consumption of 0.27 kg and 0.25 kg per month for urban and rural India, respectively. While ICMR recommends consumption of 12 kg fish per capita in a year, India is far away from achieving this target with the World Bank predicting per capita fish consumption of only 6.6 kg by 2030 (Msangi et al., 2013). Through the flagship "Blue Revolution" scheme, the Government of India tried to reach 20 MT fish production by the year 2022-23 (Shasani et al., 2020) which was not met yet. Karnataka records a meagre monthly per capita fish consumption of 0.163 kg in rural and 0.117 kg in urban areas (NSSO, 2012) far less than the national average as well as recommended intake. Identifying the factors influencing

consumption aids planners in chalking out programmes for alleviating malnutrition and bringing down hunger among vulnerable populations (Sajeev et al., 2021a). Indians exhibit rich cultural values living in diversified societies under varied agro-climatic situations (Lenka & Satpathy, 2020). Dakshina Kannada (formerly South Canara) district in Karnataka is nestled between the Western Ghats and the Arabian Sea. The Koraga tribe is one of the two most primitive and backward tribes recognised by the Indian government mainly distributed along the regions of the Dakshina Kannada, Udupi and Haveri districts. Chamarajanagar is the southernmost district of Karnataka. Soliga is an Indian ethnic community mostly living in southern Karnataka's Biligiriranga hills and adjacent ranges covering the districts of Chamarajanagar in Karnataka and Erode in Tamil Nādu. Both tribes are identified as highly vulnerable population concerning malnutrition and anaemia (Kamath et al., 2013; Prabhakar & Gangadhar, 2016). The inclusion of fish in the diet and intake of recommended dietary levels are proven to alleviate iron deficiency and anaemia. Hence, this paper is an attempt to study the fish consumption behaviour of Koragas and Soligas and to rank the factors influencing fish purchase as perceived by the tribes so as to aid planners and development officials in preparing strategies towards using fish for nutrition and health.

METHODOLOGY

The study was carried out during 2021-22 in the Dakshina Kannada and Chamarajanagar districts of Karnataka to obtain an account of the fish consumption pattern and ranking of factors influencing the purchase among the Koragas and Soliga tribes. As per the last census conducted by the Government of India in 2011, Koraga tribes were 14,794 in number (Roy et al., 2015) while Soligas had a population of 33,871 members in Karnataka (Spandana et al., 2023). Fish consumption is a long-proven remedy in alleviating iron deficiency anaemia. The vulnerability of Koraga and Soliga tribes towards anaemia enabled them suitable for the study. Considering the group of tribal hamlets as strata and households as units, stratified random sampling technique was used to select 400 tribal households (200 each from Koraga and Soliga tribes). A structured pre-tested interview schedule was used and the survey was carried out through personal interviews. The data sets obtained through the survey were analysed using descriptive statistics to infer results. Garret's Ranking technique was applied to rank the factors perceived by the tribes as having important contributions towards fish purchase and consumption. The responses were recorded from 1 to 5 for all factors; where the most important was ranked 5 and least important was ranked 1, and then converted into score value by using the Garret ranking method and standard formula.

RESULTS AND DISCUSSION

Fish and meat consumption profile of Koraga and Soliga tribes

Table 1 provides information on monthly per capita consumption (kg) of fish and different meat items by Koragas and Soligas. Among both tribes, fish consumption was above ICMR recommended levels (12 kg/annum) which is a very good sign as

Table 1. Per capita consumption of fish and other meat among Koragas and Soligas

S.No.	Meat consumed	Per capita consumption (kg)			
		Koragas		Soligas	
		kg/month	kg/year	kg/month	kg/year
1.	Fish	1.44	17.28	2.02	24.24
2.	Chicken	0.86	10.32	0.90	10.8
3.	Pork	0.26	3.12	-	-
4.	Mutton	-	-	0.24	2.88

far as extension efforts towards the alleviation of malnutrition are concerned. The fish consumption was also higher compared to that of other meat items. Per capita monthly fish consumption was 1.44 kg among Koragas and 2.02 kg for Soligas. While more than one-third of the Koragas (36%) consumed fish two to three times a week, 29 per cent of them reported having fish at least once a week. Meanwhile, in Chamarajanagar, 61 per cent of the Soligas consumed fish at least once weekly while nearly 15 per cent of them consumed fish twice a week. The other popular meat items were chicken, pork and mutton. Chicken consumption was relatively lower compared to fish in both regions, but was still a popular choice among the tribes. The per capita monthly consumption of chicken was 0.86 kg and 0.90 kg among Koragas and Soligas, respectively. The pork consumption was relatively lower than fish and chicken among Koragas with the per capita monthly consumption of only 0.26 kg. The per capita monthly consumption of mutton was 0.24 kg among the Soliga respondents. Vastly varying fish consumption profiles which range from way below the national average in the north zone of India (Sabater et al., 2008; Mugaonkar et al., 2011) to extremely high consumption in states like Tripura, Kerala, Goa and Assam have been already highlighted by various researchers (Prasad & Madhavi, 2014; Bhuyan et al., 2017; Shyam, 2020; Sajeev et al., 2021a; Shil et al., 2022).

Fish species preference among the tribes

The most commonly purchased fishes by the Koragas were Mackerel and Sardine which were preferred and consumed by all (Table 2). The other fish preferred by Koragas were Sole fish by 10.5 per cent of the respondents followed by Prawns (10.0%), Red Snappers (7.5%), Croakers (5.5%) and Cat fish (2.5%). The most favourite fishes consumed by the respondents were not found different from the ones frequently purchased by them.

Table 2. Fish species preference among the tribes

S.No.	Fish species	Purchased by % of Koragas	Fish species	Purchased by % of Soligas
1	Mackerel	100.0	Tilapia	100.0
2	Sardine	100.0	Catla	86.0
3	Sole fish	10.5	Sardine	6.5
4	Prawn	10.0	Kandhu (Shoulder fish)	2.5
5	Croaker	5.5		
6	Red snapper	7.5		
7	Catfish	2.5		

Koragas were found to have an affinity for marine fish since their availability was in plenty due to the presence of a large number of harbours in the Dakshina Kannada district. In the case of Soligas of Chamarajanagar, the species preference seemed entirely different with more preference for inland and farmed fish. This is rational because of the land-locked nature of the district and the non-availability of marine fish due to the large distance from the coastal harbours. Most Soligas preferred and purchased Tilapia (100%) and Catla (86%) followed by Sardine (6.5%) and Kandhu (Shoulderfish) (2.5%). Preference for marine fishes in coastal districts and farmed/river fishes in inland districts is obvious and has been reported recently among similar populations (Sajeev et al., 2021a, 2022).

Status and frequency of dried fish consumption among the tribes

Dried fish was the primary form in which trade and consumption of fish catches were done before the advent of technologies for ice-making and cold chains. Preservation allows for overcoming seasonal variations in fish abundance and scarcity throughout the year. Historical records globally dating back to a millennium show huge evidence of widespread production, storage, trade and consumption of dried fish (Fagan, 2017). Because of the easiness in storage and transport, dried fish reaches hinterlands where fresh fish is scarce.

Both Koraga and Soliga tribes were found consuming dried fish frequently (Table 3). While 64 per cent of Koraga tribes consumed dried fish monthly once, 54 per cent of the Soliga tribe did the same. On the other hand, the Soliga tribe consumes dried fish more frequently, which is twice a month (16%), whereas 16.5 per cent of Koragas consume dried fish at least weekly once. The weekly as well as monthly consumption frequency of dried fish among both tribes was found very satisfactory. The findings give scope for the development of products based on dried fish aimed at better health and alleviation of malnutrition.

Table 3. Frequency of dried fish consumption among the tribes

Frequency of consumption	Koragas (%)	Soligas (%)
Monthly once	64.0	54.0
Twice a month	1.5	16.0
Weekly once	16.5	9.0
Once in 2-3 days	16.0	11.0
Daily	2.0	10.0

Factors influencing the purchase and consumption of fish as perceived by tribes

Three broad categories namely products, indicators, and environment influence the selection and evaluation of any food product (Sparks & Shepherd, 1994) including fish. Though these factors vary with consumers, they are crucial to understand the important determinants of fish consumption. An increase in awareness of health benefits and increased consciousness regarding safety and quality have created new determinants of fish consumption (Sajeev et al., 2019) with a change in purchase behaviour (Sajeev et al., 2021b) in India. To rank the determinants

of tribal fish purchase and consumption, Garret's ranking method was applied. Among the 15 factors presented; 'price of fish' and the 'availability of favourite fish' were ranked as having the highest influence on their fish purchase behaviour by Koragas. Among Soligas, the 'availability of favourite fish' was ranked the most influencing factor, followed by 'convenience perception'. Wenaty et al., (2018) reported that the manifold factors affecting the consumption and purchase of fish included price, availability, accessibility, convenience and health concerns of the population. The geographic locations and socio-cultural features of consumers also were reported to affect the frequency and purchase of fish consumption (Can et al., 2015).

'Price of fish' was ranked as the most important factor affecting the purchase and consumption of fish among the Koragas (Table 4). The high retail fish prices nearing Rs. 200kg⁻¹ in Dakshina Kannada district during the period of study (2021-2022) were found to act as a barrier for fish consumption among Koragas. The lower percapita fish consumption among Koragas compared to Soligas may be attributed to the high price of marine fish in the region. 'Price of fish' was the third most contributing factor for Soligas. However, the supply and price of Tilapia and Catla, the most favoured fishes of Soligas, were found to be relatively stable compared to that of marine fishes favoured by Koragas. Birch et al., (2012); EUMOFA (2017) & Helsedirektorat (2020) also documented the factor, 'price of fish' acting as a barrier to the purchase of fish. The driver effect of 'affordable fish price' in the purchase of fish by Indians was confirmed by Prasad & Madhavi (2014) & Bhuyan et al., (2017).

For the Soliga tribes of Chamarajanagar, 'availability of favourite fish' was the most important determinant influencing their fish purchase. Tilapia and Catla were the most favoured fish species of Soligas. 'Availability of favourite fish' was the second most important determinant of fish purchase by Koragas with the marine fishes Mackerel and Sardine being their favourite fishes. Mugaonkar et al., (2011) reported species specificity among the majority of consumers during the selection and purchase of fish. It may be noted that unlike the dwindling availability of marine fish like sardines and mackerels (ENS, 2020), the availability and affordability of farmed fish like Tilapia and Catla were mostly stable over time. 'Non-availability of preferred species' was earlier identified by Christenon et al., (2017) as a hindering factor for fish consumption. Adequate supplies of fish and fisheries products drove fish consumption in China (Feng et al., 2009).

'Convenience perception' was ranked as the second most important determinant influencing the fish purchase behaviour of the Soligas (Table 4). Convenience refers to the saving of physical or mental energy and time, at all stages of the overall meal acquisition process. The meal planning process starting with shopping followed by storage, preparation and consumption ending with cleaning and disposal of fish waste as well as leftovers (Gofton, 1995; Bech, 2001; Olsen et al., 2007), all come under the issue of convenience. Most modern families consider activities like visiting fish markets, checking fish, handling fish, dressing and cooking fish as inconvenient and time-consuming (Sajeev et al., 2021b). The Soliga households also valued more free time and expressed high priority for 'convenience perception' since handling,

Table 4. Factors contributing to the purchase and consumption of fish by tribes

S.No.	Factors	Koragas		Soligas	
		Contribution (%)	Rank	Contribution (%)	Rank
1	Price of fish	7.68	1	6.66	3
2	Availability of favourite fish	7.36	2	10.42	1
3	Market accessibility	6.52	7	6.57	6
4	Health benefits	6.54	6	6.56	7
5	Safety of fish	6.69	4	6.57	5
6	Quality of fish	7.13	3	6.63	4
7	Convenience Perception	6.58	5	6.69	2
8	Sensory Perception	6.43	13	6.45	9
9	Knowledge of fish recipes	6.47	10	6.18	12
10	Place of origin of fish	6.46	9	6.00	14
11	Source of fish	6.46	11	5.99	15
12	Production Method	6.44	12	6.25	11
13	Information on fish sold in the market	6.49	8	6.53	8
14	Availability of dressing facility	6.36	15	6.35	10
15	Provision of home delivery	6.36	14	6.14	13

dressing and preparation of their favourite fishes like Tilapia and Catla were not found easy by most families. Added to the above; disposal of fish waste was another big issue for families living in congested colonies. Convenience and sensory perception were found to have a very important role in fish purchase and consumption by the mainstream population also (Gofton, 1995; Leek et al., 2000; Birch et al., 2012).

For Koragas, 'quality of fish' was another determinant having a high influence on their purchase decision (3rd rank) which attributes to the physical condition, freshness, quality and nutritional content of the fish (Bremner, 2000). Quality is a factor related strongly to the raw material itself (Grunert, 2002) and also connected to sensory perception (Wesson et al., 1979). Concerns regarding fish quality were found to act as a barrier to fish consumption among many consumers (Christenon et al., 2017). The lack of control over markets and helplessness in buying available fish without knowing the source has led to this response among Koragas. Being a landlocked district, Chamarajanagar also faced fish quality issues making Soligas record 'quality of fish' as a matter of concern (4th rank). Quality and freshness were identified as significant factors influencing fish purchase by many previous researchers (Mugaonkar et al., 2011; Birch et al., 2012; Geethalakshmi et al., 2013; Prasad & Madhavi, 2014).

CONCLUSION

The Soliga tribes were identified as having a higher fresh fish consumption rate than Koragas. The factors; fish price, availability of favourite fish and convenience perception were the most influential factors affecting purchase and consumption. However, the difference in the order of importance suggests regional differences in tribal preferences and purchase behaviour. Fish consumption can aid in the alleviation of nutritional and health vulnerability among Koragas and Soligas. Hence, the findings from this study can be useful for health department officials and policymakers in developing strategies to promote the purchase and consumption of fresh fish among these tribes. These findings will also aid fish vendors in more efficient marketing of fish and fish-based products

in Dakshina Kannada and Chamarajanagar districts. Further research is needed to identify the factors that influence fish purchase behaviour among the general population in comparison with the tribes of these districts.

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Exploring Stakeholder Attitudes towards Digital Agricultural Communication and Services

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ABSTRACT

Digital agricultural communication and services enhance agricultural production by delivering real-time data, information, and support to stakeholders, thereby substantially extending the reach and impact of agricultural extension. The study, conducted in 2023, encompassed all three agro-climatic zones within Telangana and employed an ex post facto research design. Data collection involved personal interviews with a sample size of 180 farmers, 30 input dealers, 30 extension personnel, and 30 scientists. The study found that more than half (57.04%) of the overall sample expressed favorable attitudes toward digital agricultural communication and services. Mean attitude scores varied, with scientists scoring the highest (172.87), followed by farmers (169.23), extension personnel (166.37), and input dealers (165.23). Regression analysis using selected independent variables produced R^2 values of 0.789 for farmers, 0.805 for input dealers, 0.720 for extension personnel, and 0.870 for scientists, indicating the effectiveness of the chosen independent variables in explaining changes in the dependent variable. These findings indicate the favourable attitude of stakeholders towards digital agricultural communication and services, laying a strong foundation for advancing digitalization in agriculture. This could enhance information dissemination and service improvements in the agricultural ecosystem.

INTRODUCTION

In an era where digitalization is reshaping industries and societies, its impact on agriculture, a vital sector, cannot be underestimated. Digitalization shapes modern society, impacting business and daily life (Hagberg et al., 2016). Digitalization innovates work, creates jobs, and boosts economies (Shallu et al., 2019). Digitalization employs ICT, including AI, IoT, and the fourth industrial revolution (Morley et al., 2018). Digital empowerment accelerates development through enhanced human

resource utilization (Dutta & Jeerh, 2023). Integrating digital tech in Indian agriculture is pivotal, with potential to revolutionize. It offers real-time info, expert advice, e-Services for efficient government delivery, reducing corruption, boosting transparency, convenience, and citizen empowerment (Dutta & Devi, 2015). Digitalization involves implementing digital technologies in individuals, organizations, or society (Brennen & Kreiss, 2016). Effective agricultural knowledge systems empower Indian farmers with vital information for informed decisions and farmers primarily rely on strong informal ties for accessing agricultural information

and services (Singh et al., 2023). Digital tools like mobile apps, IVR, Digital Kiosk, and social media enhance system efficiency and effectiveness (Rai, 2023). Digital communication transforms access to agricultural advisory services, bridging gaps between small-scale farmers and emerging markets (Zolkepli & Kamarulzaman, 2015). The integration of ICT in agriculture is a pivotal element of agricultural extension, aiming to advance rural and agricultural development through enhanced communication and information procedures (Dhaka & Chayal, 2010). The declining smartphone costs and budget-friendly options have broadened technology access. Social media's growing role in general and agricultural discourse is evident, with content aligning with user needs and user-friendly interfaces on these platforms (Nain et al., 2019; Sandeep et al., 2022).

In India's journey towards a digitally empowered future, initiatives like "Digital India" and digital agricultural platforms are shaping the trajectory of agricultural progress. Telangana stands out as a trailblazer, conducting a significant portion of its agricultural operations digitally. Innovative platforms in Telangana have transformed agricultural communication and services, benefiting stakeholders. These initiatives include "Mee-Seva" a platform that empowers citizens through smart governance, making government services easily accessible. "Dharani Integrated Land Records" has modernized agricultural land registration, ensuring transparency and efficiency. The "Rythu Bandhu and Rythu Bheema Portals" facilitates the registration and distribution of farm investment and life insurance support to farmers. The "Integrated Information Dissemination System (IIDS)" offers agricultural advisory services, while the "Online License Management System (OLMS)" streamlines processes of license issue. "OSSDS" (Online Subsidy Seed Distribution System) transforms agricultural seed distribution, and "Weather Based Agro-Advisory Services (WBAAS)" provides farmers with crucial weather intelligence. Agricultural institute social media initiatives are revolutionizing information dissemination, while mobile apps are underscored for efficient agriculture department management. Together, these digital platforms empower stakeholders, streamline processes, and enhance transparency, fostering agriculture's growth in Telangana. Given the pivotal role of digitalization in agricultural communication and services, examining stakeholders' attitudes towards digital agricultural communication and services is of paramount importance, as these attitudes have a direct and profound influence on the effective utilization of these digital initiatives. The success of any digital transformation in agriculture hinges on the willingness and enthusiasm of key stakeholders to embrace and integrate these technologies into their daily practices.

METHODOLOGY

The present study was conducted purposively within the state of Telangana during the months of March to June in 2023. Two districts from each agro climatic zones (ACZs) having at least one KVK selected by using random sampling. A total of thirty farmer respondents, along with five input dealers, five extension personnel, and five scientists from each districts, were chosen using a simple random sampling approach. The sample size included 60 farmer respondents from each ACZ, 10 input dealers from each

ACZ, 10 extension officers from each ACZ, and 10 scientists engaged in extension work from each ACZ. As a result, the comprehensive sample comprised 270 respondents. The ex-post facto research design was used for current investigation. Attitude in the study was operationalized as extent of favorable or unfavorable feelings expressed by respondents concerning the usability, responsiveness, quality, personalization, system availability, efficiency, and satisfaction associated with digital agricultural communication and services. A comprehensive attitude scale was constructed with six dimensions which was found statistically reliable ($r = 0.867$) and valid ($\sqrt{r_{11}} = 0.931$) was used for the study. The scale constitutes forty-eight statements was measured on five-point continuum i.e., strongly agree, agree, undecided, disagree, strongly disagree with score of 5,4,3,2,1 respectively for positive statements and inversely for negative statements. Primary data was gathered from all three ACZs with in Telangana. Mean and standard deviation was used to classify categories of least favorable, favorable and most favorable categories. The Kruskal wall is test was used to identify the significant difference among stakeholder's attitude levels. Spearman rank correlation (p value) was used to identify the relationship between attitude levels and profile characteristics. Regression analysis was carried out to check the extent of contribution of profile characteristics to attitude levels of digital agricultural communication and services.

RESULTS AND DISCUSSION

From Table 1, it can be observed that more than half (56.11%) of farmers respondents had most favorable levels of attitude towards usability dimension, favorable levels (69.44%) was observed in responsiveness dimension, most favorable (52.22%) in quality dimension, least favorable (55.00%) in personalization, favorable levels (46.67%) in system availability and efficiency dimension, and favourable levels (52.48%) was observed as high frequency categories in satisfaction dimension. In case of input dealers' favorable levels (63.33%) observed as majority in usability dimension, least favourable levels (63.33%) in responsiveness dimension, favorable levels (83.33%) in quality dimension, favorable levels (63.33%) in personalization dimension, favorable levels (90.00%) in system availability and efficiency dimension, and favorable levels (83.33%) was observed in satisfaction dimension. In the sample of extension personal favorable levels (76.67%) was observed as majority in usability dimension, favorable levels (83.33%) in responsiveness, most favorable levels (80.00%) in quality, favourable levels (76.67%) in personalization, favorable levels (83.33%) in both system availability and efficiency dimension and satisfaction dimension. Among scientists, most favorable levels (36.67%) were observed in usability, favorable levels (60.00%) were observed in responsiveness, most favorable levels (60.00%) in quality dimension, most favorable (50.00%) in personalization, favorable levels (63.33%) in system availability and efficiency and favorable levels (60.00%) as high frequency groups in satisfaction. The dimension quality ranked top among famer sample with mean score of 3.71, followed by usability (3.64), satisfaction (3.55), system availability and efficiency (3.42), responsiveness (3.39)

Table 1. Dimension wise distribution of Stakeholders in attitude towards digital agricultural communication and services

S.No.	Characteristics	Category	Farmers (n=180) %	Mean Rank	Input dealers (n=30) %	Mean Rank	Extension personnel (n=30) %	Mean Rank	Scientists (n=30) %	Mean Rank
1.	Usability (Mean 32.50 $\frac{1}{2}$ S.D 0.99)	Less favourable < 31.51 Favourable 31.51 – 33.49 More favourable > 33.49	12.78 31.11 56.11	3.64 (II)	20.00 63.33 16.67	3.63 (II)	10.00 76.67 13.33	3.49 (III)	33.33 30.00 36.67	3.66 (II)
2.	Responsiveness (Mean 23.73 $\frac{1}{2}$ S.D. 0.85)	Less favourable > 22.88 Favourable 22.88 – 24.58 More favourable > 24.58	12.22 69.44 18.33	3.39 (V)	63.33 16.67 20.00	3.33 (VI)	13.33 83.33 03.33	3.32 (VI)	06.67 60.00 33.33	3.49 (VI)
3.	Quality (Mean 29.61 $\frac{1}{2}$ S.D. 0.83)	Less favourable < 28.78 Favourable 28.78 – 30.44 More favourable > 30.44	11.11 36.67 52.22	3.71 (I)	10.00 83.33 06.67	3.68 (I)	06.67 13.33 80.00	3.71 (I)	10.00 30.00 60.00	3.78 (I)
4.	Personalization (Mean 23.80 $\frac{1}{2}$ S.D. 0.90)	Less favourable > 22.90 Favourable 22.90 – 24.70 More favourable > 24.90	55.00 13.33 31.67	2.98 (VI)	16.67 63.33 20.00	3.34 (V)	06.67 76.67 16.67	3.38 (IV)	06.67 43.33 50.00	3.51 (V)
5.	System availability and efficiency (Mean 30.77 $\frac{1}{2}$ S.D. 1.20)	Less favourable < 29.58 Favourable 29.58 -31.97 More favourable > 31.97	29.44 46.67 23.89	3.42 (IV)	10.00 90.00 00.00	3.35 (IV)	06.67 83.33 10.00	3.35 (V)	06.67 63.33 30.00	3.52 (IV)
6.	Satisfaction (Mean 28.34 $\frac{1}{2}$ S.D 1.04)	Less favourable < 27.30 Favourable 27.30 – 29.39 More favourable > 29.39	23.33 52.48 23.89	3.55 (III)	03.33 83.33 13.34	3.48 (III)	10.00 83.33 06.67	3.59 (II)	13.33 60.00 26.67	3.63 (III)

and least ranked was personalization (2.98). The dimension quality ranked top with the mean score of 3.68 in input dealers, followed by usability (3.63), satisfaction (3.48), system availability and efficiency (3.35), personalization (3.34), and responsiveness (3.33). Again, quality was observed as top dimension among extension personnel with mean score of 3.71, followed by satisfaction (3.59), usability (3.49), personalization (3.38), system availability and efficiency (3.35) and least ranked was responsiveness (3.32). The dimension quality ranked top with the mean score of 3.78, followed by usability (3.66), satisfaction (3.63), system availability and efficiency (3.52), personalization (3.51) and dimension ranked least was responsiveness (3.49).

The analysis of stakeholder attitudes towards digital agricultural communication and services under various dimensions provides valuable insights into their preferences. Across various dimensions, the responses highlighted distinct patterns within different stakeholder groups. The dimension of quality consistently emerged as the top-ranking factor among farmers, input dealers, extension personnel, and scientists, indicating its universal importance. This suggests that stakeholders highly value the reliability, effectiveness, and overall excellence of digital agricultural services. The usability dimension was consistently ranked favorably, showcasing the significance of user-friendly interfaces and easy navigation in enhancing stakeholders' experiences. Satisfaction also garnered positive ratings, emphasizing the importance of meeting stakeholder expectations and ensuring their contentment with the services provided. The dimensions of system availability and efficiency were moderately rated, underlining the significance of accessible and efficient digital platforms in supporting stakeholders' needs. Personalization and responsiveness, however, appeared as dimensions that were less favored suggesting need to focus on tailoring services to individual preferences and improving response times to ensure stakeholders feel valued and adequately supported.

From Table 2 it can be observed that majority of the farmers had favourable levels (65.00%) of attitude towards digital agricultural communication and services, followed by most favorable levels (18.33%) and least favourable levels (16.67%). Favourable levels (53.33%) were observed as majority in input dealers, followed by least favourable (26.67%) and most favorable (20.00%). Most favorable levels (50.00%) as high frequency group among extension personnel, followed by favourable levels (33.33%) and least favorable levels (16.67%). Most favorable levels (56.66%) observed as majority among scientists, followed by favourable levels (36.67%) and least favourable levels (06.67%). In overall sample the majority belonged to favourable levels (57.04%), followed by most favourable levels (26.30%) and least favourable levels (16.67%). A similar trend was reported by Reddy et al., (2017); Panda et al., (2019), Panda et al., (2019b); Nirmalkar et al., (2022) in attitude towards usage of Information Communication Tools.

Turning to the results from Table 2, it is evident that stakeholders generally hold favorable attitudes towards digital agricultural communication and services. The majority of farmers, input dealers, extension personnel, and scientists displayed either favorable or most favorable attitudes, indicating a positive overall attitude of these digital initiatives. This suggests that there is a growing recognition of the benefits and value that digital tools

Table 2. Overall attitude of stakeholders towards digital communication and services respondent wise

Category	Farmers (n ₁ =180) %	Input dealers (n ₂ =30) %	Extension Personnel (n ₃ =30) %	Scientists (n ₄ =30) %	Total (n=270) %	H value
Less Favourable (< 163.08)	16.67	26.67	16.67	06.67	16.67	27.916**
Favourable (163.08 – 174.41)	65.00	53.33	33.33	36.67	57.04	
More Favourable (> 174.41)	18.33	20.00	50.00	56.66	26.30	
Mean	169.23	165.23	166.37	172.87	168.74	
S.D.	12.15	5.85	5.94	12.96	11.34	

Mean 168.74 $\frac{1}{2}$ S.D. 5.67** Significant at 1 % levels

bring to the agricultural sector. Stakeholders' attitudes could be positively influenced by offering personalized experiences. Implement features that allow users to customize their interactions with digital platforms based on their specific needs and preferences. Address the lower rankings in responsiveness by ensuring quick and effective responses to stakeholder inquiries, concerns, or feedback. This will contribute to a sense of importance and engagement among stakeholders. Use feedback from stakeholders to continuously refine and improve digital services. Demonstrating a commitment to addressing their needs will foster a sense of partnership and collaboration.

From Table 2 it can be observed that the mean (172.87) of scientists was top, followed by farmers (169.23), extension personnel (166.37) and input dealers (165.23). The Kruskal Wallis test used to identify any significant differences between that stakeholder's attitude. The H value was found to be 27.916 which is greater than the H critical value at both 5 per cent (7.82) and 1% (11.34) levels of significance. Hence, it can be concluded that there is a significant difference in the attitude levels of stakeholders towards digital agricultural communication. The significant difference in attitude levels among stakeholders towards digital agricultural communication could be attributed to various factors. Scientists, likely more technologically oriented, may have higher expectations and appreciation for the benefits of digital communication. Farmers, primarily recipients of information and services, tend to be content and satisfied with the content and system responses. In contrast, extension personnel and input dealers, who actively engage with these digital systems, report subpar experiences, leading to lower attitudes. These varying roles and experiences contribute to the observed differences in attitudes. Recommendations to bridge the gap in attitudes toward digital agricultural communication among stakeholders include tailoring communication strategies, customizing content, and fostering collaboration among scientists, farmers, extension personnel, and input dealers. Providing digital literacy training, creating feedback mechanisms, and raising awareness can be instrumental in achieving this goal.

From Table 3 it was observed that age and professional experience was found negative and significant relationship with attitude towards digital agricultural communication and services among farmers sample. The results are supported by Mahajan et al., (2022) and Chandra et al., (2023). The variable IT savvyness, orientation towards digitalization, innovativeness, achievement motivation, self-confidence, economic motivation and risk orientation was found positive and significant relationship with

attitude towards digital agricultural communication and services among farmers sample. The results are in support with Prasad & Pradhan (2019) and Chandra et al., (2023). R² value was found 0.789 in farmers sample indicating that, the 78.90 per cent variation in the attitude towards digital communication and services was explained by selected independent variable.

The variable age, orientation towards digitalization, innovativeness and economic motivation was found significantly contributing to attitude levels of farmers was observed in regression analysis. Based on the observed results, it is suggested that include promoting digital literacy and innovation among farmers improve their attitudes toward digital agricultural communication. Encouraging achievement motivation, self-confidence, and economic incentives can enhance their positive disposition. Tailoring age-appropriate training and addressing risk concerns should also be considered to further boost attitude levels. The variables age and professional experience was found negatively significant relationship and innovativeness was found positive and significant relationship with the with attitude towards digital agricultural communication and services in the input dealer's sample. R² value was found 0.805 in input dealers sample indicating that, the 80.50 per cent variation in the attitude towards digital communication and services was explained by selected independent variable and leaving rest to extraneous. The variables innovativeness and economic motivation was found significantly contributing to attitude levels in regression analysis among input dealers. Based on the results for input dealers, it is recommended to emphasize and nurture innovativeness as a key attribute. Additionally, incentivizing economic motivation can enhance their attitudes toward digital agricultural communication and services. Addressing age-related concerns remains crucial for optimizing their positive disposition towards digital tools and services. The variable innovativeness, achievement motivation and self-confidence were found positive and significant relation with attitude towards digital communication and services. R² value was found 0.720 in extension personnel sample indicating that, the 72.00 per cent variation in the attitude towards digital communication and services was explained by selected independent variable and leaving rest to extraneous. The variable IT savvyness, orientation towards digitalization, self-confidence and economic motivation was found significantly contributing to attitude levels was observed in regression analysis.

The variables IT savvyness, orientation towards digitalization, innovativeness, achievement motivation, self-confidence, economic motivation and risk orientation was found positive and significant

Table 3. Relationships and contribution of profile characteristics towards attitude levels of stakeholders (n=270)

S.No	Variable	Farmers (180)		Input dealers (30)		Extension personnel (30)		Scientists (30)	
		Spearman rank correlation p value	Regression analysis t-value	Spearman rank correlation p value	Regression analysis t-value	Spearman rank correlation p value	Regression analysis t-value	Spearman rank correlation p value	Regression analysis t-value
1	Age	-0.913**	-3.441**	-0.581**	-1.597 ^{NS}	-0.185 ^{NS}	0.866 ^{NS}	-0.003 ^{NS}	1.682 ^{NS}
2	Professional experience	-0.736**	0.092 ^{NS}	-0.449*	-1.136 ^{NS}	-0.243 ^{NS}	-1.234 ^{NS}	0.058 ^{NS}	-0.270 ^{NS}
3	Experience in digital gadget usage	-0.092 ^{NS}	0.651 ^{NS}	0.279 ^{NS}	0.385 ^{NS}	-0.201 ^{NS}	1.675 ^{NS}	0.039 ^{NS}	-0.373 ^{NS}
4	e-Readiness	0.132 ^{NS}	0.782 ^{NS}	0.252 ^{NS}	1.296 ^{NS}	-0.001 ^{NS}	0.218 ^{NS}	0.327 ^{NS}	-0.630 ^{NS}
5	Possession of electronic gadgets	0.072 ^{NS}	-0.853 ^{NS}	-0.023 ^{NS}	-1.164 ^{NS}	0.135 ^{NS}	1.467 ^{NS}	0.046 ^{NS}	1.260 ^{NS}
6	IT savvyness	0.732**	-0.153 ^{NS}	-0.101 ^{NS}	1.770 ^{NS}	0.295 ^{NS}	2.713**	0.937**	0.849 ^{NS}
7	Orientation towards digitalization	0.890**	-2.130*	-0.072 ^{NS}	-1.615 ^{NS}	0.258 ^{NS}	-2.198*	0.951**	0.535 ^{NS}
8	Innovativeness	0.699**	2.905**	0.664**	2.966**	0.432*	2.053 ^{NS}	0.902**	2.841*
9	Achievement motivation	0.244**	-0.266 ^{NS}	-0.164 ^{NS}	0.609 ^{NS}	0.370*	1.454 ^{NS}	0.872**	-0.789 ^{NS}
10	Self confidence	0.881**	1.699 ^{NS}	0.003 ^{NS}	1.012 ^{NS}	0.590**	4.895**	0.694**	0.859 ^{NS}
11	Economic motivation	0.862**	-2.256*	-0.143 ^{NS}	2.854*	0.322 ^{NS}	-2.497*	0.890**	-1.628 ^{NS}
12	Risk orientation	0.874**	1.387 ^{NS}	-0.149 ^{NS}	0.666 ^{NS}	0.322 ^{NS}	-0.580 ^{NS}	0.677**	0.465 ^{NS}
R square value		R ² = 0.789		R ² = 0.805		R ² = 0.720		R ² = 0.870	

NS- Non significant * Significant at 5% level ** Significant at 1% level

relationship with attitude towards digital communication and services in scientist sample. R² value was found 0.870 in scientist sample indicating that, the 87.00 per cent variation in the attitude towards digital communication and services was explained by selected independent variable and leaving rest to extraneous. The variable Innovativeness was found significantly contributing to attitude levels was observed in regression analysis and results are supported by findings of Chandra et al., (2023).

From the above overall results, it is suggested that develop training programs that cater to different age groups, addressing the negative relationship between age and attitude towards digital agricultural communication. Provide targeted training resources that take into account the preferences and learning styles of various age segments, fostering their confidence and skills in using digital tools effectively. Offer workshops and resources that focus on improving IT savvyness and fostering a digital orientation among stakeholders. These initiatives can help overcome the negative impact of age and professional experience on attitudes, ensuring that participants feel more comfortable and enthusiastic about adopting digital agricultural communication and services. Design campaigns that highlight the positive relationship between innovativeness, achievement motivation, and attitudes. Showcase success stories of farmers who have embraced digital tools to achieve remarkable results in their agricultural practices. Encourage a culture of innovation and celebrate the accomplishments of tech-savvy farmers. Recognizing the positive correlation between self-confidence and attitudes, implement programs that aim to boost the self-confidence of stakeholders in using digital tools. Offer skill-building workshops and mentoring sessions that empower individuals to navigate and leverage digital platforms effectively. Leverage the positive relationship between economic motivation and attitudes by introducing incentive-based programs that highlight the potential economic gains from using digital agricultural communication services. Offer rewards, discounts, or access to exclusive benefits to motivate stakeholders to adopt and engage with digital tools.

CONCLUSION

Digital agricultural communication and services offer the potential to provide real-time insights, expert knowledge, and market trends, empowering farmers and promoting sustainability. As technology and agriculture converge, bridging information gaps, enhancing communication, and refining decision-making processes become paramount. Understanding stakeholders' attitudes towards digital agriculture is vital. Farmers predominantly hold favorable views, with a substantial portion highly positive. Input dealers and extension personnel display positive attitudes, albeit varying. Scientists exhibit the most highly favorable perspectives. To enhance stakeholder attitudes, focus on personalization and responsiveness in digital tools is essential. Tailoring services and ensuring prompt, personalized responses boost satisfaction. Promoting innovation, addressing age-related concerns, and offering targeted training can bridge attitude gaps, fostering enthusiastic adoption of digital technologies. Fostering positive attitudes toward digital agricultural communication is crucial as technology and agriculture harmonize, ushering in an era of informed choices and sustainable practices in Indian agriculture.

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Unveiling the Food and Income Insecurity among Farm Households of Lucknow, Uttar Pradesh

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ABSTRACT

The study was conducted during 2022-23 to assess the level of food insecurity and income status among farm households. Data from 474 farmers through personal interview method were collected. Agriculture was the primary occupation for most households followed by off-farm activities. Average per capita annual income (Rs. 1,00,073) was lower than the national average. The per capita annual income was Rs. 73,303, Rs. 93,256 and Rs. 1,44,456 for marginal, small, and medium farmers, respectively. About 47 per cent of the expenditure was made on consumption. A comparison of calorie intake to recommended calorie intake indicated that food insecurity was prevailing among 26 percent of the farmers. The major contribution to calorie intake was from cereals, the consumption of vegetables and fruits was low. A decision tree model using machine learning algorithms was used to identify the factors influencing food security. Per capita income, family size, consumption expenditure, social participation, and land holdings had significant importance in classifying the households as food secure and insecure. Diversifying farm activities and creating additional opportunities in rural areas, teaching households about balanced diets, promoting home gardening, and institutional policies to improve food security may be the strategic points.

INTRODUCTION

Food security is still difficult to achieve in many agriculturally dependent rural areas of Asian and African countries. Food insecurity is a worldwide problem that threatens every country, especially developing countries (Gebre, 2012; Zakari et al., 2014). Indian agriculture has made tremendous achievements, and now India is not only a self-sufficient country with regard to food grain production but also a leading exporter. Despite this achievement, India is now ranked 107th out of 121 nations on the Global Hunger Index for the year 2022, however there are some ambiguity in its methodology (PIB, 2022b). Food availability is important, but so is a family's financial stability so that they can afford to buy food

(Dhamija et al., 2021). Although food production is sufficient, poverty remains a significant barrier to food security in many rural areas. The changes brought about by NFSM and RKVY-RAFTAAR, before and after launch revealed a significantly higher socio-economic impact on the beneficiary farmers (Vijayan et al., 2022; Vijayan et al., 2023). Uttar Pradesh is one of the most agriculturally important states in India. According to the National Family Health Survey (NFHS-4) conducted in 2015-16, around 35 per cent of households in rural Uttar Pradesh experienced food insecurity to varying degrees which is mainly attributed to the poverty level. However, in recent days the State has made progress and 3.4 crore people escaped from multidimensional poverty (TNN, 2023). Lucknow is one of the major mango fruit belts in Uttar Pradesh.

Mango cultivation is the major source of livelihood for the farmers, but its contribution to sustaining livelihood has diminished over the years (Mishra et al., 2019). Unemployment and under employment have made food insecurity worse. Without a reliable source of income, it can be difficult for people to buy enough food to sustain themselves and their families. Firsthand knowledge of farmers' current status of income, employment and food insecurity is vital to developing strategies to increase farmers' income and food security. Food and income insecurity can be studied at various levels, i.e., global, national, regional, and household levels, but the food insecurity at the national level does not necessarily explain the food insecurity among households (Rautela et al., 2020). Knowing the causes of food insecurity allows for the identification of at-risk households and the development of more effective strategies to reduce poverty. Despite growing attention to the issue of food security, little is known about the socioeconomic factors, and differential significance of various ecosystems' contribution and knowledge of users (Rejula et al., 2017) that lead to food insecurity on a household level in rural areas. In light of the scarcity of information on the level of food insecurity among local households, this investigation was undertaken to answer two research questions: what is the level of food insecurity and income status among the rural households of the area, and what are the factors contributing to food insecurity? This study defines key indicators to measure the progress made to reduce food insecurity.

METHODOLOGY

The baseline survey was conducted in three villages (Dhakhava, Bhanpur and Hasnapur) of Lucknow district. Purposive sampling was adopted in selection of the villages as the interventions are planned to reduce food and income insecurity. Random sampling was employed for the selection of respondents. Data were collected from 474 farm households through personal interview method. Wealth index was constructed using the variables concerning asset ownership (Smits & Steendijk, 2015; Aditya et al., 2019). In this study, principal component analysis was used for the construction of weights as used by Balaganesh et al., (2020) & Mishra et al., (2023). Based on the computed wealth index, the households were categorized as high, medium and low using quantile approach. Howe et al., (2009) reported that quantile approach for categorization was the most preferable approach. The quantity of each food item consumed by the household was converted into its calorie content by multiplying all respective food items (kg) by the corresponding food energy content, referring to Longvah et al., (2017). This was further converted into per capita calories by dividing the estimated total household calorie

intake by the adjusted household size in adult equivalent (consumption unit). A household whose daily per capita calorie intake exceeded the recommended level (2400 kcal per capita per day) was regarded as food secure, whereas others were considered food insecure (Bellundagi et al., 2020). The decision tree classification methodology was employed for the development of prediction algorithms pertaining to a certain target variable (Song & Ying, 2015; McCordic et al., 2022). The proposed methodology involves the classification of the respondents into secure and insecure households that resemble branches, forming an inverted tree structure. This structure consists of a root node, internal nodes, and leaf nodes. The decision tree model was created using the "rpart" tool in the R programming language. The dataset was partitioned into separate sets for training and testing purposes. The model was constructed using a train dataset and subsequently predicted and evaluated for its accuracy in predicting using test dataset. Accuracy in a decision tree model is the ratio of correctly predicted instances to the dataset's total occurrences. For more comprehensive evaluation of the model's performance precision, recall, F1-score, and ROC-AUC were used (Chang et al., 2022).

RESULTS AND DISCUSSION

Occupational structure (Table 1) is indeed one of the underlying causes of food insecurity because incomes from different occupations have a positive effect on food security (Barrett, 2010). The per capita annual income and expenditure details of the households are represented in Table 2. It was noticed that agriculture was the major primary occupation for all three categories of farm households (> 95%). Agriculture income contributes around 43 and 61 per cent of total income respectively in case of small and medium farmers. Though agriculture was the major primary occupation for marginal farmers its contribution to total income was just 22 per cent and was less than income from off farm activities as well as daily wage income (27% each). The contribution of agriculture in the sustenance of livelihood of marginal and farmers was marginalized. This is because of low agriculture land and migration of farmers to nearby cities. It was noticeable that more than half of the marginal (63%) and small (52%) farm households were also working as farm laborers to meet their livelihoods. The off farm activities such as livestock rearing and nursery contributed to about 26 per cent of the total income in case of marginal and small farmers. Daily wage contributed to 27 and 16 per cent of total income in case of marginal and small farmers, respectively. The per capita annual income was Rs. 1,00,073 for all the farm households in totality was less than the national average. The National Statistical Office said the estimated annual

Table 1. Occupational details of the households (%)

Particulars	Marginal		Small		Medium		Overall	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Agriculture	95	5	99	1	99	1	97	3
Off farm activities	0.5	68	0	85	1	92	0.50	79
Agriculture labour	4	63	1	52	0	30	2	51
Daily wages	1	53	0	55	0	52	0.25	53
Job	0	6	0	6	1	7	0.25	6
Petty shop	0	8	0	6	0	7	0	7

Table 2. Per capita annual income and expenditure pattern of the households

Particulars	Marginal	Small	Medium	Overall	F value
Income (Rs.per capita per annum)					
Agriculture	15949(22)	39842(43)	88781(61)	44273(44)	160.43**
Off farm activities	19690(27)	24105(26)	27776(19)	23303(23)	10.66**
Agriculture labour	10656(15)	8828(9)	8153(6)	9415(9)	0.23 ^{NS}
Daily wage	20085(27)	14468(16)	12079(8)	16177(16)	13.41**
Salary	3465(5)	3402(4)	5585(4)	4088(4)	1.32 ^{NS}
Petty shop/Business	3459(5)	2611(3)	2081(1)	2818(3)	0.72 ^{NS}
Total income	73,303	93,256	1,44,456	1,00,073	145.21**
Expenditure (Rs. per capita per annum)					
Consumption expenditure	23990(50)	23219(46)	23152(44)	23532(47)	0.24 ^{NS}
Non consumption expenditure	24178(50)	27226(54)	30000(56)	26745(53)	6.30**
Total expenditure	48,168	50,445	53,152	50,277	1.16 ^{NS}

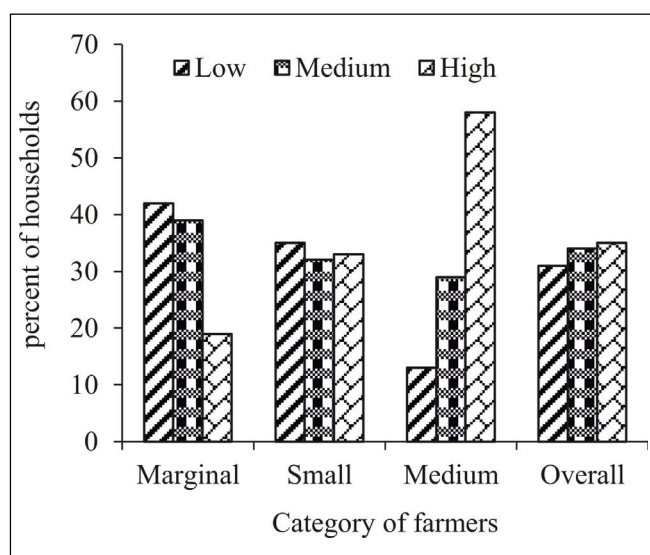
Note: 1. Figures in parenthesis indicate percent to total and 2. ** indicates significance at 1 and 5 percent, respectively.

per capita income (net national income) at current prices for 2022-23 stands at Rs. 1,72,000 per annum (PIB, 2023). As per the Situation Assessment Survey (SAS), average monthly income per agricultural household in Uttar Pradesh was Rs. 96,732 per annum (PIB, 2022a) for agricultural year July 2018- June 2019. However, there was a huge significance difference in annual per capita income across different categories. Per capita yearly income was Rs. 73,303 for marginal farmers, Rs. 93,256 for small farmers and Rs. 1,44,456 for medium farmers in the study area. The per capita income increased with the increased land holdings. According to the findings of Sharma et al., (2018), the average annual income of a rural household in Uttar Pradesh was Rs. 96,199.

The per capita annual expenditure of the farm households in the study area was Rs. 50,277. The per capita annual expenditure was more in case of medium farmers (Rs. 53,152) and low in case of marginal farmers (Rs. 48,168). The per capita income as well as expenditure among various categories of households was significantly different. Of the total expenditure, consumption expenditure was about 47 per cent for all categories of farm households which was on a higher side. This is worrying as farmers are spending more on consumption than on saving or investment, which affects the long term sustainable economic growth. The higher per cent of consumption expenditure besides obtaining the subsidized food grains from Public Distribution System can be attributed to the lower income of the farmers. There was no significant difference in the consumption expenditure across the different farm categories. The share of consumption expenditure to total income was high for marginal farmers.

Wealth of the households

It was evident from the analysis that overall 31 per cent of the households belonged to the low category, while 35 per cent belonged to the high category of the wealth (Figure 1). About 58 per cent of medium farmers belonged to high wealth category, as against 33 per cent and 19 per cent in the marginal and small farmer categories, respectively. The wealth of the households across different categories of farmers had significant association. The percent of households belonging to the high category of wealth increased with the size of land holdings. The results are in line with the findings of Swathi Lekshmi et al., (2008).

**Figure 1.** Wealth status of the households

Extent of food insecurity among the households

The information on how different socio-economic groups consume calories from various food categories are depicted in Table 3. Cereals provide the highest energy to households (1310.68 kcal/CU/day) followed by edible oil (385.90 kcal/CU/day), milk and milk products (222.22 kcal/CU/day), and pulses (125.53 kcal/CU/day). Food system in the area is cereal based (mainly rice and wheat) and cereals were the main source of calorie intake across all category of farm households. According to National Institute of Nutrition, a healthy diet needs to include nearly 500 grams of vegetables and fruits accounting for at least eight per cent of the daily calorie intake. However, the consumption of vegetables and fruits was 376.66 grams per day and contributed to just 4.57 per cent of total calorie intake. Mango is the major crop in this area and the area available for vegetable production is very less and hence, there is a need to provide interventions in the form of nutria garden with production of diversified vegetable and fruit crops. About 150 m² area of planned nutrition garden is appropriate to medium size family consisting 5 to 7 members (Singh et al., 2019). Meenakshi et al., (2019) found that providing grow bags

Table 3. Comparison of dietary intake and level of food insecurity among the households

Particulars	Marginal	Small	Medium	Overall	F value
Calorie consumed from different food items (kcal/CU/day)					
Cereals	1315.73(11.85)	1281.48(11.54)	1329.17(11.98)	1310.68(11.81)	4.41*
Pulses	146.28(1.36)	139.34(1.29)	153.01(1.42)	146.47(1.36)	4.06*
Edible oil	384.06(0.90)	386.79(0.91)	387.75(0.91)	385.90(0.91)	0.06 ^{NS}
Nuts & Dry fruits	25.26(0.14)	27.88(0.16)	29.74(0.17)	27.31(0.16)	2.27*
Milk & milk products	206.82(6.55)	218.54(6.88)	247.54(7.75)	222.22(7.00)	6.94**
Meat & animal products	36.78(0.83)	35.55(0.76)	29.37(0.66)	34.22(0.76)	2.31 ^{NS}
Sugar & Junk foods	153.99(1.16)	170.88(1.29)	166.82(1.30)	162.35(1.24)	5.10**
Vegetables	95.22(10.61)	91.23(10.77)	95.64(10.66)	94.28(10.67)	2.23 ^{NS}
Fruits	16.89(0.59)	16.44(0.60)	17.43(0.72)	16.94(0.63)	0.21 ^{NS}
Spices	23.03(0.47)	22.59(0.46)	21.94(0.46)	22.58(0.46)	0.51 ^{NS}
Others	6.58(0.17)	7.14(0.18)	7.65(0.19)	7.05(0.18)	6.39**
Total calorie intake	2410.64	2397.87	2486.06	2430.00	7.26**
Food insecurity (%)	29	27	21	26	-

Note: 1. **-Significant at one per cent and NS- Non significant; 2. Figures in parenthesis indicates quantity consumed in kg per month

and vegetable seeds improved nutritional status. Apart from this, the consumption of milk and milk products is also less than the recommended intake.

Total calorie intake from consumption of all food items was higher in the medium farm farmers (2486.06 kcal/CU/day), followed by marginal farmers (2410.64 kcal/CU/day) and low in case of small farmers (2397.87 kcal/CU/day). The average calorie intake was 2430.00 kcal/CU/day in the study area. There was no significant difference across the groups in consumption of edible oil, meat and animal products, vegetables, fruits and spices but there was a significant difference in consumption of other food items across the groups. Majority of the farm households met the minimum calorie intake of 2400 kcal/capita/day as recommended by the ICMR for rural households. The food security analysis of the farm households revealed that, 74 per cent of the total farm households were food secure. About 21 per cent of medium farmers, 27 per cent of small farmers, and 29 per cent of marginal farm households were food insecure. Food security of the marginal farmers was poor. Gautam & Jha (2022) also reported that food security was low among marginal households. The study indicated that food security is still prevalent among 26 per cent of the farm households and this needs to be addressed. Apart from this, the lower level of income of the farmers in the region may affect the food security of the households in long run.

Decision tree classification model – factors influencing food security

A machine learning algorithm (decision tree classification model) was used to find out what factors affect the food security of farm households. According to Chodur et al., (2018), decision trees offer multiple advantages compared to standard regression approaches, particularly in terms of speed and the quality of outcomes. The dependent variable was a '0' or '1' variable, with '0' representing food insecurity and '1' representing food security. The structure of the decision tree suggests the class (either 0 or 1) based on the values of different conditions and attributes. The model employed a combination of continuous variables, including family size, land holdings, per capita income and expenditure, and

education attainment, as well as categorical variables for age, gender, social participation, livestock possession, and wealth. The model was constructed using the training dataset, and subsequent predictions were made using the test dataset. The accuracy of the model was assessed, revealing an 80 per cent accuracy rate. The precision of the model's performance was 0.90, indicating the proportion of correctly predicted positive instances out of all instances predicted as positive. The recall of the model's performance was 0.84, indicating the proportion of correctly predicted positive instances out of all actual positive instances. The F1-score achieved a value of 0.87, while the area under the curve was 0.70 indicating moderate discriminating power of the model. All of the conducted tests suggest that the model was well-suited for the given data. Predicting outcomes under multiple scenarios is made possible by the decision tree model (Figure 2). Each leaf in the tree represents a different possible outcome, and the nodes themselves represent conditions. Following the tree's branches leads to a prediction of whether or not a person is food secure. Each branch of the tree is based on a different set of situations or traits. The findings revealed that the outcome is influenced by food spending, family size, and social participation in households with a per capita income of less than Rs. 66,414 per year.

The size of the family had a negative effect on food security, but food spending and social activity both had favorable effects. Growing numbers of people have a ripple effect on global food production, threatening food security. Increased family size with less active household members, increases dependency and consumer spending thus reduces the ability to provide enough food for a household (Sugandh & Tawheed, 2022). Social participation in FPOs and SHGs can positively impact food security by enhancing agricultural productivity, income, knowledge, and access to resources, while also promoting sustainable practices, risk management, and community support. The influence of social participation on the outcome of individuals with an income below Rs. 66,414, expenditure on food below Rs. 22,629, and a family size of 4.5 or greater is an additional factor to consider. Households who possess the aforementioned criteria and engage in social

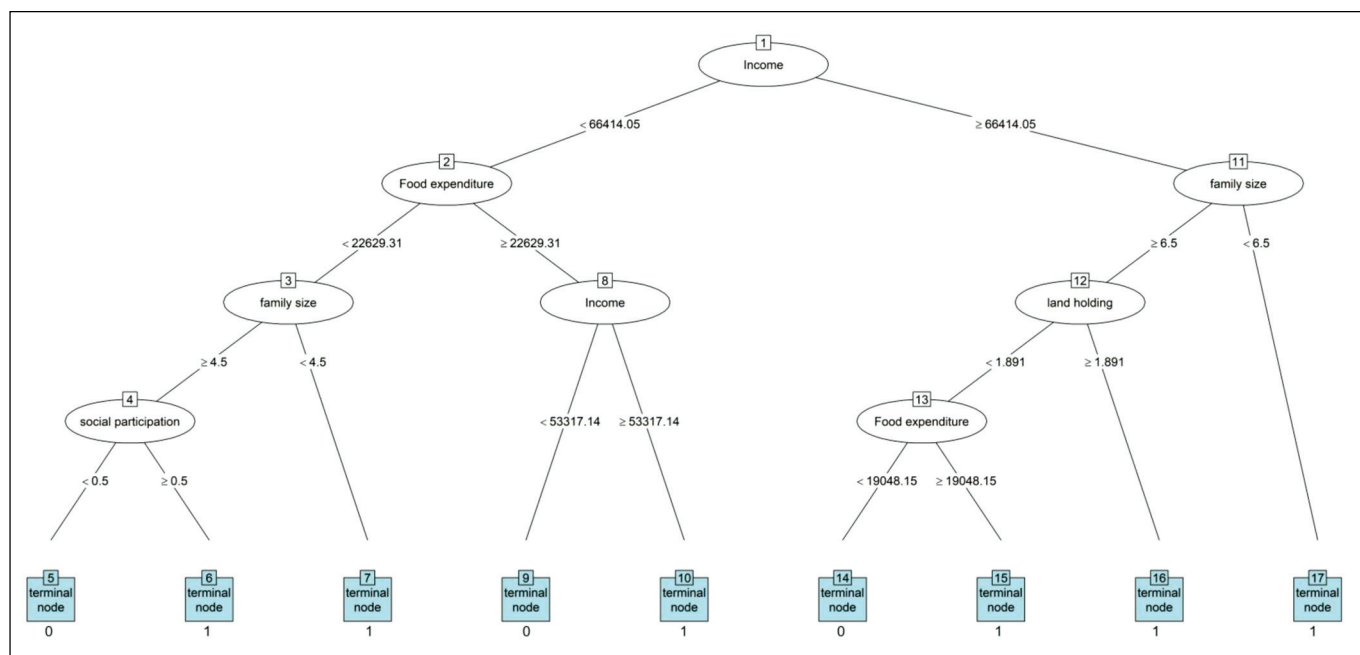


Figure 2. Decision tree model depicting the factors influencing food security of the farm households in the study area
 Note: '0' indicates food insecurity and '1' indicates food security.

participation have positive prediction towards food security else food insecure. This observation highlights the significance of social participation among farmers with low income. However, households with a family size of fewer than 4.5 exhibited food security. Conversely, in the event that the amount spent on food exceeds Rs. 22,629, the final result is again contingent upon the individual's income. If the income is below Rs. 53,317, the forecast yielded a negative outcome.

For those with an income of Rs. 66,414 or more, family size and land ownership are significant factors. If family size is greater than or equal to 6.5 and land holding is less than 1.89 acres, the outcome is influenced by food expenditure. In such cases, those with food expenditures below Rs. 19048 were predicted to be food insecure. On the other hand, families with an income greater than Rs. 66,414 and a family size greater than 6.5, as well as a land holding greater than 1.89 acres, were predicted to be food secure. In essence, increased land holding provides opportunities for diversification and economies of scale, thereby enhancing both food and economic security. In recent years, land fragmentation caused by family separation has worsened food security. Families with a household income of at least Rs. 66,414 and a family size less than 6.5 were predicted as food secure.

CONCLUSION

Most farm family subsisted on farming. Per capita income was poor, especially for marginal and small landholders. Mango cultivation was the dominant agricultural pursuit in the region, although its income-contributing capacity was jeopardized by various challenges necessitating the development of additional income-generating avenues within rural settings. Approximately 47 per cent of household spending went to consuming. The sample respondents' average per capita calorie intake was 2430 kilocalories,

almost meeting the recommended daily amount of 2400 kcal/capita/day. However, 26 per cent of respondents were food insecure. There is a need for educating households about balanced dietary habits to meet basic nutritional requirements. It is prudent for the area to encourage kitchen gardening that features a wide variety of fruit and vegetable crops. The study's findings highlighted that factors such as per capita income & expenditure, landholding size, family size and social participation were key influencers of food security.

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Adoption Pattern of Farm-Machinery based Solutions for *In-situ* Paddy Straw Management in Punjab

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ABSTRACT

Farmers burn paddy residues in the field harvested by combine harvester to prepare fields for sowing of the next crop in the narrow window between paddy harvesting and the next sowing. Punjab Agricultural University has carried out extensive research on farm machinery for *in-situ* paddy straw management and promoted technologies in Punjab from 2018 to 2022 under the “Promotion of Agricultural Mechanization for *in-situ* Management of Crop Residue” scheme. A survey was carried out to assess the adoption pattern of these technologies by Punjab farmers. The adoption of Happy seeder was maximum (16.80%) among different technologies during 2019 while Super seeder was preferred and accepted on a large scale (14.99%) during 2020. Farmers growing potatoes and other winter crops preferred residue incorporation using chopper, rotavator, MB plough, or harrow and adoption varied from 9.17 per cent to 20.4 per cent over five years. Overall, paddy straw management has increased from 20.49 per cent during 2016 to 49.91 per cent during 2023.

INTRODUCTION

The intensive rice-based cropping systems, particularly in north-western India are characterized by the use of combine harvesters on almost entire area and a narrow window of time for sowing of next crop. This system consists of a combination of farming techniques that include rice as the primary crop followed by the cultivation of other crops (Kumar et al., 2022). The situation predisposes farmers to burn paddy stubbles and loose straw in the combine harvested fields. Around 75-80 per cent of the area under paddy is combine-harvested, and loose paddy straw is burnt by farmers in the state to prepare the field for next crop (Singh et al., 2018). Farmers resort to burning to avoid the extra burden of additional tractor operations and heavy machinery.

Moreover, burning helps in destroying soil-borne insects, disease-causing organisms, and weed seeds in the surface soil layer. Approximately 23 million tonnes of paddy residue are burned in Punjab, Haryana, and Uttar Pradesh, leading to severe regional pollution. (Ravindra et al., 2019; Singh, 2018; IARI, 2020). Paddy straw, unlike wheat straw is used less as fodder due to its high silica content. Apart from environmental pollution, nutrients (N, P, K and S), precious soil organic carbon and microbial diversity are lost. According to estimates, one tonne of straw contains 400 kg of organic carbon, 5.5 kg of nitrogen, 2.3 kg of phosphorus, 25 kg of potash, and 1.2 kg of sulphur. Moreover, 50–70 per cent of micronutrients are lost through burning of straw, which results in expense of more than Rs. 200 crores (Sidhu et al., 2007).

Rice residues can be managed using *in-situ* (retention of rice straw on the surface as mulch on surface or incorporation of the residue into the soil by mixing or inverting) or *ex-situ* (use of paddy straw for energy, mulching, biochar, etc.) straw management technologies (Mahal et al., 2019). Among all available paddy straw management options, *in-situ* use of paddy straw is the most feasible, economical and sustainable option (Singh et al., 2020). Punjab Agricultural University has carried out research on farm machinery-based solutions for *in-situ* paddy straw management. The major technologies introduced are Happy Seeder, Super Seeder, Smart Seeder, paddy straw mulcher, cutter-cum-spreader, zero-till seed-cum-fertilizer drill, reversible mould board plough, rotavator etc. One solution module aimed at direct drilling of wheat seed in paddy stubbles, with retention of straw on the surface as mulch while another solution was based on incorporation of straw in the soil, which was an essential requirement for planting of vegetable crops like potato and pea (Singh et al., 2022). There has been significant scaling up of these technologies in the last 5 years. Government of India sanctioned a Central Sector Scheme on "Promotion of Agricultural Mechanization for *in-situ* Management of Crop Residue in the States of Punjab, Haryana, Uttar Pradesh and NCT of Delhi". At this point of time, a re-appraisal of technological and dissemination strategies seems relevant and to understand the adoption pattern of different paddy straw management technologies by Punjab farmers the present study has been undertaken.

METHODOLOGY

Under the patronage of Punjab Agricultural University and ICAR-ATARI, Ludhiana, there are 18 Krishi Vigyan Kendras working in different districts of Punjab (hereafter, PAU-KVKs). PAU-KVKs reached out to all stakeholders (including farmers, school/college students, NGOs, social influencers) through trainings and demonstrations, farmer-scientist interfaces, Kisan Melas, campaigns, literature, mass and social media. Elaborate campaigns were organized by PAU-KVKs for awareness and trainings for paddy straw management throughout October-November of 2018 to 2022 under this project.

To study adoption pattern of different crop residue management technologies, a survey was conducted every year in January month from 2017-18 to 2022-23. For this, five villages from three block of eighteen districts were selected on random. In each village, 10 farmers were selected on random for survey and questions about how crop residues were managed. Therefore, a total of 150 farmers were questioned for assessment of adoption pattern, and to identify the reasons for such adoption behaviour. Farmers employed different crop residue management techniques for retention or incorporation (partial or full) or removal (manual or by baler). Farmers retained the crop residue as mulch using three different machines such as Happy seeder, Smart seeder and Surface seeding. Happy Seeder directly seeds the wheat in residue-retained field without performing any preparatory tillage operations. Super Seeder incorporate the straw at shallow depth and sow wheat seed in lines. Smart Seeder works as a strip till drill and retains benefits of both Happy seeder and Super seeder in a single

machine. Smart Seeder places wheat seeds in a well-tilled narrow band of soil and covers seed rows and leave the inter-row area as such with residue on its surface. In surface seeding, wheat seed is broadcasted in the standing stubbles either manual or mechanical followed by chopping of straw by chopper-cum-mulcher. Farmers who managed rice straw by incorporation using chopper, rotavator, mould board (MB) plough, rotavator or harrow was categorized in one method of incorporation. The data about adoption pattern of different paddy straw management technologies was analysed using mathematical tools and weighted-arithmetic means were computed.

The Pearson correlation analysis was performed with the extent of adoption of paddy straw management technologies and profile characteristics of farmers viz., age, education, total land holding, annual income, experience, mass media exposure, extension contacts and social participation. Karl Pearson's product moment correlation coefficient (r) was used to find out the degree of relationship between independent (x) and dependent variable (y).

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

With a participatory approach, reasons for under-utilization of crop residue machinery were recognized and farmers were asked to give them ranking. The econometric analysis of this data was done by calculating Rank Based Quotient (RBQ) using the following formula:

$$RBQ = \frac{\sum fi (n+1-ith)}{N \times n} \times 100$$

where, fi = number of farmers reporting a particular reason under i^{th} rank, N = number of farmers, n = number of reasons identified

RESULTS AND DISCUSSION

A total of 430 training camps and 390 farmer-scientist interactions were conducted between 2018 and 2022 under the project (Table 1). Young minds of schools and college students were also sensitized for promotion and adoption of paddy straw management technologies. For mobilization of students, a total of 302 programs (such as *Prabhat Pheris*, poster competition, *nukkad natak*, etc.) were conducted with active participation of 52,061 students during 2018 to 2022 (Table 1). Along with that, several mass awareness programs such as farmers' fairs (*Kisan Melas*) and TV/Radio talks related with benefits of crop residue management and its technologies were organised. Beside this, extension literature related to technologies was distributed among all stakeholders. Various slogans in vernacular language were displayed at common places in the villages and these were written at village bus stop and boundary walls in large fonts for creating awareness and curiosity amongst general public.

Under the project, the states have distributed more than 2.42 lakh machines to individual farmers and more than 0.38 lakh machines to CHCs for the states of Punjab, Haryana, Uttar Pradesh, and Delhi NCR during 5 years from 2018 to 2023. Out of this, a total of 1.10 lakh machines were provided in Punjab only and year-wise details of machine supplied under central sponsored scheme is given in Table 2. PAU-KVKs procured a total of 550 implements related with crop residue management (such as Happy

Table 1. Extension activities conducted during 2018-2021

Extension activities conducted	2018-19		2019-20		2020-21		2021-22	
	Number	Beneficiaries (No.)	Number	Beneficiaries (No.)	Number	Beneficiaries (No.)	Number	Beneficiaries (No.)
Trainings	181	4,680	68	1,900	100	2,698	81	2,174
Farmer-scientists interface	62	7,943	102	7,335	134	6,176	92	5,850
Mobilization of school & college students	88	18,040	117	21,190	33	1,030	64	11,801
Kisan Melas	18	2,55,287	19	85,134	1	100	4	4,043
Campaigns	390	32,215	150	27,080	73	6,758	89	7,609
TV/radio talks	78	Numerous	31	Numerous	27	Numerous	20	Numerous
Extension articles	45		103		27		22	
Bulletins/manuals	20		9		5		78	
Literature distributed	2,20,750		2,06,624		1,91,481		1,57,056	
Wall painting (Sq Feet)	2,27,351		1,24,664		1,28,415		69,501	
Hoarding-banners	2,592		7,994		1,395		1,111	

Table 2. Machines supplied in Punjab under centrally sponsored scheme during five years

Name of Implements	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Happy seeder	9552	3223	541	224	37	13577
Super seeder	0	963	16734	8608	13324	39629
Paddy straw chopper	1623	4505	811	828	614	8381
Mulcher	2640	1888	1154	553	369	6604
RMB plough	2904	2948	1686	587	373	8498
Zero till drill	3372	7332	2842	2563	4028	20137
Super SMS	3628	695	1607	42	141	6113
Rotary slasher	384	270	7	273	0	934
Shrub Master	69	14	0	0	434	517
Cutter cum spreader	26	944	0	0	0	970
Rotavator	3549	286	0	0	0	3835
Baler	0	0	224	62	336	622
Rake	0	0	205	50	290	545
Reaper/Reaper Binder	0	0	0	6	17	23
Smart Seeder	0	0	0	0	10	10
Total	27747	23068	25811	13796	19973	110395

Source: Department Agriculture & Farmers Welfare, Punjab

seeder, mulcher/chopper, cutter-cum-shredder, mould board plough, rotavator, zero till drill, etc.) during 2018-19 to 2020-21 for demonstrations at farmers' fields. During these years, demonstrations on Super SMS, Happy seeder, Super seeder, Mulcher, MB plough, Zero till drill and Rotavator were conducted on thousands of hectares at the farmers' fields (Table 3). The perusal of data in Table 4 indicated that variables such as education, experience in farming and social participation had positive and significant relationship with adoption index at 1% probability. Mass media exposure and extension contacts had positive and significant relationship with adoption index at 5% probability. On the other hand, age had negative correlation with adoption behaviour of *in-situ* straw management technique.

It was observed that burning of paddy straw is practiced only in combine harvested fields for clearing loose paddy straw and/or standing stubbles (of 25-30 cm height), and to clear the fields for sowing of *rabi* crops (mainly wheat and potato). Only a narrow window of 2-3 weeks is available between harvesting of paddy and sowing of next crop. Innovative farm machinery

solutions developed at PAU, including Happy Seeder and Super Straw Management System (Super-SMS) formed the core of the technology dissemination initiative for the management of paddy straw without burning (Mahal et al., 2019). Super-SMS was developed and commercialized by Punjab Agricultural University, Ludhiana, to equip the operational combine harvesters in the state with mechanized straw spreaders, which help in uniform spreading of rice residue as a part of rice harvesting process itself. PAU had developed Happy Seeder in the year 2006 for direct sowing of wheat in the combine harvested paddy field. It was observed that only 0.23 per cent of area was managed by Happy seeder during 2018 which further increased in succeeding years (Table 5). The adoption of Happy seeder was maximum (16.80%) during 2019. Thereafter, Super seeder technology was demonstrated amongst farmers during 2020-21. Farmers accepted this technology on a large scale (14.99%) as this technology resonates well with farmers' psychology of clean cultivation as in conventional agriculture system. Two new mulching technologies viz., surface seeding and Smart seeder was also demonstrated at farmers' fields during 2021-

Table 3. Demonstrations conducted during 2018-19 to 2021-22

Demonstrations conducted	2018-19		2019-20		2020-21		2021-22	
	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)	Number	Area (ha)
Super SMS	1,376	2803.2	1004	2137	733	1166.5	948	2193.4
Happy Seeder	2,402	3224.4	2962	4325	1564	2330.5	879	1304
Super Seeder	-	-	-	-	284	701	840	1071.8
Mulcher	738	2152.4	1458	3173.8	636	1118.3	581	1108.8
MB Plough	469	910	835	1960.4	466	915.1	534	770.4
Zero till drill	-	-	679	959.2	944	1771.4	1155	1422.7
Rotavator	-	-	291	284.2	627	963	327	475.2

Table 4. Relationship of the socio-personal characteristics of respondents with adoption index of in situ management techniques

Independent variables	Karl Pearson (r value)
Age	-0.237*
Education	0.358**
Total land holding	0.111ns
Annual income	0.033ns
Experience	0.412**
Mass media exposure	0.386*
Extension contacts	0.267*
Social participation	0.382**

*Significant at 0.05 level; **Significant at 0.01 level; ns: Non-significant

22 and 2022-23, respectively. Area managed with residue incorporation using chopper, rotavator, MB plough or harrow varied from 9.17 to 20.4 per cent during 2018 to 2022. Farmers growing potato and other winter crops preferred this method over others for rice residue management. The perusal of survey data indicated that 12.44 to 21.30 per cent of rice residues were removed manually or with the help of baler. Overall, paddy straw management has increased from 20.49% during 2016 to 49.91% in 2023 (Table 5).

There are more than 1.0 lakh machines supplied on subsidy in the state of Punjab (Table 3). Out of these machines, about 50 per cent are with individual farmers, 39 per cent with custom hiring centres/farmer groups/panchayats/FPOs and 11 per cent are with cooperative societies. For the management of paddy straw, various machines are to be used in combination for complete operation/practice. The reasons for low adoption of paddy straw management machines and their under-utilization were also identified in the survey (Table 6). Paddy straw management machines involved high

cost, and are available with medium to large farmers. Large farmers who owned such machinery don't go for custom hiring due to various socio-political factors. The long duration varieties are sown on approximately 30 per cent area which leave short window for sowing of next *rabi* crop that also prompt farmers to burn the straw. The marginal and small farmers cannot afford buying these machines due to financial constraints, and mostly hire the services of these machines from CHCs or Co-operative Societies.

In the survey, farmers were asked about any difference in package/production technology and benefits from crop residue management technologies. They were of the view that there was significant reduction (80-90%) in the density of *Phalaris minor* at 25 days after sowing in the fields depending upon amount of straw retained as surface mulch. This is in agreement with the findings of Buttar et al., (2022). Also, wheat crop in which rice residue was retained on the surface as mulch (e.g. Happy seeder/Smart seeder/Surface seeding) escaped the negative effect of terminal heat stress in 2021-22. This is also reported by Singh et al. (2022).

In order to supplement use of crop residue management machinery, PAU stressed upon cultivation of short duration varieties of rice. Short duration varieties covered 70 per cent of *parmal* rice area and PR 126 was most popular variety covering 22 per cent area during *kharif* 2022. Short duration variety (PR 126) played a significant role in paddy straw management. This variety is recommended for general cultivation in the Punjab state during 2017 which matures in about 93 days after transplanting. Its average paddy yield is 81.9 quintals per hectare and can be transplanted from 25th June onwards taking only 93 days for maturity. PR 126 has 10 per cent less straw load (97.7 quintals per hectare) as compared to Pusa 44 (108.9 quintals per hectare) which take 128 days for maturity after transplanting. It provides a window period of 25-40 days between rice harvesting and wheat

Table 5. Adoption of paddy straw management (area in lakh ha) in Punjab

Practice	2016	2017	2018	2019	2020	2021	2022
Mulching (Happy Seeder)	0.69(0.23)*	0.25(0.85)	4.74(15.8)	4.98(16.80)	3.04(10.20)	3.04(10.26)	2.54(8.17)
Mulching (Smart Seeder)	-	-	-	-	-	-	0.14(0.47)
Mulching (Surface Seeding)	-	-	-	-	-	0.30(1.01)	0.34(1.10)
Partial Incorporation (Super Seeder)	-	-	-	-	4.46(14.99)	5.48(18.48)	4.50(14.47)
Incorporation (Chopper, Rotavator, MB, Harrow etc)	0.05(0.17)	0.18(0.61)	6.11(20.4)	6.19(20.90)	5.08(17.08)	3.63(12.22)	2.85(9.17)
Collection/ Removal with balers, manually etc (including Basmati)	6.03(20.09)	4.37(14.57)	6.41(21.3)	6.75(22.80)	4.72(15.83)	3.69(12.44)	5.15(16.53)
Total	6.15 (20.49)	4.81 (16.03)	17.25 (57.50)	17.92 (60.50)	17.30(58.10)	16.14(54.41)	15.52(49.91)

*Figures in parenthesis denote per cent area under each technology

Table 6. Ranking of reasons for low adoption of paddy straw management machinery by farmers

S.No.	Reasons	RBQ	Rank
1.	High cost of inputs/ machinery for marginal/small farmers	85.50	I
2.	Machines are available with medium to large farmers only	45.52	IX
3.	Individual farmers don't practice custom hiring services	55.56	VIII
4.	Lack of empathy for environment	40.60	X
5.	Socio-political factors	78.90	II
6.	No benefit of subsidy scheme to small farmers	52.00	VI
7.	Cultivation of long duration varieties	75.10	III
8.	Less involvement of Co-operative Societies for machinery hiring	60.60	V
9.	Non-availability of complete set of machines	68.20	IV
10.	Non-availability of matching tractor	49.50	VII

sowing as compared to 0-5 days of Pusa 44. Cultivation of short duration rice varieties saves 5-6 irrigations (~3000 cubic m per hectare), which in turn saves 740 crores of electricity subsidy. Further, it was observed that application of additional microbial decomposers did not improve the rate of decomposition in the available window, and no yield advantage in wheat was achieved.

Farmers were satisfied with crop residue management technologies. Keeping in view the global warming, it is important that farmers should be encouraged to adopt climate resilient agricultural technologies. This is in line with findings of Pabba et al., (2022). Farmers were of the opinion that residue retention or incorporation resulted in the improvement of soil structure and fertility. The continuous experiments related with crop residue management are being conducted in the Punjab Agricultural University (Gupta et al., 2022; 2023) and it is confirmed that there is almost 25, 35, 14 per cent increase in nitrogen, phosphorus and potassium, respectively in residue managed (incorporation/surface retention of residue) plots as compared to residue removed plots. The decrease in bulk density was observed with *in-situ* management of residue which reflected the improvement in soil structure and porosity. Survey data indicated that adoption rate of Happy seeder and Super seeder is increasing in past few years. Residue retention or incorporation continuously for 13 years increased soil organic carbon from 0.42 to 0.68-0.75 per cent. An increase in quality and quantity of soil organic carbon will finally improve the soil and crop productivity as soil organic matter acts as a source of plant nutrients and restorer of soil structure. It was observed in the continuous experiments that there was 8-10 per cent increase in productivity of rice-wheat cropping system from fourth year onwards. In Punjab, fire events successively decreased by 18.9-51.2 per cent in successive years from 2017 to 2022 compared to 2016. It has been observed that stubble burnt area was reduced by 79.51 to 69.44 per cent from 2016 to 2021. To reduce residual crop burning for sustainable agriculture, the government of India is also taking many lucrative and punitive measures (Rohilla et al., 2022). Air quality index (AQI) was also improved over these years from 'poor' (201-300) to 'moderate' (101-200) quality.

CONCLUSION

The implementation of paddy straw management technologies has gained great relevance with imposition of ban on the burning of paddy straw by the governments and restrictions imposed by

the Courts/National Green Tribunal. There are so many management alternatives available including *in-situ* and *ex-situ* management of crop residue. Different rice straw management techniques were used to manage 49.91 per cent area without burning during 2022. The *in-situ* residue management methods are sustainable solution for maintaining soil organic carbon, aggregate stability and porosity. The provision of monetary compensation for farmers or by ensuring the timely availability of residue management machines through custom hiring services or by *ex-situ* uses of paddy straw can prove to be better alternatives for addressing the State's paddy straw management problem. Additional extension services, active participation of all stakeholders and policy support is required to reduce the paddy straw burning further.

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Effect of ARYA Programme in Employment and Income Generation of the Rural Youths

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ABSTRACT

Rural youths are the future of India's progress in agriculture. In order to keep the interest of youths in agriculture and maintain their sustainable livelihoods, ICAR through its Agricultural Extension division has implemented Attracting and Retaining Youth in Agriculture (ARYA) programme through different identified KVKs in the country. Five KVKs from Odisha have been implementing this programme, out of which present research carried out in the Puri KVK in the year 2022, where the ARYA project has been focusing on four enterprises i.e., mushroom, poultry, apiary, fish production including fish seed with a total of 174 rural youths. After the implementation of ARYA, among the five enterprises promoted under ARYA, the performance of the mushroom enterprise gave the highest net income and highest average production. On the other hand benefit-cost ratio was higher in fishery enterprises. Various economic performance indicators showed a positive and significant relation with the social profile of the rural youths. The implementation of programme brought the convergence of several institutions to render technical support to rural youth.

INTRODUCTION

Agriculture remains fundamental to poverty reduction and economic growth especially for the developing countries for the 21st century (Pingali, 2010). Despite having one of the world's fastest-growing economies, a substantial portion of India still experiences hunger, poverty, marginalization, and social exclusion. The country's main employer, the agriculture industry, is accountable for ensuring that its workers have a sustainable and secure way of life (Som et al., 2018). India's rural population was over 70 per cent in 2007, down to 65 per cent in 2021, from about 80 per cent in the 1960s. To guarantee more equal and inclusive growth, the emphasis has been on enhancing the quality of life in rural areas (Indian Economic Survey, 2021-22). The investment in agriculture is additionally not capable to attract private firms

needed in marketing, processing, input supply and finance (Brooks et al., 2013). There is decreasing interest among youth in entering agriculture as they perceive it as an outdated field with minimal financial returns (Paisley, 2013). And due to better and diverse employment opportunities in cities, better pay or a more desirable job (Foster, 2014). Since a large number of rural youths are migrating to cities in search of work, agriculture-based entrepreneurship development is an important approach to minimize the outward migration (Singh et al., 2014; Singh et al., 2016; Nain et al., 2019; Ray et al., 2022)

India had 45.6 crores migrants compared to 31.5 crore migrants in 2001. Between 2001 and 2011, while population grew by 18 per cent, the number of migrants increased by 45 per cent. In 2011, 99 per cent of total migration was internal and immigrants comprised 1 per cent, (Census, 2011). There are several concerns

regarding getting youths involved in agriculture; in many cases, youths are not very interested in doing so since they don't consider agriculture as having many long-term career opportunities (Gandhi et al., 2001). Since 17 per cent of Indians lived in urban areas in 1951, the projected increase to 42.5 per cent by 2025 makes the migration scenario extremely concerning (Kurukshetra, 2012). So to retain the youth in agriculture requires to be made more profitable and a sustainable livelihood option. Keeping the importance of highly potential rural youth in agriculture, ICAR has initiated a programme "Attracting and Retaining Youth in Agriculture" in the year 2015 on 16th July with the focus to attract the rural youth towards agriculture and retain them by involving in agri-enterprises and making them agri-entrepreneurs. The major goal is to give rural youths the confidence they need to pursue farming as a viable career rather than seeking menial work in cities (Bairwa & Kushwaha, 2015).

Amid the corona virus outbreak and nationwide lockdown, massive reverse migration of people from urban areas to villages happened, which reiterated the focus of ARYA scheme with the several experts suggesting for full-fledged implementation of the scheme (Thakur et al., 2021) and also attain its objective to curb the rural youth migration and create productive and profitable employment. On this backdrop, present study was conducted to assess the effect of ARYA scheme in employment and income generation of the rural youths.

METHODOLOGY

The study was conducted in the state of Odisha, where five KVKs are engaged in implementing ARYA programme naming Nayagarh, Puri, Sambalpur and Ganjam. These 4 KVKs coordinated entrepreneurship development and provided assistance to trained youth in establishing and operating their own enterprises. Enterprises supported by KVKs include those for growing mushrooms, raising chickens, adding value, protecting crops, beekeeping, raising pigs, raising goats, raising ducks and fishing, and making vermicompost. In the current investigation, the Puri KVK was chosen as the site where the ARYA program was launched

during the year 2018–19 and has been focusing on four enterprises: mushroom, poultry, apiary, fish production, including fish seed. For the study, 174 rural youths who were having a firm (fulfilling the firm criteria mentioned in ARYA project) and working on the execution of the aforementioned four firms were selected. Only young entrepreneurs who were actively involved in the production of mushrooms, fish, honey bees, and poultry were taken into account in the study. Measurable economic performance indicators (before adopting ARYA and after adopting ARYA) were used in order to evaluate the success of the ARYA enterprises, including (i) average annual output (ii) average annual gross income (iii) average employment creation per year (iv) area (ac)/beneficiary (v), and cost of production (Rs/unit/yr). (vi) Market sale price per kilogram of the manufacturing Economic Return (Rs. per unit per year) (vii) Net Income (Rs. per unit per year) (viii) Sale value of the production in the market (Rs./kg). The data were collected with an interview schedule including all variables, developed for present study including Net annual income from ARYA enterprise, Net annual production cost from ARYA enterprise, indebtedness etc.

RESULTS AND DISCUSSION

The Puri district in Orissa has moderate and tropical climate. Humidity is high throughout the year, which is favorable to produce mushroom. The nutritional advantage of mushroom together with its capacity of income and employment generation prompted the scientists to strongly promote paddy straw mushroom (PSM), and the oyster mushroom as well.

ARYA project inculcated the practice of oyster mushroom production among the rural youths of Puri district is presented in Table 1. Average number of paddy straw mushroom increased upto 800 beds/year (58.13%). Average annual production increased upto 83.16 per cent. So far as the employment generation is concerned, mushroom enterprise increased upto 26 per cent of average employment generation/ year. Gross cost of paddy straw mushroom was Rs. 2,92,320 and net return was Rs. 1,49,520 for eight months. For oyster mushroom, the gross cost was Rs. 6,090 and net return was Rs. 3,390 in two months. The benefit cost ratio was 2.05,

Table 1. Effect of ARYA on mushroom enterprises

Measurable indicator of output in suitable unit			% increase	Economic of enterprise		
Before implementation of ARYA	After implementation of ARYA			Gross cost (Rs.)	Net return (Rs.)	BC Ratio
Avg. no. of bed/year: 1505 nos.	Avg. no. of PSM bed/year- 2380 + avg no. of oyster bags/year- 90		58.13	PSM for 8 months- Rs. 2,92,320 Oyster mushroom for 2 months- Rs. 6,090	For PSM- Rs. 1,49,520 For oyster- Rs. 3,390	2.05
Avg. annual production- 1063.98 kg	Avg. annual production-1948.8 kg		83.16			
Avg. production/ bed- 0.708 kg	Avg. production/ bed- 0.82 kg		15.81			
Avg. employment generation/ annum- 160	Avg. employment generation/ annum- 202		26			
Avg. gross income/ annum- Rs. 1,38,317	Avg. gross income/ annum- Rs. 2,98,410		115			
Area (ac)/no.	Cost of production (Rs/unit/yr)	Sale value of the production in the market (Rs./kg)		Return (Rs./unit/yr)	Net income (Rs./ unit/ yr)	
PSM (450 beds)- 21 days/cycle (8 months) Oyster mushroom (200 bags)- 2 months/ cycle	2,22,000	Rs. 150/kg PSM Rs. 40/kg Oyster mushroom		5,02,000	2,80,000	

Table 2. Effect of ARYA on poultry enterprises

Measurable indicator of output in suitable unit		% increase	Economic of enterprise		
Before adopting ARYA	After adopting ARYA		Gross cost (Rs.)	Net return (Rs.)	BCR
Avg. body wt Banaraja- 1.9 kg	Avg. body weight Banaraja- 2.1 kg	10.5	53690	23690	1.78
Avg. body wt Kadaknath- 1.45 kg	Avg. body wt Kadaknath-1.7 kg	17	100725	59725	2.39
Mortality rate- 12%	Mortality rate- 10%	-	-	-	-
Avg. gross income /annum- Banaraj- 53040 Kadaknath- 65625	Avg. gross income /annum- Banaraj- 161070 Kadaknath- 201450				
Area (ac)/no.	Cost of production (Rs/unit/yr)	Sale value of the production in the market (Rs./kg)	Return (Rs./unit/yr)	Net income (Rs./unit/yr)	
100 chicks/unit (Banaraj) 100 chicks/unit (Kadaknath)	81,000	Rs. 150/kg Banaraj (live bird) Rs. 280/ kg Kadaknath (live bird)	3,02,184	2,21,184	

which proved to be very remunerative in rural areas. The net income is highest in mushroom enterprise (Rs. 2,80,000). Mushroom enterprise were managed with minimum expenditure (less than Rs. 1 lakh/unit) and hence their profitability was very high.

Average body weight of Banaraj and Kadaknath birds was increased by 10.5 per cent and 17 per cent, respectively, after implementation of ARYA is presented in Table 2. Mortality rate was decreased by 2 per cent. Average gross income per annum of Banaraj and Kadaknath was Rs. 1,61,070 and Rs. 2,01,450, respectively. The benefit cost ratio of Banaraj was 1.78 where as for Kadaknath it was 2.39. It shows that Kadaknath breed of poultry bird provided relatively more profit. Poultry rearing involves less investment and mostly women are involved in backyard poultry rearing with native chicken. Kadaknath is a popular native chicken in India (Jaishankar, 2020).

Average honey production per box was increased upto 50 per cent after implementation of ARYA is presented in Table 3. Additional employment generation and gross income increased upto 125 per cent and 161 per cent, respectively. Average gross cost was Rs. 14,100, and net return was Rs. 4,460 for on an average 3 boxes per unit with a Benefit cost ratio of 1.31. Apiculture has certain migratory path for honey production (Singh et al., 1998). Its popularity increased day by day in rural areas as it does not require full time laborers. Honey has good medicinal and food value. Moreover, bee wax used in pharmaceutical, cosmetic industry and in candle making that gives extra income to the rural people.

Bee venom helps in arthritis, pains etc. Therefore, it is beneficial for adopting beekeeping at commercial level to get good income (Kumar, 2022). Apiary enterprise does not give a sudden profit because of the seasonality, proper training and handling of the boxes, a thorough guidance from the scientist of Krishi Vigyan Kendra. Despite low colony productivity, bee keeping remains a profitable and remunerative enterprise. It is less labour intensive compared to other agricultural activities and plays an important role as an additional source of income generation and diversification for bee keepers (Al-Ghamdi, 2017).

As Puri is a coastal area and ICAR-Central Institute of Freshwater Aquaculture (CIFA) is very nearer to Puri, youths used to get more advantage for starting up a fishery enterprise. Table 4 indicates that average fish production increased upto 44.34 per cent after implementation of ARYA. Average gross return and employment generation increased upto 58.78 per cent and 26.80 per cent, respectively. Gross cost of production and net return was Rs. 1,97,600/ha/year and Rs. 2,58,900/ha/year, respectively with the benefit cost ratio is 2.31.

Fish farming has the potential to generate employment for self as well as hired manpower in a commercial enterprise unit. The employment generation spreads across its supply chain, value chain and management activities (Chandre Gowda, 2023).

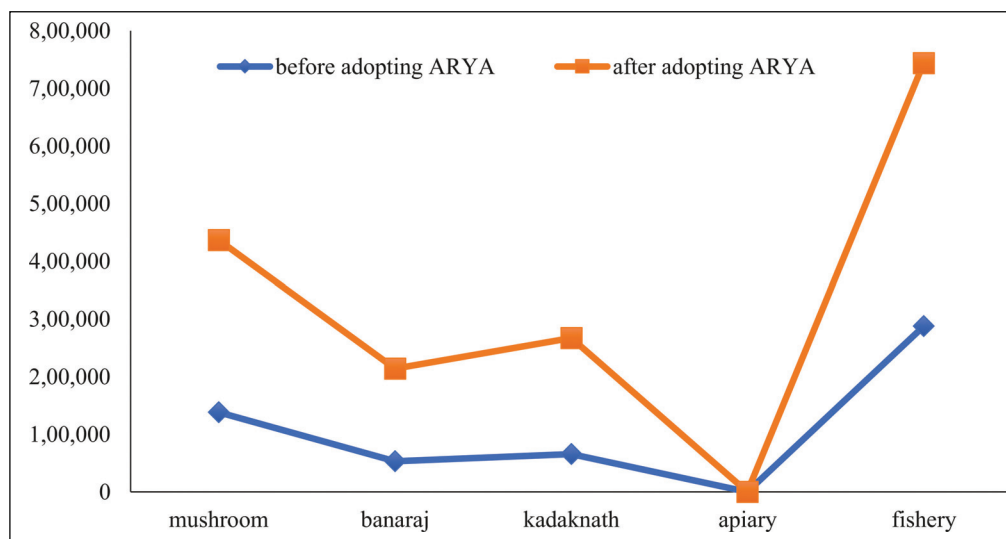
Coefficient of correlation between economic performance indicator and selected social profile variables are present in Table

Table 3. Effect of ARYA on Apiary Enterprise

Measurable indicator of output in suitable unit			% increase	Economic of enterprise		
Before adopting ARYA	After adopting ARYA			Gross cost (Rs.)	Net return (Rs.)	BC Ratio
Additional employment generation per year- 12	Additional employment generation per year- 27		125	Rs. 14,100 Avg. box/ unit- 3 nos.	Rs. 4,460Avg. box/ unit- 3 nos. (support from project- Rs. 6940 & own investment Rs 2700)	1.31
Avg. honey production/box- 3 kg	Avg. honey production/box- 4.5 kg Bee colony- 2 nos./box		50			
Additional gross income- Rs. 1800/box	Additional gross income- Rs. 4700/box		161			
Area (ac)/no.	Cost of production (Rs/unit/yr)	Sale value of the production in the market (Rs./kg)		Return (Rs./unit/yr)	Net income (Rs./ unit/ yr)	
4 boxes/ unit	8000 own investment	Rs. 600/kg (honey) Rs. 1000/ bee colony		18,000	Rs. 10,000 in 2 nd year of establishment	

Table 4. Effect of ARYA on fishery enterprise

Measurable indicator of output in suitable unit			% increase	Economic of enterprise		
Before adopting ARYA	After adopting ARYA			Gross cost (Rs.)	Net return (Rs.)	BCR
Avg. body wt of fish (kg)- 0.520	Avg. body wt of fish (kg)- 0.830		59.61	Rs. 1,97,600 /ha/year	Rs. 2,58,900 /ha/year	2.31
Avg. fish production (q/ha/year)- 28.75	Avg. fish production (q/ha/year)- 41.50		44.34			
Avg. gross return (Rs./ha/year)- 2,87,500	Avg. gross return (Rs./ha/year)- 4,56,500		58.78			
Avg. employment generation/ annum- 97	Avg. employment generation/ annum-123		26.80			
Area (ac)/no.	Cost of production (Rs/unit/yr)	Sale value of the production in the market (Rs./kg)		Return (Rs./unit/yr)	Net income (Rs./unit/yr)	
One ha (pond water area)	1,97,600	Rs. 115/ kg		3,84,100	1,86,500	

Figure 1. Average Gross Production of all the enterprises**Table 5.** Correlation (r) between social profile and economic performance indicators

Economic Performance Indicators	Age	Education	Gender	Annual income
Gross Turnover	0.109*	0.142**	0.105	-0.048
Net Income	0.157**	0.117*	-0.03	0.183**
BC Ratio	-0.092	0.131**	0.150**	0.167**
Employment Generation	0.132**	0.122**	-0.052	0.096
Per Day Income	0.068	-0.013	-0.143**	0.138**

*significant at 0.05 level, **significant at 0.01 level

5. Age of the entrepreneurs are positively correlate with gross turnover, net income and employment generation. The economic performance indicators can be managed by youths with ease. Four of five economic performance indicator were positively and significantly correlate with the education of the entrepreneurs. Increased economic performance indicators are linked to higher educational levels. Women entrepreneurs had lesser per day income as indicated by the negative and significant correlation. Annual income of the entrepreneurs are positively and significantly correlate with the net income, BC ratio and per day income. Higher education among youths will result in a more stable economy, which will lessen the issue of migration.

CONCLUSION

ARYA programme has proved to be a constructive idea of the ICAR which diligently attracting rural youths towards the agri-

preneurship and retaining them in agriculture for a profitable surplus. After the intervention of KVK in terms of promotion of different agri-enterprises, rural youth got the exposure of certain scientific methods of mushroom cultivation, bee keeping, poultry and fish farming that resulted in adoption and establishment of these enterprises for their income diversification and livelihood security. Therefore, profitable agri-enterprises require to be promoted through the involvement of potential rural youths which will curb the migration and provide a sustainable livelihood and income at a low investment.

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Gender Differences in Attitude of University Students towards Gender Roles

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ABSTRACT

Gender role attitude has gained considerable attention over the past three decades as the concern of society shifts from male dominance to the liberation of the female sex. This attitude of a country's population helps in explaining deep-rooted gender sensitivity in its society. The present research was carried out purposively in Punjab Agricultural University, Ludhiana, Punjab, India in the year 2021-22 on 200 purposively selected students throwing light on the gender role attitude of University students. Primary data was collected using a structured pre-tested questionnaire. Findings revealed that half of the respondents had an egalitarian gender role attitude followed by 40.50 per cent who had a transitional attitude. The majority of the female students had an egalitarian attitude whereas half of the male respondents had a transitional attitude. This gap in gender role attitude can be expected because of the male-dominated and patriarchal nature of Indian society. It is suggested that parents should be sensitized to teach their sons to share responsibilities irrespective of gender role norms and also more emphasis should be laid on gender empowerment.

INTRODUCTION

Gender refers to the beliefs people hold on regarding the appropriate role played by men and women in meeting work and family responsibilities (Bird et al., 1984) or a typical concept of acceptable conduct for men and women (Braun et al., 2008). Gender is not a predetermined state, according to Connell & Messerschmidt (2005), it is a condition that is always under construction. Gender role attitude are people's beliefs about the appropriate roles and obligations of women and men (Deaux & LaFrance, 1998). There are two main approaches of social gender roles: traditional approach and egalitarian approach. Within the framework of traditional gender roles, women are expected to take care of the home and refrain from engaging in business activities, while males are supposed to take care of his duties like earning a living and managing the household. However, within the egalitarian roles, men and women equally share the duties for family, career,

marriage, social life, and academics (Esen et al., 2017). However, another approach towards gender role attitude was identified by Hegelson (2012) and Hochschild & Machung (1989) which has been named as transitional attitude towards gender role. It is the attitude carried by the people who are changing their attitude from traditional towards egalitarian. It is that attitude on gender roles which makes it acceptable for women to dedicate time to both work and family responsibilities.

With an average annual GDP (Gross Domestic Product) growth rate of 5.8 per cent over the past two decades, this nation's economic and social position has undergone a significant change. Socially, it has not advanced as quickly; Indian society is still patriarchal, meaning that men dominate in positions of political leadership, moral authority, social privilege and property ownership. India is ranked 130th in terms of human development and 127th in terms of gender inequality index (HDR, 2022). In India, it can still be claimed that women are restricted to the

private sphere while men lead a “public life” and decide upon the distribution of wealth and power. In order to promote gender equality, it is necessary to understand people’s attitude and reasoning regarding gender roles. Youth are the future of any society. Training and sensitizing the young minds about egalitarian gender roles will contribute in slashing the prevailing gender stereotypes from the society as well as development towards gender equality. Thus, the present study was conducted to analyze gender differences in the attitude of university students towards gender roles.

METHODOLOGY

The study was conducted in Ludhiana city of Punjab state, India in the year 2021-22. Purposive and random sampling techniques were used for the current study. The students of Punjab Agricultural University, Ludhiana who belonged to Punjab state were purposively selected for the study in order to control the effect of culture on the attitude of university students. Hundred male and 100 female students were randomly selected for the study. Thus, the sample size consisted of 200 students. Survey research design was used for the present study and it is based on primary data. The data for the current study was collected personally from the respondents with the help of a pre-tested structured questionnaire. The questionnaire contained 45 statements to determine the egalitarian v/s traditional attitude of youth towards gender roles. The statements were related to productive, reproductive, household and community services roles and political roles. According to United Nations Productive role was referred to the role performed by the individuals that contribute to the income and economic welfare and advancement of the household and community, Reproductive role is the function that people carry out in order to procreate and take care of the family and its members. The term “household and community roles” refers to the everyday tasks that must be completed to suit the requirements of the family and the community, such as cleaning, education, health care, elderly care, and food processing and preparation. Political role is the term used to describe a person’s involvement in both formal and informal political activities as well as their work with development organizations (Mensh, 2023). The responses were sought on 5 point continuum ranging from strongly

agree to not at all agree. For each of the gender role, the responses were further categorized into traditional, transitional and egalitarian attitude on the basis of category interval method. The data was analyzed using different statistical techniques such as frequency, percentage, mean scores and Z test for group mean differences.

RESULTS AND DISCUSSION

Gender wise mean difference of agreement of respondents towards productive roles

The findings in Table 1 shows that a significant difference ($z=5.31$, $p<0.01$) was observed between females and males for the statement “I prefer that men should earn and women should take care of the family” in which female’s disagreement ($\bar{x}=1.81$) was found to be more than males ($\bar{x}=2.96$). Again, a significant difference ($z=6.29$, $p<0.01$) was found between the agreement level of males and females in which majority of men agreed ($\bar{x}=4.04$) and females disagreed ($\bar{x}=2.71$) to prefer a field job as compared to an office job.

Table 1 reveals that a majority of the females disagreed ($\bar{x}=2.33$) whereas males agreed ($\bar{x}=3.95$) to prefer to be married to someone who makes more money than them. A significant difference ($z=4.70$, $p<0.01$) was also observed for the statement “I believe that financial purchases and investments is the job of male members” where majority of the females disagreed with mean score of 1.97 and males disagreed with mean score of 2.95. While no significant difference was found between agreement of male and female respondents for rest of the productive gender role attitude statements. Both males and females were in agreement with equal job opportunities, salary and financial responsibilities for family. Thus, the youth has agreement with equal productive roles irrespective of gender. Duval (2023) also found no gender difference in attitudes and revealed that on an average men and women had egalitarian gender role attitudes.

Gender wise mean difference of agreement of respondents towards reproductive roles

Similarly, Table 2 reveals that a significant difference ($z=4.01$, $p<0.01$) was found between females and males for the statement “I consider a woman more precious if she delivers a

Table 1. Gender wise mean difference of agreement of respondents towards productive roles

S.No.	Productive roles	Female (Mean score)	Male (Mean score)	z- value
1	I prefer that men should earn and women should take care of the family.	1.81	2.96	5.31**
2	I would prefer a field job as compared to an office job	2.71	4.04	6.29**
3	I would prefer to be married to someone who makes more money than me.	2.33	3.95	7.61**
4	I would prefer a male boss than a female boss at workplace.	2.38	2.58	0.95
5	I believe that financial purchases and investments is the job of male members.	1.97	2.95	4.70**
6	I prefer father/ husband should decide on how to use family income.	2.55	2.90	1.81
7	I believe that there is no need of special quotas for women in government jobs.	3.09	3.43	1.72
8	I believe that equal salary should be paid to the women and men for the same position/quantum of work.	4.47	4.46	0.06
9	I would prefer female member to do job even if the economic situation of the family is adequate.	4.44	4.34	0.62
10	I believe that the man is not only responsible for sustaining the family financially.	4.64	4.51	1.08

Mean score range 1-5; **1% level of significance; *5% level of significance

Table 2. Gender wise mean difference of agreement of respondents towards reproductive roles

S.No.	Productive roles	Female (Mean score)	Male (Mean score)	z- value
1	I consider a woman more precious if she delivers a boy.	1.74	2.62	4.01**
2	I would prefer husband to decide the place of delivery of the child.	2.00	2.56	1.61
3	I would prefer husband to decide about when to have a child after marriage.	1.99	2.60	2.80*
4	I would prefer husband and in-laws to decide about the type of food and medicine to be given to wife during her pregnancy.	2.11	2.94	3.90*
5	I would prefer husband and in-laws to decide the number of visits to doctor and ultrasounds during wife's pregnancy.	2.00	2.55	1.88**
6	I would prefer wife to decide than other members of the family about the preference of the health provider during her pregnancy.	3.95	3.83	0.33
7	I would prefer that wife along with husband should jointly decide on the time interval between consecutive children.	4.07	4.39	1.59
8	I would prefer wife and husband to jointly decide the number of children.	4.36	4.44	1.23

Mean score range 1-5; **1% level of significance; *5% level of significance

boy” in which females’ mean score indicates more disagreement ($\bar{x}=1.74$) than males ($\bar{x}=2.62$). More females disagreed ($\bar{x}=1.99$) to prefer husband to decide when to have a child after marriage than male respondents ($\bar{x}=2.60$) with a significant difference ($z=2.80$, $p<0.05$). Again, a significant difference ($z=3.90$, $p<0.05$) was observed between females and males when asked whether they would prefer husband and in-laws to decide about the type of food and medicine to be given to wife during her pregnancy for which more females disagreed with a mean score of 2.11 than males with a mean score of 2.94.

More females disagreed ($\bar{x}=2.00$) than males ($\bar{x}=2.55$) to prefer husband and in-laws to decide about the number of visits to doctor and ultrasounds during wife’s pregnancy. Thus it can be concluded that both male and female respondents agreed on joint responsibility of both the genders towards reproductive roles. Both disagreed that control over choice of food, medicine and health provider should be with husband and in-laws. Although almost for all statements related to reproductive roles, more female respondents disagreed than male respondents.

Difference of agreement of respondents towards household and community roles

Table 3 shows that with a mean score of 2.56 females disagreed when asked that females should be responsible for cleanliness and order of the house whereas males showed neutral responses with a mean score of 3.18 and a significant difference ($z=3.24$, $p<0.01$) was found between females and males. Females agreed ($\bar{x}=3.47$) whereas males gave neutral responses ($\bar{x}=3.04$) for preference that men must perform tasks outside the home with a significant difference ($z=1.95$, $p<0.05$). Interestingly, more males ($\bar{x}=4.13$) agreed than females ($\bar{x}=3.52$) for the preference that husband should stay at home with the child/children when they are ill with a significant difference ($z=4.18$, $p<0.01$). However, a significant difference ($z=7.62$, $p<0.01$) was found between females and males for preference that man should pay for the taxi, buy tickets or pay the bill in which females disagreed ($\bar{x}=1.99$) while males agreed ($\bar{x}=3.56$). Males’ agreement could be the impact of social etiquettes learnt during the process of socialization. Although, this etiquette is decreasing in youngster’s day by day.

Again, a significant difference ($z=2.97$, $p<0.01$) was found between females and males to the statement that “I believe that men should give up their seat to women on the train or bus” with a mean score of 2.73 and 3.30 for females and males respectively stating disagreement among females while neutral attitude of males. Whereas females’ agreement ($\bar{x}=4.80$) was found to be more than males’ ($\bar{x}=4.56$) for the statement “I believe that daughters should have equal authority over the inherited property and money” with a significant difference ($z=2.11$, $p<0.01$) between them. Thus, it can be concluded that youth wants to share the equal responsibility towards household and community roles. Primarily, the tasks like taking care of children, cooking, serving food were considered the responsibilities of females, now young males also want to participate in. In a study by Yadav et al., (2021), it was found that 84.2 per cent of the males had access to land, in comparison to 8.3 per cent females and only 7.5 per cent of both men and women had joint access to the property. The reason for this was because the head of the family was men, patriarchal system of society allows them access and control to property. Also, in the same study, it was reported that 50 per cent access to the cash was held jointly by both men and women, followed by 43.3 per cent of the men, whereas only 6.2 per cent of women alone had access to the money.

Gender wise mean difference of agreement of respondents towards political roles

The Table 4 reveals that a significant difference ($z=3.33$, $p<0.01$) between males and females was found where majority of the females strongly ($\bar{x}=4.46$) believed that women are more likely to report their problems and participate actively if the leader of their village is a woman while as compared to less males’ agreement ($\bar{x}=3.41$). Findings from another study revealed that half of the women faced the issue of being doubted regarding their capabilities in the political sector and more than 55 per cent women accepted that they were never supported by their family to get in politics (Awasthi et al., 2020). The findings conclude that both males and females need to be sensitized for political roles in order to increase participation of women in political sphere. On the contrary, a significant difference ($z=2.99$, $p<0.01$) was found between females

Table 3. Gender wise mean difference of agreement of respondents towards household and community roles

S.No.	Household and community roles	Female (Mean score)	Male (Mean score)	z- value
1	I believe that female should be responsible for cleanliness and order of the house.	2.56	3.18	3.24**
2	I prefer that men must perform tasks outside the home.	3.47	3.04	1.95
3	I would prefer husband to stay at home with the child/children when they are ill.	3.52	4.13	4.18**
4	I believe that fathers should decide about the upbringing of children.	2.42	2.57	0.74
5	I believe that male members of the family should be fed first.	1.86	1.59	1.32
6	I would prefer the man to pay for the taxi, buy tickets or pay the bill.	1.99	3.56	7.62**
7	I believe that men should give up their seat to women on the train or bus.	2.73	3.30	2.97**
8	I believe that girls should learn cooking from a young age.	2.39	2.66	1.31
9	I believe that cooking and serving food suits women better.	2.00	2.10	1.01
10	I don't find it wrong if a woman tolerates violence in order to keep her family together.	1.81	1.92	1.29
11	I believe that women are better care givers than men.	3.13	3.55	1.26
12	I believe that male members should be given preference of choice in food than females.	2.14	2.73	2.65**
13	I believe that families should spend equally on the education of daughters and sons.	4.50	4.63	0.97
14	I believe that domestic work should be shared equally between spouses in the family.	4.33	4.55	1.68
15	I believe that female member's opinions are valuable & should be considered for household decision making.	4.58	4.64	0.48
16	I believe that daughters should have equal authority over the inherited property and money.	4.80	4.56	2.11**
17	I would prefer husband to participate in child rearing & household chores rather than leaving it all to the wife.	4.38	4.46	1.03
18	I would prefer husband to not take decisions regarding wife's life.	4.03	3.72	1.68

Mean score range 1-5; **1% level of significance; *5% level of significance

Table 4. Gender wise mean difference of agreement of respondents towards political roles

S.No.	Political role	Female (Mean score)	Male (Mean score)	z- value
1	I believe that women have less knowledge about politics than men.	3.35	3.00	1.72
2	I believe that irrespective of gender both male and female political leaders can have strong personalities.	3.80	3.78	0.08
3	I believe that female leaders are less corrupt.	3.12	3.26	0.70
4	I believe that the woman should have the power to vote according to her own choice.	4.12	4.08	1.19
5	I believe that women are more likely to report their problems and participate actively if the leader of their village is a woman.	4.46	3.41	3.33**
6	I believe that there is a need to increase number of females in political positions.	4.04	3.98	0.34
7	I believe that female political representatives in local government are merely a front for their male relatives.	4.15	4.65	2.99*
8	I believe that there should be equal numbers of men and women in positions of political power.	4.30	4.09	1.40
9	I believe that higher number of women in parliament leads to stronger attention to women's issues.	3.22	3.11	1.58

Mean score range 1-5; **1% level of significance; *5% level of significance

and males in which males strongly agreed with a mean score of 4.65 against females' mean score of 4.15 that female political representatives in local government are merely a front for their male relatives. Overall results show that except for two statements in the political role category, females' and males' attitudes are similar regarding political roles. It can be concluded that both male and female respondents, agreed for equal participation of men and women in politics.

Attitude of the respondents towards different gender roles

Based upon the responses, the respondents were distributed among three categories such as traditional, transitional and egalitarian. Attitude of respondents towards each of the gender roles are represented in Table 5. The productive gender role scale consisted of ten statements with score range of 10-50. Table 5 depicts that more than half of the respondents (56.00%) were found to have egalitarian attitude towards productive roles. Three

fourth of the female respondents (75.00%) had egalitarian attitude compared to around one third of the males (37.00%) while more than half of the males (54.00%) had transitional attitude. The transitional attitude in males compared to the egalitarian attitude in females can be understood by their responses towards productive roles wherein more females and fewer males disagreed that men should earn while women should take care of the family and also financial purchases and investments being the job of male members. Ana Raj et al., (2022) also pointed out in their study that decision making power of females was limited as compared to males.

Similarly, the reproductive gender role category consisted of eight statements with scores ranging from 8 to 40. The results revealed that majority (59.50%) of the respondents had egalitarian attitude towards reproductive gender roles out of which females constituted 66 per cent and males constituted 53 per cent. More females having egalitarian attitude towards reproductive roles can be justified from their responses where females disagreed to prefer

Table 5. Attitude of the respondents towards different gender role

Attitude category	Score range	Female (n=100) (%)	Male (n=100) (%)	Total (n=200)	
				Frequency	Percentage
Productive roles					
Traditional	10-23.3	5.00	9.00	14	7.00
Transitional	23.4-36.6	20.00	54.00	74	37.00
Egalitarian	36.7-50	75.00	37.00	112	56.00
Reproductive roles					
Traditional	8-18.7	4.00	8.00	12	6.00
Transitional	18.8-29.4	30.00	39.00	69	34.50
Egalitarian	29.5-40	66.00	53.00	119	59.50
Household roles					
Traditional	18-42	2.00	4.00	6	3.00
Transitional	43-66	30.00	55.00	85	42.50
Egalitarian	67-90	68.00	41.00	109	54.50
Political roles					
Traditional	9-21	4.00	4.00	9	4.50
Transitional	22-33	49.00	50.00	99	49.50
Egalitarian	34-45	47.00	46.00	93	46.50
Overall gender roles					
Traditional	45-105	5.00	13.00	18	9.00
Transitional	106-165	29.00	52.00	81	40.50
Egalitarian	166-225	66.00	35.00	101	50.50

husband and in-laws to decide about the food, medicine, place of delivery during pregnancy than males. The household and community roles category, eighteen statements with a score range of 18-90 were considered. Percentage of total respondents who supported egalitarianism was found out to be 54.50 per cent respondents, among which majority were females with 68 per cent while around half of the male respondents (55.00%) had transitional gender attitude. This is reflected from their responses wherein more females and fewer males disagreed that females were responsible for order and cleanliness of the house and also males to be given preference of choice in food. Also, their attitude can be justified from some responses where females agreed more than males for daughters having equal authority over inherited property and husbands not taking decisions regarding wife's life. This finding might be due to the fact that in the Indian context, society is still in the process of evolving to embrace women's employment in the public sector, and women still face significant challenges in balancing their professional and personal lives (Nglube, 2018). Although the government today supports working of women by providing facilities like childcare centres, flexible work schedules and maternity leave, etc. However, strongly embedded gendered ideology may be a part of the explanation for why males are still in the transitional stage when it comes to family and community gender responsibilities, such as caring for children, cooking, and helping with housework. Previous literature also reported that men have not made as much progress as women in adopting the egalitarian gender roles (Thornton & Young-DeMarco, 2001). Literature also proves that egalitarian gender role attitudes are associated with a more gender-egalitarian division of household chores (Shelton & John, 1996). Contrary to this, another study finding from other European countries (Anderson & Johnson, 2002; Fortin, 2005) pointed out that both men and women show rather traditional

attitudes when it comes to the domestic sphere. The political role comprised of nine statements with a score range of 9-21. A large proportion of respondents (49.50%) in this category endorse transitional gender roles which comprised of 50.00 per cent males and 49.00 per cent females. The transitional attitude of both females and males towards political roles can be justified from their neutral opinion and not disagreement towards female leaders being less corrupt and also for women having less knowledge about politics than men. It has also been proven that egalitarian gender role attitudes are associated with a higher civic participation i.e. participation in various formal and informal activities including voting, volunteering, participating in group and community activities by people (Inglehart et al., 2003).

The overall gender role category was calculated on the basis of the entire different gender role categories. Overall, half of the respondents (50.50%) had egalitarian gender role attitude. More females had egalitarian attitude towards gender roles (66%) than males (35%) whereas more number of males (52%) had transitional attitude compared to the females (29%). This is in line with the study of Twenge (1997) who stated women exhibited significantly higher egalitarian gender role attitude than men. Also, female students were found to have a more egalitarian perspective of gender roles than male students in a study done to determine attitude about gender roles of university students in Turkey (Baykal, 1988).

CONCLUSION

Majority of the total respondents had egalitarian attitude towards reproductive gender roles out of which females constituted 66 per cent and males constituted 53 per cent. 49.50 per cent endorsed transitional gender role regarding political roles. 50.50 per cent were having egalitarian gender role attitude whereas 40.50 per cent respondents reported transitional attitude and only 9.00

per cent respondents were having traditional attitude. It can be concluded that youth are moving towards egalitarian attitude towards gender roles with equal responsibilities to be shared between both sexes. It is suggested that gender sensitization programmes can be organized to sensitize the University students in order to improve their attitude towards gender roles. Men were found to have more traditional attitude than women in all the categories of gender roles. Thus, it is suggested that parents should be sensitized to teach their sons egalitarian attitude towards gender roles.

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Knowledge Level of the Farmers about Hybrid Rice Cultivation in Jammu District

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ABSTRACT

Hybrid rice technology is crucial for securing the food security of the burgeoning population of India. The study carried out in 2021 aims to assess the knowledge level of farmers regarding hybrid rice technology. Three specifically chosen sub-divisions of Jammu District; Marh, Akhnoor, and R.S. Pura, having the cultivation of hybrid rice and using the proportionate and purposive random techniques 38 from R.S. Pura, 13 from Akhnoor and 99 respondents from Marh, making a total sample size of 150 hybrid rice growers. A standardized knowledge test with reliability 0.86, was developed for assessing the knowledge level of hybrid rice growers. The Cube root method was applied to devise different knowledge categories of hybrid rice growers, which varied from medium to high. According to the results of the ANOVA test, there was no discernible difference between the knowledge levels of hybrid rice growers in the three sub-divisions.

INTRODUCTION

Agriculture is a significant contributor to economic activity in other areas of the economy as a provider of industrial raw materials (Blandford, 2011). It is predicted that India's agricultural sector will expand by 3.9 per cent in 2022–2023, which is better than the current fiscal year. To feed the rising population there is need for improved technologies like hybrid rice cultivation which gives higher yield than other rice varieties (Gogoi et al., 2022). According to the International Rice Research Institute (IRRI), hybrid rice is crossbred from two very different parents and compared to other rice types, it has a higher yield potential. The extension agents can help farmers as they proceed along their knowledge-acquisition and decision-making paths (Van den Ben & Hawkins, 1996). Asian rice that has been crossbred from two extremely dissimilar parent kinds is known as hybrid rice (Rout et al., 2020). When grown under the same conditions as equivalent purebred rice varieties, hybrid rice can generate up to 30 per cent greater yield. Rice is the one of the most important cereal crops in India and has been highly labour and energy-intensive crop (Bhatt & Singh, 2022). China is the world's top producer of rice, with India coming in second and Indonesia coming in third (Statista,

2021). The staple food crop of the majority of South, South-East, and East Asia, rice is India's greatest contribution to global agriculture (Directorate of Economics & Statistics, 2020). According to the recent data from the Directorate of Economics and Statistics (2018-19), Jammu and Kashmir planted 262010 acres of rice, producing 616100 tonnes wherein 63882 acres of rice were planted in the Jammu district, yielding 283900 tonnes (DES, 2021). In the Jammu district, the average production of rice in 1964–1965 was 10.57 quintals per hectare, and in 2018–19 it was 21.58 quintals per hectare, nearly doubling it during the 55 years from 1960 to 2019 (DES, 2021). A large portion of the untapped potential farm yield could be exploited by using optimum inputs and by adopting appropriate production techniques without incurring additional cost (Singh et al., 2011). Awareness generation was advocated specifically concentrating on ecological sustainability through rice production by Rejula et al., (2017), so that people start thinking rejuvenating the existing paddy fields. In the years 2015–16 and 2016–17, the total area with hybrid rice in the Jammu division was 13544 ha and 12533 ha, respectively (Directorate of Agriculture). Knowledge about different cultivation practices is pre-requisite for farming community to obtain the maximum output under actual field conditions. Although number of stakeholders such as field

extension functionaries, research stations of different SAUs etc. are actively engaged in the job of disseminating knowledge about different cultivation practices of hybrid rice cultivation to farmers, but still the knowledge gap exists shown by different research studies. Farmers' knowledge is directly and significantly associated with the adoption of hybrid rice. Farmers, who are well informed about the usage of hybrid rice and are likely to embrace it and raise their revenue, can be influenced by knowledge (Sarma et al., 2022). The present research effort entitled "Knowledge Level of the Farmers about Hybrid Rice Cultivation Practices in Jammu District" was undertaken to assess the status of knowledge level of hybrid rice growers.

METHODOLOGY

Due to the highest area under hybrid rice cultivation, the study was carried out in three agricultural sub-divisions of Jammu division of Jammu and Kashmir UT namely; Marh, Akhnoor, and R.S. Pura. Descriptive research design was employed for the study. Purposive sampling was employed to choose the sub-division. The respondents were chosen using the proportionate random sample technique. With the assistance of the relevant agencies, a list of hybrid rice growers was obtained for each chosen agricultural sub-division. From a total list of 1123 hybrid rice growers in the selected sub-divisions, 38 hybrid growers were selected from R.S Pura, 13 from Akhnoor and 99 from Marh by proportionate random sampling technique, making a total sample size of 150 hybrid rice growers. A well devised pre-tested interview

schedule was used for collection of primary data. Secondary data was collected from different published resources. Cube root technique given by Singh (1975) was applied for devising different knowledge categories. ANOVA technique given by Fisher (1958) was applied to find out the difference among knowledge level of hybrid rice growers belonging to three sub-divisions.

RESULTS AND DISCUSSION

Data in the Table 1 revealed that 100.00 per cent of the farmers were well versed with the knowledge about methods of sowing seed in the nursery, 61.00 per cent had correct knowledge about recommended time of nursery sowing, correct knowledge about the recommended seed rate were 73.00 per cent. It was an astounding finding that only 10.00 per cent of the farmers had knowledge about the seed treatment and very less (6%) knew about the dosage of the seed treatment chemical. It showed that 43.00 per cent farmers had knowledge about dosage of urea which was recommended whereas least per cent i.e. 1.00 per cent of them knew about the recommended dosage of DAP and 11.00 per cent had knowledge about the quantity of FYM used during nursery raising. Knowledge of hybrid rice growers about recommended weed management indicated that 100 per cent of the farmers had knowledge about both weed controlling method as well as the weeds attacking the seedlings. Here, 97.00 per cent of the farmers were well versed with the knowledge of the name of herbicide but only 17.00 per cent of the farmers knew about its dosage. All the farmers were able to identify the insects attacking the nursery of

Table 1. Knowledge of the hybrid rice growers about different aspects of nursery raising

Knowledge about	District wise per cent of respondents			Overall percent (n=150)
	R.S. Pura (n=38)	Akhnoor (n=13)	Marh (n=99)	
Recommended time of nursery sowing (first fortnight of June)	25(66)	4(31)	63(64)	92(61)
Methods of sowing seed in nursery (wet/dry method)	38(100)	13(100)	99(100)	150(100)
Recommended seed rate (15-20 kg/ha)	26(68)	8(62)	75(76)	109(73)
Name of chemical used for seed treatment (Carbendazim= Bavistin)	5(13)	4(31)	6(6)	15(10)
Dosage of seed treatment chemical (2.5-3 gms/kg of seed)	4(11)	2(15)	3(3)	9(6)
Knowledge about recommended nutrient management practices				
Dosage of urea (60-65g/10 sqm)	19(50)	2(15)	43(43)	64(43)
Dosage of DAP (100g/10 sqm)	0(0)	0(0)	2(2)	2(1)
Quantity of FYM (15 kg/10 sqm)	8(21)	1(8)	7(7)	16(11)
Knowledge about recommended weed management				
Weeds controlling method(Manual, chemical or both)	38(100)	13(100)	99(100)	150(100)
*Name the weed (<i>Cyperusrotundus</i> , <i>Cyperus difformis</i> , <i>Cyperus iris</i> , <i>Echino cholacolona</i> , <i>Echino cholacrus gallis</i> and <i>Cynodon dactylon</i>)	38(100)	13(100)	99(100)	150(100)
Name of herbicide (recommended are: Machete= butachlor 5% GR), nomini gold= Bispyribac Sodium 10% SC)	38(100)	13(100)	95(96)	146(97)
Dose of herbicide (Recommended for: Machete: 2.47 litre/ha (L)* 1.5 kg/ka (G) & nominee gold: 200 ml/ha), (L)-Liquid form(G)-Granular form	4(11)	0(0)	22(22)	26(17)
Knowledge about plant protection practices				
Identified insects, attacking the nursery of hybrid rice (root weevil, stem borer, threadworm, leaf hopper, rice hispa, leaf folder and grasshopper)**	38(100)	13(100)	99(100)	150(100)
Knowledge of the insecticides (Cartaphcl= Padaan, Carbofuran=Furadan, Lindaine and Chloropyriphos=Lorsban and Dursban)	9(24)	4(31)	22(22)	35(23)
Knowledge about the dosage of insecticide (Cartaphcl=1 kg/500 m ² carbofuran=1 kg/500 m ² , lindaine= 1.25-1.5 kg/500m ² and chloropyriphos= 500-750 ml/acre)	12(32)	6(46)	52(53)	70(47)

hybrid rice. Less than half the respondents had knowledge about the dosage of the insecticide whereas only 23 per cent of the farmers had knowledge about the insecticide names. About the recommended seed rate similar results were reported by Chandawat et al., (2018). Another findings from the present study revealed that majority of the growers had good knowledge (100%) about the methods of sowing seed in the nursery which quite agreed with the findings of Pradeep et al., (2017).

The Table 2 showed that 27 per cent of farmers recognized the age of the seedling, 69 per cent of farmers were knowledgeable about the ideal period for transplanting, and 43 per cent of farmers knew the number of seedlings per hill. Majority of the farmers (65.00%) were aware that the first irrigation should be administered at the 4-6 leaf stage of the crop, while 72.00 per cent of farmers were aware of the number of irrigations. The current study found that knowledge about irrigation practice was higher, which may be because irrigation is a fundamental component of rice cultivation and farmers of all categories had good knowledge about the various stages of irrigation. The present findings also corroborated the findings of a study by Meena et al., (2012), in which it was found that growers had above 90 per cent knowledge of irrigation management, Prusty et al., (2020) also found higher knowledge about the irrigation practice followed by Pradeep et al., (2017).

Regarding suggested nutrient management techniques for the main field, the Table showed that just 11 per cent of the farmers were aware of the suggested urea and FYM dosages for this area. The majority of farmers (83%) were aware of the split dosages that should be utilized, but just 15 per cent and 29 per cent of farmers, respectively, were aware of the suggested dosages for DAP and zinc. In the current study, it was discovered that farmers had strong understanding of the suggested seed treatments but very little awareness of the dosages of these treatments. In contrast to study conducted by Sharma et al., (2017), which found that more than 76.00 per cent of the farmers had complete knowledge about the chemical used for seed treatment, the current study revealed that only 10 per cent and 6 per cent of farmers knew the name of the chemical used for seed treatment and dosage of the chemical, respectively. The lack of interaction with SKUAST-J experts, who may provide them with improved understanding about the methods that can increase crop output, may be the cause of their poor level of expertise. According to the table's recommendations for managing weeds in the main field, all of the farmers were aware of the best practices for weed control and the types of weeds that pose a threat to the main field crop. Despite 100 per cent of them knowing the name of the herbicide being used to manage the weeds, only 17 per cent of them were aware of the dosage. It was

Table 2. Hybrid rice growers' knowledge about recommended nutrient management practices in main field

Knowledge about	District wise per cent of respondents			Overall percent (n=150)
	R.S. Pura (n=38)	Akhnoor (n=13)	Marh (n=99)	
Age of seedling (20-25 days)	8(21)	7(54)	26(26)	41(27)
Time of transplanting (Recommended time is first fortnight of July)	28(74)	7(54)	69(70)	104(69)
No. of seedlings per hill(recommended is 2-3 seedling/hill)	16(42)	8(62)	41(41)	65(43)
No. of irrigations (recommended are 10)	29(76)	3(23)	76(77)	108(72)
First irrigation at what stage(recommended is 4-6 leaf stage of crop)	26(68)	7(54)	64(65)	97(65)
Knowledge about recommended nutrient management				
Dosage of urea (200-210 kg/ha)	8(21)	7(54)	1(1)	16(11)
Split dosages of urea (2-3 recommended)	13(34)	13(100)	99(100)	125(83)
Dosage of DAP (130-140 kg/ha)	3(8)	3(23)	17(17)	23(15)
Quantity of FYM/ha (15 tonnes per ha)	8(21)	1(8)	7(7)	16(11)
Dosage of ZnSO ₄ (20-25 kg/ha)	10(26)	5(38)	28(28)	43(29)
Knowledge about recommended weed management				
Weeds controlling method (Manual, chemical or both)	38(100)	13(100)	99(100)	150(100)
*Name the weed (<i>Cyperus rotundus</i> , <i>Cyperus difformis</i> , <i>Cyperus iris</i> , <i>Echino cholacolona</i> , <i>Echino cholacrus gallis</i> and <i>Cynodon dactylon</i>)	38(100)	13(100)	99(100)	150(100)
Name of herbicide (recommended is Machete=Butachlor)	38(100)	13(100)	99(100)	150(100)
Dose of herbicide (Recommended for: Butachlor: 30 kg/ha)	4(11)	0(0)	22(22)	26(17)
Knowledge about recommended plant protection practices				
*Identified insects attacking hybrid rice(root weevil, stem borer, threadworm, leaf hopper, rice hispa, leaf folder and grasshopper)	38(100)	13(100)	99(100)	150(100)
Insecticide used (Cartaphcl=Dartriz, Carbofuran=Furadan, Lindaine and Chloropyriphos=Lorsban and Dursban)	3(8)	1(8)	4(4)	8(5)
Dosage of insecticide (Cartaphcl=1 kg/500 m ² , Carbofuran=1 kg/500m ² , lindaine=1.25-1.5 kg/500m ² , Phorate=10-15 kg/ha & Chloropyriphos=500-750 ml/acre)	2(67)	1(100)	2(50)	5(63)
*Diseases observed in hybrid rice crop (brown leaf spot, bacterial leaf blight, bacterial leaf streak, sheath blight, sheath rot, false smut, blast and khaira disease)	38(100)	13(100)	99(100)	150(100)
Fungicide (Carbendazim=Bavistin, tricylazole=Blastin, Hexaconazole=Trigger)	7(18)	2(15)	16(16)	25(17)
Dosage of fungicide (carbendazim=100-120g/ha, tricylazole=300-400g/ha, hexaconazole=750-1000 ml/ha)	12(32)	6(46)	52(53)	70(47)

*Multiple response

discovered that 100 per cent of farmers were aware of the insects that attacked hybrid rice crops and the diseases that were noticed in hybrid rice crops. Additionally, it revealed that 63.00 per cent of the farmers knew how much insecticide to use. The survey also revealed that only 17 per cent of farmers were knowledgeable with fungicides. However, it was astounding to learn that 47.00% of the farmers knew the fungicide dosages. In contrast to Kshash's (2018) study, which found a medium degree of knowledge regarding various aspects of fertilization, the current study showed that hybrid rice growers had little understanding of fertilizers and their management techniques. The hybrid rice farmers in the current study had a high level of weed control knowledge, which was consistent with the findings of a study by Pradeep et al., (2013).

Data depicted in the Table 3 showed that 100.00 per cent of the farmers had knowledge about the symptoms indicating that crop is ready for harvest, time of harvesting and proper way of drying the harvested produce. The findings regarding harvesting techniques showed that 100 per cent of the producers were aware of both harvesting and post-harvesting procedures, which was also the case for the findings of the study conducted by Pradeep et al., (2013).

Cube root method showed information about the level of knowledge of the farmers. The overall average knowledge score was 19.94, while it was 19.32, 19.86, and 20.22 in the R.S. Pura, Akhnoor, and Marh sub-divisions, respectively. Farmers' overall understanding of hybrid rice cultivation procedures ranged from medium to high, with 41.00 per cent having medium knowledge,

49.00 per cent having high knowledge, and 10.00 per cent having little awareness of it. This might be the case because farmers have a good understanding of the advantages of hybrid rice production, which has allowed them to learn enough about its various facets. These results are well associated with those of the Shah et al., (2016) study, which found that most farmers in the Navsari district had medium level (67%) knowledge of rice production technologies. However, only 14 per cent of the farmers in this study had the least amount of knowledge, which conflicts with the findings of the current study. The results also agreed with those of a study by Prasad et al., (2015), which showed that more farmers who received benefits had higher levels of knowledge about rice growing technology than non-beneficiary farmers. The average recipient farmer had a medium level of knowledge, followed by high and low level farmers with, respectively, 28.57 and 15.24 per cent of knowledge. The results of this study do not agree with those of Nagmani et al's study, which found that most tenant farmers had little to no understanding of critical rice farming interventions (80.00%), followed by medium (15.56%) and high (4.44%) knowledge. According to a 2018 study by Rahangdale et al. the majority of respondents (54.37%) had a medium level of knowledge about hybrid rice production technology, followed by 35.63 per cent of respondents with a high level of knowledge and 10 per cent of respondents with a low level of knowledge.

ANOVA test was applied to work out the significant difference in knowledge level of farmers about different practice of hybrid rice cultivation and the result obtained showed that there was no

Table 3. Knowledge of hybrid rice growers about different aspects of harvesting

Knowledge about	District wise per cent of respondents		
	R.S. Pura (n=38)	Akhnoor (n=13)	Marh (n=99)
Symptoms indicating crop ready to harvest *(recommended are: color of the crop becomes yellow when matured and ready to harvest; 80 per cent of panicles mature and become golden in color)	38(100)	13(100)	99(100)
Time of harvesting (recommended time is month of October)	38(100)	13(100)	99(100)
Proper way of drying the harvested produce (recommended is: drying in shade)	38(100)	13(100)	99(100)

*Multiple response

Table 4. Overall knowledge level of hybrid rice growers about the hybrid rice cultivation practices

Knowledge about	R.S. Pura (n=38)	Akhnoor (n=13)	Marh (n=99)	Overall (n=150)
Average knowledge score (10-26)	19.32±3.12	19.86±3.39	20.22±3.56	19.943.44
Knowledge level (per cent farmers)				
Low (10-15)	4(11)	2(15)	9(9)	15(10)
Medium (16-20)	19(50)	5(38)	37(37)	61(41)
High (above 20)	15(39)	6(46)	53(54)	74(49)

Table 5. Mean difference of knowledge in different sub-divisions

Dependent variable	(I)	Varieties (J)	Mean difference (I-J)	Std. error	p-value	Model summary
Knowledge	Marh	Akhnoor	-.29960	1.09666	.785	F=1.132 P=.325
		R.S Pura	-.94684	.65133	.148	
	Akhnoor	Marh	.29960	1.09666	.785	
		R.S Pura	-.64724	1.00686	.521	
	R.S. Pura	Marh	.94684	.65133	.148	
		Akhnoor	.64724	1.00686	.521	

significant difference observed in the knowledge levels of hybrid rice growers among farmers of all three sub-divisions.

CONCLUSION

It is concluded that almost fifty percent farmers had high level of knowledge about hybrid rice technology. It needs to be improved as knowledge level is directly associated with the adoption of different cultivation practices at field level and moreover also associated with farmer's satisfaction. For better technical guidance, there should be more contacts between extension staff and farmers. The rice growers should have access to timely supply of hybrid seeds and related input. Farmers being exposed to demonstration plots are anticipated to hasten adoption. The reach of government programmes must be expanded to include small and marginal farmers. The success stories of hybrid rice growers should be highlighted through various forms of advertising in order to entice rice farmers to cultivate hybrid rice. Given the expanding population and the widespread consumption of rice as a staple meal in the future, hybrid rice will be crucial in maintaining food security.

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Factors Driving Jute to Maize Shift in Uttar Dinajpur, West Bengal

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ABSTRACT

Jute is an important crop that contributes a pivotal role in the economy and supports the livelihoods of the farmers of the Northern part of West Bengal. However, farmers in the region are gradually shifting away from traditional jute cultivation to adopting maize as their preference and the study investigated the factors influencing transformation. Responses were collected from 60 farmers of Chopra Block using a structured interview schedule during the peak season of maize cultivation in 2019. Principal Component Analysis was used to extract significant factors explaining the motives behind farmers' preference for maize over jute crops. The study envisages that the factors including lack of capital, remunerative market price, high labor costs, poor soil quality and inadequate irrigation water, unavailability of improved seed varieties, high input costs, and inadequate market facilities are the key factors for discouragement of cultivation of jute. The government should develop some supportive infrastructure like providing high-quality maize seeds, conducting awareness programs to educate the farmers about the benefits and byproducts of maize, and offering knowledge about export and import markets. Capacity building and extension approaches can aid the transition and foster positive contributions to the agricultural sector of the locality.

INTRODUCTION

The agricultural sector continues to be vital for development, especially in developing countries where the sector is significant in terms of both total income and labour force (Shetty et al., 1990). The Northern part of West Bengal has a variety of productive soil and weather condition makes the people dependent on agriculture. Farmers produce mainly cereals, pulses, oil seeds, vegetables, and jute. The state is a significant contributor to the production of jute in India. It accounts for approximately 65 per cent of the raw jute acreage in the country. It plays a crucial role in the jute industry, with 61 out of the 78 composite jute mills located in West Bengal. These mills have a total of 48 thousand looms with 7.5 lakh spindles. The production of jute goods in West Bengal and its contribution to the total production of jute

in the country is substantial (Ministry of Textiles, 2022). Jute was once referred to as the “Golden Fibre” because of its significance to the country (Ray et al., 2022). Rural areas in West Bengal's northern region are undergoing fast change as demand- and market-driven agriculture creates new prospects (Haque et al., 2022). However, due to several factors, the area in West Bengal where the jute crop is grown is rapidly decreasing (Sarkar & Majumdar, 2016; Chatterjee et al., 2022). Along with the reasons viz. lack of an appropriate market system, uncertainty over crop returns, labor-intensive crops, high labour costs, insufficient retting infrastructures, and a lack of input availability at the local level are also hindered the cultivation of jute (Islam et al., 2015; Rahman, 2017; Akter et al., 2020). Consequently, the farmers of this region are replacing the jute crop with maize. In this respect, the process of adoption is considered the central concept of the researchers in

the field of diffusion of innovation. It has been defined by Rogers (1962) as a mental process through which an individual passes from first hearing about an innovation to final adoption.

One of the most adaptable developing crops, maize is grown for a variety of reasons during many seasons and ecologies (Dass et al., 2012). With a yield of 2525490 tonnes, maize is grown in West Bengal on an area of 361339hectares (Directorate of Economics and Statistics, 2023). Pre-kharif maize is becoming more and more popular among farmers in North Bengal, mainly because it has the highest yield potential due to the availability of nutrients from prior crops (Chhetri et al., 2018). Cropping sequences is a rotation system approach in crop production that enable the available natural resources to be preserved and more efficiently utilized. According to Siddiqui & Afzal (2018), the area planted with maize has significantly expanded as a result of greater economic benefit, but the area planted with jute has significantly decreased and its cropping order has changed as a result of higher profits of Uttar Dinajpur district. Previously the cropping sequence of some parts of North Bengal was paddy-vegetable- jute, now the new cropping pattern of some parts of North Bengal is paddy-vegetable-maize. The West Bengal government, acknowledging the maize production potential, earned the “Krishi Karman Award” from the Union Government for 2017-18, a recognition they had secured for five consecutive years, spanning from 2011-12 to 2015-16. The study is likely to reveal key factors influencing the preference for maize cultivation over jute, aiding the understanding of farmers’ choices and agricultural dynamics in the region which may help to support agricultural transitions and enhance farmers’ livelihoods.

METHODOLOGY

With an ex-post-facto and exploratory research design, the study’s goal was to identify the variables that discourage the growing of jute and encourage the adoption of maize farming. The study was conducted in the Chopra block of Uttar Dinajpur district. The methodology suggested by Kerlinger (1966); Ray & Mondal (2011) was followed with modifications. Chopra block was selected purposively. Two villages, viz. Satramgach and Sadhuramgach, were selected, and 30 farmers from each village were selected through a random sampling method. Thus, a total of 60 farmers were selected for this study as respondents. The data were collected from the farmers by personal interview method with the help of structured interview schedule during the month of October to December 2019. To make the results comprehensible and understandable, the data were coded, tabulated, analyzed, and presented in tables. Initially, thirty-six items were identified after going through related literature and expert suggestions from related disciplines, as per guidelines set up by Edwards (1969). Out of thirty-six factors, twenty-eight factors were finally selected and presented to the respondent in four points continuums viz. fully agreed, partially agreed, not agreed at all, and can’t tell with weights 4, 3, 2, 1 respectively. The data were analyzed using descriptive statistics, which are useful for summarizing data. Descriptive statistics are divided into two main categories: central tendency (such as the mean) and variability (like standard deviation). These metrics help represent either the entire dataset or a subset of it. Later, the Principal Component Analysis (PCA)

was utilized, which is also the method used by Gupta et al., (2020); Gupta et al., (2021); Paine et al., (2021) & Sahoo et al., (2023). PCA is a technique for reducing the number of dimensions in large data sets by condensing a large collection of variables into a smaller set that retains most of the large set’s information. Statistical Package for Social Sciences (SPSS), version 23.0 software was used to perform Principal Component Analysis.

RESULTS AND DISCUSSION

Table 1 describes the findings, which show that the data were suitable for principal component analysis (BTS at 583.667, level of significance at $P = 0.000$). The KMO test for sampling adequacy yielded a value of 0.603, indicating that there was sufficient data to support substituting jute with maize. The two tests demonstrate that the principal component analysis method is appropriate.

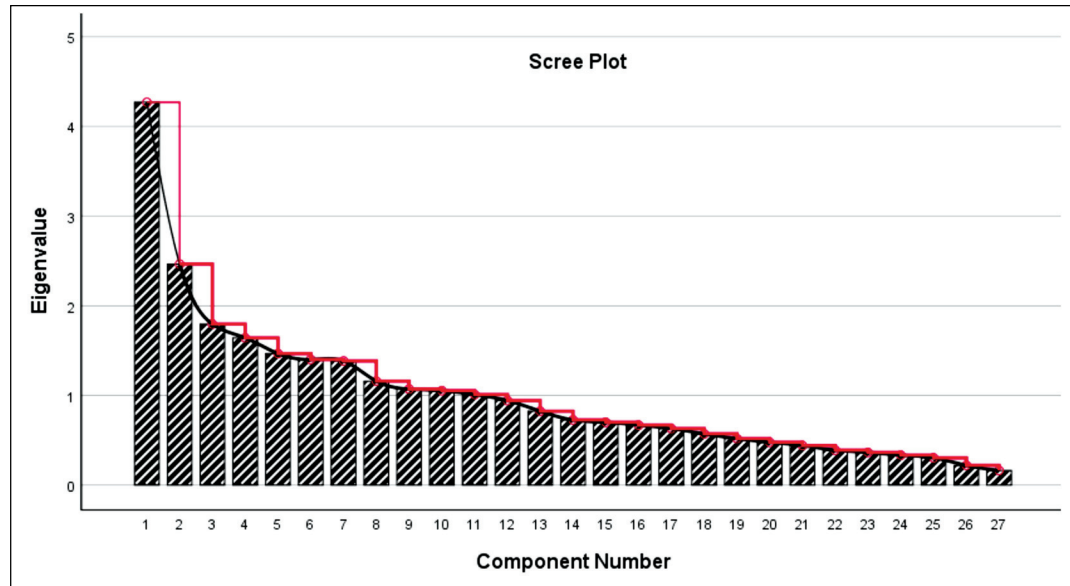
Table 1. KMO and Bartlett’s test

Kaiser-Meyer-Olkin measure of sampling adequacy (KMO)		0.603
Bartlett’s test of sphericity (BTS)	Approx. chi-square	583.667
	df	351
	Sig.	0.000

Figure 1 illustrates graphically and lists the 10 components that affected the shifting from jute to maize farming. Eigenvalue represents the variance or importance of the data that is accounted for by a corresponding factor or component. Higher eigenvalues indicate that the associated factor explains more variance in the data. In contrast, lower eigenvalues suggest that the corresponding factor contributes less to explaining the variance. The scree plot representing the 10 components which are greater than 1.000 eigenvalue implies that more than one factor is relevant in describing the relationships between the items of the factorial component.

Table 2 depicts that the ten components have the eigen value greater than 1.000. For the first component there was an Eigen value of 4.269, a variance and cumulative percentage of 11.041 and 11.041, respectively. The three factors i.e., lack of capital/finance at right time (0.800), low harvest price (0.719) and lack of zone-specific technological know-how’s (0.793) combined to form the component. Component one is labeled as “lack of capital and the remunerative market price of jute” which minimize the jute cultivation. The second component was labeled as “high labour cost during crop season” where three factors have high loading viz, lack of sufficient family manpower, adverse climatic situation and large size of holding. The second component had an Eigenvalue of 2.463, a percentage of the variance of 6.933, and a percentage of cumulative of 17.975 and was labeled as “high labour cost during crop season” where three factors have high loading viz, lack of sufficient family manpower (0.729), low harvest price (0.829) and large size of holding (0.797). Similar findings to the present study, Chapke (2009); Biswas (2001) also found that over 80 per cent of farmers lack awareness regarding improved production technologies. This lack of awareness is attributed to the absence of a well-organized market and grading system, which is reported to be at 93 per cent. Labor-intensive jute cultivation, involving all activities from sowing to fibre extraction, faces higher cultivation costs due to recent increases in human labor prices caused by shortages and higher wages. (Haldar, 2021)

Figure 1. Scree plot of strategic conglomeration of variables into factor



The third component, “poor quality of soil and lack of irrigation water,” was derived with an eigenvalue of 1.797. This component’s two constituents, “poor quality of land” (0.805) and “lack of irrigation water” (0.880), both showed high loadings. The insufficient availability of irrigation water and subpar soil quality ranks as the third most crucial factor driving shifts in crop choices, leading to the preference for maize over jute in the surveyed region due to jute’s water-intensive retting process. In addition to the substantial water demand for the retting procedure, the conventional method of obtaining water for jute processing results in poor water quality. Frequently, the water is unsuitable for reuse in other agricultural activities (Das et al., 2014). Insufficient bodies of water for irrigation and retting (both 28 and 42%) are also noted by Chapke (2009). The fourth component has a variance percentage of 6.481, an eigenvalue of 1.643, and a total variance of 31.338. Due to a high loading of factors, component 4 is labeled as “lack of suitable and improved variety of seed,” specifically “lack of seed of suitable variety of crops” (0.719) and “situation of land” (0.750). Similar findings reported by Pathak (2001) that lack of good-producing jute variety seeds, soil issues, terrain, and a lot of weeds in the field.

Component 5 was marked as having a “high input cost of cultivation”, and two of its factors have high loading, high input costs (0.801), and limited mechanical power availability (0.666) during crop season. The cumulative variance explanation for this component is 37.752 per cent, and it is associated with an eigenvalue of 1.468. Jute production has become a non-profit enterprise due to rising costs of agricultural supplies and manpower, and traditional jute farmers are gradually switching to more remunerative crops like maize, according to Naik et al., (2016). Due to the high loading of the two components, lack of management skill (0.812), and lack of market facilities (0.608), component 6 is labeled as “absence of market facilities”. This component’s cumulative variance was 43.771, while the overall variance was 6.018 and eigenvalue of 1.401. Similar findings were revealed by Chapke (2009) that jute farmers face constraints like no appropriate regulated market, absence of managerial skills, middle man in jute

market.’. Farmers did not receive the required remuneration because the market price of jute dropped.

Due to significant loadings of the components such as lack of crop insurance (0.817) and lack of knowledge about financial institutions (bank, co-ops, etc.) (0.744), component 7 was labelled as “absence of awareness about crop insurance, financial practices.” The seventh component had an Eigenvalue of 1.386, a percentage of the variance of 5.826, and a percentage of cumulative of 49.597. Crop insurance and advanced practices helps in adverse condition of cultivation like low production, adverse climate condition etc. But the farmers of the village were not aware about crop insurance, advanced practices. Similar findings were revealed by Prasad and Choudhary (2022) that boro rice farmers in Bihar did not embrace boro rice production technique due to the absence of financing availability accounting for 81.66 per cent of the identified factors. The eighth component had an Eigenvalue of 1.160, a percentage of the variance of 5.812, and a percentage of cumulative of 55.408. there were three factors in this component. Factors covered by this

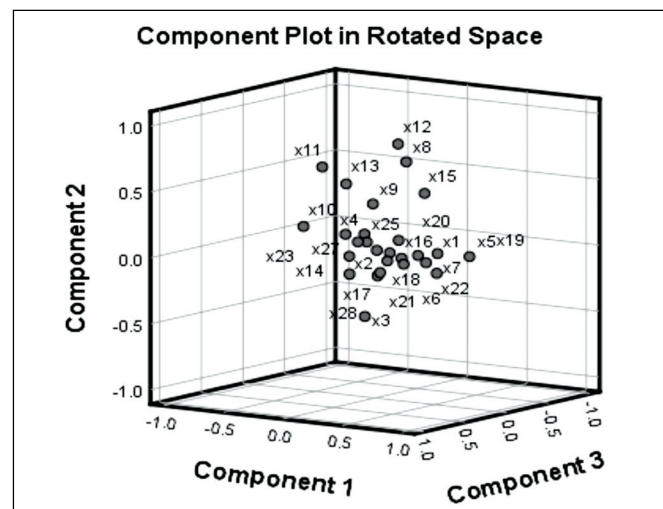


Figure 2. Component plot in rotated space strategic conglomeration of variables into factor

Table 2. Principal component analysis (varimax rotation), factor loading and communalities for factors influencing shifting from jute to maize cultivation

Rotated component matrix											Communalities
Variables	Component										
	1	2	3	4	5	6	7	8	9	10	
<i>Lack of capital and remunerative market price of jute</i>											
Lack of capital/finance at right time (x_8)	0.790										0.800
Low harvest price (x_{11})	0.743										0.719
Lack of zone-specific technological know-how's (x_{12})	0.748										0.793
<i>High labour cost during crop season</i>											
Lack of sufficient family man power (x_{16})		0.585									0.729
Adverse climatic situation (x_{26})		-0.564									0.829
Large size of holding (x_{27})		0.855									0.797
<i>Poor quality of soil and lack of irrigation water</i>											
Poor quality of soil/ land (x_{10})			0.656								0.805
Lack of irrigation water (x_{14})			-0.904								0.880
<i>Lack of suitable and improved variety of seed</i>											
Lack of seed of suitable variety of crops (x_3)				-0.754							0.719
Situation of land (x_9)				0.658							0.750
<i>High input cost of cultivation</i>											
High(input) cost of cultivation (x_4)					0.752						0.801
Low availability of mechanical power during crop season (x_5)					-0.709						0.666
<i>Absence of market facilities</i>											
Lack of managerial ability (x_{19})						0.749					0.812
Lack of market facilities (x_{20})						-0.697					0.608
<i>Absence of awareness about crop insurance, financial practices</i>											
Lack of crop insurance (x_{22})							0.759				0.817
Lack of knowledge about financial institutions (bank, co-operatives, etc.) (x_{28})							-0.726				0.744
<i>High capital for jute cultivation</i>											
Lack of capital/finance for crop cultivation (x_1)								0.559			0.736
Lack of orientation improved crop culture (x_2)								-0.633			0.769
Low availability of insecticide, herbicide (x_{21})								0.783			0.824
<i>Absence of suitable technological knowledge</i>											
Lack of improved technological know-how's (x_{17})									-0.649		0.786
Illiteracy/little education of the farm family head (x_{18})									0.813		0.822
<i>High incentive and organic manure</i>											
Low availability of organic manure at disposal (x_7)										0.820	0.705
Lack of man power at the time of crop operation (x_{24})										0.509	0.651
Eigen value	4.27	2.46	1.80	1.64	1.47	1.40	1.37	1.16	1.07	1.05	
Percentage of variance	11.04	6.93	6.88	6.48	6.41	6.02	5.83	5.81	5.55	5.41	
Percentage of cumulative	11.04	17.97	24.86	31.34	37.75	43.77	49.60	55.41	60.96	66.36	

component lack of capital/finance for crop cultivation (0.736), lack of orientation improved crop culture (0.769), and, low availability of insecticide, herbicide (0.824). the component labeled as “high capital for jute cultivation”. Similarly, Chapke (2009) found in his respective study that farmers face problems like low cost for jute cultivation, lack of awareness about the improved crop culture.

As a result of the factors' high loadings, component 9 was labelled as “lack of appropriate technological knowledge.” The head of the farm household is illiterate or has limited education (0.786) and lacks advanced technological knowledge (0.822). The ninth component had an Eigenvalue of 1.071, a percentage of the variance of 5.548, and a percentage of cumulative of 60.957. The component 10 was made up of two factors i.e., low availability

of organic manure at disposal (0.705) and lack of manpower at the time of crop operation (0.651)” This component's eigenvalue is 1.053, and its cumulative variance explanation is 66.362. Chapke (2009) reported a similar finding. Major labor-related challenges faced by farmers include the need for more work during jute retting operations (81%) and high labour costs during peak seasons, such as weeding and harvesting (79%). During the busy season, almost 23 per cent of farmers reported a workforce shortage.

Figure 2 indicates this graphically, showing how the components plotted in space rotated present a clearer presentation in which both the position of data pertaining to the factorial component and the relationship between data provided by the variables of factors influencing the shifting from jute to maize cultivation.

CONCLUSION

Traditionally, farmers have been growing jute, but due to its low production, limited profitability, high labour cost, inadequate market facilities and unattractive market prices, they have increasingly turned to maize cultivation. To sustain maize cultivation in the respective locality, the Government should develop some supportive infrastructure and promote capacity building. These include providing high-quality maize seeds, conducting awareness programs to educate farmers about the benefits and byproducts of maize, and offering knowledge about export and import markets. Implementation of such initiatives may facilitate the adoption and distribution of maize technology among farmers, leading to an overall improvement in agricultural practices and economic outcomes in the region.

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Knowledge and Adoption of Good Management Practices Among Litchi Farmers in Muzaffarpur District of Bihar

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ABSTRACT

Litchi is one of the nutritionally rich and economically significant fruit of Indian subcontinent. With the advent of Good Management Practices (GMPs), litchi farming technology has advanced drastically. The study was conducted in 2022 in the Muzaffarpur district of Bihar to assess the level of knowledge and adoption of GMPs among litchi farmers and their relationship with the socio-economic profile of litchi growers. The primary data were personally collected through a well-structured interview schedule from 120 respondents. Knowledge and adoption were determined, practicewise on 19 different parameters of GMPs. The highest number of litchi growers (77.50%) had a medium level of knowledge while 71.67 per cent had a medium adoption level of the recommended GMPs in litchi production. Variables viz., the area under litchi, cosmopolitness, farming experience, risk preference, innovativeness, and attitude towards GMPs were positively and significantly related to knowledge as well as adoption. Primary work and education were positively and significantly related to adoption. Dissemination of information about modern agricultural practices is necessary for the adoption of GMPs in litchi production.

INTRODUCTION

India is popularly known as fruit basket of world and stands 2nd in fruit production after China. Litchi is one of important fruit grown in tropical and sub-tropical regions of the world due to its specific climate and soil needs. Litchi is one of the popular fruits of Indian subcontinent and known for its high mineral and vitamin content. Litchis have a significant economic impact in addition to their nutritional value (Kumar et al., 2023). In recent years, global demand for litchi has steadily increased, resulting in increased production and export. Litchi cultivation employs millions of people worldwide, particularly in China, India, Thailand, and Vietnam, which are the world's largest producers of litchis. Litchi cultivation is also culturally important in many parts of the world. Litchis are traditionally associated with the Lunar New Year in China and are regarded as a symbol of good fortune and prosperity.

However, there are some challenges to litchi cultivation. The fruit is susceptible to a variety of diseases and pests, which can result in significant crop losses if not managed properly. Climate change and extreme weather events, such as floods and droughts, can also have a significant impact on litchi productivity. India accounts for 727,000 metric tonnes of litchi production with about 95,000 hectares of area under cultivation (Anonymous, 2018). Litchi contributes significantly to grower's economy in Bihar, West-Bengal, Assam and Jharkhand states of India that accounts for 78 per cent of total production in the country. Bihar stands first and accounts for production of 43 per cent of total litchi and covers 38 per cent of country's land area under litchi cultivation (NHB, 2018).

With the advent of Good Management Practices (GMPs), litchi farming technology has advanced dramatically. It has social impacts as it takes care about workers health, safety and welfare

(Nain et al., 2020). No doubt we came a long way but still there is more to achieve in production, productivity, and quality parameters. There still exists a significant gap between current productivity (6.1 tone ha⁻¹) and potential output (Sahni et al., 2020). Litchi has been cultivated for a long time, and farmers are relying on traditional farm practices for litchi cultivation. Only 0.4 per cent farmers have access to public extension workers for information on modern farm technologies in Bihar against 5.7 per cent at national level (NSSO, 2005). There exists a knowledge gap and slow adoption rate of Good Management Practices among farmers. The goal of study is to determine the level of knowledge and adoption of GMPs for litchi. The study also offers to investigate the relationship between socio-economic profile of farmers and knowledge and adoption of GMPs. The study will help in awareness of gaps and acceptable ways for encouraging the use of improved litchi production.

METHODOLOGY

According to the FAO (2003), Good Management Practices (GMPs) is a science-driven application of available knowledge to address environmental, economical and social sustainability aspect of on-farm and post-production processes for safe and healthy agricultural products. The study was conducted in year 2022 to determine the knowledge and adoption level regarding recommended GMPs for litchi cultivation and relationship of socio-economic variable of respondents with knowledge and adoption. Muzaffarpur district in Bihar was purposively selected for the study owing to maximum area and production of litchi in India. In the second stage two blocks Mushari & Bochaha were selected purposively based on high area and production of litchi. Two villages with maximum number of Litchi growers were purposively selected from each block making four villages. From each village 30 farmers were selected randomly, constituting a total sample size of 120.

For determining the level of knowledge, a set of 19 items relevant to GMPs of were included in the schedule. The responses were recorded on a two-point continuum as possess knowledge or not and were given 2 and 1 score, respectively. Similarly, for determining the extent of adoption of respondents regarding the recommended GMPs of litchi, all the 19 aspects (as mentioned in the knowledge test) were included. The responses were recorded on three-point continuum as fully adopted, partially adopted and not adopted and were given 3, 2 and 1 scores, respectively. The maximum achievable score in case of knowledge was 38 and in case of adoption maximum achievable score was 57. The respondents were categorized into three categorized based on mean and standard deviation from individual score obtained. The three categories were low (<Mean - SD), medium (between Mean $\pm$ SD), high (>Mean + SD). Further in order to assess the extent of relationship between level of knowledge and adoption and socio-economic profile of farmers correlation coefficient were calculated with the help of Pearson's formula of correlation coefficient.

RESULTS AND DISCUSSION

Knowledge greatly influences decision-making process at the individual level. It is pre-requisite before any innovation is adopted. Knowledge and adoption go hand in hand, without initial knowledge

regarding the technology it may be challenging to predict the extent of adoption. After analyzing the practice wise knowledge and adoption of GMPs and their relationship with socio-economic variables the outcome interpreted in this part of result and discussion.

Practice-wise knowledge of the respondents about GMPs

Knowledge of the litchi farmers about GMPs of litchi was analysed for nineteen practices namely, soil type, pH, variety, planting technique, spacing, protection of young plant, intercropping, training, pruning, nutrient management, irrigation methods, irrigation interval, flowering, major pest, insecticides, major diseases, management practices, stage and time of harvesting (Table 1). An overwhelming majority (90%) of the respondents had knowledge about soil type, followed by appropriate pH requirement (79.16%), correct time (75.00%), stage of harvesting (70.00%) and recommended variety (68.33%). The table further shows that respondents had fair knowledge about appropriate intercropping (66.66%), protection of young plant (66.66%), major pest attack (65.00%) irrigation method (63.33%), spacing (62.50%), irrigation interval (60.00%) and nutrient management (60.00%). Furthermore data also indicate that certain fraction of respondents had no knowledge regarding training (56.67%), flowering and insecticides (57.50%), pruning (40.84%) and nutrient management (39.10%). We can conclude that for these variable most of respondents are still relying on old traditional practices and are not able to realize the potential yield of litchi. It is apparent that high percentage of respondents adopted practices like recommended variety, spacing, protection measures for young litchi, intercropping, irrigation methods and intervals as these are very crucial inputs which impact yield level. The findings partially supported by

Table 1. Knowledge level of Litchi growers with respect to recommended GMPs of litchi cultivation

S.No.	Recommended practices	Knowledge level	
		Aware F (%)	Not-aware F (%)
1	Soil type	108(90.00)	12(10.00)
2	pH (6-6.5)	95(79.16)	25(20.84)
3	Recommended variety	82(68.33)	38(32.00)
4	Planting technique	54(45.00)	66(55.00)
5	Spacing	75(62.50)	45(37.50)
6	For protection of young plant	80(66.66)	40(33.30)
7	Intercropping	82(68.33)	38(31.67)
8	Training	52(43.33)	68(56.67)
9	Pruning	71(59.16)	49(40.84)
10	Nutrient management	73(60.90)	47(39.10)
11	Irrigation method	76(63.33)	44(36.67)
12	Irrigation interval	72(60.00)	48(40.00)
13	Flowering	69(57.50)	51(42.50)
14	Major pest	78(65.00)	42(35.00)
15	Recommended insecticides	69(57.50)	51(42.50)
16	Major disease	88(73.30)	32(26.70)
17	Management practices	61(50.84)	59(49.16)
18	Appropriate stage of harvesting	84(70.00)	36(30.00)
19	Time of harvesting	91(75.84)	29(24.16)

F= Frequency, %= Percentage, Figure in parenthesis shows percentage

Nirmala (2015); Pandit et al., (2017); Jat et al., (2022); Shambhvi et al., (2022).

Practice-wise adoption of the respondents about GMPs production technology

Results from Table 2 had been used to provide information of distribution of respondent according to practice wise extent of adoption of recommended GMPs for litchi cultivation. Regarding the 'recommended soil type' an overwhelmingly (94.00%) had fully adopted followed by medium (4.00%). Regarding the adoption of 'recommended pH', 50.84 per cent of litchi growers had high adoption followed by medium (45.84%) and low (3.33%). About the 'recommended variety', 48.34 per cent of respondents had fully adopted followed by partially (47.84%) and 4.17 per cent not adopted. For the practice 'planting technique', (36.67%) litchi growers had partially adopted followed by not-adopted (34.17%) and fully adopted (29.17%). Regarding the adoption of 'required spacing', 45.86 per cent had partially adopted followed by fully (31.66%) and not adopted (22.50%). Regarding 'protection of young plants', 49.17 per cent had fully adopted the recommended technique followed by partially (35.00%) and not adopted (15.84%). For the adoption of 'intercropping', 43.34 per cent had fully adopted followed by partially (40.00%) and not adopted (16.67%). For the practice 'training and pruning', (44.17%) had partially adopted followed by fully (35.00%) and not adopted (20.00%). Regarding 'Nutrient management' half of the litchi growers had partial adoption followed by complete (32.50%) and no adoption (17.50%). About the 'irrigation method', the majority of litchi growers (49.16%) had partial adoption followed by complete (39.17%) and no adoption (11.67%). For 'irrigation interval', 50.54 per cent had partially adoption followed by complete (38.33%) and no adoption (10.33%). Regarding the practice of 'spray for flowering induction', 41.67 per cent of litchi growers had complete adoption followed by partial

(33.34%) and no adoption (25.00%). About 'recommended insecticides', 50.84 per cent had partial adoption followed by complete (35.83%) and no adoption (13.34%). Regarding 'disease management', 52.50 per cent had partial adoption followed by complete (30.00%) and no adoption (17.50%). For adoption of 'appropriate stage of harvesting' majority of litchi growers (56.67%) had adopted followed by partial (30.84%) and no adoption (12.50%). Regarding adoption of 'appropriate harvesting time', 46.67 per cent litchi growers complete adoption followed by partial (35.00%) and no adoption (18.34%). It is evident that a fair number of litchi growers adopted practices recommended variety, spacing, protection measure for young litchi plants, intercropping, irrigation methods and irrigation interval. As compared to this the practices like propagation methods, planting technique, training and pruning, nutrient management and plant protection measures have comparatively less percentage of litchi growers who had completely adopted. The findings are partial agreement with the study of Deshmukh et al., (2007).

Overall knowledge and adoption level of litchi growers

Table 3 shows the distribution of respondents based on their overall knowledge and adoption level. The findings of study indicates that majority of respondents (77.50%) had a medium level of knowledge followed by 14.17 per cent had high knowledge level and 8.33 per cent had low level of knowledge about recommended GMPs of litchi. Kumar et al., (2020) in his study on knowledge of mango growers about management practices in western Uttar Pradesh observed similar findings. Knowledge of the innovation is a prerequisite before it can be adopted (Rogers, 2003). Lack of knowledge about improved farming techniques directly affects the level of adoption. Table 3 further shows that maximum number of respondents (71.67%) had medium level of adoption followed by high (16.66%) and low (11.67%). Similar findings were supported by Yadav et al., (2010) in his study on Adoption Behaviour of

Table 2. Adoption of Litchi farmers with respect to recommended GMPs

S.No.	Recommended Practices	Adoption level		
		Fully F (%)	Partially F (%)	Not adopted F (%)
1.	Soil type	113(94.00)	7(6.00)	0
2.	pH	61(50.84)	55(45.84)	4(3.33)
3.	Recommended variety	58(48.34)	57(47.84)	5(4.17)
4.	Planting technique	35(29.17)	44(36.67)	41(34.17)
5.	Spacing	49(31.66)	45(45.86)	26(22.50)
6.	Protection measure for young plant	59(49.17)	42(35.00)	19(15.84)
7.	Intercropping	52(43.34)	48(40.00)	20(16.67)
8.	Training	41(34.17)	53(44.17)	26(21.67)
9.	Pruning	42(35.00)	53(44.17)	25(20.00)
10.	Nutrient Management	39(32.50)	60(50.00)	21(17.50)
11.	Irrigation method	47(39.17)	59(49.16)	14(11.67)
12.	Irrigation interval	46(38.33)	61(50.84)	13(10.33)
13.	Spray for flowering induction	50(41.67)	40(33.34)	30(25.00)
14.	Major pest	57(47.67)	45(37.50)	18(15.00)
15.	Recommended insecticides	43(35.83)	61(50.84)	16(13.34)
16.	Major disease	66(55.00)	34(28.34)	20(16.67)
17.	Disease Management	36(30.00)	63(52.50)	21(17.50)
18.	Appropriate stage of harvesting	68(56.67)	37(30.84)	15(12.50)
19.	Time of harvesting	56(46.67)	42(35.00)	22(18.34)

F= Frequency, %= Percentage, Figure in parenthesis shows percentage

Table 3. Overall knowledge and adoption level

S.No.	Categories	Percentage	Mean	SD	Percentage	Mean	SD
1.	Low < (mean - SD)	8.33	12.84	2.34	11.67	22.57	4.40
2.	Medium (mean $\pm$ SD)	77.50			71.67		
3.	High > (mean + SD)	14.17			16.66		
	Total	100			100		

Commercial Potato Growers in Ghaziabad district of Uttar Pradesh. Singh et al., (2015) in his study on adoption of modern agricultural technologies at farm level in Bihar observed that farmers are in low adoption category in adopting modern farm technologies. An improvement in knowledge is necessary factor in adoption of an innovation.

Association of socio-economic variables with knowledge and adoption

The total knowledge score of GMPs of litchi for each respondent were put to correlation analysis with personal, farm, communication, and psychological characteristics. Independent variables such as farm size, productivity of Litchi, income from litchi and achievement motivation are non-significant relationship with knowledge. On the other hand, independent variable like Area under litchi, cosmopolitness, experience in farming were significantly correlated with knowledge at 1 per cent level of significance. While Risk preference, Innovativeness and Attitude towards GMPs were significantly correlated with knowledge at 5% level of significance. Sweta et al., (2019) observed that risk taking ability of farmer and achievement motivation are positively and significantly associated with the knowledge level of farmers about drip irrigation system. Diksha et al., (2023) viewed that cosmopolitness of farmers has a direct and positive relationship with the knowledge level of litchi growers in Punjab.

Variables such as area under litchi, primary work, cosmopolites, experience in farming, risk preference, achievement motivation, innovativeness and attitude towards GMPs are significantly related with level of adoption at 5% level of significance. Sai (2021) in his study found that area under litchi and experience in the farming

significantly associated with adoption of modern litchi production technologies. Warshini et al., (2022) viewed that risk orientation of farmer and sources of information has a significant role in adoption of banana production technologies.

CONCLUSION

It can be concluded that majority of farmers have medium level of knowledge and majority falls in medium adoption level of GMPs of litchi cultivation. Thus, it becomes important for extension agencies to play a crucial role to create awareness among litchi growers about GMPs. This can be done through training, result demonstration, field trips as well as group discussions. In coming years litchi can play a pivotal role in export, so there is need to enhance litchi in terms of quantity as well as quality and adopting GMPs of litchi can be a crucial step.

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Table 4. Relationship between profile characteristics of Litchi growers with their knowledge level

S.No.	Characteristics	Knowledge value of r	Adoption value of r
1.	Area under Litchi	0.945**	0.939**
2.	Cosmopolitness	0.928**	0.969**
3.	Experience in Farming	0.939**	0.959**
4.	Farm Size	0.059 ^{NS}	0.086 ^{NS}
5.	Productivity of Litchi	0.051 ^{NS}	0.141 ^{NS}
6.	Income from Litchi	0.010 ^{NS}	0.027 ^{NS}
7.	Risk preference	0.226*	0.355**
8.	Achievement Motivation	0.057 ^{NS}	0.396**
9.	Innovativeness	0.191*	0.421**
10.	Attitude towards GMPs	0.192*	0.315**
11.	Level of education	0.752 ^{NS}	0.143 ^{NS}
12.	Primary work	0.586 ^{NS}	0.285*

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at 0.01 level (2- tailed), NS: Non-significant

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Determinants and Constraints for Adoption of Zero Budget Natural Farming (ZBNF) Practices

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ABSTRACT

Zero Budget Natural Farming (ZBNF) follows agroecological principles and promotes chemical-free farming. It has emerged as cost-effective farming improving soil fertility and providing chemical-free food. For determining factors for the adoption of ZBNF practices in the purposively selected Wardha district of Maharashtra, conducted during 2022-23, Logit regression and for analyzing the constraints, factor analysis was used. The study revealed significant factors like integrated soil fertility management practices, adoption of ZBNF practices and IPM practices. The scarce raw materials for input preparation, management of weeds and pests were identified as input related whereas, lack of knowledge about liquid fertilizers, insect pest and weed management practices were reported as technology constraints, in case of the constraints related to labour and machinery, non-availability of the bullock, high demand of skilled labour and high labour wages were reported. In case of institutional constraints, higher conversion period, high demand of skilled labour, and high certification fee were found. The assurance of better prices, purchase agencies at distant places, and lack of proper market structure were reported as the marketing constraints. In the case of political and legal constraints, a lesser number of FPOs, the synergy of the ZBNF practices with mainstream agriculture, lack of globalized market, and the need for convergence were found significant.

INTRODUCTION

Declining crop productivity and uncertain market conditions has resulted in un-remunerative agriculture. Consequently, farmers have fallen into the debt trap due to the rising cost of crop production apart from health hazards due to serious exposure to harmful chemical pesticides (Kumar et al., 2023). These issues have led to the decreasing share of agriculture in productive economy; employment is taking place at different speeds and different challenges have been emerging across the regions (Chatterjee et al., 2022). The Farmer Field School (FFS) is a season-long training for farmers involving participatory activities and interactive learning with the doctrine of integrated pest management and agro-ecosystem analysis (Bhuiyan et al., 2022). In FFS, various other

sustainable agricultural practices have a vital role to maintain sustainability of agriculture in the long run (Niranjan et al., 2023). These have facilitated the rise of Zero Budget Natural Farming (ZBNF) practices in several states throughout India, with the goal of creating a more effective and resource use agricultural system. Sh. Subash Palekar, an Indian agriculturists in the mid-1990s started ZBNF based on agro-ecological principles. Natural Farming (NF) is one-of-a-kind chemical-free farming approach that is regarded as an agro-ecological approach (Rosset et al., 2012). In other terms it can be discussed as a type of sustainable agricultural system, which is one such alternative to chemical fertilizer based agriculture and high input cost agriculture. It represents agro-ecological principles where the emphasis is on “enhanced soil conditions by managing organic matter and soil biological activity;

diversification of genetic resources; enhanced biomass recycling; and enhanced biological interactions” (Khadse et al., 2018). In the last couple of years, the government of India has promoted natural farming in a big way to promote chemical-free farming. The Prime Minister of India in his address to the nation on the 76th Independence Day of India stated ‘ZBNF is a promising tool to minimize the dependence of farmers on purchased inputs; it reduces the cost of agriculture by relying on traditional field-based technologies which also lead to improved soil health (Duddigan et al., 2022). The emergence of ZBNF in India has not been without its challenges in implementation. It has been facing several issues at different levels such as, awareness level among farmers, acceptability of good results in crops’ yields, proper coordination with implementing agencies etc. Skeptics argue that transitioning from conventional farming to ZBNF requires a paradigm shift in the mindset of farmers, as well as significant investment in training and capacity-building. Furthermore, the adoption of ZBNF may initially lead to lower yields during the transition period as the soil and ecosystem adapt to the new farming techniques. The scaling up of NF may not only depend on the farming practices, but social factors such as social movements, public policies, markets, pedagogical processes, leadership, and discourse. Farmer-focused and farmer-led knowledge exchange is a key driver of the sustained spread of NF practice. Keeping this in mind, present study examines the different associated factors and constraints faced by farmers in adopting ZBNF practices.

METHODOLOGY

This study was conducted in the Wardha district of Maharashtra that was purposively selected. Two blocks, i.e., Wardha and Deoli, were selected, and two villages from each block and 30 farmers from each village were selected through a random sampling method. Thus, a total of 120 farmers were selected as respondents for this study. Data were collected from the respondents in structured interview schedule on different socio-economic characteristics. Logit regression was used for determining the factors for adoption of ZBNF practices in the farmer field school where Participation in Farmer Field school as dependent variable and other socio economic and personal variables as other

independent variable as ordinal variable labeled as 1 and 0. For constraints, a 5-point likert scale, varying strongly agree to strongly disagree, was used to obtain the responses on six different categories of constraints, such as input constraints, technology constraints, labour and machinery constraints, institutional constraints, marketing constraints, and political and legal constraints.

Factor analysis was used to categorise and reduce the variables/ factor which were more prominent and was easy to group them for easy identification of constraints and Varimax rotation analysis was used to extract the factors. Data was analyzed using IBM-SPSS-29 package.

RESULTS AND DISCUSSION

The determining factors that were having a significant impact on the adoption of ZBNF practices facilitated through participation in FFS were analyzed. The Logit model regression was used to find out the determining factors for adoption of ZBNF practice. Here adoption of ZBNF practices is set of practices used in ZBNF so one or more practices. So practicing one or more practices has been considered as independent variable for measuring the adoption in participation to FFS.

From the Table 1, it is clear that some variables had positive effect like integrated soil fertility management practices, adoption of ZBNF practices and integrated pest management practices at 1 per cent of level of significance, use of live mulching and drip irrigation at 5 per cent level of significance.

Waste decomposer, and extension contact were found to be negatively associated with the adoption of ZBNF practices; however, not significantly influencing. The other factors like gender, ICT use, farm participation, education and livestock ownership were also found not significant. A study was conducted on impact of IPM practices in Jammu and reported similar result that IPM training programme impacted adoption of IPM practices in farmer field school (Sharma et al., 2015) which in line with our study.

The different types of constraints were listed through direct contact with farmers and through review of literature and grouped into different dimensions. Factor analysis method was used and their data reliability was tested using Kaiser-Meyer-Olkin Measure of sampling adequacy explains the strength of the partial correlation

Table 1. Determinants for practising sustainable agricultural practices/ZBNF practice in Farmer Field School

S.No.	Variables	Estimate	Std. error	Z	Sig.
1.	Age	.003	.008	.322	0.748
2.	Integrated Soil Fertility Management	2.975	.734	4.053	<.001
3.	Integrated Pest Management	2.016	.640	3.151	0.002
4.	Waste Decomposer	-.040	.189	-.213	0.832
5.	Drip Irrigation	.392	.203	1.936	0.053
6.	Gender	.285	.206	1.383	0.167
7.	ICT Use	.048	.266	.180	0.857
8.	Farm Participation	.067	.209	.319	0.750
9.	Livestock Ownership	-.053	.205	-.256	0.798
10.	Extension Contact	-.086	.196	-.441	0.659
11.	Education	.017	.111	.152	0.879
12.	Adoption of ZBNF	1.365	.281	4.857	<.001
13.	Live Mulching	0.785	.318	2.466	0.014

Table 2. KMO and Bartlett's test for constraints perceived by ZBNF farmers in Maharashtra

Constraints	Input	Technology	Labour & Machinery	Institutional	Marketing	Political & Legal
Kaiser-Meyer-Olkin measure of sampling adequacy (KMO)	0.552	0.611	0.615	0.598	0.562	0.512
Bartlett's Test of Sphericity (Approx. Chi-square)	46.841	61.118	48.983	41.761	52.367	46.570
df	21	21	21	21	21	21
Sig.	<.001	<.001	<.001	0.005	<.001	0.001

(how the factors explains each other) between the variables and Bartlett's test of sphericity test the null hypothesis and a significant chi-square at 0.001% and 0.005% level of significance. The sample adequacy scale was also examined and its value was determined in a range of 0.5 to 0.6 which falls under acceptable tolerance range.

Table 2 indicated that KMO and Bartlett's test values of input constraints (BTS 46.841 and the significance point in $P < .001$), technology constraints (BTS 61.118 and the significance point in $P < .001$), labour and machinery constraints (BTS 48.983 and the significance point in $P < .001$), institutional constraints (BTS 41.761 and the significance point in $P = 0.00$), marketing constraints (BTS 52.367 and the significance point in $P < .001$) and political and legal constraints (BTS 46.570 and the significance point in $P = 0.001$) showed that all the constraints of the ZBNF farmers were suitable for analysis of principal component. Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) provided the values of input constraints (0.552), technological constraints (0.611), labour and machinery constraints (0.615), institutional constraints (0.598), marketing constraints (0.562), and political

and legal constraints (0.512) which showed that the constraints of the ZBNF farmers had adequate items. Both tests favored the adequacy of principal component analysis.

From Table 3, it is revealed that input constraints were categorized into three components based on eigen values. Input constraints component 1 (levelled as scarce raw material for input preparation) had higher eigen value of 1.44, a variance percentage of 20.61, and a cumulative percentage of 20.61 and under this component non-availability of quality seeds (0.744) was the major constraint followed by scarcity of bio fertilizers and manures of 0.712, and Preparation of inputs is labour intensive and costly (0.538). The second component, levelled as crop management practices, comprise with difficulty in management of weeds, insect pest and disease, and non-availability of urine/dung of local/indigenous cow having highest covariance values, and eigen value of 1.42, a variance percentage of 20.32, and a cumulative percentage of 40.94.

Rao et al., (2021), in his study found that the major constraints of ZBNF were non availability of Subhash Palekar Natural Farming

Table 3. Factor analysis following PCA (Varimax rotation) of constraints related to input and technology as perceived by the ZBNF farmers (N=100)

S. No.	Constraints related to input	Rotated component matrix			Communalities (Sum of squared factor loadings for the variables denoted as R ²)
		1	2	3	
1.	Non-availability of urine/dung of local/indigenous cow	0.075	0.715	0.167	0.545
2.	Non-availability of biomass for compost preparation	-.127	0.326	0.809	0.776
3.	Difficulty in management of weeds, insect pest and disease	0.062	0.768	-.108	0.606
4.	Non-availability of quality seeds	0.744	-.070	-.029	0.559
5.	Preparation of inputs is labour intensive and costly	0.538	0.310	0.302	0.476
6.	Non-availability of liquid inputs in the market	0.261	-.327	0.696	0.660
7.	Scarcity of bio fertilizers and manures	0.712	0.089	0.016	0.515
	Eigen values	1.44	1.42	1.27	
	% of variance	20.61	20.32	18.15	
	Cumulative %	20.61	40.94	59.10	
	Constraints related to technology				
1.	Lack of Knowledge about insect and pest in ZBNF	0.053	0.773	0.174	0.631
2.	Lack of Knowledge about weed management practices in ZBNF	-.064	0.332	0.804	0.761
3.	Lack of capacity building regarding preparation of inputs in ZBNF	0.155	0.770	-.094	0.625
4.	Lack of Knowledge about use of liquid fertilizers in ZBNF	0.768	-.045	-.015	0.593
5.	Non availability of package of practices on ZBNF	0.569	0.253	0.335	0.500
6.	Less demonstration units for FYM/Compost/Liquid manure preparation	0.237	-.233	0.733	0.649
7.	Lack of soil & water testing facilities for ZBNF farmers	0.685	0.137	0.053	0.490
	Eigen values	1.469	1.440	1.339	
	% of variance	20.98	20.57	19.13	
	Cumulative %	20.98	41.55	60.69	

(SPNF) inputs. The third component (leveled as non-availability of biomass for compost preparation) had an Eigenvalue of 1.27, a variance percentage of 18.15, and a cumulative percentage of 18.15, the next major input constraint. The component consists of 3 items such as non-availability of biomass for compost preparation (0.809) major constraints followed by non-availability of liquid inputs in the market (0.696) and preparation of inputs is labour intensive and costly (0.302) were the major constraints. Similar results were also observed as ZBNF adoption include time and labor constraints found by Bhattacharya (2017) & Gupta et al., (2020) found the beejamrutham required the most labor out of all ZBNF inputs.

Technological constraints categorized into three components based on eigenvalues of more than one (Table 3). The first component (Lack of knowledge about different liquid fertilizers in ZBNF) was major technological constraint as it has a higher Eigenvalue of 1.469, a variance percentage of 20.989, and a cumulative percentage of 20.989 than the other two components. The component consists of three constraints; lack of knowledge about use of liquid fertilizers in ZBNF (0.768) was a major constraint followed by the lack of soil & water testing facilities for ZBNF farmers (0.685) and the non-availability of package of practices on ZBNF (0.569). Singh & Thakur (2022) found the similar result for ZBNF practicing farmers. The second component (Leveled as Appropriate knowledge about pest management) has an eigen value of 1.440, a variance percentage of 20.570, and a cumulative percentage of 41.559. The component consists of two

constraints, lack of knowledge about insect and pest in ZBNF (0.773) was a major constraint, followed by lack of capacity building regarding preparation of inputs in ZBNF (0.770). The third component, leveled as knowledge about weed management practices had an eigenvalue of 1.339, a variance percentage of 19.133, and a cumulative percentage of 60.692, the next major technology constraints. The component consists of two constraints such as lack of knowledge about weed management practices in ZBNF with covariance value of 0.804 and less demonstration units for FYM/Compost/liquid manure preparation (0.733).

From Table 4, it is revealed that constraints related to labour and machinery were categorized into three components based on Eigen values. In labour and machinery constraints component 1 (levelled as non-availability of farm machineries) had higher eigen value of 1.408, a variance percentage of 20.110, and a cumulative percentage of 20.110 and under this non-availability of bullock/tractor/power tiller at proper time (0.793) was the major constraints followed by less information about custom hiring services of 0.618. Das (2020) also found the similar constraints including farmers were less likely to adopt ZBNF due to labor and time constraints, as the increased costs to hire labor affected their profitability.

The second component, leveled as increased demand of skilled labour, had eigen value of 1.398, a variance percentage of 19.967, and a cumulative percentage of 40.077 and under this high demand of specialized/skilled labour (0.775) was major constraint followed by, non-availability of human labour (0.757). The third component

Table 4. Factor Analysis following PCA (Varimax rotation) of constraints related to labour/machinery and institutional issues as perceived by the ZBNF farmers (N=100)

S. No.	Constraints related to labour and machinery	Rotated component matrix			Communalities (Sum of squared factor loadings for the variables denoted as R ²)
		Component			
		1	2	3	
1.	Non-availability of human labour	0.051	0.757	0.184	0.610
2.	High wages of labour	-.106	0.230	0.825	0.746
3.	High demand of specialized/skilled labour	0.129	0.775	-.100	0.628
4.	Non-availability of bullock/tractor/power tiller at proper time	0.793	-.117	-.015	0.643
5.	High charges of tractor/power tiller	0.538	0.292	0.324	0.479
6.	Lack of machinery bank at village level	0.279	-.165	0.692	0.584
7.	Less information about custom hiring services	0.618	0.211	0.044	0.428
	Eigen values	1.408	1.398	1.311	
	% of variance	20.110	19.967	18.725	
	Cumulative %	20.110	40.077	58.802	
	Institutional issues				
1.	Certification is difficult and time consuming	0.783	0.078	0.156	0.643
2.	Certification fee is high	0.197	-.264	0.774	0.707
3.	Conversion period from chemical to natural farming is longer	0.822	0.079	-.093	0.690
4.	Difficulty in fulfilling certification norms/rules	-.016	0.662	-.168	0.467
5.	Certification agencies are less and located at distant places	0.272	0.547	0.359	0.503
6.	Insufficient extension staff	-.182	0.348	0.626	0.546
7.	Lack of appropriate transfer of technology measures by extension organizations/Agriculture department/ private agencies	0.096	0.697	0.082	0.502
	Eigen values	1.444	1.428	1.188	
	% of variance	20.622	20.398	16.970	
	Cumulative %	20.622	41.020	57.990	

(leveled as high labour wages) had an Eigen value of 1.311, a variance percentage of 18.725, and a cumulative percentage of 58.802, the next major labour and machinery constraints. The component consists of 2 items such as high wages of labour of 0.825 major constraints followed by lack of machinery bank at village level (0.692). Laishram et al., (2022) reported that shortage of skilled labor, higher wage rate, non-availability at peak operation time were the major constraints in adopting ZBNF practices.

From Table 4, it is revealed that constraints related to institutional issues were categorized into three components based on eigen values. In institutional constraints component 1 (leveled as longer conversion period from chemical to non chemical/organic) had higher eigen value of 1.444, a variance percentage of 20.622, and a cumulative percentage of 20.622 and under this component conversion period from chemical to natural farming is longer (0.822) was the major constraint followed by certification is difficult and time consuming of 0.783. Devi et al., (2020) & Nain et al., (2020) also found the similar results. The second component, leveled as an lack of appropriate transfer of technology measures by extension organizations, has Eigen value of 1.428, a variance percentage of 20.398, and a cumulative percentage of 41.020 and under this lack of appropriate transfer of technology measures by extension organizations/Agriculture department/ private agencies (0.697) was major constraint followed by, difficulty in fulfilling certification norms/rules (0.662) and certification agencies are less and located at distant places (0.547). The third component (leveled as high certification fee) had an Eigenvalue of 1.188, a variance percentage of 16.970, and a cumulative percentage of 57.990, the next major

institutional constraint. The component consists of 2 items such as certification fee is high of 0.774 major constraints followed by insufficient extension staff (0.626).

From Table 5, it is revealed that marketing constraints were categorized into three components based on Eigen values. In marketing constraints component 1 (levelled as lack of better prices assurance) had higher Eigen value of 1.657, a variance percentage of 23.66, and a cumulative percentage of 23.664 and under this component lack of assurance of better prices (0.796) was the major constraints followed by lack of robust supply chain network of 0.789. Similar result was also observed by Priya & Naidu (2019) that marketing is a major constraint. Vashishat et al., (2021), in his study reported that major constraints were non-availability of a specialized market and unfair price for produce in market.

The second component, leveled as at distant location of purchase agencies, has eigen value of 1.258, a variance percentage of 17.965, and a cumulative percentage of 41.629 and under this purchase agencies at distant places (0.777) was major constraint followed by lack of information for value addition and marketing (0.745). The third component (leveled as lack of market structure) had an eigen value of 1.197, a variance percentage of 17.098, and a cumulative percentage of 58.727, the next major constraint. The component consists of 2 items such as lack of proper market structure of 0.830 major constraints followed by high transportation charges (0.605).

In Table 5 it is depicted that, political and legal constraints were categorized into four components based on Eigen values. In

Table 5. Factor analysis following PCA (Varimax rotation) of constraints related to marketing and political concerns as perceived by the ZBNF farmers

S. No.	Constraints related to marketing	Rotated component matrix			Communalities (Sum of squared factor loadings for the variables denoted as R ²)	
		Component				
		1	2	3		
1.	Lack of robust supply chain network	0.789	0.252	0.000	0.685	
2.	Lack of information for value addition and marketing	0.081	0.745	-.228	0.614	
3.	Lack of assurance of better prices	0.796	-.120	-.016	0.649	
4.	Lack of proper market structure	-.045	-.074	0.830	0.696	
5.	Low level of marketable surplus	0.490	-.052	0.200	0.283	
6.	Purchase agencies at distant places	-.066	0.777	0.225	0.658	
7.	High transportation charges	0.384	0.114	0.605	0.527	
	Eigen Values	1.657	1.258	1.197		
	% of variance	23.664	17.965	17.098		
	Cumulative %	23.664	41.629	58.727		
	Constraints related to Political and legal concerns	1	2	3	4	
1.	Subsidy on input such as seeds, fertilizers, machinery etc.	0.843	-.082	-.044	0.037	0.721
2.	Government support through different scheme (PMFBY, Support to Agri MSMEs)	-.072	0.475	0.098	0.636	0.644
3.	Less public investment on research and development	0.162	-.685	0.449	0.061	0.701
4.	Lack of globalized market and integrated market intelligence approach	0.014	0.084	0.898	-.001	0.813
5.	Need of convergence between different departments and NGOs	0.130	-.220	-.051	0.834	0.763
6.	Effort to online the ZBNF practices with mainstream agriculture	0.107	0.755	0.315	-.029	0.681
7.	less number of FPOs/ farmer based organization	0.850	0.061	0.106	0.046	0.739
	Eigen values	1.493	1.331	1.132	1.107	
	% of variance	21.328	19.014	16.164	15.820	
	Cumulative %	21.328	40.342	56.506	72.326	

political and legal constraints component 1 (levelled as appropriate number of FPOs) had higher Eigenvalue of 1.493, a variance percentage of 21.328, and a cumulative percentage of 21.328 and under this component less number of FPOs/farmer based organization (0.850) was the major constraint followed by subsidy on input such as seeds, fertilizers, machinery etc. of 0.843. The second component, leveled as mainstreaming of ZBNF practices, has Eigenvalue of 1.331, a variance percentage of 19.014, and a cumulative percentage of 40.342 and under this effort to online the ZBNF practices with mainstream agriculture (0.755) was major constraint. The third component (leveled as lack of global market structures) had an Eigenvalue of 1.132, a variance percentage of 16.164, and a cumulative percentage of 56.506, the next major constraint. The component consists of 2 items such as lack of globalized market and integrated market intelligence approach of 0.898 major constraint followed by less public investment on research and development (0.449). The fourth component (leveled as need of convergence based approaches) has an Eigenvalue of 1.107, a variance percentage of 15.820, and a cumulative percentage of 72.326, and under this, need of convergence between different departments and NGOs (0.834) was the major constraint followed by government support through different scheme (PMFBY, Support to Agri MSMEs) (0.636).

CONCLUSION

The factors such as integrated soil fertility management practices, integrated pest management practices, adoption of ZBNF practices, use of live mulching and drip irrigation were found significant factors for practicing sustainable agriculture/ZBNF practices for the participants of Farmer Field School. ZBNF practicing farmers faced constraints like, scarce raw material for input preparation, lack of weed management practices, lack of appropriate pest and disease management practices and non-availability of biomass for compost preparation, knowledge about use of liquid fertilizers, lack of specialized labour, high labour wages, higher conversion period and several others. Farmers showing interest in adopting ZBNF should be fully aware of basic ZBNF practices and they need to be trained on the aspects constrained by them. Beside these technical and other constraints the number of farmers in ZBNF is increasing due to intervention of government of India and different state specific schemes. These constraints need to be overcome for sustaining the yield and income through natural farming practices.

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Assessing Organic Poultry Farming Knowledge Among Tribal Farmers: A Tailored Knowledge Test

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ABSTRACT

The increasing demand for organic agricultural products necessitates the assessment of farmers' knowledge levels, particularly among tribal communities engaged in organic poultry farming. This manuscript presents the construction and development of a knowledge test specifically designed for tribal farmers in India who have undergone training in organic poultry farming. The test aims to evaluate their understanding of organic farming principles, best practices, disease management, and other relevant aspects. A total of 56 items were selected, and their difficulty and discrimination indices were calculated using item analysis. The final selection of items for the test was based on criteria of difficulty and discrimination indices. The reliability of the test was assessed using the split-half method, yielding a correlation coefficient of 0.82. The validity of the test was established through point-biserial correlation analysis. The developed knowledge test provides a valuable tool for evaluating the productivity of training programmes and identifying areas for further support and improvement in organic poultry farming among tribal farmers.

INTRODUCTION

Knowledge tests have a crucial role in evaluating the skills and competencies of individuals in our rapidly changing world (Vijyan et al., 2022). The poultry industry provides job opportunities and boosts household income in rural communities (Patel et al., 2022; Jat & Yadav, 2022). Across the world, in countries like the USA there has been 25 per cent growth rate in the poultry industry and in United Kingdom there is a 100 per cent increase in organic poultry meat (Willer et al., 2022; Willer et al., 2023). The global demand for a more sustainable approach to farming has led to the rise of the organic agriculture movement, which has gained traction among farmers, including tribal farmers in India (Gills et al., 2020). The expansion of organic farming has been witnessed globally, with increasing areas under organic management and a wide range of organic food products (Nain et al., 2020), with the international market for organic food & drink

expanded by 5 per cent to 135.5 billion US dollars in 2021 (Willer et al., 2023). In India, organic farming is gaining momentum, particularly among small and marginal farmers in rain-fed, arid, and hilly regions (Subrahmanyeswari & Chander, 2022). Tribal farmers, who constitute a significant portion of the agricultural community in India, face challenges such as limited resources, inadequate technical knowledge, and lower socio-economic status (Pawluk et al., 1992; Singh et al., 2022; Sajeev et al., 2021). Implementing training initiatives aims to promote sustainable and organic farming practices among tribal farmers, particularly in free-range poultry rearing, which holds the potential for income generation, women's empowerment, and improved nutrition (Chaturvedani et al., 2017; Singh et al., 2017). Knowledge of many of the critical technical know-how which is a prerequisite for practicing organic farming (Malik et al., 2022). However, existing assessment tools may not adequately capture the specific knowledge requirements and cultural

context of tribal farmers engaged in organic poultry farming. This research aims to develop a tailored knowledge test for tribal farmers in India who have received training on organic poultry farming, taking into consideration their unique needs and cultural background.

METHODOLOGY

The knowledge assessment focused on evaluating the understanding and critical thinking abilities of tribal farmers engaged in organic poultry production, specifically in India. The assessment was meticulously designed to align with the core concepts of organic farming and utilised questions, referred to as "items," sourced from the National Programme for Organic Production (NPOP) standards (APEDA, 2014). The selection of these items adhered to two primary criteria. Firstly, the questions aimed to foster thoughtful comprehension rather than relying solely on rote memorisation, encouraging farmers to apply their knowledge and analytical skills in practical scenarios. Secondly, the items were carefully tailored to differentiate between farmers who possessed sound knowledge and those who lacked expertise, effectively gauging their level of proficiency. Each item was assigned a difficulty value to ensure an appropriate level of challenge. To ensure the test's validity, items that were either poorly understood by farmers or elicited unanimous correct or incorrect responses were deemed unsuitable. Initially, a total of 56 items were selected, encompassing key aspects of the organic poultry production curriculum. Subsequently, a schedule was devised to execute the test to a comparable target group of farmers. The motive of administering them was to conduct item analysis, evaluate the relevance of each item, and identify any weak or non-applicable questions. The items were presented in diverse formats, such as multiple-choice or other open-ended formats, to accommodate different perspectives and provide a comprehensive assessment of farmers' knowledge and understanding of organic poultry production.

The items were distributed to 30 tribal farmers who had received training in organic farming. After computing the scores obtained by the respondents, the scores were arranged in descending order. The respondents were then divided into six equal groups, each consisting of five respondents, and sorted based on their total scores. These groups were named G1, G2, G3, G4, G5, and G6, respectively. The middle two groups (G3 and G4) were excluded from the analysis because test items were to be analysed. Only the four groups with high and low scores were considered for calculating item difficulty and item discrimination indices. The range of scores (out of a maximum of 56) obtained by the respondents in the six groups were analysed and were later grouped as follows:

G1 = 52 to 56	G4 = 29 to 33
G2 = 44 to 51	G5 = 27 to 28
G3 = 34 to 43	G6 = 20 to 26

The item difficulty index (P_i) in this study was calculated as the percentage of interviewees who acknowledged an item correctly.

$$P_i = \frac{n_i}{N_i} \times 100$$

Where; P_i = Difficulty index (%) for the i^{th} item, n_i = Number of respondents who answered the i^{th} item correctly, N_i = Total number of respondents who were administered the i^{th} item (30 in this case)

The discrimination index evaluates how effectively an item separates informed from uninformed respondents. In this study, the E1/3 formula was used to calculate the discrimination index.

$$E\ 1/2 = \frac{\{(S1 + S2) - (S5 + S6)\}}{N / 3}$$

Where; $E\ 1/3$ = Discrimination index of an item, $S1, S2, S5, S6$ = Frequencies of correct answers in groups G1, G2, G5, and G6, respectively, N = Overall number of respondents in the sample for item analysis (30 in this case)

RESULTS AND DISCUSSION

Final selection of items for the test

The items selected for the knowledge assessment were determined based on a difficulty index ranging from 46.6 to 93.3 and a discrimination index ranging from 0.1 to 0.9. Hence, out of the 56 items initially selected only 34 were retained as mentioned in Table 1.

Reliability of the test

In order to appraise the reliability of the knowledge test, the split-half method was employed. The test consisted of 34 items, which were divided into two equal halves based on odd and even item numbers. This split-half test was then administered to a group of 24 farmers. As a result, two arrays of scores were obtained, and these scores were correlated using the product-moment correlation. The resulting product-moment correlation coefficient between the two sets of scores was determined to be 0.82. This product-moment correlation coefficient serves as the reliability coefficient for half of the test. However, this coefficient underestimates the reliability of the full-length measure, which encompasses a broader sample of the content domain and tends to generate a wider range of scores. The correction factor used to obtain the full-length reliability coefficient, according to the Spearman-Brown prophecy formula, is calculated using:

$$rtt = \frac{2 \times r\ 1/2}{1 + r\ 1/2}$$

Where, rtt = Reliability coefficient of the complete test; $r\ 1/2$ = Reliability coefficient of the half test

The value of rtt was determined to be 0.90, indicating a good internal consistency of the knowledge test.

Test of validity

The point-biserial correlation coefficient ($rp\text{-}bis$) was estimated to establish the internal validity of the test. The formula for calculating $rp\text{-}bis$ for each item is as follows:

$$rp\text{-}bis = \frac{(M_p - M_q)}{\sqrt{pq}} \times \sigma$$

Table 1. Organic poultry production knowledge test for tribal farmers

S.No.	Item	Point-Biserial Correlation (Rp-bis)
1	Are farmyard & poultry manure and slurry permitted in organic farming?	0.63
2	Is the transfer of livestock and poultry between inorganic and organic units permitted?	0.39
3	Should the birds be kept in isolation in usual circumstances?	0.35
4	Is it mandatory to have housing for poultry?	0.23
5	Is insulation, heating, and cooling facilities a prerequisite for organic poultry farming?	0.39
6	Is stocking density important for organic poultry farming?	0.2
7	Can poultry birds be tethered/confined in an area for long periods?	0.43
8	Is mixing between poultry and pigs permitted?	0.35
9	Should poultry have open access area for their entire lifetime?	0.21
10	Can synthetic protein/non-protein nitrogen compounds be provided?	0.2
11	Is mutilation of body parts generally allowed?	0.33
12	Can any type of feed materials and enzymes be fed to organic poultry?	0.24
13	Can Nitric acid be used for cleaning and disinfection in organic poultry farms?	0.42
14	Can non-biodegradable packaging be used during processing/sale of organic products?	0.21
15	Should the Internal Control System (ICS) in a grower group be a legal identity?	0.34
16	Do farmers who used prohibited items need to undergo the full conversion period again?	0.3
17	Is confinement of animals allowed in certain circumstances?	0.42
18	For storage of products, is fumigation of containers, irradiation/ionisation allowed?	0.22
19	What type of poultry housing should be used for construction material?	0.35
20	Each poultry house shall contain	0.22
21	Among poultry layers, which type of rearing system is used?	0.35
22	What is the usual interim/conversion period to convert a conventional farm to an organic farm?	0.23
23	If the land in the farm has attained organic status and the poultry eggs have not attained it, how much time should the poultry be raised according to organic standards before it is sold as an organic produce?	0.41
24	What is usually the minimum percentage of feed products on a dry matter basis that shall be classified as organic and be fed to poultry?	0.33
25	What is suggested to be used during the fattening phase in poultry?	0.26
26	What is the general withdrawal period of drugs when it is not specified?	0.22
27	When is hormonal treatment of birds advised for organic poultry stock?	0.38
28	What is the maximum limit set for the number of chickens per hectare?	0.31
29	What is the day length requirement of layers at 0-8 weeks of age?	0.28
30	In consultation with the veterinarian, which diseases should be tested in an organic poultry farm?	0.23
31	What treatments are recommended for pest control in organic food processing and handling?	0.22
32	Which labelling is allowed for organic products with a certification level of 70-95%?	0.24
33	Who is responsible for organising internal inspections, coordinating between field staffs, approval staff, and the accredited Certification Body?	0.41
34	Which of the following types of additives is NOT allowed to be fed to organic livestock and poultry according to the Bureau of Indian Standards?	0.26

Where; rp-bis = Point-biserial correlation coefficient, Mp = Mean score for respondents answering the item correctly (coded as 1s), Mq = Mean score for respondents answering the item incorrectly (coded as 0s), σ = Standard deviation for the entire test, p = Proportion of cases answering correctly (coded as 1s), q = Proportion of cases answering incorrectly (coded as 0s)

The point-biserial correlation coefficient for the odd number and even number statements from the 34 questions were given to 24 persons and were compared. Some of the items have stronger relationships with the overall test score than others.

Classification of tribal farmers into distinct knowledge levels

Farmers were grouped into various levels of knowledge by considering their total scores. The individuals were categorised into high, medium, and low knowledge levels by examining the cumulative scores obtained from both odd and even questions.

Individual scores for both odd and even questions were obtained from a dataset of farmers in order to carry out this categorisation. Cumulative scores were calculated by summing the scores obtained for each person across all the questions. These cumulative scores were used as the basis for the subsequent categorisation. The list for their classification is mentioned in Table 2.

This tool uniquely focuses on assessing the knowledge of tribal farmers, setting it apart from other studies like Pottiez et al., (2012); Priyadarshni et al., (2020) & Bhanu et al., (2022)

Table 2. Classification of tribal farmers into distinct knowledge levels

Knowledge level	Classification
High	25-34
Medium	9-25
Low	0-9

which explore different aspects of organic farming knowledge without considering the indigenous perspective in organic poultry production. There are several benefits to using this knowledge test, including identifying knowledge gaps and enabling customised training programmes. These findings could strengthen organic poultry farming practices and boost economic growth and environmental sustainability in tribal communities by promoting policymaking, encouraging compliance with organic standards, and improving farming practices.

CONCLUSION

The present research study developed a specialised knowledge test for tribal farmers trained in organic poultry farming. The test assessed understanding of organic farming principles, best practices, disease management, and relevant aspects of organic poultry farming. The study described the standardised procedure of test development, including the identification of knowledge domains, construction of test items, and validation procedures. The results of this study suggest the need for tailored training programmes and policy initiatives that address knowledge gaps in organic poultry farming among tribal communities promoting sustainability and cultural preservation while enhancing economic opportunities within these communities.

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Crafting a Gender Disparity Index to Unveiling the Tea Garden Workers' Gender Dynamics

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ABSTRACT

Gender dynamics significantly impact tea garden workers' performance. A Gender Disparity Index (GDI) was developed for assessing gender differences within the tea plantation sector during 2022-23. The construction of GDI commenced with item analysis, employing the Likert's Technique. A total of seven dimensions were included following the Harvard analytical and Moser frameworks of gender analysis. Based on the relevancy, t statistics, and content validity, five dimensions were kept in the index, namely, activity profile, influencing factors for differential roles, gender role identification, gender need assessment, and decision-making behaviour of tea garden workers. A universe of 92 items under five dimensions was prepared, and the relevancy of each item was judged by 56 experts; subsequently, 72 items were screened on which the responses of 60 workers of non-sampled tea gardens were obtained and finally 68 items were selected under five dimensions of the index followed by testing of their content validity and reliability of the index. This GDI may be used as an effective instrument to unravel gender disparities in tea gardens and other similar plantations' estate.

INTRODUCTION

The tea plantations are mainly situated in rural and backward regions of the country, providing crucial livelihoods and employment opportunities to the local population, effectively contributing to regional economies (Shen & Chou, 2022). The socio-economic nature of the plantation sector, which depends primarily on manpower and has made few technical developments, makes it unique (Dishanka & Ikemoto, 2014; Dishanka et al., 2021; Rout & Samantaray, 2022). Employment within tea gardens often follows a family-based system, with workers committing their lifetime labour in exchange for shelter security (Das, 2016; Bhattacharyya, 2019; Sarkar, 2019b). The tea industry offers employment to both men and women, but they encounter distinct attributes, activities, and norms associated with their gender roles (Sita & Herawati, 2017). Unfortunately, women, particularly the most vulnerable section of society, face various challenges and hardships within

this industry (Sarkar et al., 2016; Roy, 2017). Gender discrimination persists, as women workers receive unequal pay, limited chances for advantage, and substandard working conditions (Bhattacharyya, 2019; Sarkar, 2019a). Women are also frequently excluded from decision-making processes and may suffer from harassment and abuse (Kubendran, 2020). Study uncovers a pyramid-shaped employment hierarchy in the tea sector, where key roles like Managers, Deputy Managers, and Assistant Managers hold central positions (Saha et al., 2019). At the bottom, over 90 per cent of the labour force, consisting of both genders, comprises permanent and temporary workers earning daily wages. This hierarchical structure is deemed exploitative, reminiscent of the British colonial system. Previously Behal (2014); Saha et al., (2019) highlighted exploitative work patterns, low wages, deplorable housing and living conditions, and the lack of collective bargaining provisions faced by workers on tea estates.

Recognizing gender roles, differences, and inequalities is crucial to improve the living conditions of tea garden workers. Various strategies and policies have been devised to address these disparities and harness their full potential (Bhati et al., 2023). Gender equity goes beyond mere gender parity, striving to offer equal opportunities to all genders, redressing historical and social imbalances, and ensuring fairness and justice in distributing resources. Measures based on gender equity are vital to uplift the lagging gender in society, and it is essential to gauge how the farming community perceives and embraces these measures. Existing assessment tools for gender disparity as mentioned by the respected Reviewer have been referred and it was found that these indexes have mostly dealt with the women empowerment with respect to production, resources, income, leadership, and time (Raj et al., 2022). Similarly, gender inequality index of UNDP uses three dimensions to measure reproductive health, empowerment, and labor market participation (UNDP, 2020). Thus, these tools fall short in capturing the unique dynamics of tea garden workers, whose gender describes roles like plucking, pesticide spraying, and pruning vary significantly across the male and female workers, thus necessitating tailored evaluations. The above mentioned text is incorporated to justify the crafting of a gender disparity index to unveiling the tea garden workers' gender dynamics.

METHODOLOGY

While developing this composite GDI, a combination of the Harvard analytical and Moser frameworks for gender analysis was utilized for identifying various dimensions. For the final inclusion of the dimensions in the index, the relevancy of each dimension was tested based on the experts' ratings. Similar approaches were used by Chaudhari et al., (2010); Mukherjee et al., (2018); Vijayan et al., (2022) in their respective studies. Dimensions with relevancy percentage (RP) above 85, relevancy weightage (RW) above 0.85, and mean relevancy score (MRS) above 2.40 were included in the index; thus, five dimensions were chosen for further consideration.

In the initial phase, a comprehensive literature review led to the creation of a list comprising 92 potential items. To ensure validation and item significance, a panel of experts linked to the tea plantation sector, including universities, colleges, KVKs, Government of India, and the Tea Board of India, were consulted. The 56 experts participated in an online survey to establish the level of relevancy. To ensure the relevance of the items, item analysis was performed. based on criteria suggested by Edward (1957). The items were screened and a total of 72 items were administered to the 60 tea garden workers of non-sampling tea gardens in Kalimpong district of West Bengal obtained their responses in terms of agreement on 3-point continuum scale; thereafter, 68 items were selected following the Likert's Summated Rating Technique (1932). To categorize the respondents based on their responses, the total summated scores of the items for each respondent were calculated and the respondents were ranked in descending order. The top 25 per cent of respondents with the highest scores formed the high group, while the bottom 25 per cent with the lowest scores constituted the low group. Each group comprised 15 respondents. t-statistics was calculated for each item considering the mean scores of high and low groups. Similar

approaches were used by Ghosh et al., (2011); Bareh & Ghosh (2016); Kumar et al., (2016) & De et al., (2023) in their respective studies. Thus 68 items with significant t-statistics were included under the five dimensions of GDI. Subsequently, the content validity of each item was tested based on significant Pearson's correlation coefficient (r) values, and reliability was worked out following the split-half techniques.

RESULTS AND DISCUSSION

Domain selection and relevancy of dimensions

The construction of the GDI started by choosing the dimensions given in both Harvard analytical and Mosser frameworks for gender analysis and as described in methodology The dimensions included in GDI were activity profile of tea garden workers (D1), factors influencing the differing roles of male and female workers (D2), decision-making behaviour (D3), gender roles in tea gardens (D4), gender-specific needs for both men and women tea garden workers (D5); two excluded dimensions were access and control profile, control and access of resources dimensions based on t value and relevancy of each dimension.

Item selection and final inclusion of items

On the basis of 56 judges who returned the evaluated set of items, a total of 72 items were retained and were subsequently considered to obtain the responses from 60 tea garden workers of non-sampling areas/ tea gardens. Experts' responses were tabulated and analysed to derive RP, RW, and the overall MRS for each item by given formulas.

$$RP = \frac{\text{Frequency score of most relevant and relevant}}{\text{Number of judges}} \times 100$$

$$RW = \frac{\text{Actual score obtained for the item}}{\text{Maximum possible score obtainable for the item}}$$

$$MRS = \frac{\text{Actual scores obtained for the item}}{\text{Number of judges responded}}$$

The estimated value of RP fallen between 80.00 (minimum) and 96.36 (maximum) percentages. A range of 0.75 (minimum) to 0.92 (maximum) score was obtained for the estimated value of RW. The calculated value of MRS was found in the range of 2.24 minimum to 2.76 maximum.

Total respondent scores were computed by summing all item scores. Respondents were ranked in descending order. To conduct item analysis, the top 25 per cent and bottom 25 per cent of respondents based on total scores were chosen as high group and low group respondents, respectively. Employing the t-test, each item was evaluated using responses from these two groups, employing a specific formula. A distribution between 2.46 and 8.62 was obtained for the computed t-value. Later, the 68 items having a t value of >3.75 were included in the final index.

Standardization of the index

Split-half method was employed to test the reliability and the reliability coefficient was obtained as 0.766.

Table 1, 2, and 3 displayed items alongside their corresponding Relevancy Percentage, Relevancy Weightage, and Mean Relevancy Scores. It comprises 68 deliberately chosen items, spanning five dimensions, to effectively measure gender disparity within the tea sector with a harmonious blend of positive and negative content, ensuring impartial responses. Among these, 21 items are grouped under the domain of activity profile, 20 items to assess gender-related needs, 10 targeting gender role identification, 9 for scrutinizing decision-making behaviour, and 8 for comprehending influencing factors. This index administered to both male and female tea workers to reveal the gender dynamics of tea garden workers. Following a similar methodology, Chaudhari et al., (2010);

Mukherjee et al., (2018) & Roy et al., (2022) also developed indices to assess entrepreneurial behaviour of dairy farmers, farmers' attitudes towards Farmers Producing Companies (FPCs), and FPC role performance respectively. Similarly, Raj et al., (2022) delved into gender empowerment among cassava farmers in Kanyakumari district of Tamil Nadu, considering empowerment domains such as production, resources, income, leadership, and time. Roy et al., (2022) devised an empowerment index for women's Self-Help Groups (SHGs), employing it to analyse 290 SHGs in North 24 Parganas, West Bengal. This GDI may be used as an effective instrument to unravel gender disparities in tea gardens and other similar plantations' estate.

Table 1. Selected items under the dimension- activity profile of tea garden workers

Dimension/Items	RP	RW	MRS	t value	r value
Activity profile (D1)	93.91	0.90	2.49	7.740**	0.851**
Field activity in a tea garden					
Land preparation	89.09	0.85	2.56	5.551**	0.873**
Infilling operation	87.27	0.84	2.51	5.667**	0.881**
Transplanting operation	87.27	0.82	2.47	3.372**	0.833**
Creation of drainage	85.45	0.82	2.47	8.271**	0.906**
Manuring	85.45	0.82	2.47	4.504**	0.890**
Tipping activity	85.45	0.80	2.40	4.019**	0.800**
Plucking	89.09	0.82	2.47	3.378**	0.781**
Sprinkler irrigation	85.45	0.79	2.36	4.504**	0.875**
Spraying pesticides	87.27	0.82	2.47	3.378**	0.890**
Weeding	83.64	0.80	2.40	4.163**	0.828**
Pruning activities	85.45	0.82	2.45	6.497**	0.878**
Hoeing activity	87.27	0.82	2.47	5.551**	0.920**
Transporting of the plucked leaves	81.82	0.77	2.31	8.017**	0.892**
Factory activities					
Operation of machines	83.64	0.78	2.35	6.816**	0.848**
Withering activity	89.09	0.78	2.33	4.946**	0.884**
Rolling operation	85.45	0.78	2.35	5.828**	0.880**
Fermenting of tea leaves	83.64	0.77	2.31	6.623**	0.907**
Drying activity	85.45	0.81	2.42	5.551**	0.869**
Sorting of tea leaves	87.27	0.81	2.44	8.017**	0.912**
Packaging	83.64	0.78	2.33	8.017**	0.927**
Transportation activities	80.00	0.75	2.25	6.816**	0.874**

** Significant at 0.01% level of significance

Table 2. Selected items under the dimensions-influencing factor, decision-making behaviour, and gender roles of tea garden workers

Dimensions/Items	RP	RW	MRS	t value	r value
Influencing factor (D2)	96.39	0.90	2.71	5.114**	0.787**
Community norms	94.55	0.88	2.65	4.163**	0.776**
Social hierarchy	94.55	0.88	2.65	4.163**	0.776**
Lack of literacy	94.55	0.86	2.58	3.710**	0.761**
Men dominance	92.73	0.81	2.44	3.679**	0.653**
Legal parameters	87.27	0.78	2.35	3.889**	0.726**
Higher exposure of men	90.91	0.83	2.49	4.163**	0.731**
Being trained	89.09	0.80	2.40	5.491**	0.810**
Differential wages for men and women	90.91	0.86	2.58	4.192**	0.792**
Decision-making behaviour (D3)	94.55	0.91	2.40	7.578**	0.877**
Household expenditure	89.09	0.81	2.44	4.946**	0.750**
Expenditure on education of child, health, etc.	92.73	0.83	2.49	4.837**	0.776**
Savings and capital transactions	87.27	0.84	2.51	5.667**	0.852**
Small non-interest loans	85.45	0.80	2.40	8.628**	0.851**

Table 2 contd...

Dimensions/Items	RP	RW	MRS	t value	r value
Domestic work duration	85.45	0.78	2.35	6.623**	0.833**
Tea garden work duration	80.00	0.76	2.27	6.623**	0.807**
Equal wage for bothmale and female	89.09	0.84	2.53	5.491**	0.689**
Involvement of children or any other member	89.09	0.83	2.49	5.551**	0.769**
Socio-religious decision-making	89.09	0.82	2.47	5.667**	0.759**
Gender roles (D4)	94.55	0.91	2.51	5.794**	0.771**
Domestic roles					
Purchase household essentials	96.36	0.88	2.64	4.837**	0.774**
Livestock care	92.73	0.86	2.58	6.510**	0.809**
Leisure time	90.91	0.83	2.49	4.769**	0.724**
Import drinking water	89.09	0.84	2.51	4.266**	0.814**
Food storage	90.91	0.84	2.51	5.828**	0.805**
Community roles					
Community activities	96.36	0.88	2.65	4.837**	0.787**
Social organisation membership	92.73	0.85	2.56	4.192**	0.767**
Social gatherings	94.55	0.84	2.51	6.510**	0.813**
Religious gatherings	90.91	0.79	2.38	4.163**	0.726**
Political events	89.09	0.76	2.29	4.163**	0.828**

** Significant at 0.01% level of significance.

Table 3. Selected items under the dimension-gender needs of tea garden workers

Dimension/Items	RP	RW	MRS	t value	r value
Gender need assessment (D5)	92.73	0.88	2.65	6.408**	0.861**
Practical domestic needs					
Education is basic need	96.36	0.91	2.73	4.163**	0.530**
Health facility is important	96.36	0.90	2.71	2.876**	0.535**
Access to information is important	92.73	0.87	2.60	4.163**	0.623**
Childcare facilities is need	96.36	0.86	2.58	3.797**	0.610**
Availability of alternate income source	90.91	0.84	2.53	4.759**	0.476**
Strategic domestic needs					
Good societal status is important.	92.73	0.81	2.44	4.163**	0.580**
Ownership of resources is important for your decision making	92.73	0.84	2.53	4.769**	0.712**
Control of resources is basic need.	96.36	0.81	2.44	4.745**	0.766**
Leadership is needed.	90.91	0.85	2.55	4.76**	0.760**
House ownership is important	89.09	0.81	2.42	5.551**	0.766**
Access to credit is need	85.45	0.83	2.49	3.894**	0.715**
Practical plantation needs					
Crucial tea skills (transplanting, tipping, etc.)	92.73	0.84	2.51	4.83**	0.772**
Equipment accessibility	92.73	0.83	2.49	4.372**	0.733**
Knowledge of intercultural practices	87.27	0.78	2.35	4.769**	0.711**
Knowledge of pesticides, fertilizer, and manure application	87.27	0.80	2.40	4.769**	0.662**
Daily workplace transport	94.55	0.86	2.58	2.463**	0.707**
Strategic plantation needs					
Training/ Exposure	89.09	0.85	2.55	4.204**	0.662**
Expert advice	92.73	0.84	2.51	5.078**	0.758**
Scale-neutral wage system	92.73	0.84	2.51	4.759**	0.683**
Domestic and export market information	90.91	0.78	2.35	5.507**	0.697**

**Significant at 0.01% level of significance

CONCLUSION

The developed index covers five dimensions of disparity viz. activity profile of tea garden workers, factors influencing the differing roles of male and female workers, decision-making behaviour, gender roles in tea gardens, gender-specific needs for

both men and women tea garden workers and includes 68 items to unveil the gender dynamics of tea garden workers. Recognizing the persistence of gender disparities, especially in non-organizing sectors like plantations, the information derived from this index may be assist administrators and policymakers in making unbiased decisions while planning programs or projects to promote gender

equality. Additionally, with suitable modifications, this index could be adapted for use in different appropriate fields. The obtained results can be instrumental in devising strategies to combat gender bias in non-organizing sectors and rural communities, fostering a world that offers equal opportunities and standing for all genders.

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Development and Standardization of Household Food and Nutritional Security Index

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ABSTRACT

An assessment of Household Food and Nutritional Security (HFNS) is important to understand the nutritional state of a household. There are various techniques available for measuring it but they are all in scattered form, making the study tedious. Present research carried out during 2022-23 was aimed at constructing a composite HFNS index that would aid in amalgamating the different techniques to holistically study the HFNS. Initially, four dimensions and 48 indicators were identified and subjected to relevancy testing through judges' opinions which resulted in the selection of 32 indicators. A questionnaire with finalized indicators was administered to 60 households in the non-sampling area. The test-retest and split-half method was followed for testing the reliability of the tool and the reliability co-efficient was 0.84 and 0.87, respectively. Content validity and statistical validity were used to confirm the validity of the tool which was 0.96. The developed tool finally consisted of four dimensions and 32 indicators which are reliable and can produce consistent results while assessing the food and nutritional security of rural households.

INTRODUCTION

Agriculture and nutrition share a common entry point: "food". Food and nutrition are the byproducts of agricultural activities, but the availability of food from agriculture does not ensure good nutrition. India has done significantly well in the agricultural forefront since independence, it is one of the leading producers of rice, wheat, milk etc., but despite all these accolades; India has ranked 107 out of 121 countries in the recent Global Hunger Index Report with stunting and wasting being one of the major concerns (Von Grebmer et al., 2022). The food security of the country has not directly correlated with the nutrition security of its citizens and the nation at large.

According to the Food and Agriculture Organization (1996), food security is achieved when it is ensured that all people, always, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. The concept of food

security has undergone metamorphosis with the ever-changing scenario worldwide. Presently, the concept of nutrition has been deemed equivalent to food security due to the intertwined nature of these subjects hence emerging the concept of food and nutritional security. These concerns were previously studied in an overall regional, national, or even global food supply and shortfalls in supply compared to requirements. With due consideration to the bottom-up approach, a more intrinsic view of studying food and nutritional security at the community, local, household or individual level is more rational. While Family is the basic unit of society, the household-level study will be able to speak volumes about the state of food and nutritional security at the household level in particular and society in general. There are various standardized tools, and techniques developed over time to measure food and nutritional security at the household level like the Household Dietary Diversity Score (HDDS), Food frequency, anthropometric indices, Household Food Insecurity and Access Scale (HFIAS), Household Hunger Scale (HHS) etc. (Vhrumuku et al., 2014).

However, with all due understanding of the intricacies of each of them, the household food and nutritional security index was aimed to develop maintaining the essence of these techniques in addition to bringing the various new advances/areas under a composite index. A composite index is a collection of a large number of indicators or variables that are aggregated together to represent the overall performance of a phenomenon over time or space (Chand, 2019). Hence, the index on household food and nutritional security will serve the purpose of bringing the new as well as old indicators under an umbrella to study food and nutritional security, particularly from an agricultural lens.

METHODOLOGY

The study design consisted of identification of the dimensions and indicators, validating and standardizing them using appropriate statistical methods. Initially, a systematic review of literature from various sources like research articles, journals and thesis repositories was used to identify the dimensions and indicators. The selected indicators were given to 120 judges for judgement using google forms. The degree of relevancy of each indicator had to be given on a three-point continuum. The comparative scores of 3, 2 and 1 were assigned for the “most relevant” (MR), “relevant” (R) and “not relevant” (NR) responses, respectively. Appropriateness of each indicator was defined with relevancy weightage (RW), relevancy per cent (RP) and mean relevancy score (MRS), using the following formulae as followed by Chaudhari et al., (2007); Kumar et al., (2016); Mukherjee et al., (2018); Chandhana et al., (2022) & Gupta et al., (2022).

$$\text{Relevancy Weightage of } i^{\text{th}} \text{ indicator} \\ (RW_i) = \frac{(MR \times 3) + (R \times 2) + (NR \times 1)}{\text{Maximum possible score}}$$

$$\text{Relevancy per cent of } i^{\text{th}} \text{ indicator} \\ (RP_i) = \frac{(MR \times 3) + (R \times 2) + (NR \times 1)}{\text{Maximum possible score}} \times 100$$

$$\text{Mean Relevancy Score of the } i^{\text{th}} \text{ indicator} \\ (MRS_i) = \frac{(MR \times 3) + (R \times 2) + (NR \times 1)}{\text{Number of judges responded}}$$

Thereafter, the relevant indicators were screened for testing reliability and validity in a non-sampled area with a total of 60 randomly selected respondents.

Reliability was measured with the test-retest (coefficient of stability) and split-half (coefficient of equivalence) method (Wuensch, 2012; Naik et al., 2019; Bardhan et al., 2023). The test-retest measures the correlation between scores on two administrations of the same form of test, separated by a fortnightly. In the split-half method, the responses for the odd and even-numbered items were obtained and the scores of both sets were used to calculate the coefficient of correlation.

Further, the reliability coefficient of the whole test was computed using the Spearman-Brown prophecy formula.

$$r_{xx} = \frac{2r_{hh}}{1+r_{hh}}$$

Where r_{hh} is the split-half reliability coefficient.

The validity of the scale was assured by assessing the content validity and statistical validity. Content validity is the representativeness or sampling adequacy of the content of a measuring instrument (Kerlinger, 2007). Content validation was carried out by subjecting the selected indicators to the judge's opinion.

Further, the data was subjected to statistical validity using the formulae. $v = \sqrt{r_{xx}}$

Where r_{xx} is the whole test reliability value.

RESULTS AND DISCUSSION

Finalization of dimensions and indicators

With due consideration to the myriad literature, household food and nutritional security is defined as a situation when a household always has physical and economic access to nutritious food with proper utilization of the available food to meet their dietary requirements for a healthy life. The definition has four distinct dimensions that have been highlighted viz., availability, accessibility, utilization, and stability. These are key dimensions to study food and nutritional security (Jatav et al., 2022). Each of these dimensions is described as; a) availability is the extent to which food is within reach of the household members and the household in general, both in terms of sufficient quantity and quality; b) accessibility is the ease with which one can acquire nutritious foods within adequate reach of their household; c)utilization is the utility pattern and practices followed by the household for the consumption of nutritious foods; and d)stability is the volatility and affordability of the various food items in the particular household (Pieters et al., 2013). In addition to these dimensions, there were 48 indicators identified for the study which were processed by seeking response from the 120 judges out of which 60 judges responded. After duly recording their judgments, the relevancy analysis was undertaken.

Relevancy test

Considering the calculated values, the relevancy weightage of the indicators ranged from 0.67 (minimum) to 0.96 (maximum), the relevancy percentage ranged from 67.2 (minimum) to 96.1 (maximum) percentage mean relevancy score ranged from 2.02 (minimum) to 2.88 (maximum). The indicators with their relevancy percentage, relevancy weightage and mean relevancy scores having a relevancy weightage of more than 0.81 relevancy percentage of more than 81.1, and a mean relevancy score of more than 2.43 was considered for the final selection of statements as shown in Table 1. Accordingly, 32 out of the 48 indicators could meet the set criteria of the study.

Reliability and validity test

In the study, reliability was measured through test-retest and split-half methods. The correlation coefficient (r) of the test-retest method between two administrations with a time gap was found to be significantly higher (0.842) whereas the correlation value of the split-half method was also significantly high (0.873). Thus, the coefficient of stability and the coefficient of equivalence are considerably high as per the test-retest and split-half methods.

Table 1. Selected statements based on Relevancy Weightage (RW), Relevancy Percentage (RP) and Mean Relevancy Score (MRS)

S.No.	Indicators	RW	RP	MRS
Availability				
1.	Are cereal foods available in your household?	0.889	88.9	2.667
2.	Is there an availability of vegetables in your household?	0.878	87.8	2.633
3.	Is there an availability of seasonal fruits and dry fruits in your household?	0.850	85.0	2.550
4.	Do you have milk and milk products available in your household?	0.894	89.4	2.683
5.	Are non-vegetarian food items available in your household?	0.839	83.9	2.517
6.	Are you raising livestock in your household for consumption purposes?	0.811	81.1	2.433
7.	Do you have a kitchen garden?	0.822	82.2	2.487
Accessibility				
8.	What is the average monthly expenditure of your household on food items?	0.911	91.1	2.733
9.	Are the fruits available at your home accessible for all the household members?	0.872	87.2	2.617
10.	Do all the household members have access to the vegetables and cereals available in your household?	0.911	91.1	2.733
11.	Is the non-vegetarian food available at your household accessible to all the household members?	0.822	82.2	2.733
12.	How often do you buy food items from the neighbourhood stores?	0.828	82.8	2.483
13.	Are you purchasing your food items from the farmers' market?	0.844	84.4	2.533
14.	How often are you purchasing perishable food items?	0.833	83.3	2.500
Utilization				
15.	Is your household consuming a diverse diet comprising of different food groups like cereals, millet & pulses, fruits & vegetables, milk& animal products, fats & oils?	0.961	96.1	2.883
16.	Are you aware of the significance of each food group?	0.861	86.1	2.583
17.	Does your daily consumption include traditional diets like fermented foods, native tubers green leafy vegetables, etc.?	0.894	89.4	2.683
18.	Do you consume processed food items, and exotic food items daily in addition to the traditional diets?	0.811	81.1	2.433
19.	Are you washing the vegetables before cutting them?	0.833	83.3	2.500
20.	Do you peel vegetables thinly?	0.817	81.7	2.450
21.	Are you likely to cook food in a covered pan?	0.817	81.7	2.450
22.	How many meals do you and your household members consume in a day at your household?	0.889	88.9	2.667
23.	How frequently do you consume food items from different food groups?	0.850	85.0	2.550
24.	Are your food choices dependent on the nutritional value of the food item?	0.911	91.1	2.733
25.	Does the easy availability of the food item determine your food choices?	0.856	85.6	2.567
26.	Do you choose a particular food item just because it keeps you healthy?	0.894	89.4	2.683
27.	Have you brought any changes to your eating habits due to the changing market trends?	0.861	86.1	2.583
Stability				
28.	Have you observed variations in the prices of different food items?	0.911	91.1	2.733
29.	Are fruits and vegetables frequently affordable for your household consumption?	0.889	88.9	2.667
30.	How frequently affordable are the non-vegetarian food items for your household?	0.889	88.9	2.667
31.	Does the seasonal change disrupt your supply of food items?	0.878	87.8	2.633
32.	Do you think poor transport facilities are the reason for the poor supply of food?	0.850	85.0	2.550

Therefore, the index was found reliable. The reliability coefficient of the whole test as per the Spearman-Brown prophecy formula was calculated to be 0.932. This value re-emphasized the high reliability of the index.

The validity of the test was confirmed with the help of content validity as well as statistical validity. The indicators selected had a relevancy weightage of more than 0.81, a relevancy per cent of more than 81.00 per cent and a mean relevancy score of more than 2.43; hence, the content validity of the index was assured. The statistical validity was found to be 0.965 indicating high validity of the developed household food and nutritional security index (Table 2). The reliability and validity test has significantly increased the consistency and objectivity of the index, hence ascertaining the potential of the index. Subsequently, Naik et al., (2019) & Chandhana et al., (2022) followed a similar methodology to develop indices to assess the farmers' participation in effective canal irrigation management and sunflower farmers' perception of

public-private extension systems respectively. Likewise, Sharma & Singh (2017) studied the state-wise food security index using indicators related to food availability, food stability and food accessibility. Similarly, Adjimoti & Kwadzo (2018) also studied the household food security status in rural Benin with the help of the Food Security Index (FSI) by considering several indicators/ dimensions like food availability, food accessibility, food affordability, food utilization and food stability.

Table 2. Reliability and validity of the tool

Particulars	Tests	Values
a) Reliability	Test-retest	0.842*
	Split-half test	0.873*
	Whole-test	0.932*
b) Validity	Statistical validity	0.965*

*Significant at 5% level

In the present study, the final developed Household Food and Nutritional Security Index consists of four dimensions and 32 indicators, these will be measured in ratio scale and qualitative using both ordinal and nominal scales. The standardized indicators will be able to give a holistic view of the food and nutritional security of a household.

CONCLUSION

The Household Food and Nutrition Security Index developed and validated in the present study provides a comprehensive outlook rendering a systematic and standardized approach to develop statistically sound measures along with conducting a proper content validation of the research tool for measuring the food and nutritional security of households. Furthermore, the empirical data, which will be collected from this household food and nutritional security index, will provide an understanding of the status of the food and nutrition in a household in addition to forming a foundation for studying the root cause of food and nutritional insecurity in various households and will assist in the formulation of strategies to combat the situation. The developed tool can be useful to researchers, policymakers and concerned organizations in taking necessary steps to improve household food and nutritional security that would in turn improve the food and nutritional security of the nation. Hence, the developed tool can be effectively utilized for future research in similar contexts and broader purviews.

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Farmers' Challenges in Adopting Soil Health Card Recommendations in Saharsa, Bihar

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ABSTRACT

The study was aimed to identify the constraints associated with the adoption of soil health cards recommended by Mandan Bharti Agriculture College (MBAC), Agwanpur in Sattarkataiya block, Saharsa district, Bihar during 2017-2021. Two villages named Barahsher and Puroshottampur Purikh were selected based on the maximum card holders. 100 respondents from each village with Soil Health Card (SHC) were selected. A pretested and well-structured interview schedule was used to collect data, tabulate, and analyze the results. Major constraints faced by farmers were inadequate follow-up by extension agency (71%); soil samples not taken from each farmer's field (59%), not getting SHC reports in time (57%), and not using of the recommended dose of fertilizers as per SHC recommendation (49%). While major suggestions that came out to tackle the mentioned constraints were that SHC should be issued prior to crop season (70%), Soil sampling laboratory should be established at Block level with highly qualified staff (61%), farmers should be trained to take soil samples (63%), and soil sampling should be based on hands-on training of farmers (59%).

INTRODUCTION

A healthy soil provides a sufficient amount of macronutrients and micronutrients to the crop and determines its yield. A healthy soil should contain adequate and proportional macronutrients and micronutrients (Patel, 2013). The health of the soil is important for producing healthy crops, which nourish people and animals (FAO, 2015). As part of soil health, four key functions should be maintained: carbon transformation, nutrient cycles, soil structure, and control of pests and diseases (Kibblewhite et al., 2008). A quality and healthy soil does play a significant role in the production of food, the resilience of the environment, and the sustainability of ecosystems (Stevens, 2018). The majority of farmers use chemical fertilizers in their fields in order to increase their crops' yields without understanding the soil composition and fertility status in their fields (Chowdary et al., 2017). In order to achieve sustainable agriculture, it is imperative to adopt sustainable

soil fertility management (SFM) practices (Chowdary et al., 2018). According to the survey conducted by Kumar et al., (2021), it was revealed that the knowledge level and adoption of SFM are relatively much lower among farmers, i.e., the adoption rate is eight percent of farmers are aware of it. To resolve all these problems, it is necessary to adopt sustainable soil fertility management practices based on soil tests (Saha et al., 2016). There are always reported constraints in adoption of technologies and several researchers tried to study constraints in different settings (kumar et al., 2010; Kumar & Nain, 2012; Gupta et al., 2013; Das et al., 2014; Slathia et al., 2015; Gireesh et al., 2019; Kobba et al., 2020). Taking all these factors into account, the government of India has launched a national flagship program namely the soil health card scheme (SHC). The aim of the SHC scheme is to do soil tests on each and every farm, and to formulate micro-level maps of soil fertility at the farm level (Singh et al., 2020). Most of the nutrients are reflected in the soil health card (SHC), which represents the state

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of soil health. As a key objective of the System, one of its main objective is to assess the current status of soil health to determine changes in soil health that are affected by land management to improve its efficiency, a website has been developed called Soil Health Card, which allows you to register soil samples, record soil test results, and generate a Soil Health Card along with fertilizer recommendations after registering soil samples on this site (MoA & FW, Govt. of India, 2018). The attitude of farmers towards this scheme was positive for some variables. Farmers faced numbers of constraints while adopting the scheme (Ghate et al., 2020). Extension personnel's should plan organising capacity building along with demonstrations on soil sampling to utilization of soil health card recommendations by the farmers (Rani et al., 2022). Several researches has empirically proved that balanced use of organic and inorganic nutrients resulted in improved soil physio-chemical and biological status of the soil which in turn makes the soil healthier and productive on sustainable basis (Singh et al., 2023).

METHODOLOGY

This study was conducted at Mandan Bharti Agriculture College (2017-21), Agwanpur Saharsa. On the basis of data of maximum soil health card issued by MBAC, Agwanpur, a block named *Sattarkataiya* was selected for the study. Further, on the basis of maximum density of card holders, two villages named *Barahsher* and *Puroshottampur Purikh* were selected from

Sattarkataiya Block to identify respondents as per the comprehensive list of soil health card holders in Mandan Bharti Agriculture College, Agwanpur, Saharsa. Hundred respondents from each village were selected randomly making a sum total of 200 Soil Health Card Holders. The data were collected through pre-tested interview schedule (questionnaire), tabulated and analyzed in the light of the objectives to draw the result and conclusion in terms of percentage and frequency. The constraints faced by the farmers for soil health card recommendation with more focus on cereals cultivation were identified, documented and ranked.

RESULTS AND DISCUSSION

There are many significant constraints perceived by the farmers in the study area and they can be viewed in table 1 as a representation of the concerns raised by the respondents were inadequate follow-up of extension agency (71.0%), soil sample not taken from each farmer's field (59%) followed by not getting SHC reports in time (57.0%), not using of recommended dose of fertilizers as per SHC recommendation (49%), no productivity of results (46%), No awareness of SHC Scheme (37%) among farmers, complexity of recommendations on the SHC (31.0%), lack of knowledge about soil health card (23.0%), non-scientific method of collecting soil samples (17%), less benefit (13.0%), receiving of soil health card after crop showing/planting (11.0%), Inability to report any problem (9.0%), and non-availability of final recommendation of fertilizers in *kattha* (4.0%).

Table 1. Constraints faced by respondents in the adoption of SHC recommendations

S.No	Constraints	Percentage	Rank
1.	Inadequate follow-up by extension agency	71.00	I
2.	Soil sample not taken from each farmer's field	59.00	II
3.	Not getting SHC reports in time	57.00	III
4.	Farmers generally do not use recommended dose of fertilizers as per SHC recommendation	49.00	IV
5.	No productivity of results	46.00	V
6.	No awareness of SHC Scheme	37.00	VI
7.	Problem in understanding / complexity of recommendations on the SHC	31.00	VII
8.	Lack of knowledge about soil health card	23.00	VIII
9.	Non-scientific method of collecting soil samples	17.00	IX
10.	Less benefit	13.00	X
11.	Receiving of soil health card after crop sowing/planting	11.00	XI
12.	Inability to report any problem	9.00	XII
13.	Not being Recommendation of fertilizers in local unit of land (<i>Kattha</i>)	4.00	XIII

Table 2. Suggestions as per analysis of view of farmers to tackle constraints while adoption of soil health card programme

S.No.	Suggestions offered by the farmers to overcome constraints	Percentage	Rank
1.	SHC should be issued prior to crop season	70	I
2.	There is a need for farmers to be trained to take soil samples from their soil	63	II
3.	Soil testing laboratory to be established at the block level with highly qualified staff to support it	61	III
4.	Soil sampling procedure should be done in presence of farmer	59	IV
5.	Internet facility should be provided at village level	57	V
6.	Reports should be distributed in time	56	VI
7.	The soil sample should be collected regularly and from every farmer's land so that the soil can be tested	51	VII
8.	Farmers should use recommended dose of fertilizer for betterment.	47	VIII
9.	Needs to be increased awareness about the Soil Health Card Scheme, as well as providing proper information regarding the importance / reading / and usage of the Soil Health Card.	43	XI
10.	No suggestion	14	X

We analyzed the views of the respondents and drew up a list of suggestions based on their responses. In order to rank the suggestions of farmers according to their importance, the percentages were expressed in the Table 2. It was suggested that Soil Health Card should be issued prior to crop season (70%), there is a need for farmers to be trained to take soil samples from their soil (63%). It is recommended that a soil testing laboratory to be established at the block level with highly qualified staff to support it (61%), hands on sampling techniques should be promoted (59%), Internet facility should be provided at village level (57%), reports should be distributed in time (56%), The soil sample should be collected regularly and from every farmer's land so that the soil can be tested (51%), farmers should use recommended dose of fertilizer for betterment (47%), there needs to be increased awareness about the Soil Health Card Scheme, as well as providing proper information regarding the importance / reading / and usage of the Soil Health Card (43%). However, no suggestion came out from 14% farmers.

CONCLUSION

There were many challenges faced by farmers in Saharsa district, Bihar, when implementing the recommendations on the soil health cards. Although the government and stakeholders have made significant efforts to improve soil health management, there are still significant barriers. Farmers in Saharsa faced many challenges due to their lack of knowledge and awareness about soil health management. These recommendations are discouraged by farmers because they are not aware of their long-term benefits. Many farmers do not fully understand the information contained in the soil health cards due to a lack of awareness. Extension workers should promote soil health knowledge as a way to strengthen agricultural education and attitudes. Agricultural Extension Officers and KVK specialists should visit villages to encourage farmers to adopt cultivation-friendly practices.

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Determinants for Adopting ICTs by Livestock Farmers in Barnala District, Punjab

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ABSTRACT

A study was conducted to determine the propensity of livestock farmers to adopt ICTs in the Barnala district of Punjab, India. The convenience sampling technique was used to select 60 livestock farmers from all three blocks of the Barnala district and the data was collected from respondent livestock farmers via direct interview using a pre-formulated schedule. Livestock farmers were using ICT (GADVASU apps) to enhance their farm income. The commonly used ICT tools were mobile phones, Internet browsing, newspapers, and television. The use of ICT (GADVASU apps) by livestock farmers was effective as it contributed to enhancing livestock productivity. Socio-economic and institutional factors significantly influenced the use and adoption of ICTs by livestock farmers. Tobit analysis results indicated that age, education level, herd size, and participation in extension activities were significant ($p \leq 0.1$) determining factors influencing the adoption of ICTs. Farmers have small herd sizes, little experience using ICT, and higher education levels. Adoption of ICTs (GADVASU apps) may be sustainable among livestock farmers if the extension agencies prioritise developing strategies and programmes to educate farmers. The government also subsidises farmers so that they can purchase data and ICT tools.

INTRODUCTION

Livestock is a part of integrated farming that provides additional income to the farming community. An integrated farming system is considered a sustainable agricultural system that can help enhance food and nutritional security. In mixed-farming systems, not only can farmers mitigate risks by producing a multitude of commodities, but they can also increase the productivity of both crops and animals in a more profitable and sustainable manner. In this context, livestock can make a major contribution to the efficient use of available natural resources. But poor livestock production management practices are one of the major factors in unsustainable livestock production. Farmers need various types of information on livestock production practices, but due to the limited availability of extension personnel, particularly in the field of animal science, it is difficult to communicate the latest information to them through traditional

methods. Information and communication technologies (ICTs) for livestock extension are one approach to addressing the information needs of farmers (Chandra et al., 2023). ICTs have the potential to change the economy of the livestock sector (Sasidhar & Sharma, 2006). So, the agriculture extension sector should develop need-based, area-specific content in the local language in the form of ICT tools with respect to livestock farming (Tiwari et al., 2010; Panda et al., 2019). ICT-based livestock advisory services for information dissemination to the farming community at the farm level have become available on time. Mobile phones, among ICT tools, are cheaper, easily available, and easy to use, which has had a positive impact on the farming community as well. Mobile phones are maximally used to get information on farming compared to other ICT tools and mass media sources like TV, radio, etc. (Gangil & Verma, 2018). Livestock apps are software programmes designed to run on smart phones, tablets, and other devices and offer various kinds of services, such as livestock breeds, feeding,

healthcare management, etc. In the context of this study, the term “livestock apps” is used to characterise GADVASU mobile apps targeting the needs of livestock farmers. Studies that focus on cataloguing available sources of information on livestock farming and understanding factors influencing livestock farmers’ decisions to adopt and sustain ICTs (GADVASU apps) in district Barnala are limited. This knowledge gap will be minimised by examining three objectives: (1) the socio-economic characteristics of livestock farmers; (2) available sources of information on livestock farming and their use; and (3) finally, looking at the factors influencing the adoption of ICTs among livestock farmers in the Barnala district of Punjab, one of the important milk-producing districts in Punjab.

METHODOLOGY

The study was conducted through a survey in all three blocks, viz., *Mehal Kalan, Barnala, and Sehna*, of district Barnala in Punjab. Barnala is situated at 30° 22' 46.704" N latitude and 75° 32' 46.0356" E longitude and is bordered by Ludhiana district on the north, Moga district on the northwest, Bathinda district on the west, and Sangrur district on all other sides. Livestock farmers were interviewed directly with the help of a pre-formulated schedule. The sampling method was non-probability sampling, under which the convenience sampling technique was used. Four villages were selected from each block based on easy accessibility, and five livestock farmers were selected from each village; this exercise resulted in the selection of 60 livestock farmers. The collected data were analysed using descriptive statistics such as frequency counts and percentages, as well as the Tobit model in R software (version 3.6.1) to estimate livestock farmers’ proclivity to adopt ICT (GADVASU apps).

Since the data includes ICT (GADVASU Apps) adopters and non-adopters, the dependent variable has many zero observations, so the Tobit model is appropriate to handle such observations. The Tobit model, in its simplest form, is presented as:

$$y_i^* = \beta x_i + \mu_i \quad \text{if } \text{RHS} > 0 \quad (i = 1, 2, \dots, n) \\ y_i^* = 0 \quad \text{otherwise}$$

Where y_i^* is a latent variable that is not observable and μ is the error term that is independently and normally distributed with $\mu \sim N(\mu, \sigma^2)$. Thus, Tobit’s analysis of factors influencing the adoption of ICTs is specified as:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_n x_{in}$$

Where y_i is an observed dependent variable that is only observed or exists when the latent or unobservable variable y_i^* is greater than zero, x (s) are the independent socio-economic and institutional vectors of causal variables, and β (s) are parameters to be estimated. The Empirical model is depicted as:

$$y_i = \text{Livestock farmers propensity to adopt ICTs (High= 1, Low= 0)} \\ x_1 = \text{Age (>40 Years = 2; 30-40 Years = 1; 20-29 Years = 0)} \\ x_2 = \text{Education level (Above= 3; Middle= 2; Primary= 1; Illiterate= 0)} \\ x_3 = \text{Herd size (> 8 = 2; 4-8 = 1; <4 = 0)} \\ x_4 = \text{Participation in extension activities (Yes = 1; No = 0)}$$

RESULTS AND DISCUSSION

Sources of information on livestock farming

The farmers were asked to indicate their sources of information for livestock farming, which shaped their knowledge and awareness

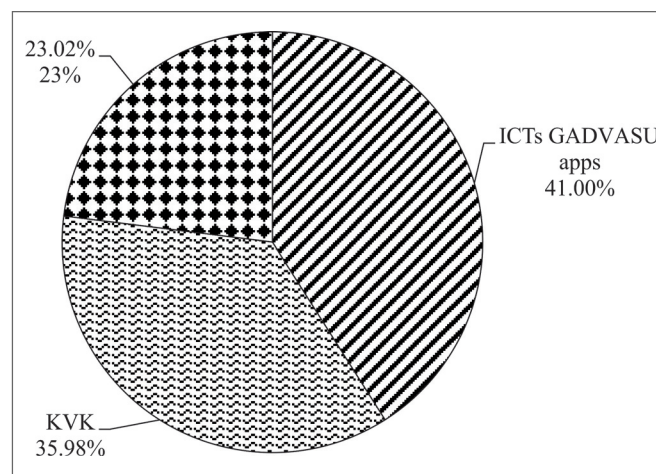


Figure 1. Sources of information on livestock farming

of livestock production practices. The results are depicted in Figure 1. It is an important finding that an overwhelming majority of the farmers confirm that they received vital information regarding livestock farming mainly from ICTs: GADVASU apps (41.00%) and KVK (35.98%). The other source was the university helpline (23.02%). Livestock farmers with mobile phones were using them to seek information via GADVASU apps, and KVK scientists were updating them about new farming techniques. These results are in agreement with those of Chikaire et al., (2017), who found that mostly farmers in developing countries use mobile phones, radios, and televisions as the only ICT devices available to them. These ICT tools played a major role in changing the lives of livestock farmers through the provision of new agricultural inputs and relevant information. KVK has been promoting the dissemination of livestock farming information through its regular and various extension activities. KVK tried to motivate farmers to use GADVASU apps through personal visits (field visits), animal health camps, and communication with extension functionaries. Training and demonstrations are provided to farmers through a number of programs. The KVK emphasises the use of GADVASU apps by farmers for getting scientific livestock farming information. The results show that farmers had a higher level of awareness of livestock technologies. These results may be due to farmer’s participation in extension activities organised by KVK. The results were in line those of Sharma & Sahoo (2008).

ICTs used by the livestock farmers

All the farmers use ICTs for one purpose or another (Table 1). It shows high adoption of ICTs through GADVASU apps, which are easy to download and use for reliable and timely information in the local language with all subject matter coverage like feeding, housing, calf and kid healthcare, and breeding management. The study found that the use of GADVASU apps has improved livestock farming in the district. The use of these apps has increased farm productivity and income, the availability of timely information, and knowledge on livestock farming. As a result, the livestock farming preference has improved in the district, and youth are starting to be involved in livestock farming as compared to the past time as there is more information about

Table 1. ICTs used by livestock farmers for various purposes (n = 60)

Purpose	Mobile (GADVASU apps)	Internet browsing	Newspaper	Television
Breeds	83.33	18.33	3.33	1.67
Feeding management	91.67	35.00	5.00	1.67
Housing management	86.67	15.00	0.00	0.00
Calf/Kid management	88.33	10.00	0.00	0.00
Health care management	60.00	35.00	3.33	1.67
Breeding management	48.33	5.00	0.00	0.00

Table 2. Estimated Tobit model of livestock farmers' propensity to adopt ICTs (GADVASU apps)

Variable	Estimate	Std. error	t value	Pr(> t)
Intercept	0.97339	0.11049	8.810	<2e-16 ***
Age (x_1)	0.02398	0.04774	0.502	0.616**
Education level (x_2)	-0.02885	0.03417	-0.844	0.398**
Herd size (x_3)	-0.01653	0.04750	-0.348	0.728**
Participation inextension activities (x_4)	0.01369	0.06443	0.212	0.832**
Log-likelihood	-1.656605			

*** 0.001 ** 0.01 * 0.05

livestock production and management, more farm income and exposure, and which livestock technology to practice. This finding was in agreement with the findings of Dhaka & Chayal (2010). TV, the internet, and newspapers were less used by the livestock farmers in the study area.

Estimation of livestock farmers' propensity to adopt ICTs: GADVASU apps

The results of the Tobit estimates of livestock farmers' propensity to adopt ICTs (GADVASU apps) indicate that age, education, herd size, and participation in extension activities independent variables significantly influence the farmers' propensity to use GADVASU apps in the Barnala district. The age (x_1) variable has a significant ($p < 0.1$) influence on the propensity to use GADVASU apps in the study area. This may be attributed to the fact that more experienced farmers would have come across more problems and found their solutions through these apps and are therefore more convinced about their usefulness. Education level (x_2) is similarly significant at a 10 per cent level of significance. This implies that the more educated a farmer is, the higher his propensity to use ICTs (GADVASU apps). Igodan et al., (1988) said that farmers who are more educated have a higher propensity towards adoption. Herd size (x_3) significantly relates to the propensity to use ICTs (GADVASU apps) at a 10 per cent level of significance. The results show that farmers with a small herd size will have a low propensity to use ICTs (GADVASU apps). Participation in extension activities (x_4) significantly ($p < 0.1$) influenced the use of ICTs (GADVASU apps) by the livestock farmers in the study area (Table 2). The implication is that KVK's activities for the dissemination of information and advisory services have given farmers more confidence to use GADVASU apps.

CONCLUSION

This study established that livestock farmers use ICTs for one purpose or another in the Barnala district, but there is a need

to make livestock farmers aware, especially those with small herd sizes, little experience of using ICTs (GADVASU apps), and low education levels, by the extension agencies through developing strategies and programmes for these farmers in the Barnala district of Punjab, India. So, they can improve their livestock farming practices, farm income and living standard.

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Awareness and Determinants of Farmers Participation in e-Marketing of Agricultural Commodities in India

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ABSTRACT

Integration of APMCs across the country through e-NAM was to augment price discovery and dissemination. The process of electronic marketing being new to the stakeholders, the awareness and constraints entailed herein are addressed. This study evaluates the extent of awareness among farmers about different processes of e-marketing, along with the determinants of their participation. A total of 240 farm households were selected randomly through multistage sampling for the primary survey. The result of the study infers that distance to the market and farm size of the farmers was the most important factors that determine farmers' participation in e-marketing. Awareness about different e-marketing processes among farmers is relatively lower in Andhra Pradesh compared to Karnataka. The promotion of more participation to create an efficient marketing system there is a need for elaborated awareness about e-marketing among farmers and also increases the capacity building programmes to enhance knowledge about several process of trading.

INTRODUCTION

Over the years the dissonance between the increases in food production of the country has significantly increase in income of the farmers has been descend explicitly. This might be due to poor marketing infrastructure, prevalence of inefficiency, fragmented marketing channels, and policy distortions (Chand, 2012). Agricultural marketing's post-harvest supply chain architecture, which directly affects revenue realization, has not received much attention (Reddy, 2018). Existing system proves poor price discovery process against the background of subpar marketing and related infrastructure (Nuthalapati et al., 2020). Moreover, the conceptually farmers friendly APMC (Control) Act has turned to an apathetic and acquired anti-competitive behaviour. To overcome this prevailing environment, the major reform in agricultural marketing was in the year 2003 by implementing Model Agricultural

Produce Market Committee (Development and Regulation) Act, 2003. However, APMC aimed at removing several hurdles viz restricting private players in creation of infrastructure, development of alternative marketing channels for farmers and creating a competitive market for the agriculture development. Similarly, to overcome limitations in present marketing system and improve overall efficiency in the system. Government of India came up with new marketing reform by amending model act into Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act, 2017. This act facilitates freedom to the farmers to sell their produce across time and space. It allows for integration of the APMCs creating common platform for trade across states. In essence, it is a common market not a single market because taxes and charges still applicable (Roy et al., 2017).

The essence of a common market was to make the free flow of agricultural commodities in market without any institutional

barriers, so that producers or traders can sell them with the same freedom across the borders (Roy et al., 2017). Despite the adoption of improved information communication technologies to provide transparency in agri-business and appropriate decisions making in marketing of agricultural produce with the objectives of real-time price dissemination and spot price discovery has not been achieved (Dey, 2016). An attempt was made in this direction by Government of Karnataka by implementing reforms in market structure and devising innovative practices to improve agriculture market and competitiveness (Chand, 2016).

To achieve transparency and price determination with technology enabled environment Government of India, implemented e-National Agricultural market (e-NAM) in 2016 which is in line with famous Karnataka model of e-trading i.e. Rashtriya e-Market Service (ReMS). In Karnataka ReMS has implemented e-tendering in all 165 markets covering about 60 commodities, whereas e-NAM covers 203 commodities (www.enam.gov.in). As a result, a farmer would now be able sell to a distant buyer without having to choose or travel to a different market, by market integration at state level eventually nationwide and streamline uniform market procedures (Bisen & Kumar, 2018). The implementation of these reform needs to ensure that farmers have better understanding and awareness about different processes. In this backdrop, it becomes imperative to evaluate the extent of awareness of different processes of e-marketing and factors motivating farmers to participate in e-market.

METHODOLOGY

The secondary data related to farmers' participation was collected from e-NAM database. The detailed primary survey was undertaken during the 2019-20 with the pre-tested questionnaire. Each district from Karnataka and Andhra Pradesh were chosen randomly to understand learning under awareness and perceptions of the both the e-NAM and ReMS model. Data comprising of 240 farmers were randomly selected with 120 farmers each in Chitradurga and Kurnool districts with 60 participants and 60 non participants of e-marketing in each district. The awareness of farmers pertaining to different process of e-marketing like,

computerised gate entry, bidding process, sale of produce, mode of payment received by farmers were collected. The perception related information was also analysed using parameters like, training facilities, extent of implementation, infrastructure created and quality assaying and grading.

The logit model analyses determinants of the participation of the farmers in e-marketing considering the household characteristics, resources endowment, asset class etc. Such a model is appropriate if participation fits into a dichotomous choice, essentially taking on values of zero and 1. The behaviour of the household towards participation of farmer in electronic market is defined as:

$$Z_i = \beta_0 + \sum_{i=1}^n \beta_i X_{ki}$$

Where, β_0 represents the intercept term and β_i s are the coefficients associated with the explanatory variables X_{ki} . These factors explain the participation behaviour and the probability that i^{th} household decides to adopt a certain practice. The probability of participation is modelled as:

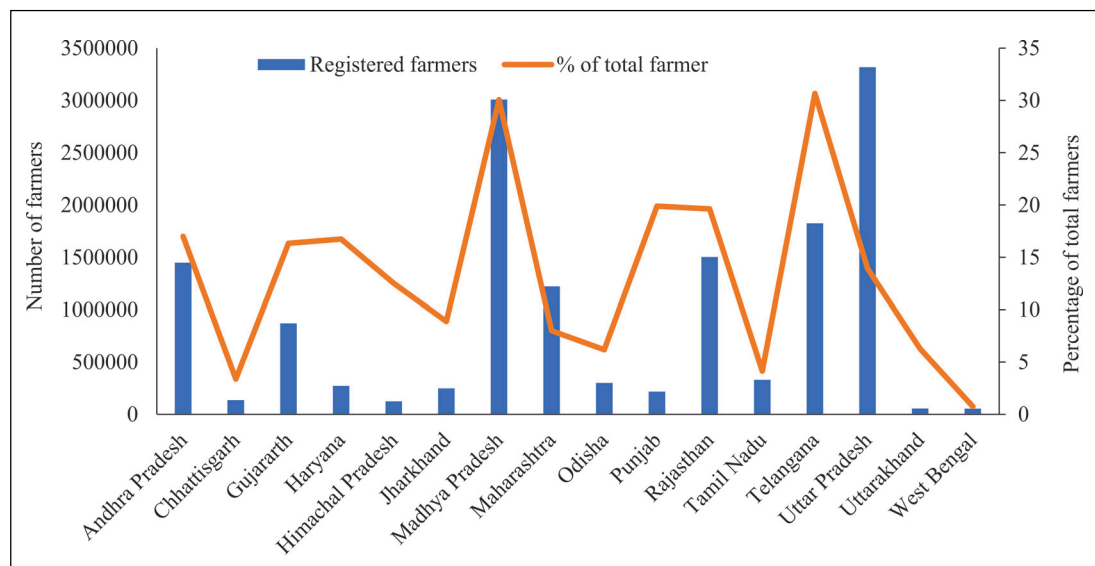
$$P_i = \frac{e^{Z_i}}{1 + e^{Z_i}}$$

where P_i is the probability that Y_i takes the value 1 and then $(1 - P_i)$ is the probability that Y_i is 0 and e is the exponential constant. In the analysis, explanatory variables like age of the farmer, number of years of schooling, experience in farming, unitary or joint type of family, category of the farmers with dummy 1 if SC/ST, 0 otherwise, distance to market, and extension service were considered.

RESULTS AND DISCUSSION

The farmers registered with the e-NAM markets in states are provided in Figure 1. The large number of farmers are registered in states like Uttar Pradesh and Madhya Pradesh with more than 30 lakh farm household population. States like Telangana and Madhya Pradesh farmers account for 30 per cent of their state farmer population. Proportionally small participation can be seen

Figure 1. Registered farmers participation under e-NAM (as on October, 2022)



from states like West Bengal, Chhattisgarh and Tamil Nadu with less than 5 per cent of farm households registered in the e-Nam. On an average about 1.7 crore i.e. 12 per cent of the farmers in India are registered with e-NAM, indicates the scope for reaching the large base of population involved in agriculture.

The basic socio-economic characteristics of the participants are highly educated with 22 per cent of them completing graduation and another 38 per cent having studied up to high school. Only 13 per cent of the illiterates could sell in the electronic market. Most of the respondents have obtained high school or higher education in selected area. Average family size of 7 to 8 members and having 30 years of experience in the farming. A quarter of farmers belong to social class of SC/ST in e-market participants and around 1/5th is in same category of non-participants. The financial service availability specially in the form of short-term loans under KCC for 35 and 39 per cent in participants and non-participants respectively. Again, a quarter of respondents have membership in cooperative societies. The land holding pattern of sample farmers shows that small and marginal farmers constitute around 50 per cent of the respondents with mean land holding of 1.7 acre for marginal and 3.8 acres for small farmers in e-market participants. Non-participants are marginally smallholding compare to e-market participants with mean holding of being 5 acres and 5.5 acres for non-participants and participants respectively.

Awareness about e-marketing operations

The extent of awareness about different processes and components of the e-marketing among the participating farmers were recorded (Table 1). Results shows that 69 per cent of famers aware of computerised entry at the gate of market. The first step in e-marketing starts with computerised entry at the gate to record the information about the farmer, commodity, quantity and quality of produce bought for sale. However, only 45 per cent of the farmers aware that the computerised gate entry is mandatory for the sale in market. In Chitradurga 78 per cent of the farmers and in Kurnool 60 per cent of famers aware that higher price bidder will win the auction. The results of bidding announce at a specified time is known to farmers in larger proportion. These results were in consistent with Pavitra et al., (2018); Chengappa et al., (2012). Online transaction of payment to farmers bank account is another feature introduced for the purpose of ease process and transparency. In Karnataka 45 per cent of the farmers have availed this facility

Table 1. Awareness about e-marketing operations by farmers (%)

Particulars	Kurnool	Chitradurga	Overall
Computerized entry at the gate	63.33	75.00	69.12
Computerized entry at the gate is mandatory	40.00	50.00	45.0
Highest bidder will win the bid	60.00	78.33	69.12
Bid results declared at specified time	68.33	73.33	70.5
Direct payment to bank account through on-line system	13.33	45.00	29.13
Opinion about e-auction process			
Highly satisfied	61.67	73.67	67.67
Satisfied	15.00	18	16.5
Not satisfied	23.33	8.33	15.4

but in Andhra Pradesh only 13 per cent of the farmers had online transaction with bank account. The satisfaction with the e-marketing process by farmers reveals that 61 per cent of Kurnool farmers and 73 per cent of Chitradurga farmers are highly satisfied with the process of e-auction and 23 per cent and 8 per cent farmers in Kurnool and Chitradurga are not satisfied with the process respectively. Similar results are reported by Raju et al., (2022) on awareness of e-NAM.

e-marketing of the commodities in this process need some infrastructure facilities under different processes. Study looks at, what extent of farmers are satisfied with these facilities developed in the respective regulated markets (Table 2). Overall infrastructure facilities are in poor condition with lot of variation in different facilities available. Majority of the farmers satisfied with the facilities available in terms of infrastructure in bidding and e-auction process, which requires computers, cabins, electronic displays and internet facilities. Overall, 70 per cent farmers consented with drying facility in the market, so that excess moisture in commodity can be dried up before sale. Quality assaying is major feature of the electronic market, which specifies the quality of the produce available to traders from other markets by displaying the different quality parameters of the goods. This facility is comparatively better in Chitradurga (76%) than in Kurnool (50%). To ease the sale of produce, the products need to be segregated by grading, to fetch price based on specified grades. Around 45 per cent of farmers satisfied with the facilities of grading available in the market. The sorting and soil testing facilities were minimal in both the district markets. Similar results are reported by Yadav et al., (2023) in a study conducted at AP and Telangana.

Table 2. Farmers reporting extent of infrastructure available in market (%)

Infrastructure facilities	Kurnool	Chitradurga	Overall
Online bid management	70.00(42)	85.00(51)	77.50(93)
e-auction facility	68.33(41)	80.00(48)	74.17(89)
Commodity drying facility	75.00(45)	66.67(40)	70.83(85)
Quality Assaying facility	50.00(30)	76.67(46)	63.33(76)
Product cleaning facility	50.00(30)	73.33(44)	61.67(74)
Produce grading facility	38.33(23)	53.33(32)	45.83(55)
Grain storage	33.33(20)	53.33(32)	43.33(52)
Produce sorting facility	26.67(16)	35.00(21)	30.83(37)
Soil testing facility	20.00(12)	28.33(17)	24.17(29)

*Figures in parenthesis indicates number of farmers

Factors Influencing farmers participation in e-marketing

To study the determinants which influence the farmer's participation in electronic marketing, the information on socio-economic, physical and institutional factors were selected (Table 3). Logit regression analysis was employed to analyse the factors which determine the farmers' participation in Kurnool and Chitradurga. The parameters considered were age, education, farming experience, farm size and access to extension service had a positive effect on the participation, while type of family and distance to market, land holding and access to extension services.

The estimated odds ratio indicated that as the distance to market increase by 1 km his probability of participation in e-

Table 3. Factors determine participation in e-marketing of agricultural commodities

Variables	Odds Ratio		
	Kurnool (N=120)	Chitradurga (N=120)	Overall (N=240)
Age (Years)	1.011(0.055)	0.747*** (0.082)	0.952(0.044)
Education (Years)	1.017(0.061)	1.046(0.106)	1.053(0.049)
Experience (Years)	1.005(0.053)	1.286*** (0.122)	1.063(0.046)
Family type (Joint family = 1, Otherwise = 0)	0.529(0.262)	1.573(0.945)	0.670(0.231)
Distance to market (km)	0.911** (0.048)	0.697*** (0.049)	0.832*** (0.030)
Landholding size (ha)	1.189** (0.107)	1.160*** (0.101)	1.116*** (0.060)
Access to extension service (Yes = 1, No = 0)	5.334*** (2.637)	5.758*** (3.359)	4.292*** (1.385)
Constant	0.187(0.339)	6103.39*** (20757.2)	2.389(3.326)
Observations	120	120	240

Note: values in the parenthesis indicates standard error, ***, ** significance at 1% and 5% respectively

marketing reduces by 9 per cent, since longer distant farmers participation is constrained by transportation cost and facilities. Farm size of the farmers had positive relation along with access to extension service being major factor to influencing participation (Gautam et al., 2022), therefore dissemination activities need to gear up for the further implementation participation in e-marketing. However in case of Karnataka the parameters like age and experience shows significant positive influence. Age had negative relation as the age increase by 1 year the participation in e-marketing reduces by 26 per cent. Whereas experience had positive effect with increases in this adds participation in electronic market. Participation increases with increase in the land holding among the farmers significantly. These results were in accordance with Chengappa et al., (2012) & Aggarwal et al., (2017).

CONCLUSION

Awareness about e-marketing process was low among all the stakeholders. The infrastructure on quality assaying, storage facility needs to be improved for further augmenting the ease of commodity flow in market and larger participation by different stakeholders. Distance to market, farm size and access to extension services were the major parameters having significant influence on e-market participation. This will break up the jinks of Fair Average Quality (FAQ), average price of the produce. This will makes farmers to go for quality food production for realizing premium prices. Measures must be taken to disseminate information through use of innovative communication tools by respective agencies to create awareness among farmers, traders and other stakeholders. Further, involvement of institutions like state department of agriculture, horticulture, KVKs, SAUs must work together at grassroots level to create awareness about the process among farmers.

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The **ABSTRACT** is a mini version of full paper. Abstract should contain year of study, brief account of principal objective(s), methods used, principal results, and main conclusion in understandable form so that the reader need not refer to the whole article except for details. It should be written in simple past tense, in complete sentences, limited to 150-200 words. It should not have references to literature, illustrations, and tables.

The **KEYWORDS** best describes the nature of the research after the abstract. Provide a list of 5 to 8 keywords (indexing terms). The first letter of each keyword should be in upper case or capital letter. As major words in the title are not used in the subject index, appropriate words from the title (or synonyms) should be listed as keywords.

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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 be written separately and avoid repetition of the results in the discussion.

The 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.

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