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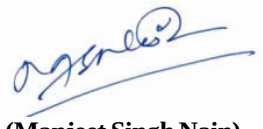
EDITORIAL

Organization for Economic Cooperation and Development (OCED) has projected that that global economy will take a bigger hit than previous forecast in 2023 amid the Russia- Ukraine conflict and projected at 2.2%. During 77th United Nations General Assembly, looming famine in Somalia and other African countries was discussed and in wake of the humanitarian crisis in the Horn needs to be at the top of the international agenda, and we need commitment, resources and action urgently. Simultaneously, Pakistan flooding shows 'adapting' to climate change can be a dangerous illusion as one third of the country is under water during September 2022. The recent United Nations climate report embraced supporting Indigenous self-determination, recognizing Indigenous Peoples' rights and supporting Indigenous knowledge-based adaptation for reducing climate change risks and effective adaptation. Few of the manuscripts covered the pertinent question in current issue of the Indian Journal of Extension Education.

It's my privilege to present the current issue (October- December, 2022) containing 38 manuscripts from cross sectional authors and content ranging from basic research in the form of measuring tool development; use of multivariate typology livelihoods in climate sensitive agro-ecosystems; food and nutrition security of farm households; outlook of wheat and vegetable market; studies on producer federations;Impact of COVID-19 lockdown; value chain analysis; varietal preferences; social media predictors analysis; adoption studies; CHCs study; depredation by wild animals; CFLDs impact analysis; use of critical incident technique , ordinary least square method and ARIMA model for analysis; studies in fisheries science; efficacy on core life skills and MDP; dairy farming and milk consumption pattern; participatory seed production study:Constraints analysis in different settings, awareness and adoption studies; and role performance-expectation gap. During the quarter, with the inclusion in Index Copernicus International Journal Master list the IJEE is now getting wider circulation with the opportunity for citations and indexing. As on date indexed at CAB International; ICI; BASE; Google scholar; Scilit; Semantic Scholar; WorldCat; Science gate; Agricultural Science and Technology Information data base of FAO which has become possible by submitting metadata in desirable form to Crossref. The claim for inclusion in UGC CARE list has also been submitted.

I extend my sincere thanks to all the authors for making valuable contributions. I also extend sincere thanks to all the expert members in the editorial board (Himanshu K. De, Kalyan Ghadei, Rajeev Bairathi, S. S. Dolli & V.P.S. Yadav) for their painstaking efforts. The reviewers like Souvik Ghosh, Mahesh Chandra, P.K. Tiwari, Satyveer Meena, M.S. Meena and many other contributed a lot and deserve sincere thanks. I extend my sincere thanks to all the authors for making valuable contributions. The support extended by Executive Council is duly acknowledged.

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



(Manjeet Singh Nain)
Chief Editor

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Contrasting Farm Livelihoods in Climate Sensitive Agro-Ecosystems in Odisha

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ABSTRACT

The spree of tackling climate change issues stems from every global corner, which remains unique to specific agro-ecosystems. Rural India with a fair majority of livelihoods dependent on agriculture, are facing the severity of challenges to cope up with climate change. Therefore, livelihood analysis is an important aspect to address the climate change issues. Present study was conducted in the year 2020-21, in a climatically vulnerable state of India, Odisha, which suffers from climate induced natural disasters both in coastal and non-coastal ecosystems. Sustainable livelihood framework was followed in analyzing differential level of human, social, physical, financial and social assets holding of three dominant livelihood groups, viz., crop, livestock and crop + livestock farmers in one each coastal and non-coastal districts covering a total of 200 farm households. The analyses showed contrasting livelihood status with varied level of assets, crop + livestock farmers having above average overall livelihood level and social assets being at above average level contributing highest to overall livelihood status. Overall level of coastal livelihoods was at lower level as compared to non-coastal livelihoods. Better livelihood assets along with both technological and institutional interventions result in better insulation to rural households against ill effects of climate change events.

INTRODUCTION

The exorbitant rates of climate change and its impacts on human life is a matter of serious concern. In an extended version of United Nations Framework Convention on Climate Change (UNFCCC) of 1992, the signing of Kyoto Protocol in 1997 by all signatories pledged to reduce the greenhouse gas emissions that directly contributed to global warming was a significant leap towards addressing the climate change concerns at global level. Twenty-five years to date, India too has gradually joined the climate campaign for a sustainable future.

Majority of rural households being agrarian in nature are challenged by the climate change, witnessing resources degradation, shortage of food and social inequalities. Climate change has been influencing agriculture-livelihood equilibrium as agriculture-based livelihoods are sensitive to climate change (Sheikh & Akter, 2017). More than half of the South Asian population's livelihood capabilities are at risk due to rising temperature and erratic rainfall resulting in decline of crop yield, water-logging/ water scarcity, reduced farm income and migration (World Bank, 2018). Livelihood is the function of assets holding, activities and capabilities required to earn a living. Sustainable livelihood underlines the importance of coping with and recovering from shocks and stress (Chambers & Conway, 1992). Climate variability is one such shock to recover from. Sustainable livelihood approach advocates measure of livelihood in terms of human, social, natural, physical and financial

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assets of a household (DFID, 1999). Differential possession of these resources along with institutional infrastructure influence farmer's decision making and coping strategies to combat climate change threats on their livelihoods (Alam et al., 2016; Ayanlade et al., 2017; Delaporte & Maurel, 2018). Adoption of climate resilient agricultural interventions aiming to sustainable livelihoods tends to vary across the farm livelihood groups depending on their level of asset holding and livelihood sensitivity (Das & Ansari, 2021). Therefore, livelihood analyses in climatically vulnerable ecosystems are the precursor of formulation and promotion of location specific adaptation and mitigation measures.

Over 70 per cent of rural livelihoods in India are agriculture driven and majority of share (82%) is with small and marginal farmers (https://www.fao.org/india/fao-in-india/india-at-a-glance/en/). Though agriculture in India has reached grain self-sufficiency but many aspects relating to the livelihood options arising out of that are still at cross roads. According to Global Report on Internal Displacement (2021), India is expected to see huge internal displacements to a tune of 2.3 million displacements every year due to climate induced disasters like floods, cyclones, earthquakes, storm surges, tsunamis etc., which in turn threatens the structure of rural livelihoods, rural asset holding and ultimate survival of rural people. And the worst sufferer of such impacts of displaced livelihood contributed by climate change is the farm households inhabiting in rural India. On this backdrop, present research is contemplated to mapping the farm livelihoods through measures of various livelihood capitals.

METHODOLOGY

The state of Odisha, purposively selected for the study is characterized with a unique geographic location on the east coast of India with contrasting agro-ecosystems, dominated with small and marginal farmers with about 38 per cent cultivators and 62 per cent agricultural labourers along with a vulnerable coastline and fragile ecosystem (State of India's Environment Report, 2021). Indian Council of Agricultural Research (ICAR) launched National Innovations in Climate Resilient Agriculture (NICRA) since 2011 through ICAR institutes, SAUs and Krishi Vigyan Kendras (KVKs or Farm Science Centers) in climate sensitive districts of India. For the present study, one coastal and one non-coastal NICRA district was purposively selected, namely, Kendrapara and Dhenkanal, respectively; based on the functionality of NICRA project as well as their level of vulnerability to climate change (Bahinipati, 2014). During the pilot study it was identified that each district had a classified distribution of rural livelihood options, namely, crop farming (CF), livestock farming (LF) and crop + livestock farming (CF+LF). Therefore, to represent three dominant farm livelihood groups, random sampling with proportionate allocation was followed to select 200 beneficiary farm households (100 from each district) as respondents for present study.

Livelihood was considered as a function of asset holding of farmers like physical, social, financial, natural and human assets following the DFID (1999) framework to have a holistic and sustainable way of conceptualization of livelihood opportunities (Chambers & Conway, 1992). The better holding and better access a household is having to assets, the lower will be negative impact of climate change. Five types of assets as they are described in the literature, have been identified as measures of livelihood. This considers the comparative position of physical, social, financial, human and natural assets of the farm households. All the variables under five types of assets were measured on the basis of the responses of farmers on appropriate scales of measurements with the help of semi-structured personal interview schedule. Thereafter, the measured data was normalized.

Overall Livelihood Status (L_i) was calculated as given below:

$L_i = \Sigma(P_i+S_i+F_i+H_i+N_i)$, where, i indicates number of farmers-respondents

$P_i = \Sigma PA_{ij}/\Sigma j$, j (=1,2, …) indicates variables measuring physical assets

$S_i = \Sigma SA_{ik}/\Sigma k$, k (=1,2, …) indicates variables measuring social assets

$F_i = \Sigma FA_{il}/\Sigma l$, l (=1,2, …) indicates variables measuring financial assets

$H_i = \Sigma HA_{im}/\Sigma m$, m (=1,2, …) indicates variables measuring human assets

$N_i = \Sigma NA_{in}/\Sigma n$, n (=1,2, …) indicates variables measuring natural assets

RESULTS AND DISCUSSION

The livelihood groups varied in number in climatically vulnerable ecosystems of Kendrapara and Dhenkanal districts of Odisha. In Kendrapara district, more than half (55%) of the selected respondents belonged to crop farmers category while 25 per cent and 20 per cent farmers were from livestock and crop + livestock categories, respectively. For the Dhenkanal district, 60 per cent of the selected beneficiaries were from crop farmer category and 20 per cent each belonged to livestock farmers and crop + livestock farmer category. Similar results were reported by Pal et al., (2017). Overall, crop farmers were dominant farm livelihood group followed by livestock, and crop + livestock farmers (Figure 1).

The physical assets holding of farm households in both climatically vulnerable districts are given in Table 1. It is evident that respondents of both the districts had certain similar distribution of holdings and certain dissimilar distribution of holdings. Majority of the farm households had concrete type house for human inhabitation while semi-concrete type house for livestock inhabitation. The share (in per cent) of households with

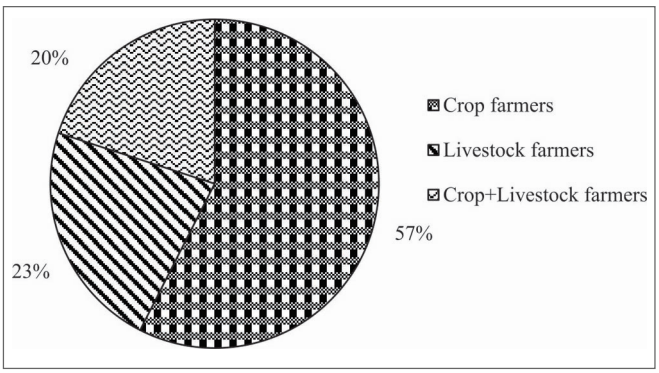

Figure 1. Overall livelihood groups in selected climate sensitive region

Table 1. Physical assets holding of the farmers in coastal & non-coastal districts

S.No.	Physical assets	Coastal district (Kendrapara)	Non-coastal district (Dhenkanal)
		Respondent farmers (%)	Respondent farmers (%)
1.	House Type (Human)		
	Concrete	74	59
	Semi-Concrete	24	41
	Mud house (hut)	2	-
	House Type (Livestock)		
	Concrete	34	21
	Semi-Concrete	36	40
	Mud house (hut)	13	13
2.	Communication Devices		
	Radio	1	-
	TV	94	97
	Mobile phone (Non-smart phone)	62	74
	Mobile phone (Smart phone)	63	53
	Internet connectivity	55	53
3.	Electricity		
	Domestic connections	100	100
	Farm connections	84	98
4.	Conveyance / Transportation		
	Bi-cycle	85	82
	Two-wheeler	81	77
	Four-wheeler	7	6
5.	Farm machinery/implement		
	Tractor	8	8
	Power Tiller	10	26
	Farm implements	91	86
	Mean no. of machinery/implement (SD)	2 (1)	2 (2)
6.	Water source for domestic purpose		
	Pipe/Supply water	68	96
	Tube well	69	59
	Dug well	32	57
	Community (tube well/dug well)	50	9
7.	Water source for farm irrigation purpose		
	Lift irrigation- own well	65	50
	Borrowed or shared from neighbors' well	13	30
	Canal	32	73
	River	69	2
	Community or village pond	3	35
8.	Road connectivity and condition		
	Coal tar road	34	73
	Mean perceived condition:5-point scale (SD)	3.43 (0.92)	3.79 (0.64)
	Concrete road	66	27
	Mean perceived condition:5-point scale (SD)	3.23 (0.63)	3.81 (0.56)
9.	Sanitation facility		
	Inside	80	62
	Outside	21	54
10.	Cooking facility: Means of cooking		
	Gas	90	100
	Kerosene stove	17	43
	Wood	54	66

smartphones was greater for Kendrapara (coastal district) but internet connectivity of both the districts were at par. Average farm machinery or implement ownership remained same for both districts. But clear difference in the source of water for both drinking and irrigation purpose differed among the coastal and non-coastal districts. The road condition for both the districts remained average but for coastal district majority households responded to have concrete roads connecting their houses while for non-coastal district majority responded to have coal tar made roads.

Table 2 represents social assets distribution of both the districts. For coastal district, the social recognition was marginally lower than non-coastal district; the coastal district had better social participation and cohesiveness than non-coastal district. Overall community initiatives and accessibility to common facilities were similar; it remained at moderate level for coastal district and higher level for non-coastal district.

The average annual family income of non-coastal district was better than the coastal district (Table 3). However, the number of income sources was more in coastal district than the non-coastal

Table 2. Social assets holding of the farmers in coastal & non-coastal districts

S.No.	Social assets	Coastal district (Kendrapara)	Non-coastal district (Dhenkanal)
		Respondent farmers (%)	Respondent farmers (%)
1.	Social Recognition: Household status in society		
	Low	19	11
	Medium	66	53
	High	15	36
	Mean score (SD)	1.96 (0.58)	2.25 (0.64)
2.	Social participation: Involvement in different social organizations		
	Very low	-	-
	Low	50	54
	Medium	40	41
	High	10	5
	Very high	-	-
	Mean score (SD)	2.60 (2.21)	2.46 (2.03)
3.	Social cohesiveness		
	Very low	-	-
	Low	1	1
	Medium	13	22
	High	48	62
	Very high	38	15
	Mean score (SD)	4.23 (0.71)	3.91 (0.64)
4.	Participation in different types of community initiatives (Numbers)		
	Never	26	23
	One type	64	41
	Two types	8	31
	≥Three types	2	5
	Mean number (SD)	1 (0.68)	1.08 (0.85)
5.	Accessibility & use of common facility		
	Very low	-	-
	Low	2	-
	Medium	71	3
	High	27	68
	Very high	-	29
	Mean score (SD)	3.25 (0.48)	4.26 (0.50)

Table 3. Financial assets holding of the farmers in coastal & non-coastal districts

S.No.	Financial assets	Coastal district (Kendrapara)		Non-coastal district (Dhenkanal)	
		Respondent farmers (%)	Mean (SD)	Respondent farmers (%)	Mean (SD)
1.	Economic status		-		-
	BPL	17		10	
	APL	83		90	
2.	Annual family income (Rs.)		75750 (36758)		118530 (70650)
	Low	15		9	
	Medium	70		70	
	High	15		21	
3.	Number of income sources		1.40 (0.60)		1.20 (0.40)
	One source	65		80	
	Two sources	31		20	
	≥Three sources	4		-	
4.	Annual family expenditure (Rs.)		44710 (22529)		56555 (31811)
	Low	15		7	
	Medium	68		65	
	High	17		28	
5.	Savings (Rs.)				
	No saving	10	-	7	-
	Low	63	4658 (4555)	70	10588 (9003)
	Medium	20	20714 (4617)	18	46389(4791)
	High	7	47143 (4880)	5	92000 (10955)

Table 3 contd...

S.No.	Financial assets	Coastal district (Kendrapara)		Non-coastal district (Dhenkanal)	
		Respondent farmers (%)	Mean (SD)	Respondent farmers (%)	Mean (SD)
6.	Credit behavior				
	Loan Amount (Rs.)		12290 (6923)		8063 (4494)
	No credit	80		84	
	Low	12		14	
	Medium	6		2	
	High	2		0	
	Ease in accessibility of credit		2.47 (0.61)		2.25 (0.58)
	Difficult	2		1	
	Moderately difficult	8		10	
	Easy	10		5	
7.	Insurances		-		-
	Type of insurances				
	Life insurance	55		63	
	Crop insurance	11		66	
	Health insurance	10		16	
	KCC	14		84	
	PMJDY	86		65	
	No. of insurance		2 (0.90)		3 (1.14)
	Nil	7		1	
	One	31		8	
	Two	44		27	
	≥Three	18		64	

Note: Low (≤Mean-SD), Medium (>Mean-SD to Mean + SD), High (>Mean + SD)

district. The savings behavior was towards lower side in both the districts. In terms of credit behavior, coastal district rural households used to take on an average higher loan than the non-coastal rural households. The type of insurance initiatives taken up by both the districts was dissimilar in terms of availing them and the non-coastal households were better on an average in availing these insurances than the coastal households.

The human assets of rural households of the two districts are given in Table 4. The education level remained alike in both the districts. However, the communication sources and pattern of use of these sources were different. The coastal district respondents had more reliance on mass media sources while the non-coastal district had communication interactions with personal cosmopolite sources. Overall, the communication scenario was better among the non-coastal respondents. Majority of the respondents of both the districts were similar in seeking information about various facilities and had have rated them moderately. The coastal rural households had a better exposure to trainings and they participated better in most extension services than the non-coastal respondents. The coastal belt respondents experienced relatively less suffering than the non-coastal respondents. And the average family health statuses of both the districts were similar.

Table 5 depicts the natural asset holdings of the respondents in both the districts. It is evident that non-coastal households had a better average farm land holding than the coastal households. Majority rural households in both the districts were belonging to the category of marginal and small farmers and additionally many landless farmers in coastal district. There were two growing seasons in coastal belt while three (an additional summer season) in non-coastal belt and a similar pattern was found in case of irrigated landholdings throughout a year. The non-coastal respondents had a better gross cropped and gross irrigated area than the coastal respondents. The coastal respondents had better dairy animals rearing while the non-coastal respondents had better small ruminants and poultry birds rearing. A good number of coastal respondents had ownership of fish ponds while it was sparse for non-coastal respondents.

The Figure 2 depicts differential level of five assets as well as overall livelihood status of the three dominant farmers' groups in coastal district (Kendrapara) and non-coastal district (Dhenkanal). It indicated irrespective of type of climatic events; lower level of natural & financial assets has a significant bearing on the livelihood status of the respondent farmers of both the districts. It further intensifies the fact that natural assets take longer time than any other assets to be re-created post climatic hazards, so it is lowest in contributing to the overall livelihood status of the farmers in these districts. And during any climatic malady the poorest of the poor are hit hardest, the same is concluded from lower level of the financial assets holding of the farmers in these districts. The livelihood analyses of dominant farmers' groups in climatically vulnerable coastal and non-costal eco-systems unravel differential levels of assets holdings. Better level of social assets in comparison to other assets shows the strong social positions of households that are often referred as one of the important facets of rural development. And social asset holding for both the districts were having the highest contribution to their overall livelihood status that maybe attributed to the different agencies intervening into the social structure of the climatically vulnerable areas. Thus, we can conclude that a farm household with better social assets is better insulated from the detrimental effects of climatic maladies.

The higher level of physical assets and human assets also strengthen the household level resilience. According to past studies,

Table 4. Human assets holding of the farmers in coastal & non-coastal districts

S.No.	Human assets	Coastal district (Kendrapara)		Non-coastal district (Dhenkanal)	
		Respondent farmers (%)	Mean (SD)	Respondent farmers (%)	Mean (SD)
1.	Education (years)		11 (3.28)		10 (3.17)
	Illiterate	1		-	
	Primary (≤4 years)	3		4	
	Secondary (5-10 years)	40		49	
	Higher secondary (11-12 years)	30		29	
	Graduation (>12-15 years)	26		18	
2.	Communication sources use pattern:				
	Mass media sources use		9.69 (3.64)		11.58 (3.86)
	Low	20		16	
	Medium	68		68	
	High	12		16	
	Personal cosmopolite sources use		8.39 (3.26)		14.11 (4.56)
	Low	17		15	
	Medium	65		67	
	High	18		18	
	Personal localite sources use		6.50 (3.77)		7.06 (3.76)
	Low	1		22	
	Medium	87		54	
	High	12		24	
3.	Information availability:			-	
	Information related to weather		3.40 (0.59)		3.34 (0.62)
	Agricultural practice		2.41 (1.30)		2.37 (1.32)
	Livestock management (Vet. service)		2.04 (1.43)		1.62 (1.45)
	Agricultural inputs		2.12 (1.36)		2.07 (1.19)
	Market prices		1.31 (0.90)		1.76 (0.88)
	Health		1.41 (0.72)		1.58 (0.59)
	Government programmes and subsidies		1.43 (0.70)		1.66 (0.60)
	Credit facilities		1.36 (0.76)		1.38 (0.49)
	Overall information availability		13.31 (5.11)		13.73 (5.02)
	Low	16		21	
	Medium	73		58	
	High	11		21	
4.	Participation in training and extension services (no. of times)		11 (7)		10 (5)
	Low	12		18	
	Medium	76		64	
	High	12		12	
5.	Family health status: Extent of suffering		1.50 (0.66)		1.44 (0.62)
	No. suffering	56		38	
	Low suffering	26		38	
	Medium	14		22	
	High	4		2	

Note: Low (≤Mean-SD), Medium (>Mean-SD to Mean + SD), High (>Mean + SD)

poor households are vulnerable to climatic change due to lack of social safety nets, access to education and health care, so they are least able to adapt measures safeguarding from climate change events thus questioning their livelihood security (Singh, 2020). Low level of natural and financial assets of households hampers their farming operations in disaster years due to lower resilient capacity to extreme climatic events. The findings of present study have a similarity with the results reported by Sarkar et al., (2022). Narayanan and Sahu (2016) & Ashoka et al., (2022) have reported importance of financial and natural assets like access to credit facilities, access to irrigation, ownership and size of land holding in influencing farmers' vulnerability and adaptation capacity to various measures to become climate resilient. Brown et al., (2019) & Letha et al., (2021) have suggested that better access to wide range of resources give better livelihood opportunities. With diversified livelihood options, better income can be generated thus boosting agricultural practices & other adaptation strategies for climate change concerns (Rijal et al., 2021). The relatively better index values in case of coastal district of Kendrapara as compared to non-coastal district of Dhenkanal may be attributed to the effective & efficient implementation of different capacity building measures by Krishi Vigyan Kendra (KVK) besides the technical & institutional interventions promoted under the ICAR's NICRA project. And it is worth concluding that involvement of KVK in implementation of NICRA has resulted in a better impact in that district (Kendrapara) as compared to other district (Dhenkanal) where interventions were made by ICAR institutes/SAUs alone on pilot basis without involvement of KVK. It also reiterates that

Table 5. Natural assets holding of the farmers in coastal & non-coastal districts

S.No.	Natural assets	Coastal district (Kendrapara)		Non-coastal district (Dhenkanal)	
		Respondent farmers (%)	Mean (SD)	Respondent farmers (%)	Mean (SD)
1.	Farm size (acre)				
	Own land		1.68 (1.33)		2.27 (1.37)
	Landless	21		19	
	Marginal	62		51	
	Small	15		25	
	Semi medium	2		5	
	Leased in (acre)		1.31 (0.75)		2.19 (1)
	Landless	57		92	
	Low	35		6	
	Medium	1		2	
	High	-		-	
	Operational land (own + leased in) (acre)		2.21 (1.35)		2.49 (1.41)
	Landless	19		19	
	Low	51		47	
	Medium	28		27	
	High	2		7	
2.	Cultivated land				
	Kharif season		2.21 (1.35)		2.47 (1.39)
	Landless	19		12	
	Low	51		47	
	Medium	28		28	
	High	2		6	
	Rabi season		2.21 (1.35)		2.24 (1.44)
	Landless	19		12	
	Low	51		53	
	Medium	28		22	
	High	2		6	
	Summer season	-	-		2.17 (1.59)
	Landless			19	
	Low			46	
	Medium			22	
	High			6	
	Gross cropped area (acre)		4.43 (2.71)		6.69 (4.37)
	Landless	19		19	
	Low	21		16	
	Medium	21		14	
	High	39		51	
3.	Irrigated land				
	Kharif season		2.21 (1.35)		2.47 (1.39)
	Landless	19		12	
	Low	51		47	
	Medium	28		28	
	High	2		6	
	Rabi season		2.21 (1.35)		2.24 (1.44)
	Landless	19		12	
	Low	51		53	
	Medium	28		22	
	High	2		6	
	Summer season	-	-		2.21 (1.60)
	Landless			22	
	Low			43	
	Medium			22	
	High			6	
	Gross irrigated area (acre)		4.43 (2.71)		6.65 (4.40)
	Landless	19		19	
	Low	21		16	
	Medium	21		15	
	High	39		50	
4.	Livestock holding				
	Dairy animals	85	5 (4)	59	7(6)
	Farm animals	6	3 (1)	4	3 (1)
	Small ruminants (Goat, sheep)	30	5 (4)	37	9(8)
	Poultry birds (hen, duck)	38	36 (34)	27	102 (89)
5.	Water bodies/ fish ponds				
	Number	37	1 (0)	7	1 (0)
	Size (sq. m)	-	233.78 (75.51)	-	200 (65)

Note: Low (upto 2.5 acre), Medium (>2.5-5 acre), High (>5-10 acre)

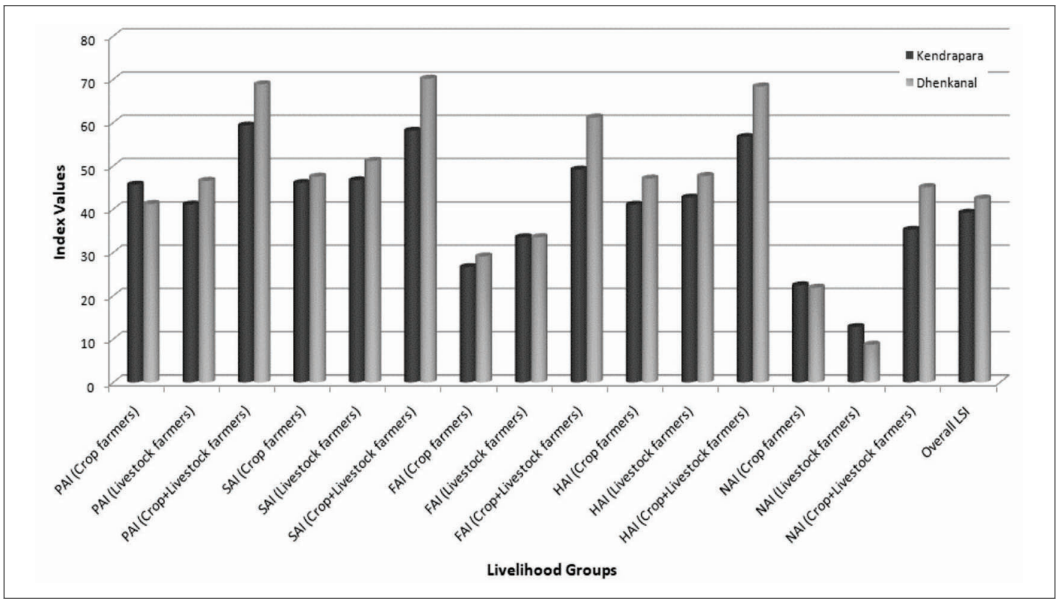

Figure 2. Comparative measures of livelihood of Kendrapara (coastal) and Dhenkanal (non-coastal) districts

institutional interventions are of pivotal importance to put climate smart technologies in practice resulting in sustainable livelihood in rural areas. Agricultural diversification like crop-livestock integration results into a better livelihood; therefore, climate smart agricultural policy may focus on livelihood diversification for better income and resilience in climatically vulnerable rural areas.

CONCLUSION

Any policy advocacy, program or subsidy pushed in the dimension of uplifting the livelihood status must consider such division & diversification of livelihood options and differential levels of assets determining overall livelihood status in any climate compromised rural area identified in three dominant livelihood groups. Irrespective of type of climatic events lower level of natural & financial assets has a significant bearing on the livelihood status of the farm households. Natural assets take longer time than any other assets to be re-created post climatic hazards, so it is lowest in contributing to the overall livelihood status of the farmers. The highest contribution of social assets to overall livelihood status may be attributed to the different agencies intervening into the social structure of the climate sensitive rural areas. Household with better social assets is better insulated from the ill effects of climatic maladies. To reduce the adverse impacts of climate change need to consider strengthening livelihood assets in convergence with climate smart agriculture interventions in contrasting ecosystems.

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Impact of COVID-19 Lock down on Farmers of Nalgonda District, Telangana State

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ABSTRACT

COVID-19 is the greatest humatarian challenge the world has faced and effected agriculture and allied sectors. The study was carried out to know the Impact of COVID-19 lockdown on farmers and allied sectors in terms of Social, Economic, Psychological, Situational parameters. The Google form Questionnaire was used to collect the information from randomly selected 120 farmers of Nalgonda district. It was observed that non-celebration of important events (98.33%), high labour wages coupled with low market price of horticulture produce drastically affected the farmers returns (85%) and majority of farmers had fear of increasing debts due to low market price of produce (80%) and non-availability of agriculture labour for performing field operations (70%) etc. were the major Social, Economic, Psychological and Situational effects on farmers respectively. In case of impact on agriculture and allied sectors, despite the problem few of the farmers adopted alternative mechanism of door-to-door supply of fruits and vegetables, few of the villagers aggregated their vegetable produce and marketed to nearby local towns and cities. Majority of the farmers found that technology driven advisories issued by KVK, Kampasagar, Nalgonda District has helped the farmers to tackle the problems timely.

INTRODUCTION

Agriculture and its allied sectors like animal husbandry, fisheries etc., are the largest source of livelihood in India. About 65 per cent of rural household still depend directly on agriculture for the livelihood. De et al., (2005) opined that India has been traditionally vulnerable to natural disasters because of its unique geo-climatic conditions, droughts, floods, cyclones, landslides and earthquakes. The outbreak of novel COVID-19 disease has left no sectors untouched Saadat et al., (2020). The COVID-19 pandemic has brought new risks that threaten livelihood of small and marginal farm holders and food security of the nation. As a result of the pandemic, many people have avoided large gatherings, encouraged physical distancing, and quarantined citizens (Gupta & Madgavar, 2020). The Lockdown led to sudden termination of all economic activities in the nation and has disrupted the production and supply of goods and services in different sectors. Measures effecting the movement of the people and resulting the labour shortages will have an impact on agricultural value chains, affecting food availability and market prices globally (FAO, 2020).

The major crops grown in Nalgonda District are Paddy, Cotton, Redgram, Sweet orange and Vegetable crops. Harvesting and marketing of crops was in crisis in the whole country due to the shortage of labour and restrictions imposed by Government during the initial period of lockdown. Farmers were struggling to harvest crops as well as market *Rabi* produce. Maintaining an undisrupted supply chain and access to markets for small / marginal farmers was the major challenge during the lockdown period. The

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worst part of imposing social restriction was that it coincided with the country's peak harvesting time of variety of crops in both *Kharif* and *Rabi* seasons in 2020-21. Farmers are exploring alternate channels to directly sell to consumers through farmer producer companies or linking directly to retailers and wholesalers in urban centres (Ravula & Dandugudumu, 2020). The study was carried out to know the Impact of COVID-19 lockdown on farmers and allied sectors in terms of Social, Economic, Psychological, Situational parameters.

METHODOLOGY

The major crops grown in Nalgonda District were paddy, Cotton, Sweet orange and other vegetable crops viz., Tomato, Chilli, Brinjal and leafy vegetables etc. COVID Lockdown showed impact on farmers and this study was planned to see the impact of Lockdown on different aspects such as agriculture, horticulture, agricultural labourer, marketing, farmers social, economic and psychological conditions and other allied sectors. The study was conducted among the farmers of Nalgonda District of Telanagana State during the Lockdown period. A cross sectional online survey was conducted among the farmers using google form questionnaire. The questionnaire includes the statements in local language i.e., Telugu regarding Social, Economic, Psychological and Situational effects of famers and also impact on agriculture and allied Sectors. The Google form link was circulated through WhatsApp groups to collect information from farmers. Respondents were selected randomly from six divisions of the district i.e., Miryalaguda, Nalgonda, Halia, Devarakonda, Munugode and Nakrekal divisions for the study. Two mandals from each division i.e., total of 12 mandals and one village from each mandal i.e., total of 12 villages were selected randomly. From each selected village 10 respondents were selected randomly, thus a total of 120 respondents were constituted as a sample for the study. The farmers were asked to respond for each statement and responses (Yes or No) were collected against each statement. For calculating each dimension's impact Frequency, Percentage and Mean were used.

RESULTS AND DISCUSSION

Impact of COVID-19 lockdown in terms of social effects on farmers

The data (Table 1) reveals that 85.00 per cent of farmers had fear of disease spread from neighbors in the society and felt that maintenance of social distance and following precautionary measures is only safest way of avoiding COVID-19 spread Singh et al., (2021); Roy & Ghosh, (2022) and 51.67 per cent farmers restricted their movement to home, fields and for other daily essential needs. Providing food grains, fruits, vegetables and other essential items both in rural and urban areas, is the most vital challenge and due to lockdown public transportation and distribution system has been severely affected as such scarcity of public commodities was expressed by 65.00 per cent. Due to lock down many festivals, family events, fairs and social/cultural events have been cancelled and postponed, almost 98.33 per cent of respondents agreed that they were not carried out any kind of events in their vicinity. Cancellation of events and celebrations had a profound impact on social and family relation of individuals Vatta & Tiwari (2020). Majority of respondents 68.33 per cent believed that during lockdown they are spending more valuable time with themselves, they spent quality time with their family and got more time for communication with near and dear ones.

Impact of COVID-19 lockdown in terms of economic effects on farmers

Data (Table 2) revealed that when lockdown was announced, it was the peak season of *Rabi* 2019-2020 and paddy harvestings were started. In order to avoid the glut of produce at the procurement centers, Telanagana State Government initiated token system and helped the farmers and procured Paddy in a systematic manner was expressed by 80.83 per cent Rose & Aiyappanpillai (2020). Unavailability or scarcity of farm labour increased the daily wages during harvesting operations. Small land holders harvested their crops manually either by themselves or through mutual agreement with each other. Large land holders faced tough time because they did not have enough man power. Thus, they were forced to pay high price for harvesting operations either by manually or through combine harvesters. Shortage of labour at peak time of harvesting of vegetables Deshmukh, (2020) and fruits increased daily wages and low market price of the produce drastically affected the farmers' returns expressed by 85 per cent. Respondents 61.67 per cent opined that vegetable farmers were forced to sell their produce at lower prices due to impact of COVID-19 and they didn't get required support price for their produce. It was revealed that 40.83 per cent of respondents expressed that the prices of Agri-inputs has increased because of lower availability due to complete lock down and disruption in supply, closure of markets and shops lead to low purchasing power by farmers as they faced difficulty in marketing of their produce (Govindaraj et al., 2022). During COVID-19, Central Government has helped financially to needy and beneficiary farmers through PM Kisan Samman Nidhi (KISAN) Yojna by Central government Rs. 6000 and Rithu Bandu Scheme by State

Table 1. Impact of COVID-19 lockdown in terms of social effects on farmers (N=120)

S.No.	Items	Yes	No	Mean
1.	Maintenance of social distances and following precautionary measures.	102(85.00%)	18(15.00%)	0.85
2.	Movement is restricted to home, fields and for daily essential needs.	62(51.67%)	58(48.33%)	0.516
3.	Scarcity of public commodities.	78(65.00%)	42(35.00%)	0.65
4.	No Social/cultural Events, Non celebrations of important events have showed impact on family and social relations	118(98.33%)	02(1.67%)	0.983
5.	Spending time with family members	82(68.33%)	38(31.67%)	0.683

*****Figures in parenthesis: Percentage of respondents

Table 2. Impact of COVID-19 lockdown in terms of economic effects on farmers (N=120)

S.No.	Items	Yes	No.	Mean
1.	Government initiative of Token System helped the farmers in procuring the Paddy produce and obtained amount.	97(80.83)	23(19.17)	0.808
2.	High labour wages coupled with low market price of the produce affected the farmer's returns.	102(85.00)	18(15.00)	0.850
3.	Impact of lock down on farmers availability of support price of the produce	74(61.67)	46(38.33)	0.616
4.	Whether Prices of Agri-inputs has increased	49(40.83)	71(59.17)	0.408
5.	Opinion about financial assurance from Central govt. through PM-KISAN Yojana and State Dept through Rythu bandu as a help for farmer	92(76.67)	28(23.33)	0.767

* Figures in parenthesis: Percentage of respondents

Government Rs. 8000 directly to the farmers' bank accounts through direct benefit transfer (DBT)was agreed by 76.67 per cent of respondents Lindsay (2021).

Impact of COVID-19 lockdown in terms of psychological effects on farmers

It was evident while studying the impact of COVID-19 on agriculture and allied sectors, various effects on psychological parameters were also studied (Table 3). The study revealed that majority of 74.17 per cent respondents felt that they should support the needy persons around them with donation of food, money and most importantly morally during distress situation. During COVID-19 infection in the country, majority of respondents 52.5 per cent agreed that they have developed the feeling of frustration when others are not following the pre-cautionary measures. After COVID-19 pandemic the lifestyle of people would change in public and private places expressed by 43.33 per cent. The scope of sanitary practices has been put first by people during this pandemic. The study further revealed that 80.00 per cent farmers had fear of increasing debts due to low market price of produce. The most important issue that farmers have to overcome the problem of repaying their crop loans, gold loans and other informal debts. Low market prices lead to defaulter as unable to repay the amount in time and they are pressured to borrow money from other informal sources at high rates of interest for the next season Chetan & Yogish (2020). Government has launched the Arogya Setu App and 70 per cent of respondents said that the app has created awareness among people regarding staying away from infected persons, besides regular checkup and other recommendations regarding protection from COVID-19.

Impact of COVID-19 lockdown in terms of situational effects of farmers

It was evident from 51.67 per cent respondents that the shortage of essential commodities and high demand caused the rise in price of goods (Table 4). Due to shortage of labour the harvesting of agriculture and horticulture crops was severely affected as expressed by 64.17 per cent of respondents (Azim Premji University, 2020). Respondents 65.83 per cent expressed that farmers faced problems in transporting and marketing of horticulture produce due to non-availability and restrictions on vehicles for transportation. The first visible impact of COVID-19 under lockdown 1.0 was on agricultural supply chain. Nation-wide complete lockdown restricted the movement of people as well as vehicles between states, districts and even local areas. This not only adversely affected agriculture but also horticulture sector including fruits and vegetables. Few of the respondents 39.17 per cent opined that the farmers access to basic banking services such

Table 3. Impact of COVID-19 lockdown in terms of psychological effects on farmers (N=120)

S.No.	Items	Yes	No.	Mean
1.	I support the needy persons around me during distress situation	89(74.17%)	31(25.83%)	0.741
2.	Feeling of frustration when others are not following the pre-cautionary measures for COVID-19	63(52.5%)	57(47.5%)	0.525
3.	Lifestyle of people could be changed after COVID-19 pandemic at public and private places	52(43.33%)	68(56.67%)	0.433
4.	I have a mental fear of increasing debts due to low market price of produce	96(80.00%)	24(20.00%)	0.800
5.	I think Arogya Setu App helped people by staying away from infection, symptoms, regular checkups and other recommendations regarding protection from COVID-19	84(70.00%)	36(30.00%)	0.700

* Figures in parenthesis: Percentage of respondents

Table 4. Impact of COVID-19 lockdown in terms of situational effects of farmers (N=120)

S.No.	Items	Yes	No.	Mean
1.	The price of essential commodities has increased	62(51.67%)	58(48.33%)	0.516
2.	Harvesting of Agriculture and horticulture crops were effected.	77(64.17%)	43(35.83%)	0.641
3.	Difficulty in getting vehicles for transportation of produce	79(65.83%)	41(34.17%)	0.341
4.	Access to basic banking services such as deposits/withdrawal were effected?	47(39.17%)	73(60.83%)	0.391
5.	Non-Availability of agriculture labour for performing field operations.	84(70.00%)	36(30.00%)	0.700

* Figures in parenthesis: Percentage of respondents

as loan approvals, deposits and withdrawal were also affected due to restrictions and limited Bank staff. Due to migration of labour to native States and fear of infection and disease spread there was non-availability of agriculture labour for performing field operations expressed by 70 per cent of respondents.

Impact on agriculture and allied sector

The data (Table 5) reveals that 73.33 per cent of the respondents expressed that the availability of Agri-inputs has effected due to restrictions imposed on movement of people, material, closure of shops and availability of agri inputs viz. seeds, fertilizers, pesticides, feed, fodder etc. was declined Alagukannan et al., (2020); Department of Economic Analysis & Research (2020). There was Nation-wide complete lockdown which restricted the movement of people as well as vehicles between states, districts and even local areas but later some relaxation was given to agriculture and farmers could able to arrange combined harvesters at the time of harvesting expressed by 61.67 per cent. Majority of the farmers 90.83 per cent found that the technology driven advisories issued by KVK, Kampasagar in Nalgonda District has helped the farmers to tackle the related problems. Only few Farmers 35 per cent opined that there was delay in receiving payment for the sold paddy produce.

Very few farmers 28.33 per cent expressed that the harvesting and marketing of major fruit sweet orange has been affected majorly due to untimely labour and transport availability lead to poor access to the markets. But, majority farmers sold their produce at low cost in local markets, nearby towns and cities as there is huge demand for citrus fruits during the COVID situation. Marketing of farm products to outside market is the major occupation seasonally to earn income for some local farmers. The impact of lockdown was observed on horticulture sector and it was found that majority of respondents 77.5 per cent agreed that there were significant post-harvest losses in vegetables and other horticulture produce in the district due to lack of transportation facilities and there were limited merchants to purchase the produce Roy et al., (2022). Regular farm labour unavailability has increased the labour cost and cost of cultivation of crops Chand et al., (2020) as agreed by majority of the respondents 95 per cent. This might be due to shortage of laborers and other reasons such as fear of infection and restriction on movement.

The study revealed that farmers have developed the alternative marketing channels such as door to door supply of essential commodities by following COVID precautions, has proved to be an important tool for empowering the farmers Singh et al., (2020) as agreed by most of the respondents 80.83 per cent. Further, the study revealed that majority of respondents 85.83 per cent highly appreciated the efforts of Government to help the farmers, traders, vendors, etc. in meeting the demand and supply of horticultural commodities up to certain extent. Respondents 30.83 per cent expressed that harvesting and marketing of Fish and poultry was affected more because of rumors that COVID infestation will spreads through eggs and poultry chicken, it has attracted consumers to purchase fishes and very few 20 per cent expressed that the price of the fish has fallen down. Due to restricted movement of people, the Government allowed the farmers with curfew passes to sell their perishable products milk, fish, chicken, vegetables and grains etc. considered as a very prominent and needful decision for farmers, most of the respondents 95.83 per cent agreed and appreciated the Govt. decision. Very few famers 15 per cent expressed that there was problem of selling of milk in the district and few 19.17 per cent also expressed that prices of milk have fallen down. But the lockdown made people more health conscious and demand for milk consumption has increased (Shanabhoga et al., 2022). With the help of curfew passes they could able to sell their produce at better price as there was huge demand in the district.

Table 5. Impact on agriculture and allied sector (N=120)

S.No.	Items	Yes	No.	Mean
Agriculture				
1.	The availability of Agri-inputs i.e., seeds, fertilizers, pesticides has affected	88(73.33%)	32(26.67%)	0.733
2.	The combined harvesters were available at the time of harvesting.	74(61.67%)	46 (38.33%)	0.617
3.	Do you feel that technology driven advisories issued by KVK has helped the farmers to tackle the related problems?	109(90.83%)	11(9.17%)	0.908
4.	Is delay in receiving payment for the sold paddy produce?	42(35.00%)	78(65.00%)	0.350
Horticulture				
1.	The harvesting and marketing of sweet orange has been affected in the district	34(28.33%)	86(71.67%)	0.283
2.	There are significant post-harvest losses in the vegetable and Horticulture crops	93(77.5%)	27(22.5%)	0.775
3.	Unavailability of farm labour increased the labour costs & cost of cultivation of the crops	114(95.00%)	6(5.00%)	0.950
4.	Does alternative mechanism for marketing such as door to door supply of fruits and vegetables has empowered group of farmers?	97(80.83%)	23(19.17%)	0.808
5.	Do you feel that relaxation is given by Govt. has helped the farmers, vendors, traders etc. in meeting the demand and supply of horticultural commodities upto certain extent?	103(85.83%)	17(14.17%)	0.858
Livestock				
1.	Harvesting and marketing of fish was affected	37(30.83%)	83(69.17%)	0.308
2.	The price for the fish has fallen down	24(20.00%)	96(80.00%)	0.200
3.	Do you feel that Government has allowed farmers to sell their products with curfew pass is a good initiative.	115(95.83%)	5(4.17%)	0.958
4.	Do you feel that farmers are facing problem in selling of milk in the district	18(15.00%)	102(85.00%)	0.150
5.	Do you think that prices of milk have fallen down	23(19.17%)	97(80.83%)	0.191

* Figures in parenthesis: Percentage of respondents

CONCLUSION

Small and marginal farm holders are highly vulnerable to crisis due to their limited access to resources and credit. Farmers also constantly battle against erratic rainfall, crop failures, increasing input costs and price fluctuations for their produce. Now, COVID-19 poses serious threats on livelihood of farmers and there is a need to follow the general guidelines for safety of person and supporting the needy persons during the distress situations. In order to avoid the post-harvest losses, value addition of fruits and vegetables has to be encouraged. Farm mechanization need to be adopted by the farmers to avoid the labour unavailability. Farmers should be encouraged and motivated towards collective farming or Farmer Producer Organizations for carrying out farming in a profitable way.

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Food and Nutrition Security under Different Farm Households in Bundelkhand

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ABSTRACT

The concept food security was born out of an appreciation of the need to comprise nutrition in food security. Unlike food, which is generally described everything that community consume and drink to sustain existence and development, nutrition adds facet of wellbeing, a vigorous atmosphere, and nurturing practices. The study was conducted in Bundelkhand from 2018-19 to 2020-21. Respondents were selected based on proportional stratified random sampling technique. Data were collected by personal interviews using a structured interview schedule. The results revealed that among marginal farmers, the majority (70.37%) of respondents had low food security, followed by medium and high food security. Regression analysis was performed on the data to confirm the R^2 value, and it was found that the independent variables included in the study were cumulatively responsible for explaining 63.80 per cent of the variability in the dependent variable.

INTRODUCTION

The notion of food and nutrition security was developed in terms of food supply to make certain that everyone has a passable amount of food. Singh et al., (2019) found higher consumption of legumes among agricultural respondents. The statistics also showed that 21.67 per cent of kids consumed more legumes, again higher than both male and female respondents. The majority (63.33%) consumed legumes with moderate frequency. This was higher compared to male and child respondents. Meenakshi et al., (2019) revealed that respondents were interested in organic farming, so they provided and promoted growing bags and seeds to ensure food and nutrition security in rural communities. Thanks to organic farming initiatives, they were able to properly dispose of their food waste.

Kumari et al., (2019) found that many social benefits stem from home gardening practices. Improved wellbeing and nutrition, increased earnings and employment, food security in households and improved societal life in the community. Increasing your fruit and vegetable intake is one of the easiest and cheapest ways to improve your health. Most of the respondents were the moderate utilization of leafy vegetables and 25 per cent were low consuming. The grains and grain products are regularly consumed by a significant number of children. From the data, we can conclude that the respondents ate a lot of chapattis and rice. Gupta et al., (2013) highlighted the importance of entrepreneurial skills of dairy and poultry farmers for enhanced capabilities for socio economic upliftment. Formation of tribal dairy farm women committee in the form of cooperatives, strengthening the livestock extension service by recruiting sufficient number of women dairy extension personnel and liberal arrangement of credit facilities have been advocated as the damage control measures was advocated by Singh et al., (2017). The concept of food security was born out of recognition of the need to include nutrition in food security. In contrast to food, which is most often defined as the substances communities eat and drink to sustain existence and development, diet adds aspects of wellbeing services, healthy environments, and nurturing practices.

Weingärtner (2010) describe food and nutrition as the state in which sufficient food (amount, quality, well being, sociocultural suitability) has been always accessible, accessible and well utilized by all. One-size-fits-all strategies can therefore suffer from the

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failure of both exclusion and inclusion goals, as has been observed in the past with several government programs to address food and nutrition insecurity in public distribution systems (Khera, 2008). Due to its diversity and scale, this requires accurately measuring the amount and type of food households consume over time and comparing it nutritional needs. Therefore, in order to understand and consider food and nutrition scenarios in dairy farms in Bundelkhand, the present study was the primary focus on to assess food and nutrition status.

METHODOLOGY

The study was conducted from 2018-19 to 2020-21 in Bundelkhand, which includes Uttar Pradesh (7 districts) and Madhya Pradesh (6 districts). Two districts were selected from each state: Lalitpur and Banda from Uttar Pradesh, and Datia and Damoh from Madhya Pradesh. Then, from each district randomly selected two blocks. Two villages were arbitrarily selected from every block. From each selected village, a list of dairy farmers was generated based on land ownership, and respondents were selected based on a proportional stratified random sampling procedure. From each village, 20 dairy farmers were selected proportionately from a list provided. Therefore, a total of 320 dairy farmers was selected for the study. Based on an extensive literature review and consultation with experts, an index was developed to measure food and nutrition security in dairy households. The food and nutrition aspect consists of 9 indicators/parameters. The indices were processed according to 14 informal criteria suggested by Edwards (1957). Selected indicators underwent jury evaluation on the three-point continuum. Relevance weights and mean relevance weights were calculated separately for selected indicators. Respondent's livelihood status is calculated based on the sum of all indicators. Households were classified as low, medium, and high using the cumulative square root frequency technique. Data were collected through personal interviews using a structured interview schedule. In addition, we used correlation tests to calculate r-values to know the association between food and nutrition security and independent variables. Multiple regressions were performed to determine the size of the contributions of selected independent variables to food and nutrition security.

RESULTS AND DISCUSSION

Food and nutrition security of the dairy farmers

A perusal of the Table 1 showed that among the marginal farmers the majority (70.37%) of the households had low food security. The above results explain that the food security of the marginal household was very poor. Similar results can be seen among small farmers where, the majority of the households had a low food security, i.e. 58.11 per cent. Among semi-medium farmers majority (>75%) of the respondents had low to medium food security. Medium and large farmers follow a similar trend where most of the respondents had medium to high level of food security. The higher the household income, the more likely the household will be able to secure food. This is anticipated, as superior incomes mean improved admittance to food, which is too supported by (Arene & Anyaeji, 2010).

The study focused on some critical issues of food security like food availability in terms of production of foods like wheat, rice, vegetables and milk. It was understood that a farmer cultivating food grain crops along with rearing livestock has very less dependency on the market for their food consumption. The majority of the farmers in Bundelkhand region had marginal, small and semi-medium land holding producing small quantity and farmers focused on staple food production rather than other cash crops. Table 1 revealed that among the marginal farmers the majority (56.79%) of the households had low nutrition security. Farmer entrance to staple foods is largely supported by production, domestic produce, purchases, transfers from community programs, or other households (Baiphethi & Jacobs, 2009). Rice and corn are staple foods for farmers, making them more readily available than other products (Carolina & Hidajat, 2016).

The above results revealed that the nutrition security of the marginal farmers was very poor. Table 1 revealed that among the marginal farmers the majority (56.79%) of the respondents had low nutrition security. The above results showed that marginal farmers have very poor food security. Adequate food production should be promoted in the study area as a necessary step towards regional food security. Habits of consuming nutritious and healthy foods should be fostered among farmers in the locality. The incorporation of agriculture and farm animals increases the availability and accessibility of food, and reduces dependence on markets.

Current research, especially conducted to focus on food security issues, such as ensuring that all household members are always getting adequate nutrition, including protein, energy, vitamins and minerals (IFPRI, 2016). Food security means that all communities has admitted to adequate quantity and quality of food at every time in terms of diversity, multiplicity, nutritional substance and safety, and that together with a hygienic environment means to be healthy. It exists when the necessary nutrition and food preferences for a vigorous living are met (FAO, 2012). Food security exists as soon as food security is pooled with hygienic conditions, satisfactory medical care, and good concern and nutrition

Table 1. Distribution of respondents according to food and nutrition security

Farm household	Category	Food security No. (%)	Nutrition security No. (%)
Marginal (n= 81)	Low	57 (70.37)	46 (56.79)
	Medium	22 (27.16)	28 (34.56)
	High	2 (2.47)	7 (8.65)
Small (n= 74)	Low	43 (58.11)	38 (51.35)
	Medium	28 (37.84)	31 (41.89)
	High	3 (4.05)	5 (6.76)
Semi-medium (n=78)	Low	18 (23.07)	27 (34.62)
	Medium	41 (52.57)	43 (55.12)
	High	19 (24.36)	8 (10.26)
Medium (n=57)	Low	11 (19.29)	17 (29.82)
	Medium	17 (29.83)	23 (40.35)
	High	29 (50.88)	17 (29.83)
Large (n=30)	Low	4 (13.34)	8 (26.67)
	Medium	12 (40.00)	16 (53.33)
	High	14 (46.66)	6 (20.00)

practices that, make sure a vigorous living for each and every one (World Bank, 2015). Agricultural production in emergent countries has to increase to get together the food needs of the increasing inhabitants (Branca et al., 2013)

Correlation among farm households

A perusal of Table 2 shows the relationship between the independent variables viz., age, education, experience in dairying, social participation, occupation, land holding, livestock holding, annual income, milk production, milk sale, mass media exposure and extension contact with food security were analyzing with a coefficient of correlation (r). It was clear from the table that land holding, livestock holding, annual income and milk production had positive and highly significant relationship with food security. It indicates that by increasing the standards of the above factors, the value of food security of the respondent's augment. Other factors, such as milk sale had negative and highly significant association with food security. Family food security increases as farm dimension increases.

Abu & Soom (2016) also noted in a study conducted in Benue state that as farm size increases, farmers are likely to increase their awareness in farming and continue to advance their actions and production. The relationship between the independent variables viz., age, education, experience in dairying, social participation, occupation, land holding, livestock holding, annual income, milk production, milk sale and informational factors with nutrition security were analyze with coefficient of correlation (r) and results were represented in Table 2. It was clear from the table that livestock holding, annual income and milk production and milk sale had positive and highly significant relationship with nutrition security. It indicates that by escalating the values of the above factors, the value of nutrition security of the respondent's amplifies.

Factors like education, occupation, land holding, mass media exposure and extension contact had encouraging and significant relationship with nutrition security. However, variables such as age, experience in dairying, social participation was not found to be correlated with the nutrition security of the respondents. Food utilization describes as the intake and digestion of sufficient and high quality food to maintain health, proper use of food, adequate energy and nutrient needs, storage, processing, basic nutrition, parenting and illness (Kuwornu et al., 2013).

Table 2. Pearson Correlation among households

Variables	Correlation coefficient (r)	
	Food security	Nutrition security
Age	0.267^{NS}	0.153^{NS}
Education	0.351*	0.327*
Experience in dairying	0.089^{NS}	0.139^{NS}
Social participation	0.117^{NS}	0.087^{NS}
Occupation	0.103^{NS}	0.294*
Land holding	0.528**	0.251*
Livestock holding	0.461**	0.532**
Annual income	0.482**	0.407**
Milk production	0.653**	0.536**
Milk sale	-0.597**	0.475**
Mass media exposure	0.286*	0.296*
Extension contact	0.328*	0.317*

**Significant at the 0.01 level; *Significant at the 0.05 level
NS: Non significant

Influence of socio-economic factors on food and nutrition security

Table 3 shows the results of a regression analysis performed to split the predictive power and degree of variability in food security explained by the independent variables. Beta coefficients and their corresponding values indicate different contributions to the dependent variable within the study. Regression analysis of the data was performed to confirm the R^2 value, and it was found that the independent variables included in the study were cumulative, accounting for 52.80 per cent of the variability towards Food security. The fitted regression model was observed to be significant.

Further, the variables land holding, livestock holding, annual income, milk production, mass media exposure and extension contact were found to be highly significant ($p<0.01$) while, education and milk sale were found to be significant ($p<0.05$). Table 3 shows that when the data were subjected to regression analysis to confirm the R^2 value, it was found that the socio-economic variables

Table 3. Influence of socio-economic factors on food and nutrition security

Variables	Food security		Nutrition security	
	Regression coefficients (b) value	"t" value	Regression coefficients (b) value	"t" value
Age	-0.243	1.637^{NS}	0.215	1.529^{NS}
Education	0.053	2.136*	0.137	2.217*
Experience in dairying	0.097	0.452^{NS}	0.086	0.328^{NS}
Social participation	-0.024	0.054^{NS}	0.153	0.064^{NS}
Occupation	0.154	0.154^{NS}	-0.132	0.172^{NS}
Land holding	0.215	3.248**	0.179	2.013*
Livestock holding	0.036	4.126**	0.042	4.147**
Annual income	0.087	6.215**	0.093	5.831**
Milk production	0.186	2.981**	0.178	2.736**
Milk sale	0.265	1.984*	0.217	1.857*
Mass media exposure	0.452	5.412**	0.381	2.938*
Extension contact	0.258	3.216**	0.301	2.045*
	R^2= 0.528; F stat= 23.247**		R^2= 0.638; F stat= 17.372**	

** Significant at the 0.01 level; * Significant at the 0.05 level; NS: Non significant

incorporated in the study were cumulatively responsible and explained 63.80 per cent of the variability to nutrition security. The fitted regression model was observed to be significant. However, livestock holding may be a source of income. If held by households for historical and cultural reasons, this can too affect the association between livestock and family nutrition security.

CONCLUSION

From this result, we can conclude that most of the medium-sized farmers have low to moderate food security. Food security on marginal farms was very poor, and on medium-sized farms, the majority of respondents had low to moderate food security. Land holding, livestock holding, annual income, and milk production had positive and highly significant associations with food security. We find that increasing the scores of the above factors increases the value of food security for respondents. Improved wellbeing and nutrition, increased earnings and employment in households and improved societal life in the community. Adequate employment and earnings has a constructive impact on family food security. Households should be encouraged to be productive, especially when new training technique and skill provided to the farmers.

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Research Article

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Farmers' Perception Regarding Custom Hiring Services in Jabalpur District of Madhya Pradesh

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ABSTRACT

Indian agriculture has witnessed a labour crisis and a dearth of farm mechanization resulting in inadequate production and productivity in various parts of the country. The study was undertaken in Jabalpur district of Madhya Pradesh in 2020, to analyse farmers' perception of Custom Hiring Services (CHS). Patan block was selected purposively by involving 80 respondents spread over ten villages using proportionate random sampling technique. Farmers actively engaged in agricultural operations and availing the services of the Custom Hiring Centres (CHCs) were selected purposively. The majority (75%) of the farmers had moderate perception towards CHS. The independent variables such as age, annual income, cropping pattern, information processing behavior, information sharing behavior and extent of utilization of CHS were found to be significant and positively related with the perception of farmers regarding CHS. Proper measures must be taken for the provision of enhancing mainly small and marginal farmers' understanding of mechanization as well as ensuring quality and timely services by the CHCs in order to realize its sustainable adoption.

INTRODUCTION

Agriculture is majorly dependent on the availability of land, labour and capital in which agriculture labour may be considered as one of the most important input in farm operations. One of the biggest issues that Indian farmers in rural areas experience is a lack of agricultural labour (Kadaraiah et al., 2022). The rise in the labour cost has created new challenges for the farmers in gaining decent returns from their produce. The maintenance cost of draft animal has also been increasing which has resulted into shifting of dependence of human from animals towards mechanical power in agriculture sector (Sukhpal & Kingra, 2013). Agriculture mechanization has a significant role in improving agriculture output by minimizing input cost, drudgery reduction and realizing growth in agricultural productivity with timely completion of farm operations. Systematically, mechanization is mostly observed in farmers possessing large operational holdings while it is still beyond the reach of many small and marginal farmers across the country. Poor availability of farm machinery especially among marginal and small farmers has been considered as one of the major hindrance to agricultural outputs (Anonymous, 2015a & b). Prior to the implementation of the scheme, SMAM (Sub Mission on Agricultural Mechanization), the average Farm Power Availability (FPA) in India was found to be 1.84 kW/ha. To achieve the required intensity of productivity and cropping average, farm power of 2.5 kW/ha by 2022 and 4.00 kW/ha by 2030 is considered crucial (Final Report on M&E SMAM, 2018).

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However, a bulk of the farmers in the country cannot afford expensive machinery for their farm operations, they may look for custom hiring of machines through cooperatives or other agencies (Kamboj et al., 2012; Kisku & Bisht, 2022). Custom hiring services (CHS) is a well-known method of acquiring short-term control of farm machinery among the farmers not owning them. Additionally, farmers have less responsibility for maintenance and working of machines, they are relieved from long-term capital investment, this eases farm planning and budgeting and therefore provides with further spare time to accomplish other activities. Over the past decades, Madhya Pradesh has emerged as the state with the highest agricultural growth rate, with agricultural GDP growing at 7.5 per cent per annum from 2005–06 to 2018–19 (MoSPI, 2019). The state originally launched the scheme in 2012–2013 under the Rashtriya Krishi Vikas Yojna (RKVY), to encourage young entrepreneurs in establishing CHCs. And more than 1000 CHCs have been established with its popularity increasing since then.

Farmers' perception is a major factor in the adoption and influences their decision to use new agricultural technologies. Although previous research has belaboured impact in terms of economic viability, implications of CHCs and observable farmers' characteristics influencing their adoption, scanty research has been conducted to identify how farmers perceive particular technologies/ services in terms of the benefits they provide. Therefore analysing their perception is a subject of research interest for sustainable adoption of any intervention.

METHODOLOGY

The study was carried out in the Jabalpur district of Madhya Pradesh. Patan block was selected purposively with the highest number of custom hiring centres out of the seven blocks. Ten villages were selected randomly out of the twenty villages where the custom hiring centres were available. Proportionate random sampling technique was followed and only 8 per cent of the households were taken from each village and further from each household one member who was actively engaged in agricultural operations was selected as respondent. Thus, a sample size of 80 farmers was selected for the purpose of the study who were availing the services of custom hiring centres. Primary data was collected using a well-structured and pre-tested interview schedule that included both open-ended and close-ended questions. For the research study, Ex-post facto research design was confined. The data were analysed by following several parametric and non-parametric tools like frequency, percentage, mean, standard deviation, mean scale value, correlation co-efficient. In the present study, thirteen independent variables viz. age, education, occupation, family size, land holding, annual income, farm power/implements, farming experience, social participation, communication behaviour, economic motivation, and extent of utilization of CHS whereas perception of farmers regarding custom hiring services as dependent variable were taken.

To measure the perception of farmers regarding custom hiring services an index was developed. Perception statements were constructed with the help of available literature reviews and by consulting the experts/scientists from the relevant fields. The index consisted of 26 final statements which were selected after conducting a relevancy test for the statements by administrating it to the experts from agriculture extension, agriculture engineering and other concerned departments. The final perception index was used in the interview schedule to identify the perception of farmers regarding CHS. The respondents were asked to rate each of the statements on a three point continuum i.e., 'agree', 'undecided' and 'disagree' and the numerical values of 3, 2 and 1 was assigned to the positive statements whereas 1, 2 and 3 was assigned to the negative statement. Further by analysing the scores, the respondents were divided into three categories viz. farmers with poor perception, moderate perception and good perception regarding CHS on the basis of calculated mean and standard deviation. Mean scale value (MSV) score was calculated for all the statements and ranking of statements was done on its basis. MSV is the total sum of the intended scores obtained by multiplying the frequency with the category's given scores and dividing the results by the total number of respondents. It has been used to convert each preference's frequency into a comparative level. The following formula was used to determine the mean scale value:

$$\text{Mean scale value} = \frac{P_1 \times 3 + P_2 \times 2 + P_3 \times 1}{N}$$

Where, P1= Frequency of respondents indicating first preference, P2= Frequency of respondents indicating second preference, P3= Frequency of respondents indicating third preference, N= Total number of respondents

A statistical tool of Karl Pearson's simple correlation coefficient (r) was followed to estimate the nature of relationship between the selected variables leading to a comprehensive understanding of the farmer's perception regarding CHS.

RESULTS AND DISCUSSION

Perception of the farmers regarding custom hiring services was assessed and the data on Table 1 represents the overall perception of farmers regarding CHS. It is observed that maximum numbers of respondents (75.00%) were having moderate perception regarding CHS followed by good perception (13.25%), whereas 11.25 per cent respondents had poor perception about CHS. The finding is supported with the work of Anonymous (2012); Singh et al., (2014); Gudadur & Jahanara (2017); Shobha et al., (2018) & Kadaraiah et al., (2022). The reason for this might be due to the fact that the farm mechanization is slowly increasing in the region of the study area and farmers still had not much understanding of the improved agricultural implements used in the cultivation of various crops. However, they were eager to learn about the technology of farm mechanization and ways to opt for their implementation.

A perusal of Table 2 reveals that the perception statement "farmers need not buy costly machines as the machines provided

Table 1. Distribution of respondents according to their overall perception regarding CHS

Category	Percentage
Poor perception (Up to 55 score)	11.25
Moderate perception (56 to 64 score)	75.00
Good perception (Above 64 score)	13.75

Table 2. Perception of farmers regarding Custom Hiring Services

S. No.	Perception Statement	MSV Score	Rank
1.	We do not need to buy costly machines as the machines provided by the custom hiring centres are cost-saving and time-saving.	3.00	I
2.	Custom hiring services has reduced the drudgery and workload.	3.00	II
3.	Custom hiring has facilitated crop residue recycling and prevents burning of residues.	2.80	III
4.	Custom hiring has enabled on-time completion of activities especially sowing and intercultural operations which are important for healthy crop stand and sustained agricultural yield.	2.80	IV
5.	During the peak season the machine hirers increases the cost with the increased demand due to which the rate of hiring the machineries increases.	2.76	V
6.	Farmers make inappropriate selection of machineries in the absence of proper guidance, resulting in loss in monetary terms.	2.70	VI
7.	The quality of the custom hiring services are not up to the mark.	2.68	VII
8.	We generally face problems while availing services from the custom hiring centres.	2.66	VIII
9.	Custom hiring services of farm machineries has enable us to get the benefits of mechanization & are helpful to us to increase the production, productivity and income.	2.6	IX
10.	We are able to make decisions regarding farm operations that can be mechanized in order to achieve better profits and to carry out operations efficiently.	2.49	X
11.	Custom hiring has helped in adoption of new technology and easy access to high value and technical agricultural equipment at our doorsteps.	2.43	XI
12.	Custom hiring has enabled the use of efficient machines which has improved the utilization efficiency of inputs like fertilizers and agrochemicals which has reduced the negative impact on the environment.	2.43	XII
13.	Custom hiring has been a special support to small farmers in their scientific farming.	2.43	XIII
14.	Use of machineries instead of traditional method of farming has improved the safety condition for farmers.	2.35	XIV
15.	Custom hiring centres has provided work opportunities to skilled labour and artisans.	2.34	XV
16.	Custom hiring has reduced the burden of owning and operating the machines, eliminating long-term capital commitments, eased farm budget planning and given us more time to focus on other activities.	2.18	XVI
17.	The cost of custom hiring services are high and the procedure in getting the services is quite complicated.	2.14	XVII
18.	Custom hiring has significantly facilitated diversification in agriculture specifically from wheat and paddy to other crops and has also increased the cropping intensity.	2.08	XVIII
19.	Before Custom hiring, mechanization was enjoyed by only large and medium farmers but now it has also benefitted small land holding farmers.	2.04	XIX
20.	Custom hiring has helped the farmers in adopting climate resilient practices.	1.99	XX
21.	Small and marginal farmers face economic burden as they take loans from other sources to hire machineries at the time of need.	1.98	XXI
22.	We are not fully aware about the services provided by the custom hiring centres.	1.73	XXII
23.	There was a delay in carrying out the operations due to insufficient number of machines available.	1.70	XXIII
24.	Hiring of machineries are not much of use for the marginal and small land holding farmers.	1.68	XXIV
25.	Custom hiring could be a way out to achieve doubling farmer's income through practicing hi-tech agriculture.	1.61	XXV
26.	The heavy machineries working on the land has degraded the quality of soil over the time.	1.55	XXVI

(MSV= Mean Scale Value)

by the custom hiring centres were cost-saving and time-saving" was ranked first according to the mean scale value calculated on the basis of the level of perception on each statement by the respondents whereas "Custom hiring services has reduced their drudgery and workload" and "Custom hiring has facilitated crop residue recycling and prevents burning of residues" were ranked second and third respectively. Furthermore, the statements "Custom hiring could be a way out to achieve doubling farmer's income through practicing hi-tech agriculture" and "The heavy machineries working on the land has degraded the quality of soil over the time" were ranked as twenty-fifth and twenty-sixth respectively. CHS has provided several benefits to the farmers over their traditional non-mechanized method of farming especially to the small and marginal farmers. Ownership of farm machineries is not possible for all farmers and CHS are a way of reaching those farmers at affordable costs.

Karl Pearson's Correlation coefficient (r) was calculated to find out the relationship about perception of farmers regarding CHS with the socio-personal, economic, communication and psychological profile of farmers by considering perception of farmers. The results depicted in the table 3 revealed that the value of the correlation coefficient of the independent variables namely age (r=0.285*), annual income (r=0.234*), cropping pattern (r=0.243*), information sharing behaviour (r=0.245*) and extent of utilization of CHS (r=0.295*) were positive and significantly related with perception of farmers regarding CHS at 0.01 per cent. Similar finding were reported by Kalagi (2018); Naik (2019) & Mishra et al., (2020); Singh et al., (2020). It reflects that age, cropping pattern, information sharing behaviour and extent of utilization of CHS were the important factors for increasing the level of perception of the farmers regarding CHS. It may be due to reason that with the understanding, knowledge and decision taking ability of an individual is enhanced. Farmers growing diverse crops in different seasons realize the importance of the requirement of machineries for timely farm operations. Sharing of information among others could be a responsible factor improving their own

Table 3. Relationship of profile characteristics with perception of farmers regarding CHS

S.No.	Independent Variables	Correlation coefficient value 'r'
1.	Age	0.285*
2.	Education	-0.231^{NS}
3.	Occupation	-0.169^{NS}
4.	Family Size	0.014^{NS}
5.	Land Holding	0.031^{NS}
6.	Annual Income	0.243*
7.	Cropping Pattern	0.243*
8.	Farm Power/ Implements	0.077^{NS}
9.	Farming Experience	0.027^{NS}
10.	Social Participation	0.218^{NS}
11.	Communication Behaviour	
	a) Extension agency contact	0.056^{NS}
	b) Information seeking behaviour	0.208^{NS}
	c) Information processing behaviour	0.345**
	d) Information sharing behaviour	0.245*
12.	Economic Motivation	0.093^{NS}
13.	Extent of utilization of CHS	0.295*

(* Significant at the 0.05 level of probability, ** Significant at the 0.01 level of probability, NS- non-significant)

perception towards things. Those farmers who are regular in utilizing the services of CHCs are likely to have moderate or good perception towards it. Similarly, information processing behaviour (r=0.345**) was positive and significantly related with the perception of farmers regarding CHS at 0.01 per cent levels of significance. Retaining the information about any phenomena helps in acquiring understanding and a clear idea about it. Farmers having a medium to high information processing behaviour are likely to have moderate to good perception regarding the CHS. Whereas, the variables education, occupation, family size, land holding, farm power/ implements, farming experience, social participation, extension agency contact, information seeking behaviour and economic motivation did not reveal any significant relationship with perception regarding CHS.

CONCLUSION

This research revealed that more than half of the respondents had a moderate perception regarding the services rendered by the CHCs. Farm mechanization is increasing, but still, many farmers are unfamiliar with the improved agricultural implements. However, they are always eager to know and opt for their implementation. CHCs provide a good opportunity for improvement in farming conditions but due to insufficient knowledge of farm implements and improved technology, many farmers experience inadequate utilization of CHS. Efforts must be made to create ability among the farmers through guidance and training for gaining acquaintance with the implements and services. The Government should pay keen interest in regulating proper hiring prices for different farm machinery in varied regions of the country to ensure its affordability for all farmers. Proper measures must be taken for quality and timely services by the CHCs to realize its sustainable adoption.

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Multivariate Typology of Osmanabadi Goat Farming in its Home Tract: A Cluster Analysis

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ABSTRACT

The study was conducted to identify the typology of the Osmanabadi goat-keeping households and farms in a home tract of the breed during 2020-21. Hierarchical and K-mean clustering techniques were used to classify 107 households into three homogenous clusters. In extensively large flock keeping households with large landholdings (C1, n=25, 23%), the respondents were using scientific practices to a great extent than the households with extensively keeping small flock with small landholdings (C3, n=59, 55%). Goat rearing was being the sole farm activity of relatively more households in C3, where primarily women had control over farm decisions and returns than the households who semi-intensively kept medium flock with medium landholding (C2, n=23, 22%). Households in C3 were mostly using open sheds, had lower goat income than the rest of the clusters. Households in C2 were higher in employment generation than households in C3. The typologies of Osmanabadi goat-keeping households showed significant heterogeneity in clusters and critical points which need to be considered to find sustainable solutions. Government policies and extension approaches are likely to be more effective if they consider the heterogeneity in the planning and delivery of extension interventions.

INTRODUCTION

In India, goats are the second largest (27.74%) species in the livestock category and showed an increase of 10.1 per cent over the previous (19th) livestock census. The goat sector shares 14 and three percent of total meat and milk production. Out of 148.88 million goats in the country, the pure and graded Osmanabadi goat breed constitutes a share of 2.4 per cent (GOI, 2019). Maharashtra's goat population is 10.60 million, 7.11 per cent of the country, and ranks sixth (Das, 2022). Maharashtra had the highest (15.2 lacs) of pure Osmanabadi goats (GOI, 2019). Osmanabad and Latur districts are the breeding tract of Osmanabadi goats (Acharya, 1982; Das, 2022). This goat breed is hardy, dual-purpose, adaptable under adverse climatic conditions, and generally reared for meat purposes (Raskar et al., 2018) and reared under extensive (open grazing), semi-intensive (grazing and closed enclosure) and intensive systems (Wakchaure et al., 2021).

The productivity of goats under the traditional extensive system is low (Singh & Kumar, 2007), mainly because of feed scarcity and the lack of adoption of improved technologies and management practices. Livestock technology use may vary among farm households because of differences in socioeconomic characteristics (Somda et al., 2005; Milan et al., 2006). Smallholder farming systems are highly complex and heterogeneous in their characteristics (Pal et al., 2017; Kumar et al., 2019; Panda et al., 2022). The productivity and profitability of the existing goat rearing system need to be improved substantially by harnessing the potential of goat rearing activity. Goats are increasingly the

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subject of special attention in livestock research and the government's various schemes to generate rural livelihood.

In such circumstances, developing unique recommendations, technologies, educational programs and policy interventions for each household is complex. A more objective classification of livestock enterprises is needed to reveal the main factors that dictate the level of intensity in their production system (Gelasakis et al., 2012). Multivariate analysis may be a valuable tool in planning extension activities and using communication channels effectively for the target farmers with varied needs, constraints, and motivations for change (García et al., 2015). More in-depth characterization of goat-keeping households would help to improve regional goat farming. It would also help in technology transfer programs depending on differences between their socioeconomic and farm-specific characteristics. It is necessary to define Osmanabadi goat-keeping households into specific clusters based upon similarities in farm and households' characteristics for comparative evaluation, which would help develop suitable recommendations and effective interventions. In this context, the current study was conducted to identify the typology of the Osmanabadi goat-keeping households and farms in a home tract of the breed.

METHODOLOGY

A descriptive and cross-sectional study purposively was conducted in the home tract of Osmanabadi goat, i.e., Osmanabad and Latur districts of Maharashtra state. One hundred twenty households keeping at least two adult Osmanabadi goats were selected randomly from 20 villages equally distributed across every two talukas in both districts. The respondents were persons belonging to the Osmanabadi goat-keeping household who had control over farm decisions and goat returns. A field survey was conducted in 2020-21 using a pre-tested interview schedule. Through personal contact, the investigator asked each respondent about personal, family, and farm-specific characteristics and recorded the responses on the interview schedule. Collected data was edited, coded and tabulated. Quantitative variables were classified using the cumulative square root frequency rule (Dalenius & Hodges, 1957). Outliers were removed using boxplots and finally the retained 107 respondents were the sample size considered for further analysis.

Normalized (z score) farm-specific variables, *i.e.*, landholding, flock size, and goat rearing system were used to construct clusters. A typology was constructed applying multivariate statistical techniques, i.e., hierarchical and K-mean cluster analysis (CA), to classify groups of Osmanabadi goat-keeping households with similar farm characteristics into homogenous clusters. The hierarchical cluster analysis based on Ward's method was applied to decide the ideal number of clusters. Euclidean distance as a clustering measure was employed in this analysis. After that, Osmanabadi goat-keeping households were partitioned into three predefined clusters using K-mean clustering. Finally, a one-way ANOVA and post-hoc Tukey HSD tests were applied to examine the existence of statistically significant differences between these clusters. The three clusters were named as C1, C2 and C3 with 25, 23 and 59 respondents respectively. The flock size for C1, C2 and C3 were extensively large with large landholdings, semi-intensively medium goat flock with medium landholdings and extensively small goat flock with small landholdings respectively.

RESULTS AND DISCUSSION

The maximum proportion of extensive Osmanabadi goat-keeping households had high agricultural landholding (3 to 6 acres) in C1, moderate (1.5 – 3 acres) in C2, and low (<1.5 acres) in C3 (Table 1). The average landholding of households in C1 was significantly higher and significantly lower in C3 than in the rest of the clusters.

The majority of goat keeping households in C1 owned large to medium flock, small to medium flock by the plurality in C3 and were rearing goats exclusively under an extensive system. A greater extent of semi-intensive goat-keeping households in C2 also possessed large to medium flock. Under an extensive goat rearing system, high landholding households had a significantly higher average flock (8.16 SGU) than those extensively rearing small flock with lower landholding, except for semi-intensive goat keeping households in C2.

Most semi-intensive goat-keeping households had moderate landholdings and medium size (4.6-8.5 SGU) flock. In contrast,

Table 1. Farm specific variables considered for cluster formation

Variables	Class interval	C1	C2	C3	Pooled	SD	F	*p*
Land holding (acre)	Low (Below 1.5)	0.0	17.4	59.3	36.4			
	Moderate (1.5 to 3)	16.0	52.2	33.9	33.6			
	High (3 to 6)	84.0	30.4	6.8	29.9			
	Mean	3.52[a]	2.30[b]	0.97[c]	1.85	1.52	50.139**	0.000
Goat flock size (SGU)	Small (2 to 4.60)	12.0	4.3	33.9	22.4			
	Medium (4.60 to 8.50)	48.0	60.9	50.8	52.3			
	Large (8.50 to 15.00)	40.0	34.8	15.3	25.2			
	Mean	8.16[a]	7.65[a]	5.69[b]	6.69	2.71	10.789**	0.000
Goat rearing system	Extensive (1)[#]	100.0	0.0	100.0	78.5			
	Semi-intensive (2)[#]	0.0	100.0	0.0	21.5			
	Mean	1.00	2.00	1.00	1.21	0.41	2.7E+16**	0.000

Values in the same row with different superscript are significantly different

**Indicate significant difference at 1 % level (p<0.01)

SGU – Standard Goat Unit (Adult=1 SGU, Kid age 3 - 6 months= ½ SGU, & Kid age < 3 months=¼ SGU)

[#]Code used for qualitative traits

about one-third of the extensive goat-keeping households with small landholdings had a small flock. In Rajasthan, Kumar et al. (2009) found that goat rearing was an important economic activity across all landholding categories.

Farm specific characteristics

In extensive goat-keeping households both in C1 and C3, mostly women took farm decisions and had control over farm returns (Table 2). Kumar et al., (2011) found less role of women in farm decisions and less control over returns in a large category than small category households in Rajasthan and Uttar Pradesh. Control over farm decisions and returns in Osmanabadi goat-keeping households varied significantly across all clusters. A post-hoc test revealed that men were significantly more dominant in semi-intensive goat-keeping households (C2) related to their control over farm decisions and farm returns than in households in C3. The significant mean difference between C2 and C3 indicates that the control over farm decisions and farm returns was primarily a domain of women in extensively small flock keeping households (C3) than the households in C2.

Goat rearing was the sole farm activity of around 20 percent of the households in C3. Most households across all clusters were doing goat husbandry as a farm activity well integrated with crop cultivation. Production systems adopted by households across all

Table 2. Frequency and mean distribution of farm specific characteristics of Osmanabadi goat keeping households

Characteristic	Class interval	C1	C2	C3	Pooled	SD	F	*p*
Control over farm decision & goat return	Men (1)#	36.0	56.5	23.7	33.6			
	Women (2)#	44.0	39.1	69.5	57.0			
	Both (3)#	20.0	4.3	6.8	9.3			
	Mean	1.84^{ab}	1.48^{a}	1.83^{b}	1.76	0.61	3.167*	0.046
Production system	Goat rearing only (8)#	0.0	0.0	20.3	11.2			
	Goat + Crop (7)#	36.0	43.5	35.6	37.4			
	Goat + Cattle /Buffalo (6)#	0.0	0.0	6.8	3.7			
	Goat + Sheep (5)#	4.0	0.0	1.7	1.9			
	Goat + Poultry birds (4)#	0.0	13.0	20.3	14.0			
	Goat + Crop + Cattle/Buffalo (3)#	16.0	30.4	1.7	11.2			
	Goat + Crop + Cattle/Buffalo+Poultry (2)#	16.0	8.7	3.4	7.5			
	Goat + Crop + Poultry (1)#	28.0	4.3	10.2	13.1			
	Mean	3.80^{a}	4.70^{ab}	5.64^{b}	5.01	2.44	5.727**	0.004
Shed type	No separate shed (within house) (1)#	4.0	0.0	16.9	10.3			
	Covered shed (inside house) (2)#	0.0	0.0	5.1	2.8			
	Open shed (inside house) (3)#	0.0	0.0	6.8	3.7			
	Open shed (attached to house) (4)#	32.0	17.4	57.6	43.0			
	Thatched shed (attached to house) (5)#	64.0	82.6	13.6	40.2			
	Mean	4.52^{a}	4.83^{a}	3.46^{b}	4.00	1.22	17.516**	0.000
Labour utilization	Family (1)#	96.0	21.7	93.2	78.5			
	Hired (2)#	4.0	78.3	6.8	21.5			
	Mean	1.04^{a}	1.78^{b}	1.07^{a}	1.21	0.41	57.153**	0.000
Employment generation (man-days/annum)	Low (55.85 to 80)	40.0	13.0	52.5	41.1			
	Medium (80 to 95)	32.0	39.1	18.6	26.2			
	High (95 to 149.27)	28.0	47.8	28.8	32.7			
	Mean	87.16^{ab}	99.07^{a}	82.40^{b}	87.10	18.74	7.335**	0.001
Adoption of scientific practices (score)	Low (31.67 to 46)	16.0	21.7	33.9	27.1			
	Medium (46 to 52)	44.0	47.8	35.6	40.2			
	High (52 to 70)	40.0	30.4	30.5	32.7			
	Mean	52.07^{a}	52.17^{ab}	47.68^{b}	49.67	7.94	4.395*	0.015
Goat marketing channel	Local butcher only (1)#	60.0	43.5	33.9	42.1			
	Local butcher + Traders (2)#	16.0	34.8	20.3	22.4			
	Fellow farmers + local butchers (3)#	12.0	4.3	22.0	15.9			
	Traders only (4)#	12.0	17.4	23.7	19.6			
	Mean	1.76	1.96	2.36	2.13	1.17	2.704	0.072
Goat selling purpose	Expected expenses (1)#	44.0	34.8	47.5	43.9			
	Unexpected expenses (2)#	56.0	65.2	52.5	56.1			
	Mean	1.56	1.65	1.53	1.56	0.50	0.530	0.590
Gross goat income (Rs./annum)	Poor (Rs. 14000 to 26000)	4.0	8.7	32.2	20.6			
	Medium (Rs. 26000 to 44000)	60.0	43.5	50.8	51.4			
	High (Rs. 44000 to 78000)	36.0	47.8	16.9	28.0			
	Mean	40920^{a}	43522^{a}	31720^{b}	36407	13929	8.775**	0.000
Goat share to family income (%)	Low (5.95 to 15)	28.0	30.4	23.7	26.2			
	Medium (15 to 25)	52.0	52.2	50.8	51.4			
	High (25 to 53.44)	20.0	17.4	25.4	22.4			
	Mean	18.71	20.97	21.97	20.99	9.47	1.039	0.357

Values in the same row with different superscript are significantly different (p<0.05); * and ** Significance at 5 % and 1% levels, respectively.
#Code used for qualitative traits

clusters showed a significant difference that implied relatively less proportionate diversification of farm activities among households with small flock under the extensive system in C3. The mean difference between C1 and C3 was significantly high, implying more dependency of households in C3 for household income over goat husbandry. Across all clusters, the usage of shed type was significantly different. The maximum proportion of goat-keeping households in C1 and C2 used a thatched type of shed attached to their dwelling. Around 17 percent of households in C3 had no separate shed and maximum kept goats in an open shed attached to their house. Agossou et al., (2017) in West Africa also observed poor housing for goats in an extensive sedentary system. Post hoc test revealed the highly significant mean differences between C1 and C3 and between C2 and C3, indicating that extensive goat-keeping households in C1 and semi-intensive goat-keeping households in C2 had better goat sheds than households in C3. Shelters for goats were a part of farmers' residences in one-third of households (Gokhale et al., 2002).

Semi-intensive goat-keeping households (C2) were significantly higher in their use of hired labourers in goat farming than extensive goat-keeping households in C1 and C3. Pathade et al., (2022) found that the hired labours were mostly utilized by the households with small landholding, small dairy herd and large flock. Extensive goat-keeping households were primarily depended on family labours. Semi-intensive goat-keeping households had an average of 99 man-days employment generation. Average annual employment generation in semi-intensive goat-keeping households (C2) was significantly higher than the households with small flock under extensive system and small landholding (C3), except for extensive goat-keeping households with large flock and large landholding (C1). Pathade et al., (2022) found a positive correlation between landholding, flock size and technology adoption with employment generation. Most goat-keeping households across all clusters used a medium extent of scientific practices. Osmanabadi goat-keeping households were significantly different across all clusters related to their use of scientific practices. The use of scientific practices in extensive goat-keeping households with large flock and large landholding (C1) showed a significantly higher average use of scientific practices than the households who extensively reared small flock and had small landholding (C3). Bidogeza et al., (2008) & Agossou et al., (2017) noticed that the limited resources of female-headed and small farmers limit their ability to adopt animal husbandry technologies which needed monetary and technical support.

Maximum goat-keeping households across all clusters were selling goats to local butchers. The sale of goats was maximum to traders/butchers (Ssewannyana et al., 2004; Kumar et al., 2009) and middlemen (Sabapara, 2016). Mostly they sold goats to meet unexpected expenses like crop failure, health expenses etc. The finding contradicts Homann et al., (2007), who reported that the selling purpose of most goat farmers was to cover expected expenses in the Semi-Arid region of Zimbabwe. Most extensive goat-keeping households in C1 and C3 had a medium extent of annual goat income, while semi-intensive goat-keeping households (C2) had generated an average of Rs 43522 annual gross income from goat husbandry. Khode et al., (2021) noticed that net annual income of dairy owners positively and directly affected with herd size. Gelasakis et al., (2017) noticed that more profitable clusters had more variation in profit, suggesting they are riskier. Semi-intensive goat-keeping households in C2 and extensive goat-keeping households in C1 had generated significantly higher average annual gross income from goat husbandry than households in C3, those rearing small flock under an extensive system with small landholding. Raghavendra et al., (2022) reported that diversified farms with both livestock and crop sectors were reaping better income. Baral & Bardhan (2016) reported that low-income households and small herd-size owning households had negligible net income, while female-headed households were not profitable. Rodriguez et al., (2015) stated that the management aspects determined profitability, and family labour-intensive producers were the most profitable. The average goat share in the family income was about 21 per cent across all clusters. Singh et al., (2013), in the Bundelkhand region, noticed the contribution of goat rearing to household income was between 14-15 percent. About one-fourth of small flock-keeping households in C3 had a high goat share in family income which might be due to their sole dependency on goat husbandry. Baral & Bardhan (2016) also reported that the low-income households had no non-farm income source, hence their dependence on farm income.

CONCLUSION

Significant heterogeneity in Osmanabadi goat-keeping households was observed in the study area. Households extensively rearing small flock prominently had more representation of women. Semi-intensive goat-keeping households primarily deploy hired labours with higher employment generation than extensive small flock-keeping households. Extensively large flock-keeping households had better adoption of scientific practices than small flock-keeping households. Small flock-keeping households depended more on goats for livelihood but generated lower income from goats. Government policies and extension approaches are likely to be more effective if they consider the heterogeneity of Osmanabadi goat-keeping households in the planning and delivery of extension interventions. Women-dominated cluster implied a need for empowerment through proper training and enhanced institutional support.

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Chickpea Value Chain in Bundelkhand Region of India: An Empirical Insight

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ABSTRACT

The study mapped the chickpea value chains in Bundelkhand region of Uttar Pradesh (BRUP) state during 2019-21. Findings showed that chickpea production was profitable in the region for producers with B:C ratio of 2.15. The average production cost of chickpea was Rs. 23191/ha with an average net return of Rs. 26809/ha. Chickpea was primarily furthered as chickpea split grains (*dal*), flour (*besan*) and wholegrain. Four marketing channels were recorded with a series of actors involved in moving chickpea and its products from producers to consumers. The total value added collectively by different value chains actors varied from Rs 1929 to Rs. 3231/q depending upon the channels and chickpea products. Processors added maximum value (Rs 849/q to1689/q), followed by wholesaler (Rs. 475/q to Rs.745/q) across all the channels. The ME of MC was higher across all the channels and products giving higher share to producers in consumer rupee (58.7 to 69.7 percent). Chickpea value chains are long and complex in the region. Establishment of farmers' managed market platforms facilitating the aggregation of produce at village level is suggested.

INTRODUCTION

Chickpea (*Cicer arietinum*), the major pulse crop cultivated and consumed in India, is one of the cheapest and readily available protein sources and hence, it is critical for food and nutrition security of the country (FAO, 2018). Besides protein, chickpea also adds an array of important nutrients, namely, carbohydrates, dietary fibre, unsaturated fatty acids, amino acids, minerals and vitamins to daily Indian diets (Jukanti et al., 2012). The BRUP, a rain fed semi-arid region of the state, is a major chickpea producing region of the state contributing more than 69 per cent (0.43 million ha) of chickpea area and adding to about 77 percent (0.63 MT) of the total chickpea production in the state. The average chickpea productivity in the region (1.43 t/ha) is far below the potential yield (2.0 t/ha). Occurrence of fusarium wilt and pod borer infestation (Sah et al., 2021) coupled with significant crop losses during harvest and postharvest stages (Kumar et al, 2010; Nag et al., 2000) are the as major challenges to chickpea production in the region. Vishwakarma et al., (2019) reported that the extent of losses in farm operations of chickpea varied from 2.08 per cent to 10.75 per cent while storage losses accounted for 0.03 per cent to 1.17 per cent across the agro-climatic regions of India. Further, the loss during storage at processing units was highest (0.55%). Therefore, attracting profitability in the chickpea production warrants a holistic view of entire value chain.

The concept of value chain was introduced by Porter (1985) as the entire range of activities involved in bringing out products or services from initiation to different phases of production to distribution, reaching the consumers and final disposal after use. Value chain involved the related actors and action as the linking chain (Norton, 2014). Value Chain Analysis (VCA) ascertain the degree of relationships among the actors and coordination mechanism (Trienekens, 2011) with focus on the dynamics of complex linkages within a network involving suppliers, distributors, partners, and collaborators (Zott et al., 2011). VCA identifies the

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value being added to the product or service rendered at each stage of the chain (Kaplinsky & Morris, 2007). In agriculture, value chain framework helps to enhance efficiency, productivity and profitability of agriculture (Kumar & Sharma, 2016), reduces costs and losses (Kumar & Rajeev, 2016). Strengthened value chain is an effective instrument against inequality, lesser income and in appropriation of value added to the products by different actors (Oddone & Perez, 2014). VCA is thus a prerequisite for any development oriented policy decisions, in agriculture (Dubey et al., 2020). The present research was undertaken to gain a holistic view of chickpea value chain in BRUP for generating appropriate empirical evidence to support policy decision making.

METHODOLOGY

The study was conducted during 2019-21 in the Bundelkhand region of Uttar Pradesh. All the 7 districts of UP Bundelkhand region were selected for the study. Multistage stratified random sampling was used for selection of blocks (14), villages (28) and farmers (840) from the selected districts. In addition, 14 members of Agricultural Produce Marketing Committee (APMC), retailers (21), whole sellers (21), traders (56), aggregators (56), village trader (28) and chickpea processors (18) were also chosen for the study as per their availability during of survey period. Semi-structured interviews, group meetings and focussed group discussions were carried out to elicit data from the respective respondents

Value chain Mapping reflected the flow of transaction from sourcing of raw materials and inputs, to production, processing, marketing and final consumption besides illustrating the factors and available services that supported chickpea production in the region. In addition, it depicted the costs, value addition at each stage, and the secondary services along a value chain. Illustrative methodology of value chain mapping (FAO, 2005) was used for the present study. The associated activities and actors in chickpea value chains operating in the region were mapped and their interconnections were worked out. Data on variables like production cost, marketing efficiency (ME), marketing cost (MC) and price spread; cost incurred and market margin (MM) obtained in the marketing channel, producers' share in consumers' price (PSCP) etc. were collected. Prevailing chickpea market price at the time of data collection was observed as base. Marketing cost was estimated as the sum of cost incurred by value chain actors in performing various marketing related functions. Value added was assesses as the sum of cost incurred and the marketing margin drawn by value chain actors before furthering the chickpea in the value chain to the next actor. Marketing Efficiency Index (MEI) and producer's share in consumer's rupee were also estimated (Acharya & Agarwal, 2016).

Producer's share in consumer's rupees:

$$P_s = (P_f/P_c) \times 100$$

Where, P_s = Producer's share in consumer's rupee, P_f = Producer's price (Rs/q), P_c= Price paid by the consumer (Rs/q)

Marketing efficiency:

$$M_E = F_P / (M_C + M_M)$$

Where, M_E = MEI, F_P = Price received by the farmer, M_C = Total MC and M_M= Net MM

RESULTS AND DISCUSSION

Enabling factors and support services

Chickpea production in the BRUP was observed to be supported by an array of enabling facilities. This included financial support from banks and money lenders; technological support from research institutes, Krishi Vigyan Kendra and agricultural universities; input support from existing sources; extension advisory support from extension machinery of UP state; the network of APMC market provided the needed market infrastructure support for sale of chickpea (Figure 1). The favourable policy environment also supported chickpea production in the region which included declaration of minimum support price, favourable EXIM policy and presence of e-NAM. Further, the existing seed hubs at district level in the region accelerated quality chickpea seed availability among producers in the region.

The map (Figure 1) further illustrates the associated actors which included the input dealers, producers, village level aggregators, aggregators, traders, processors, wholesalers, retailers and consumers. The input dealers facilitated the seeds, plant protection chemicals, fertilizers and farm machinery available to chickpea producers. The producers were either carrying the produce to market yards for sale or sold it to village level aggregators. At yards, the aggregators usually collected the produce and furthered it to traders, operating in the same market yards. The traders with the services of commission agent sold the produce to processor, located in the region or in other part of the state or the country. After adequate processing, processor sold the produce to wholesalers involving commission agents. The wholesalers packed and transported the produce to retailers who finally sold the produce to the end consumers.

Existing channels for furthering chickpea from producers to consumers

Market demand for multiple forms of chickpea has led to emergence of more complex value chain involving many actors, activities and marketing channels (Figure 1). Chickpea were primarily consumed as dehusked split grain (*dal*), in powder form as flour (*besan*) and as whole grains. Well established four channels for marketing of chickpea in different forms were documented from the region, for furthering the chickpea and its products from producer to consumers.

1. Producer- Aggregator- Trader- Processer- Whole seller- Retailer- Consumer
2. Producer- Aggregator cum Trader- Processer- Whole seller- Retailer- Consumer
3. Producer- Aggregator- Trader cum Processer- Whole seller- Retailer- Consumer
4. Producer- Village trader- Aggregator- Trader- Processer- Whole seller- Retailer- Consumer

Channel 1 and 2 were present in all the seven districts of BRUP, while channel 3 existed in Banda, Jalaun, Jhansi, Lalitpur, Mahoba districts of the region. In contrast, marketing channel 4 was prevailing only in Chitrakoot district of the region. Aggregators and village traders were the important contact point for producers

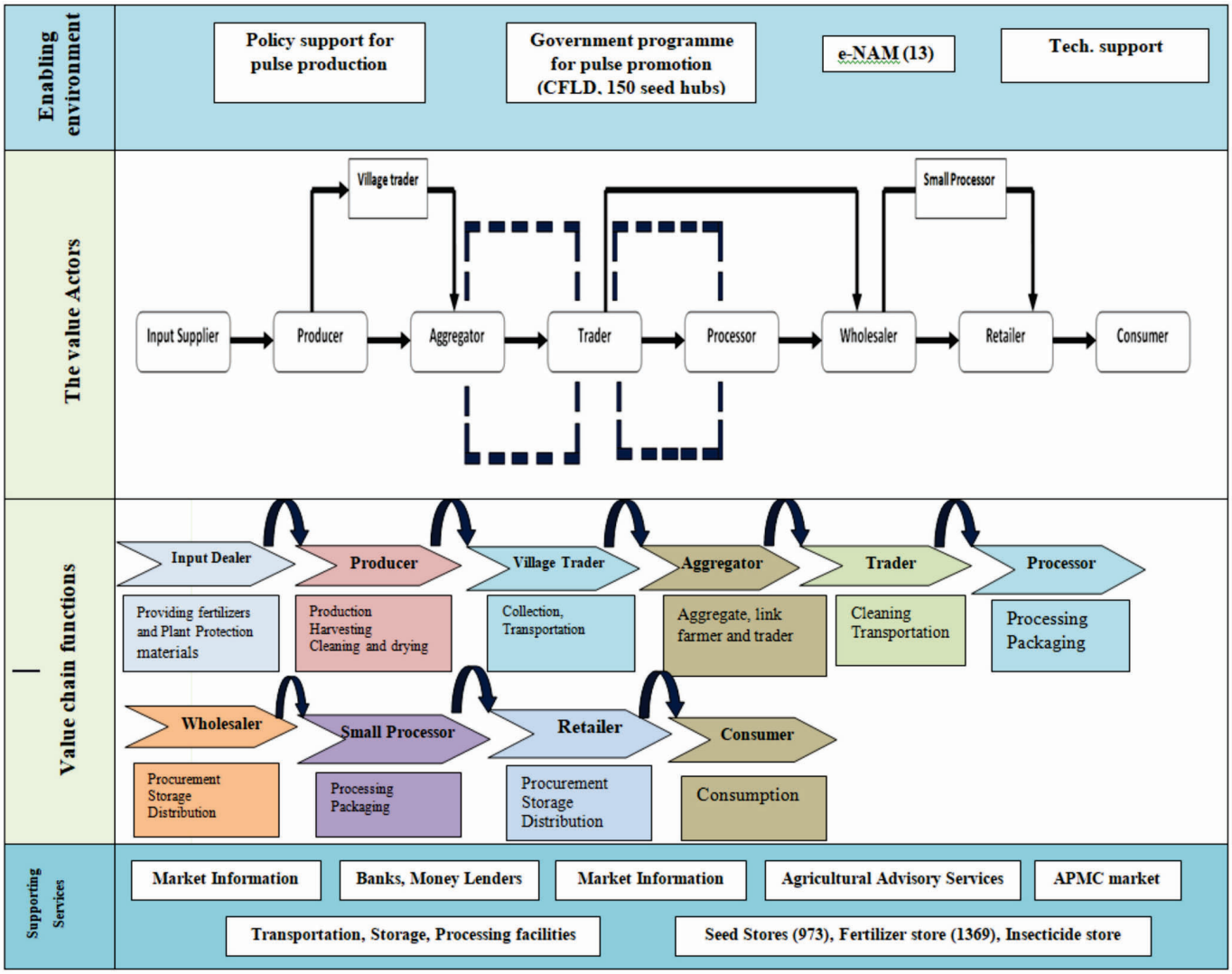

Figure 1. Value chain map of chickpea in Bundelkhand region of Uttar Pradesh state

Table 1. Average cost of production of Chickpea in UP Bundelkhand region

Particular	Operational cost	Percent cost
Human labour	4995.16	21.54
Machine labour	6578.15	28.37
Seed	6065.52	26.15
Fertilizer and manure	1835.37	7.91
Insecticides	405.33	1.75
Irrigation charges	2123.32	9.16
Total operational cost	22002.85	94.88
Interest on working capital	1188.15	5.12
Total cost	23191.00	100
Yield (q./ha)	10.00	
Gross return (Rs./q)	50000.00	
Net returns (Rs./q)	26809.00	
Benefit-Cost ratio (gross return)	2.15	

in all cases. Between every two marketing nodes right from aggregators to retailers, commission agents were linked in chickpea value chains. These commission agents added values by minimizing the financial risk to the marketing nodes, also provided assurance of quality, payment and timely delivery. In Andhra Pradesh also commission agents or brokers were involved in chickpea trade (FAO, 2018). Agbola et al., (2000) also reported presence of multiple channels for marketing of chickpea products. Village traders were the important marketing actor in chickpea marketing in Maharastra state (Naik et al., 2020), Uttar Pradesh state (Sengar et al., 2022), Chhattisgarh state (Sonvanee & Koshta 2019). However, in contrast to the findings of the present study, direct linkages of producer were also reported to exist in major chickpea marketing channel in Chhattisgarh (Seth et al., 2018). In Amravati districts of Maharashtra (Naik et al., 2020) similar observation were reported in chickpea marketing channel. In case of vegetables and flowers also similar channels were observed (Nain et al., 2019). These results reflect on limited direct access of producers to traders or processor, that made the value chains longer and less efficient.

Estimation of chickpea cost of production

Production cost estimation is requisites for value chain analysis as it provides the value build up at producers' level. The average cost of production of chickpea in the region was Rs. 22,003/ha.

Among the various cost components, machine hiring incurred highest cost (28.37%). This was because of considerable mechanization in chickpea cultivation using seed drill. Seed cost accounted for more than 26 per cent of the total cost, because of the high seed rate practice (65-75 kg/ha) in chickpea. Further, cost of human labour accounted for 21.5 per cent (Rs. 4,995/ha) of total cost of production that were engaged during sowing, intercultural operations, harvesting and threshing. The other components of investment are mentioned as in Table 1. The average chickpea yield in the region was 10 q/ha with producer receiving gross income of Rs. 50,000 per ha. The benefit cost ratio of chickpea was 2.15, reflecting on reasonable profitability of chickpea cultivation in the region.

Build-up of marketing cost along the chickpea value chains

Value chains actors while furthering chickpea to next marketing node, incurred cost in performing different marketing functions and also added their margins to total value of the produce. These services include weighing, packaging, handling, transportation of chickpea at the desired place as well as assurance of payment, quantity and quality, timely delivery and so on. In all the existing marketing channels of chickpea, producers were adding maximum value (Rs. 1878.8/q to Rs. 2028.7/q.

In marketing channel 1, chickpea initially moved from producers to aggregators and then to traders. The traders furthered chickpea in three forms –as whole grain, as dehusked split grains (*dal*) and as flour (*besan*). The traders incurred MC of Rs. 276/ q and they gained almost equal margin (Rs. 272.5/q) in furthering the chickpea. The processor incurred marketing cost of Rs. 249.57/ q and Rs. 318.60/q for processing chickpea as split grains *(dal*) as flour (*Besan*), respectively, before moving it to the wholesaler. The processors were drawing maximum MM among all the actors in the channel. The marketing cost incurred, margins drawn and the total value added by wholesalers, was recorded to be highest for chickpea whole grains followed by chickpea flour (*besan*) and split grains of chickpea (*dal*). Retailers on the other hand incurred least marketing cost (Rs. 38.40/q) in the channel, across all the three products. In Channel 2, aggregation and trading functions were integrated and jointly they incurred highest cost (Rs. 254.7/ q) and gained Rs 398.2/q as margins. Processors also incurred high MC for handling chickpea split grain (*dal*) (Rs. 252.4 /q) and flour (*besan*) (Rs 313.5/q) and earned better MM among all the value chain actors in the channel. At wholesaler level, the MC (Rs.169.8/ q) and total value added (Rs 703.4/q) were highest in furthering of chickpea wholegrain as compared to split grain or flour (*besan*) (Table 2). In channel 3, the processing and trading function were integrated creating highest value addition among all other marketing channels at this node (Table 2). The total value added at trader cum processor followed by wholesaler in this channel in furthering chickpea split grains (*dal*) (Rs. 1509/q and Rs. 594.2/q) as well as chickpea flour (*besan*) (Rs. 1689.2/q and Rs.745/q). In this channel, the overall MM earned were found to be highest in marketing of chickpea split grain (Rs. 1941.7) and chickpea flour (*besan*) (Rs. 2343.2/q). However, this did not translate into higher ME and higher value of PSCP.

Likewise, among all the existing marketing channels, producer incurred highest MC (Rs. 97.44/q) and channel 4 (Table 2). This could be attributed to presence of additional actor i.e. village level aggregator who assembled chickpea at villages itself by incurring cost of Rs. 76.3/q for furthering produce to market yards and gained Rs. 88.4/q as the margin thus enhancing the total value of the produce by Rs 164.7/q. However, in this channel, the total value enhancement at processor level was lesser in comparison to other reported marketing channels. Though the overall value addition in this channel was highest for all three products, split grain (*dal*) (Rs 2723.4/q), as flour (*besan*) (Rs. 3231.6/q) and whole grain (2098.7/q), the PSCP was recorded to be lowest (58-69%) for all the three chickpea products. Further, highest ME and PSCP was recorded in case of marketing of chickpea whole grain across all the four marketing channels. Similar findings were also reported by Sah et al., (2022). This lesser overall MC involved in marketing of wholegrain due to absence of processor in the marketing channels may be reason. In tandem with the results, Kumari et al., (2018) reported presence of village traders in marketing of chickpea in Bihar state and also observed the high processing charges of chickpea in manufacture of value added products. Similar observation was also recorded from chickpea value chains in Andhra Pradesh state (FAO, 2018). In contrast to the results, Vijayalakshmi (2015) reported no integration of chickpea supply chain elements and each element functions discretely in chickpeas industry in India. Results presented above indicated that producers added maximum value to the chickpea in all the existing marketing channels by means of making the produce available for purchase and consumption. The higher marketing surplus was also identified as the strength in case of Potatao in Meghalaya district (Rajavardhan, et al, 2020). The highest share of producers in market margins could be attributed to their higher investment, risk borne and time (almost 135 days) involved in producing chickpea. Besides producer, processors were also adding considerable value to the chickpea across all the channels. This may be because of high operational and maintenance cost involved in chickpea processing. In addition, highest investment in terms of infrastructural cost of processing units as well as bulk handling of chickpea at processor level might be attributing for high marketing cost and better margins drawn. Among the existing channels, the least value addition at processors level was observed in channel 4 which may be because of presence of more number of marketing chain actors leading to margin sharing.

Movement of chickpea from Bundelkhand region for processing

Traders as well as processors located in UPBR and nearby Kanpur city were interviewed for documenting the movement of chickpea from the region (Figure 2). Kanpur city is located in vicinity of the region and contains hundreds of pulse processing units of varying capacities. The city has emerged as a major chickpea processing hub. It was recorded that during the chickpea harvest season and a few months after (April to June), this region of UP and MP primarily supplied chickpea to processing units located within the Bundelkhand region as well as nearby major processing units in cities like Kanpur and Prayagraj. During off

Table 2. Build-up of value along the chickpea value chains (Rs./q)

Actors	Heads	Marketing channel 1			Marketing channel 2			Marketing channel 3		Marketing channel 4		
Producer	Marketing cost	89.3			87.7			95.3		97.4		
	Market margin	1939.4			1929.1			1738.5		2052.5		
	Total value added	2028.7			2016.8			1878.8		2149.9		
	Producer's price											
Village aggregator	Marketing cost									76.3		
	Market margin									88.4		
	Total value added									164.7		
Aggregator	Margins	177.6			-			177.2		183.6		
Trader	Marketing cost	276			254.7					258.2		
	Market margin	272.5			398.5					238.7		
	Total value added	548.5			653.2					496.9		
		SG	F(B)	WG	SG	F(B)	WG	SG	F(B)	SG	F(B)	WG
Processer	Marketing cost	249.6	318.6	-	252.4	313.5		524	366	244	297	
	Market margin	665.8	794.2		672.9	801		984.5	1115	605	794	
	Total value added	915.4	1112.8		925.3	1114.5		1509	1689.2	849	1091	
Whole saler	Marketing cost	152.1	155.1	171.08	150.5	167.9	169.8	154.2	157	149.8	131.8	174.1
	Market margin	435.9	565.9	558.72	433.5	308	533.6	440	588	420	582.2	520
	Total value added	588	721	729.8	584	475.9	703.4	594.2	745	569.8	714	694.1
Retailer	Marketing cost	38.4	38.4	38.4	39.6	39.2	39.6	37.5	37	37	37	37
	Market margin	353	453	416	345.2	455	445.2	340	463	325	447	425
	Total value added	391.4	491.4	454.4	384.8	494.2	484.8	377.5	500	362	484	462
Total Marketing cost (Rs/q)		805.4	877.4	544.7	784.9	863	551.8	811.5	863.5	862.7	897.7	643
Market margin		1904.8	2263.2	1424.82	1850.1	1962.5	1377.3	1941.7	2343.2	1860.7	2333.9	1455.7
Total Value added		2710.2	3140.6	1969.52	2635	2825.5	1929.1	2753.2	3206.7	2723.4	3231.6	2098.7
Marketing Efficiency Index		1.7	1.5	2.3	1.7	1.5	2.4	1.7	1.4	1.7	1.4	2.2
Producer Share in Consumer Rupee		62.9	59.3	69.7	63.5	59.6	70.6	62.5	58.7	62.8	58	68.8

SG- Split Grain; F(B)- Flour (*Besan*); WG- Whole Grain

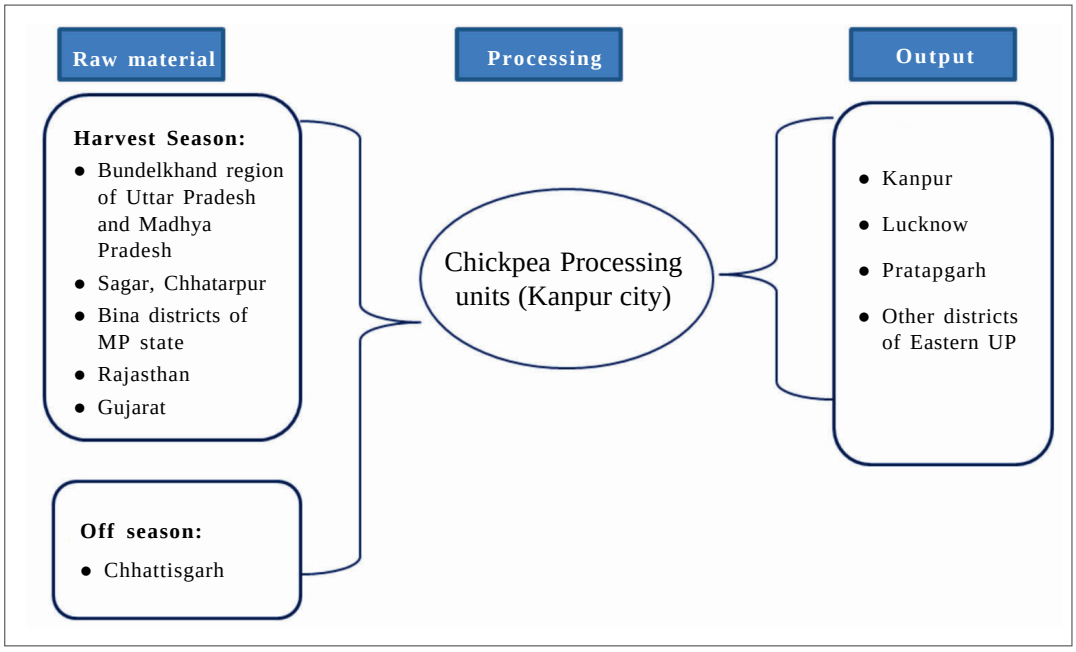

Figure 2. Movement of Chickpea from Bundelkhand region for processing

season, the processing units received chickpea from traders located in states like Chhattisgarh. Processed chickpea from processing units of Kanpur was catering to the chickpea demands of nearby districts like Kanpur, Lucknow, Pratapgarh Prayagraj and other districts of eastern UP state. The quantum of transacted produce, however, depended on the negotiation for the prices, quality and time of delivery between the commissions agents present either side.

CONCLUSION

Finding of value chain analysis of chickpea revealed the presence of long chain of market intermediaries operating between chickpea producers and consumers adding to marketing costs. Integration of value chain functions was noted in the regions; however, it failed to translate into better market efficiency and greater share of producers in consumer rupee. Higher participation of producers in collective marketing and sales of chickpea if

encourages may contribute to generate their better share in consumer price. Encouraging better linkages between chickpea farmers and traders for development of mutually beneficial contractual arrangements in the region state could safeguard producers against fluctuating prices and may also guarantee assured quantity and quality of chickpea produce to trader.

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Occupational Mobility in Farming Sector: An Analysis in Coastal and Tribal Districts of Odisha, India

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ABSTRACT

The continuous migration of Indian rural youth from farming to the non-farming sector has caused concern among the policy makers. If not checked, it is likely to affect the future agricultural activities and thereby future agrarian economy. Present research was carried out during 2020 with a comparative analysis among the respondents of the coastal district (Jagatsinghpur) and tribal district (Mayurbhanj) of Odisha with a randomly chosen sample of 480 respondents, 240 from each district including 120 each from the first-generation (father) and second-generation (son). The study aimed to find out prevalence of intergenerational occupational mobility in farming sector by using transition probability matrix to describe the pattern of mobility and direction of their movement. A statistically significant difference was found between occupations of the first and second generation in both tribal and coastal districts with hhigher occupational mobility in the coastal district. The coastal district showed a 19.17 per cent decrease in the numbers of farmers than the tribal district. The result showed 49 per cent and 62 per cent of absolute mobility rates in intergenerational occupation in tribal and coastal districts, respectively. There was prevalence of both upward and downward mobility in occupation in the farming sector in both tribal and coastal districts of Odisha.

INTRODUCTION

Agriculture supports 58 per cent of the Indian population at present, against about 75 per cent at the time of independence. In that period, the contribution of agriculture and allied sectors, to the GDP of India has fallen from 61 per cent to 15.35 per cent. Between 2000-01 and 2010-11, the number of marginal holdings increased from 75.41 million to 92.83 million (23% rise) and the number of small holdings increased from 22.70 million to 24.78 million (9% rise). Around 85 per cent of the operational holdings in the country are small and marginal, i.e., holdings of less than 2 hectares each. It is estimated that the average size of land holding, which at present is 1.15 hectares, is likely to reduce further by 2020-21 (States of Indian Agriculture, 2015-16). The survey by the Centre for the Study of Developing Societies (CSDS, 2014), Delhi, found that 61 per cent of farmers opined that they would leave farming if they get employment in cities.

Though the country has achieved the agricultural development in terms of food security, it is still being affected by many economic, technical, social and environmental factors in the face of increase in population, declining land resources, increasing demand of food due to rising income with the transition of youth from farming to non-farming sector and global climate change affecting the sustainability of agriculture. As the process of development in industrial and tertiary sector, the occupational structure has been started diversified. People started changing their occupation from one filed to another field for job security and job satisfaction. The occupations which were adopted by the parents now not remained the same in the new generation. There is a paradigm shift in the nature of occupation happening in the

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agriculture in the present scenario. With the climate change effect and other constraints in farming, the new generations are diverted from the farming occupation. Jena & Acharya (2016) found that the variables, Age (X1) & changing expenditure allocation on education (X10) have contributed respectively 49.05 per cent & 33.50 per cent variance to the consequent variable, perceived climate change effect on agriculture (Y11). Climate change largely affects to agriculture due to its dependency on natural resources. This has lead the youth to shift their parental farming occupation to non-farming occupation. The studies on migration behaviour by Kumari et al., (2021) & Maurya et al., (2022) reported certain socio- psychological factors.

With the effect of numbers of factors, the occupation of farming is termed as risk prone to make as occupation. In this context, the efforts were made to find out the prevalence of the occupational mobility in farming sector and its direction with a comparison between tribal and coastal districts of Odisha, which may help the policy makers and experts to retain youth in agriculture.

METHODOLOGY

The state of Odisha was selected as per the purposive sampling technique and the multistage random sampling technique was adopted to select the district, blocks and villages while the random sampling technique was followed for the selection of the respondents. A total of 480 respondents including 240 each from the tribal district (Mayurbhanj) and coastal district (Jagatsinghpur) of Odisha representing 120 each from the first generation (Father) and second-generation (Son) were selected randomly from the total population. The total sample respondents were selected from 16 villages, 8 villages each from the tribal and coastal districts based on 10 per cent proportion of the total population of each village. The study is based on individual and their relationship with the household head. To reduce complexity, the present study has studied only the regular occupations of second-generation (son) and their fathers (first generation) where sons are in any occupation and father must be in farming occupation as their primary occupation. The study has excluded women respondents because it doesn't give information about their father but their husband's occupation. The research study followed the ex post facto design by accessing the causes of its presumed effect on intergenerational occupational mobility in the farming sector. For the study, survey research through a structured interview schedule was considered most appropriate to gather information. Here, the occupations of respondents were classified into six categories viz. professional, teachers and managers, farmers, skilled labour, tenant farmer, agricultural labourer with the score from 6 to 1 respectively as followed by the modified Kuppuswamy scale (Sharma, 2012). This scale was developed to determine socio-economic status of the individual. The scale has facilitated the rank to different occupations by calculating total score considering the factors, education, occupation and income.

The statistical tools like percentage, mean, standard deviation, and paired t test, have been used in this study to make the inferences from the collected data. This study has used a transition probability matrix to describe the pattern of immobility and upward and downward mobility of the second-generation respondents with respect to the occupations of their respective first generation. The absolute mobility rate was calculated to derive how likely respondents from the second generation were to exceed their fathers' family occupation at the same age.

Following Xie & Killewald (2013), let us denote fij as the observed frequency in the i^{th} row (i = 1,…, N) and in the j^{th} column (j = 1,…, N) of a mobility table with N rows and N columns.

Absolute mobility rate = $1 - \frac{\sum_{i=1}^{N} f_{ii}}{f_{++}}$

Where, $\sum_{i=1}^{N} f_{ii}$ is the sum of diagonal cells of the mobility table and $\sum_{i=j}^{N} f_{ii}$ is the grand total of cells of the mobility table.

RESULTS AND DISCUSSION

A perusal of Table 1 showed various mobility patterns of respondents across the generation in the tribal and coastal districts. The tribal district witnessed a 12.50 per cent decrease in numbers of farming occupations in second-generation which indicated the prevalence of occupational mobility in the farming sector shifting from parental farming to non-farming occupations. There was a decrease of 9.16 per cent and 1.66 per cent in occupations of tenants and unskilled agricultural labourers, respectively. From the parental farming occupation, 12.50 per cent from the second-generation respondents chose higher occupations like teacher and managership whereas 13.33 per cent went for the occupation of skilled labour in the tribal area. The coastal area witnessed a downfall of 31.67 per cent in farmers' occupation numbers while there was a decrease of 5.83 per cent and 3.34 per cent in occupations of tenants and unskilled agricultural labours, respectively in the second generation. It was found that there was higher intergenerational occupational mobility in the coastal district than in the tribal district. The coastal district showed a higher 19.17 per cent decrease in numbers of farmers than the tribal district. As farming occupation is mostly associated with risk, uncertainty in quality input availability and proper market linkage, the next generations chose skilled labourer occupations like

Table 1. Distribution of the respondents as per occupational status

Occupation	Tribal		Mobility	Coastal		Mobility
	1st Gen	2nd Gen		1st Gen	2nd Gen	
Professional	0	1(0.83%)	1(+0.83%)	0	2(1.67%)	2(1.67%)
Teacher and Managers	0	15(12.50%)	15(12.50%)	0	24(20.00%)	24(20.00%)
Farmer	69(55.00%)	51(42.50%)	-18(-12.50%)	81(67.50%)	43(35.83%)	-38(-31.67%)
Skilled laborer	0	16(13.33%)	16(13.33%)	0	23(19.17%)	23(19.17%)
Tenants	35(28.33%)	23(19.17%)	-12(-9.16%)	25(20.83%)	18(15.00%)	-7(-5.83%)
Unskilled Agril. labourer	16(13.33%)	14(11.67%)	-2(-1.66%)	14(11.67%)	10(8.33%)	-4(-3.34%)

craftsmanship, plumbers, accountants, drivers, mechanics etc. for better and regularity in income and also due to its wide opportunities throughout the year. The process of urbanisation and industrialisation pushed the second generation of small and marginal landholders to opt for skilled and unskilled labour for getting a better salary in comparison with the profit gained from their parental farming occupation. Intergenerational occupational mobility is highly pronounced in the farming sector and comparatively more in coastal areas than in the tribal area. The spirit toward the change for upward mobility was highly visible among the second generation. The rapid growth of urbanisation and industrialisation has pushed the second generation of small and marginal landholders to opt for skilled and unskilled labour for obtaining regular income.

Table 2 showed the mean occupation of first-generation in the tribal area was 3.09 whereas occupation of the second generation was 3.35 which was higher than the occupational mean score of the first generation. The table found a statistically significant difference between occupations of the first and second generation in the tribal area.

Table 3 showed the mean occupation of the first generation in the coastal area was 3.12 whereas the occupation of the second generation was 4.14 which was higher than the occupational mean score of the first generation. The table found a statistically significant difference between occupations of the first and second generation in the coastal area.

Table 4 showed the distribution of occupations of sons i.e. second generations with respect to occupations of their fathers i.e. first generation in the tribal district. The intergenerational occupation trend showed that 63.77 per cent of respondents from the second generation chose their parental farming occupation whereas the remaining 10.14, 5.80 and 4.35 per cent of respondents went for other occupations like skilled labour, tenants and unskilled labour respectively which indicated the downward intergenerational occupational mobility. It was also observed that 14.49 per cent went for teacher ship and managerial occupation and professional occupation category was occupied by 1.45 per cent which indicated upward occupational mobility of the second generation. 45.71 per cent of the second generation continued their parental farming as tenant farmers whereas 11.43, 17.14, 14.28 and 11.43 per cent opted for occupations like unskilled labour and skilled labour, farming, teacher and manager respectively. 43.75 per cent of respondents from the second-generation continued their parental occupation as unskilled labourers while 18.75 per cent worked as tenant farmers, 18.75 per cent as skilled labour, 12.5 per cent as farmers and 6.25 per cent as teachers and managers to maintain their livelihood. The matrix table revealed the prevalence of both upward and downward mobility in the farming sector with respect to the first and their second generation. An important issue which could be of interest in the Indian context is downward mobility in the intergenerational context; it reflects sons moving to a lower socioeconomic position compared to their parents.

Absolute mobility rate (M) = 1-(151.78/300) = 1-0.51= 0.49 = 49%

It was found that the absolute mobility rate in the intergenerational occupational category in the tribal area was 49%. It is the probability that a son may leave the father's occupational category.

Table 5 showed that 48.15 per cent of respondents from the second generation continued their parental farming occupation whereas 18.52, 6.17 and 2.47 per cent of respondents changed their occupations from cultivator to other occupations like skilled labour, tenants and unskilled labour, respectively, which indicated the downward intergenerational occupational mobility. 22.22 per cent went for teacher ship and managerial occupations and the professional occupation category was occupied by 2.47 per cent which indicated upward occupational mobility of the second generation due to an increase in the educational status of the second generation. The coastal has witnessed 40 per cent from second-generation continued their parental farming as tenant farmers whereas 16, 20, 8 and 16 per cent chose occupations like unskilled

Table 2. Test of significance between first and second generation occupation of Tribal respondents

	Mean	N	Std. Deviation	Std. Error Mean	t value	Sig.
Occupation (1st generation)	3.09	120.00	1.28	0.12	-3.31	0.00
Occupation (2nd generation)	3.35	120.00	1.17	0.11		

Table 3. Test of significance between first and second generation occupation of Coastal respondents

	Mean	N	Std. Deviation	Std. Error Mean	t value	Sig.
Occupation (1st generation)	3.12	120.00	1.32	0.12	-8.68	0.00
Occupation (2nd generation)	4.14	120.00	1.20	0.11		

Table 4. Transition Probability Matrix: Occupational distribution of son in father-son pairs (%) in case of respondents in Tribal district

	Professional	Teacher and managers	Farmer	Skilled labourer	Tenants	Unskilled labourer	Father (Total)
Professional	0	0	0	0	0	0	0
Teacher and Managers	0	0	0	0	0	0	0
Farmer	1(1.45%)	10(14.49%)	44(63.77%)	7(10.14%)	4(5.80%)	3(4.35%)	69
Skilled labourer	0	0	0	0	0	0	0
Tenants	0	4(11.43%)	5(14.28%)	6(17.14%)	16(45.71%)	4(11.43%)	35
Unskilled labourer	0	1(6.25%)	2(12.5%)	3(18.75%)	3(18.75%)	7(43.75%)	16
Son (Total)	1	15	51	16	23	14	120

Table 5. Transition Probability Matrix: Occupational distribution of son in father-son pairs (%) in case of respondents in coastal district

	Professional	Teacher and managers	Farmer	Skilled labourer	Tenants	Unskilled labourer	Father (Total)
Professional	0	0	0	0	0	0	0
Teacher and Managers	0	0	0	0	0	0	0
Farmer	2(2.47%)	18(22.22%)	39(48.15%)	15(18.52%)	5(6.17%)	2(2.47%)	81
Skilled labourer	0	0	0	0	0	0	0
Tenants	0	4(16%)	2(8%)	5(20%)	10(40%)	4(16%)	25
Unskilled labourer	0	2(14.29%)	2(14.29%)	3(21.43%)	3(21.43%)	4(28.57%)	14
Son (Total)	2	24	43	23	18	10	120

labour, skilled labour, farming, teacher and manager respectively whereas their fathers were tenant farmers. 28.57 per cent of respondents from the second generation which was lower in comparison to the respondents of the tribal area continued their parental occupation as unskilled labourers while 21.43 per cent transitioned to tenant farmers, 21.43 per cent to skilled labour, 14.29 per cent to the farmer and 14.29 per cent to teacher ship and managerial jobs to maintain their livelihood. The matrix table revealed the prevalence of both upward and downward mobility in the farming sector with respect to first and second generations. In the face of rapid urbanisation and diversified job opportunities in non-farm sectors, the coastal respondents from the second generation are showing more variation in choosing non-farming occupations rather than their parental traditional occupations.

Absolute mobility rate (M) = 1-(115.48/300) = 1-0.38 = 0.62 = 62%

It was found that the absolute mobility rate in intergenerational occupational category in the coastal district was 62 per cent. It is the probability that a son may leave the father's occupational category. The degree of intergenerational occupational mobility implies that the inherent pros and cons in the occupational status of one generation are transmitted to the next generation. The result was supported by the findings of Tiwari (2016) who revealed that 47.8 per cent of the respondent has chosen their parental occupation and Motiram & Singh (2012) who found that a substantial proportion of sons of low-skilled and low-paid workers remained in the same occupations as their fathers. Iversen et al., (2016) found 58.6 per cent of the sons of agricultural and other labourers were also in the same occupational category. Reddy & Swaminathan (2014) collected evidence from ten villages and found that low intergenerational occupational mobility exists in all ten villages, particularly among big farmers and rural manual workers. It may be due to lack of proper awareness among young generation to adopt farming as occupation and outlook of urban job and life

CONCLUSION

The comparative analysis showed significant occupational mobility in the farming sector from the one generation to its second generation in both tribal and coastal districts of Odisha. The higher occupational mobility in the farming sector was found in the coastal district. The transition probability matrix showed the prevalence of both upward and downward mobility in the farming sector to different non-farm occupations. In the face of urbanisation and diversified opportunities in non-farm sectors, the coastal respondents from the second generation showed comparatively more variation in choosing non-farming occupations rather than their parental traditional occupation. The downward mobility in the intergenerational context reflects that sons moving to a lower socioeconomic position compared to their parents. The process of societal development and industrialisation pushed the second generation of small and marginal landholders to opt for skilled and unskilled labour for getting a better salary in comparison with the profit gained from their parental farming occupation which is also associated with high risk, market and weather uncertainty.

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Crop and Livestock Depredation by Wild Animals: The Case of Ranthambore Tiger Reserve, India

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ABSTRACT

People worry about crop and livestock destruction by wild animals in the nearby protected region, which might lead to opposition to the preservation of a protected area. We surveyed 360 households from 30 villages in the eco-sensitive region of Ranthambore Tiger Reserve in the period of December 2021 to May 2022 to assess the annually loss in the crops by the wild animals and livestock attacked by the wild animals. One-way variance followed by DMRT post hoc was used to analyse losses in crop. It was observed that farmers getting losses, in Rabi season farmers get much loss in the mustard crop, and in Kharif season farmers get loss in maize crop due to wild animals in the form of crop raiding foraging, and eating. 335 number of incidents happened with livestock in the last five years among them 155 got injured and 180 were killed by wild animals, majority of incidents happened with goat followed by calves and buffalo. Our comparative analysis helps to further ongoing conservation and compensation efforts by shedding light crops and livestock that influence conflict loss and tolerance.

INTRODUCTION

Human-wildlife conflicts are defined as Conflicts between humans and wildlife are those that arise when one of the two is harmed by a human action or a wildlife action (Redpath et al., 2013). In many locations, especially India, around protected areas (PAs), crop degradation and livestock predation by wildlife are important conservation challenges. The danger of human harm or death, along with crop and livestock losses, could make the local populace more hostile toward wildlife (Sillero-Zuberi et al., 2007).

For the very survival of humans, especially those who live nearby, this protected region and the forest area are among the most crucial natural and renewable resources. (Bhat, 2018), and tribes close to the forest receive the most of the benefits and have a significant source of income (Uchoi & Singh, 2021). The government's conservation efforts are severely hindered by a lack of funding, which also causes locals to lose employment possibilities and forest management programmes to help locals earn more money (Iqbal et al., 2021a; Iqbal et al., 2021b). Communities close to a protected region may lose out on economic opportunities, including being shut out of access to resources and having crops and cattle destroyed by wild animals. In some areas of India, tolerance for species has contributed to the survival of some huge mammals (Karanth et al., 2010). There are 52 Tiger Reserves in India, comprising a total area of 71027.10 km^2 and 140 protected areas located inside the tiger reserve (Wildlife Institute of India). Ranthambore Tiger Reserve is direst tiger reserve with 1700.24 km^2 of land of RTR designated as a Project Tiger Reserve in 1973, and on November 1st, 1980, it was designated as a national park. In the Ranthambore Tiger Reserve area, there are primarily three seasons throughout the year: summer, winter, and monsoons. The atmosphere is extremely hot and dry during the summer, with temperature variations between 40 and 45 degrees Celsius. And

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average annual rainfall (June-September) is 800 mm (DeFries et al., 2010; Karanth & DeFries, 2011).

The expansion of farmland restricts the range of many wild animals due to the loss of habitat and fragmentation which ultimately result in more contact between wild animals and humans begins. The majority of the time, these interactions result in the death of wild animals or the death of humans owing to wild animals destroying crops and livestock and farmers also obtain a good number of benefits from the reserve area. These conflicts need to be resolved immediately since the delay in conflict resolution can aggravate the people to the disadvantage of the conservation aims set for the protected areas. The assessment of the economic losses in crops and livestock depredation due to wild animal among the villages in the core and buffer zones of India's Ranthambore Tiger Reserve and analysis of a collection of forest products by the villagers on the premises of the reserve area has been attempted.

METHODOLOGY

Ranthambore Tiger Reserve is divided into two zone Tiger Habitat/Core Zone (Ranthambore National Park, Sawai Mansingh Wildlife Sanctuary, Sawai Madhopur Wildlife Sanctuary) and Buffer Zone (Keladevi Wildlife Sanctuary) spreading over four districts namely, Sawai Madhopur, Karauli, Bundi and Baran. Both zones were selected. Out of 304 villages in the vicinity of RTR 30 villages were selected randomly and 12 farmers who are engaged in agriculture activities and livestock activities from each village were selected randomly. Thus, a total of 360 farmers were interviewed either at their doorstep with the help of an open-ended interview schedule in the period of December 2021 to May 2022. Data collected from the farmers on several criteria (area, expected loss, yield) were subjected to One way Variance followed by the DMRT Post Hoc Test using all pairwise comparisons to identify the most important among them in case of livestock depredation farmers were asked about the incident happened with the livestock in last five year (2017-2021) on their memory based and documented it with the help of frequency, percentage.

RESULTS AND DISCUSSION

The annual loss in crops by wild as perceived by the farmers

Farmers in the vicinity of the Ranthambore Tiger Reserve were highly dependent on agriculture and livestock activities. The result presented in Table 1 shows that farmers were mostly growing four major crops in the Rabi season wheat, mustard, gram, and barley in the Rabi session. Farmers was grow mustard on the majority of their land that was average of 1.20 hectares land followed by 0.43, 0.21, 0.04 hectares of a land for gram, wheat, and barley grown by the farmers, respectively. In the case of the area, all the crops have a significant difference at $p<0.05$. the average yield of barley was 14.88 quintals in the area followed by 11.15 quintals per hectare in wheat and case of mustard and gram average yield was 5.27, and 4.65 quintals per hectare, respectively and there was no significant difference ($p<0.05$) in the yield of mustard and gram. Maximum percent loss observed by a wild animal in the wheat followed by gram and mustard at 9.16, 9.12, and 8.89 per cent in yield, respectively but at $p<0.005$, there was no discernible difference among these three crops but having a significant difference in barley crops with three crops in terms of losses by the wild animals. Species of wild animals like wild boar and nilgai are involved in crop losses in mainly two forms one is eating of the crops and crop raiding (Kranth & Nepal, 2011). Average crop loss in barley was 1.20 quintal per hectare by the wild animal followed by 1.00, 0.47, and 0.43 quintal per hectare in wheat, mustard, and gram, respectively. Loss in the rupee was calculated by using MSP 2021-2022 (Minimum Support Price) of the crops. The result was calculated that farmers bear a maximum loss was 2390.84 rupees in the crop of mustard followed by gram was 2332.05 rupee but when it came to rupee losses, there was a substantial difference ($p <0.05$) between these two crops. In the case of wheat average loss in rupee was 2020.14 rupee per hectare followed by a 1955.79 rupee in barley.

Farmers in the vicinity of Ranthambore Tiger Reserve mainly were grow four crops in the Kharif season namely sorghum, pearl millet, maize, and black gram. Results depicted in Table- 1 indicated that Farmers mostly use their land for the pearl millet average land used for the pearl millet was 0.78 hectares per household followed by 0.37, 0.27, 0.09 hectares land for black gram, maize, and sorghum, respectively. In the case of yield, average yield of the pearl millet was 10.15 quintals per hectare followed by 9.01, 2.71, and 2.16 quintals of maize, black gram, and sorghum, respectively. The favourite crop of wild animals was maize so farmers mostly

Table 1. Annual crop loss as perceived by the farmers in the Rabi crops and Kharif crops

Particular	Rabi Crops			
	Wheat	Mustard	Gram	Barley
Area	0.21 ± 0.01^{c}	1.20 ± 0.72^{a}	0.43 ± 0.21^{b}	0.04 ± 0.03^{d}
Yield (In qt.)	11.15 ± 8.71^{b}	5.27 ± 4.22^{c}	4.65 ± 2.95^{c}	14.88 ± 0.91^{a}
Percent Loss	9.16 ± 3.66^{a}	8.89 ± 2.91^{a}	9.12 ± 3.34^{a}	7.90 ± 2.91^{b}
Yield Loss (In qt.)	1.00 ± 0.90^{b}	0.47 ± 0.44^{c}	0.43 ± 0.33^{c}	1.20 ± 0.97^{a}
Loss in (Rupee)	2020.14 ± 1819.95^{b}	2390.84 ± 2247.05^{a}	2332.05 ± 1744.63^{a}	1955.79 ± 1589.18^{b}
Particular	Kharif Crops			
	Sorghum	Pearl Millet	Maize	Black Gram
Area	0.09 ± 0.05^{d}	0.78 ± 0.42^{a}	0.27 ± 0.15^{c}	0.37 ± 0.24^{b}
Yield (In qt.)	2.16 ± 1.31^{c}	10.15 ± 7.69^{a}	9.01 ± 4.89^{b}	2.71 ± 1.77^{c}
Percent Loss	7.04 ± 2.98^{c}	11.43 ± 6.44^{b}	17.59 ± 6.53^{a}	7.03 ± 3.88^{c}
Yield Loss (In qt.)	0.15 ± 0.12^{c}	1.16 ± 1.15^{b}	1.60 ± 1.15^{a}	0.19 ± 0.18^{c}
Loss in Rupee	421.13 ± 336.06^{d}	2613.46 ± 2603.41^{b}	2990.42 ± 2142.89^{a}	1219.17 ± 1161.77^{c}

(a, b, c, d means bearing different superscripts in a row under each criterion differ significantly ($p<0.05$). The multiple comparisons are based on the DMRT Post Hoc test)

Table 2. Annual Crop loss as perceived by the farmers in the horticulture crops

Crop Type	Area (hectare)	Yield (In qt.)	Percent Loss	Yield Loss (In qt.)	Loss in Rupee
Guava	0.54±0.34	76.39±48.03	14.10±6.41	10.90±9.18	26320.97±1167.54

Table 3. No. of Incidents with livestock by wild animals in the last five years

S.No.	Animal Type	No. of Incident	Injured of Livestock	Killed of Livestock	Death (%)
1	Buffalo	67	49	18	26.86
2	Cow	43	32	11	25.00
3	Calves	78	53	25	32.05
4	Goat	121	19	102	84.30
5	Sheep	26	2	24	92.31
	Total	335	155	180	53.73

perceived that the majority of loss happened in the maize crop that 17.59 per cent per hectare and then in pearl millet that is 11.43 per cent. According to Awasthi and Singh (2015), the Gaurishankar Conservation Area in Nepal is greatest crop damage, with maize crops suffering a 39 per cent and 30 per cent loss in potato yield due to wildlife attack on the crops. Over a decade, damage to grassland accounted for 50.10 per cent of damage cases and 57.80 per cent of the total financial compensation amount, followed by damage to maize (30.10%) and wheat (11.70%). Schley et al., (2008) found no significant difference ($p<0.05$) between sorghum and black gram in the loss percent by the wild animal. So average yield loss per hectare is more in maize followed by pearl millet crop and by using one-way variance followed by DMRT found that there was no significant difference ($p<0.05$) in case of yield loss per hectare in the sorghum and black gram crop. Around 2990.42 rupees per hectare loss happened in the maize crop followed by pearl millet, black gram, and sorghum. Farmers perceived that Maize is mostly preferred attacking crop by the wild animals followed by sorghum Malugu & Hoare (2007) & Mwakatob et al., (2014).

Farmers in the surrounding villages of RTR was growing horticulture crops like guava and earned a good amount of money. The result in Table 2 revealed that the average area for guava farming was 0.54 hectares and the average yield per hectare was 76.39 quintals. Farmers faced many problems in guava farming due to raided by the wild animal and the annual average loss in per cent was 14.10 or in case of yield loss that was 10.90 quintal per hectare or in case of the rupee that was 26320.97 rupee per hectare by the per household. Fruit crops are mostly targeted by the rehesus monkey due to various reasons like lack of fruits tree inside a forest, and increased monkey population (Baral et al., 2021) but wild boar uprooted the whole tree.

Human-wildlife conflict with the livestock

Farmers in the vicinity of the Ranthambore Tiger Reserve mostly rear four kinds of animal buffalo, cow, goat, and sheep. Data were collected from the memory of farmers based on incidents that happened in the last five years. Several incidents result presented in Table 3. The same table indicated that there were a total 335 number of incidents that happened with livestock in the last five years among them 155 got injured and 180 were killed by wild animals the maximum number of incidents that happened with a goats were 121 and among them, 19 were got injured and 102 were got killed by the wild animals like tiger and leopard so death rate of the goat was 84.30 per cent. 15.00 percent of households reported livestock loss by the two top-ranked wild animals such as tiger and leopard, and livestock incidents are positively associated with grazing time (Karanth et al., 2013). In the case of buffalo total of 67 number incidents reported among them 49 were got injured and 18 were killed by wild animals. In the case of cows the total number of incidents reported in the last five years were 43 among them 32 were got injured and 11 cows were killed by wild animals in the last five years. And in the case of sheep total number of incident with sheep was 26 among them 24 were killed and 2 were get injured and death rate of sheep is the highest compared to other animals which was 92.31 per cent. The total number of incidents were 78 with calves of cow and buffalo among them 53 were got injured and 25 were killed. Tigers and leopards collectively killed 209 and 1476 hoofed animals, respectively, between 2015 and 2019 among them at least 86 percent more sheep with hooves killed by leopards in each season than by tigers Bing et al., (2009).

CONCLUSION

People's lives are at danger close to protected area borders due to wildlife-caused damage to livestock and crops, and Ranthambore Tiger Reserve is being invaded by humans. Crop loss and livestock depredation by wild animals are major problems who are loving in the vicinity of the Reserve area. Its impact directly on their livelihood and income losses. It was found that farmers faced major loss in the mustard crop in Rabi season and Maize crop in Kharif season. Annually loss in guava farming was around 26000 by wild animals. Small ruminants like sheep and goats are highly vulnerable to kill by wild animals. Therefore, it is advised that relevant wildlife authorities educate farmers on how to manage these issues so that their fields suffer fewer financial losses.

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Women's Empowerment Index in Cassava: An Innovative Tool for Gender Mainstreaming

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ABSTRACT

Analysis of women's empowerment in cassava was done among farm women and farmers who are involved in cassava cultivation in Kanyakumari district of Tamil Nadu. Snowball sampling technique was employed for collecting data using semi-structured interview schedule from 50 women and 50 men farmers involved in cassava cultivation. The women empowerment index in cassava was used for estimating the domains of empowerment and gender parity index. Results revealed that cassava women farmers were more empowered than their household male counterparts in the domains of community leadership and time allocation. Whereas, male farmers were more empowered than their female counterparts in production decision making, access to productive resources and control over use of income. It was found that the overall women empowerment score was 0.83 with 28 per cent of women in disempowered category.

INTRODUCTION

In African and South Asian countries, women account for 43 per cent of the agriculture work force. The participation of farm women in cassava cultivation is noteworthy as they are involved in farm operations starting from planting to value addition. Most of the extension interventions in agriculture fail to address the gender specific needs of men and women. Failure to recognise this gender gap will affect the effort to achieve desirable agricultural development. This existing gender gap can be bridged by adopting gender mainstreaming as a strategy while formulating extension programmes.

United Nations exhibited its commitment on gender equality by declaring the UN decade for women from 1975 to 1985. Owing to the efforts of gender activists in this decade, several gender related terminologies were introduced in 1980s. One such term is 'gender mainstreaming' coined in early 1980s which attempts to achieve gender equality. According to the United Nations Development Programme (2004), an approach for making the needs and concerns of men as well as of women a vital part in policy-making is gender mainstreaming. The context of gender mainstreaming is often misinterpreted in different disciplines. It is considered as a 'women's component' or a feminism concept. The term 'gender' is not interchangeable with 'women'; instead it comprises both men and women (United Nations Development Programme, 2004).

Cassava (*Manihot esculenta* Crantz.) is considered as the future food security crop because of its biological efficiency coupled with ability to sustain climate change. Cassava provides livelihood security to about 10 lakh farm families in India. Almost 43 per cent of the agricultural workforce in developing countries and 30 per cent in South Asia and India were occupied by women in agriculture (FAO, 2008 & GoI, 2018). It is considerably a women friendly crop owing to its optimal cultivation practices. Participation of farm women in cassava cultivation is noteworthy as they are engaged in several cassava cultivation practices like planting, weeding, intercropping, value addition and marketing.

Women's Empowerment in Agriculture Index (WEAI) is a composite index developed by International Food Policy Research Institute (IFPRI) and USAID's 'Feed the Future' in February,

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2012. It is a first of its kind index developed from the base index Women's Empowerment Index (WEI). This comprehensive index comprises sub indicators to measure the inclusion levels of farm women (Alkire et al., 2013). There are two sub-indices in WEAI viz., Five domains of empowerment (5DE) and Gender Parity Index (GPI). Women's empowerment has traditionally been studied using education, control over income, gender of the head of household and control over property at the time of marriage (Quisumbing & Maluccio, 2003). WEAI provides an enhancement to existing indicators (FTF & USAID, 2012; Alkire et al., 2013). To understand this crucial role played by women in farming sector, a study has been designed to assess the empowerment of women involved in cassava farming.

METHODOLOGY

An ex post facto research and survey design were adopted for this study. The study was conducted in Kanyakumari district of Tamil Nadu, which is one of the leading producers of cassava in Tamil Nadu. The study area has a healthy sex ratio of 1019 women for 1000 men which emphasises the importance of analyzing the women empowerment in agriculture and allied activities (GoTN, 2017). Three blocks viz., Thiruvattar, Killiyur and Munchirai were selected for the study based on its area under cassava cultivation. Proportionate sampling was followed for selecting respondents from each of the three blocks with 30 (15 men and 15 women) respondents in Munchirai block, 50 (25 men and 25 women) respondents in Thiruvattar block and 20 (10 men and 10 women) respondents in Killiyur block. From these three blocks, 50 men and 50 women cassava farmers were sampled using snowball sampling technique. Primary data were collected using observation and semi-structured interview schedule during June-July 2020. Secondary data were also collected from the published reports of state department of horticulture and statistical handbook of Government of Tamil Nadu. Women's Empowerment Index in Cassava (WEIC) is a modified index obtained from WEAI (FTF & USAID, 2012; Alkire et al., 2013). The following formula was used for computing the index:

$$WEIC = (0.90 \times 5DE) + (0.10 \times GPI)$$

Majorly there are 5 Domains of Empowerment (5DE) and, 10 indicators under these 5 domains viz., agricultural production decision-making, access to productive resources, control over use of income, community leadership and time allocation.

5 Domains of Empowerment, $5DE = 1 - M_0 = 1 - (H_p \times A_p)$

M_0 – Disempowerment index

Disempowered Headcount Ratio, $Hp = q/n$

q – Number of individuals who are disempowered, n – Total population

Average inadequacy score of disempowered individuals, $A_p = \frac{\sum_{i=1}^{n} C_i(K)}{q}$

Whereas, $c_i(k)$ - Inadequacy score of individual i, q - Number of disempowered individuals

Gender Parity Index was calculated using the following formula:

Gender Parity Index, $GPI = 1 - (H_{GPI} \times I_{GPI})$

Proportion of gender parity inadequate households, $H_{GPI} = h/m$

Whereas, h – Number of gender parity inadequate households, m – Total dual adult households in the population

Average empowerment gap $I_{GPI} = \frac{1}{h}\sum_{j=1}^{h} \frac{c_j'(k)^W - c_j'(k)^M}{1 - c_j'(k)^M}$

Whereas, $c'j\ (k)^W$ and $c'j\ (k)^M$ – Inadequacy score of women and men, h – Number of gender parity inadequate households

RESULTS AND DISCUSSION

The data collected from the men and women farmers of the same households who were involved in cassava cultivation revealed several noteworthy findings. The male and female respondents were husband and wife, father and daughter or mother and son. From the data collected, several significant results were drawn which are listed below.

Profile characteristics of women cassava farmers

In-depth analysis of the profile characteristics of the women cassava farmers was done using the standard methodologies and procedures. It was revealed that the mean age was 49 years among the respondents which falls under middle age category. Similar results were reported by Jaganathan (2009). More than 75 per cent of the respondents were having agriculture as the main occupation and others were having teaching and home-making as their main occupation. Family types of the respondents were almost equal with regard to joint (54%) and nuclear family (46%). Mean general farming experience of the women respondents was 21 years, whereas it was 11 years for experience in cassava cultivation. Farming experience in cassava was comparatively less, as it was introduced in large scale in the year 2000 in paddy areas because of increasing cost of cultivation of paddy, socio-economic and agro climatic factors. Majority of the respondents (86%) belonged to marginal category of farm size followed by small (12%) and semi-medium (2%) category of land holding. With regard to area under cassava cultivation, all the respondents belonged to marginal category with a mean area of 0.54 acres. About three fourth of the women farmers (74%) were having low level of livestock possession and the mean monetary value was Rs. 15678. Kanyakumari district has 73,510 cattle and ranks second last in the state of Tamil Nadu. Poultry enterprise is widely found among the respondents. Livestock is an important component for providing employment opportunities and generating additional income for the women respondents. Farm women with low extension orientation were employed in non-farm occupation. None of the farm women had participated in extension trainings and programmes. With regard to level of aspiration, cassava is considered as women-friendly owing to its less labour-intensive nature. Exposure to farm magazines was also very less among the cassava women farmers. All these variables are very important for accessing the innovations for adoption in cassava cultivation for higher production and income. Innovativeness is directly related to the risk-taking ability of an individual and is an important trait to adopt a new practice/idea in cassava cultivation. About half of the women respondents (48%) belonged to low level of innovativeness followed by medium (30%) and high (22%) category.

Women empowerment index in cassava

Disempowered Headcount Ratio, H_p = 14/50 = 0.28

Average inadequacy score of disempowered individuals, A_p = 22.30/ 36 = 0.61

5DE = 1 – (H_p × A_p) = 1- (0.28 × 0.61) = 1 – 0.17 = 0.83

Proportion of gender parity inadequate households H_{GPI} = h/m= 16/50 = 0.32

Average empowerment gap is denoted as I_{GPI}. It is 0.69.

GPI = 1 – (H_{GPI} × I_{GPI}) = 1 – (0.32 × 0.69) = 1 – 0.22 = 0.78

WEIC = (0.90 × 5DE) + (0.10 × GPI) = (0.90 × 0.83) + (0.10 × 0.78) = 0.747 + 0.078 = 0.82

The WEIC score is 0.82 for the cassava women farmers of Kanyakumari district. The domain-wise empowerment values of men and women were computed to identify their strong and weak domains which are listed in Table 1.

Table 1. Domains (5DE) of women empowerment in cassava cultivation

S. No.	Domains (Indicators)	Women Contribution (%)	Men Contribution (%)
1	Production	10	28.54
	Input in productive decisions (1/10)	6.77	16.42
	Autonomy in production (1/10)	3.23	12.12
2	Resources	39.63	26.07
	Ownership of assets (1/15)	5.05	8.26
	Purchase, sale or transfer of assets (1/15)	33.03	10.84
	Access to and decisions on credit (1/15)	1.55	6.97
3	Income	15.90	25.03
	Control over use of income (1/5)	15.90	25.03
4	Leadership	15.89	14.08
	Group membership (1/10)	5.88	3.52
	Speaking in public (1/10)	10.01	10.56
5	Time	18.54	6.25
	Workload (1/10)	9.12	2.73
	Leisure time (1/10)	9.42	3.52

*Weightages of each indicator are given in parenthesis

From the results obtained in 5 domains of empowerment, it can be inferred that women are empowered in the domains of community leadership and time allocation. When the domain of 'Leadership' is judiciously exploited by promoting entrepreneurship among women, it is very useful in empowering women and enabling them to break the barriers that kept them away from agribusiness (Yadav et al., 2020). The domain of time allocation seemed to have this stark deviation from rest of the domains due to the effect of COVID 19 lockdown. Decision making of women is important in a household for the overall welfare of the family (Kumari et al., 2022). Decision making power of women in selection of variety, purchase of inputs and sale of output are found to be limited in comparison with their male counterparts. Summary of the findings is given in Table 2 for both women and men. When a woman has access to resources, she can be empowered not only economically but also socially (Shamna et al., 2022).

Table 2. Indices of women empowerment in cassava cultivation

S.No.	Indices	Women	Men
1	Disempowered Headcount (H_p)	28%	24%
2	Average Inadequacy score (A_p)	61%	57%
3	Disempowerment Index (M_0)	0.173	0.13
4	5 DE Index (1 – M_0)	0.83	0.86
5	Percentage of women with no gender parity (H_{GPI})	32%	
6	Average empowerment gap (I_{GPI})	69%	
7	Gender Parity Index (GPI)	0.77	
8	Women Empowerment Index in Cassava (WEIC)	0.82	

Strategies for women empowerment in cassava cultivation

Empowerment of women in cassava cultivation is crucial for the development of cassava farming in Kanyakumari district. The important stakeholders responsible for empowering women are researchers, extension agencies and policy makers. When each of these players executes the specific roles listed below, farm women in cassava cultivation can be empowered in all spheres of development. Hence, these strategies were formulated for women empowerment through gender mainstreaming.

From the research organizations point of view the major strategies are, development of short duration varieties with nutritional qualities and resistant to biotic/abiotic stresses for enhancing the nutritional security of the households, documentation and validation of ITKs followed by women in cassava cultivation development of technologies for crop intensification/cropping system models, generation of sustainable and organic management practices for emerging pests and diseases, development of women friendly technologies to reduce the drudgery, development of technologies for home scale processing and value addition, development of extension models for dissemination of location-specific technology and impact assessment of technologies/crop insurance in cassava on household income and savings. Institutional engagements with respective strengths were found effective in synergising actions and impact on organising interaction meets and focussed group discussion to arrive at common programmes and activities in a collaborative manner (Singh et al., 2014; Singh et al., 2016).

Establishment of FLDs/model plots in the farm lands owned by women for popularization of improved varieties and technologies of cassava, gender sensitive and gender balanced capacity building programmes, utilization of mass media/social media for technology dissemination, farm publications (magazines and books) for meeting the knowledge needs of women, mobilization of village level cassava women groups for better participation of women, awards and recognitions for successful women cassava farmers and promotion of cassava cultivation through subsidies, incentives and supply of inputs with the utilisation of JAM (Jan Dhan, Aadhar and Mobile) trinity are the important strategies with regard to Extension/ Developmental organizations. Nain & Kumar (2010) & Slathia et al., (2015) also advocated formation of women self help group for easy communication and selection of women cultivators as contact farmers and organisation in groups for their empowerment.

From the policy makers point of view the strategies viz., strengthening of credit/insurance facilities for cassava, subsidies to

motivate farm women to take up cassava cultivation, promotion of FPOs/SHGs specifically for cassava crop, establishment of marketing facilities, creation of cold storage facilities that are accessible to women farmers and establishment of techno park for value addition in cassava at block/taluk level are to be formulated for strengthening sustainable cassava farming in the long run.

CONCLUSION

The analysis clearly revealed that cassava was a remunerative tuber crop in Kanyakumari district of Tamil Nadu and also predicted the empowerment of women in the domains of community leadership and time allocation. With the exploitation of these two domains by suitable interventions, the adverse effects of the empowerment domains like productive decision making and access to productive resources may be negated to a greater extent. Networking of farm women in the form of farmers' associations/ groups and developing their capacities for scientific cultivation, crop diversification, processing and value addition of cassava will generate employment opportunities and income enhancement of the women farmers thereby making them 'self-reliant'. Efforts from research institutes, developmental agencies, farmers and other stakeholders are needed for gender mainstreaming with respect to all domains of empowerment for sustainable development of cassava cultivation.

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Research Article

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Adoption of Scientific Pig Production Practices by Small Scale Pig Farmers in Assam: A Comparative Analysis

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ABSTRACT

The research work was undertaken to compare the adoption of scientific pig production practices by small scale pig farmers in Assam in the adopted villages of ICAR-National Research Centre on Pig, Guwahati and the non-adopted villages. A composite adoption index was developed for measuring the adoption level of small-scale pig farmers. The primary data was collected from 360 small scale pig farmers equally from both the groups during 2020-2021. The data was analyzed using Mann-Whitney "U" test and observed a significant difference in adoption level between both the groups. In the adopted villages, 50.56 per cent of farmers were under high adoption category followed by 48.89 per cent in medium category whereas in non-adopted villages, about 88.33 per cent of the respondents were in the low adoption category and 10.56 per cent in medium adoption category. The independent factors like education, experience in pig farming, family size, herd size, annual income, extension contact and social participation were positively correlated with adoption level. It was observed that the adoption level of scientific pig production practices by small scale pig farmers in adopted villages is significantly higher than the adoption level of non-adopted villages.

INTRODUCTION

Livestock sector contributes a major share in the source of livelihood of tribal communities residing in the North Eastern Region of India (Kumar et al., 2007; Mohakud, 2020). This sector also provides food security as well as nutritional security along with income and employment generation (Feroze et al., 2010; Chauhan et al., 2016). Even though livestock rearing is an integral part of the life of farmers in north eastern region, there exists a significant technological and adoption gap in the practices followed by them (Pourouchottamane et al., 2012). Small scale backyard pig farming is a way of life among the tribal communities of North Eastern Region of India (Feroze et al., 2010; Gills et al., 2013; Nain et al., 2013; Patr et al., 2014; Chahal et al., 2014; Singha et al., 2016; Mohakud, 2020) like other developing countries (Lanada et al., 2005). They usually rear one or two pigs in their backyard without any housing structures and feed it with natural sources (Mutua et al., 2010; Haldar et al., 2017). Unlike intensive commercial pig farming systems which require huge inputs and establishment costs, the backyard systems rely on minimum inputs (Kumaresan et al., 2009; Patr et al., 2014). However, these small scale pig production systems hold good potential to reduce poverty (Ahmed et al., 2017) as the demand for pork is substantially high in these areas (Ansari et al., 2013). The performance of pigs depends on the production practices. By following scientific way of deworming and mineral mixture supplementation the body weight of pigs can be improved significantly (Kumaresan et al., 2009).

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Several attempts were done by researchers to show the status, constraints and opportunities of pig sub-sector in NE India (Deka et al., 2007; Patr et al., 2014; Chauhan et al., 2016). Chandraker et al., (2021) conducted a study on the adoption of improved pig husbandry practices and its determinants at Jharkhand and Chhattisgarh and focussed only on entrepreneurs. Further, in a study conducted at Mizoram, the adoption of improved technologies by the pig farmers were studied and identified the determinants of adoption (Rahman, 2007). But, measurement of adoption level specifically among small scale farmers in Assam was hardly found. Assam is recognized for highest pig population in the country and a major share was contributed by the small-scale farmers running their backyard farms with very limited resources. Hence, in this background, the present study aims to assess the level of adoption of scientific pig production practices specifically by the small-scale pig farmers in Assam. The study also attempts to do a comparative analysis of the adoption level in the adopted villages of ICAR-National Research Centre on Pig and in the non-adopted villages. The hypothesis to be tested is: "A significant difference exists in the adoption level of scientific pig production practices among the farmers of adopted and non-adopted villages".

METHODOLOGY

The study was conducted in the state of Assam during 2020-2021. The ex-post facto research design was used in this study. For assessing the adoption level, six adopted villages of ICAR-National Research Centre on Pig, Guwahati i.e, Sajjanpara, Sattargaon, Batabari, Belguri, Garilik and Kumarbari were purposively selected from Kamrup District. For comparison, six non-adopted villages were selected from Kamrup (Bengalikuchi and Baghbari villages), Tamulpur (Ambari and Barkhata villages) and Goalpara (Thekasu and Nabagram villages) districts considering the same socio-cultural and socio-economic background. From each district two villages were selected. Using a semi-structured interview schedule, primary data was collected from 360 small scale pig farmers i.e., 30 farmers from each village were selected.

For measuring the adoption rate of scientific pig production practices, a composite adoption index was developed. For this, six major dimensions were selected based on the review of literature and experts' opinion. They are breeding, housing, feeding, management, health care and biosecurity. Under these dimensions, 72 scientific practices were selected as variables. Then relevancy testing was carried out and accordingly the variables were reduced to 45. The answer regarding the adoption of each scientific practice was collected in the form of yes or no question. Further, weights were assigned using principal component analysis (PCA) to the respective variables. This method was also used by Jaina et al., (2009), Kale et al., (2016) & Sendhil et al., (2018). The principal components with Eigen value > 1 were used following the Kaiser criterion.

Then, by using the weights for each variable, a composite index value was calculated with the following formula:

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

Where, X_i = The normalized value of i^{th} indicator; W_i = The weight of the i^{th} indicator

Finally, the farmers were categorised into low, medium and high adopter categories using cumulative square root frequency method. Further, Mann Whitney "U" Statistics was used to compare the means of two independent samples viz. adopted villages and non-adopted villages. The correlation analysis was done using spearman's rank correlation coefficient in SPSS software. The hypothesis testing was done using T-test. It tested the assumption that correlation coefficient of sample data can be generalized to the population. Based on the p-value obtained, the significance was noted.

RESULTS AND DISCUSSION

Adoption of scientific pig production practices

An adoption index was developed with six major dimensions and forty-five variables based on the weights assigned through PCA as shown in Table 1. The difference in adoption level of scientific pig production practices in the adopted villages of ICAR-National Research Centre on Pig and Non-adopted villages was measured using this index.

Based on the adoption index score obtained for each farmer, three categories of adoption level were formed by Cumulative Square Root Frequency Method. The distribution of respondents from adopted and non-adopted villages in different categories of adoption level were observed. In the adopted villages, about half of the farmers (50.56%) were under high adoption level category followed by 48.89 per cent farmers in medium adoption category. Only 0.56 per cent of the respondents belonged to low adoption category. Differently, in non-adopted villages, low adoption level was found among majority (88.33%) of the respondents followed by medium (10.56%) and high (1.11%) categories.

The Mann-Whitney "U" Test was used here for assessing the difference between adopted and non-adopted villages. The results revealed (Table 2) that the mean adoption index by the farmers of adopted villages and farmers of non-adopted villages were 0.51 ± 0.01 and 0.13 ± 0.01 respectively. A significant difference ($p < 0.01$) was found in overall adoption of scientific pig production practices among the small-scale pig farmers in adopted villages from non-adopted villages. Similar finding was revealed by Garai et al., (2017) regarding the adoption of scientific dairy farming practices after extension interventions. The data portrayed in Table 2 evidently showed that the mean scores of adoption of breeding, housing, feeding, management, health care and biosecurity were significantly higher in the adopted villages compared to non-adopted villages.

Effect of independent variables on adoption

It was observed that (Table 3) the adoption of scientific pig production practices in the adopted villages after conducting the extension activities were significantly and positively correlated with the education, experience in pig farming, family size, herd size, annual income, extension contact and social participation. Among these, except family size and social participation, all were significant at 0.01 level of significance.

The table revealed that the age and land holding size were not significantly correlated with the adoption. The similar nonsignificant

Table 1. Weight assigned to different variables in adoption index

S.No.	Variables	Weights assigned by PCA
I	Breeding	
1	Avoid the first heat after farrowing for breeding	10.97
2	Avoid mating young gilts on the first and second heats	10.81
3	Purchase of new pigs only from credible source with pedigree records	9.38
4	Avoid mating of close relatives	9.25
5	Keep pedigree record	7.75
6	Separate housing for male and female growers	7.64
II	Management	
7	Farrowing areas should be well bedded, clean and disinfected	11.29
8	Pregnant sow should be housed and fed separately after 70 days of gestation	11.19
9	Provision of shades and wallows for pregnant animals	11.12
10	Proper record keeping of farm operations	8.94
11	Practice of AI using semen from a credible source	8.07
12	Remove the needle teeth of piglets as soon as possible after birth	7.92
13	Manual/foster mother feeding practices for orphan piglets	7.16
14	Ear tagging at 1-3 days of life for identification of individual animal	7.07
15	Farm animals should have insurance coverage	6.53
16	Integrated farming with horticulture crops, fish, etc.	6.20
17	Male piglets for meat purpose should be castrated at very young age (2-3 weeks)	6.01
18	Weaning of piglets once they start taking adequate quantity of solid feed	5.92
III	Feeding	
19	Preservation of feed materials while in abundancy (Silage making)	10.75
20	Creep feeding of piglets from two weeks of age	8.86
21	Practice flushing (Giving extra feed to sows and gilts from 1-2 weeks prior breeding and return to normal feeding after breeding)	8.49
22	Feeding of mineral mixture	6.77
23	Provide balanced ration (carbohydrates, protein, vitamins and minerals)	6.61
24	Adjust the feed quantity according to the breed, body weight and growing stage	5.16
25	Use of unconventional feed resources to minimize the cost	3.97
IV	Housing	
26	Provide fresh air through cross ventilation	12.71
27	Proper drainage facility with slope on the floor	11.93
28	Raise the floor above ground level to prevent reptiles, rats etc	11.93
29	Floor should be free from dampness and it should be non-slippery	11.90
30	Separate room for pregnant animals, boars and lactating mothers	10.37
31	Ample space for the exercise to the animals	9.76
32	Provision of heat/cold stress management facilities in the pig shed	8.57
33	Provision of minimum distance from farmers house	3.87
V	Health care	
34	Iron injection for piglets on 4^{th} and 14^{th} day after birth	12.70
35	Vaccination against diseases as per the recommended vaccination schedule	8.77
36	Spraying of medicines against tick and lice regularly	8.36
37	Isolation of diseased animals	7.28
38	Practice of deworming on regular intervals	7.26
39	Consultation with veterinary officers for proper investigation and treatment of the diseases	7.02
VI	Biosecurity	
40	Regular disinfection of farm and premises using disinfectants	12.08
41	Regular cleaning of pig sites and pigs	9.95
42	Proper disposal or utilization of dung, urine and feed wastes	8.51
43	Use of gum boots and separate farm dress	8.00
44	Report diseases or unusual mortalities to the government authorities	6.46
45	Proper cleaning of hand after working in pig farm	3.83

Table 2. Difference in adoption of scientific pig production practices between adopted and non-adopted villages

Dimensions of Adoption index	Adopted villages (n=180) (Mean ± SE)	Non-adopted villages (n=180) (Mean ± SE)	Mann Whitney U Statistics	
			U Statistics	p value
Breeding	0.38 ± 0.02	0.02 ± 0.01	29002	0.0001
Housing	0.63 ± 0.02	0.10 ± 0.01	31143.5	0.0001
Feeding	0.46 ± 0.02	0.16 ± 0.00	29819	0.0001
Management	0.32 ± 0.02	0.06 ± 0.00	30413	0.0001
Health care	0.77 ± 0.02	0.33 ± 0.01	29904	0.0001
Biosecurity	0.65 ± 0.01	0.21 ± 0.01	30567	0.0001
Overall adoption	0.51 ± 0.01	0.13 ± 0.01	31849	0.0001

Table 3. Correlation analysis between different variables and adoption index score

S.No.	Independent variables	'r_s' value
1	Age	0.084NS
2	Education	0.361**
3	Experience in pig farming	0.532**
4	Family Size	0.192*
5	Land holding	0.053NS
6	Herd size	0.433**
7	Annual Income	0.298**
8	Extension contact	0.414**
9	Social Participation	0.226*

*Significant at 0.05 level of significance; **Significant at 0.01 level of significance; r_s= Spearman's rank correlation coefficient

correlation between age and adoption of dairy practices was reported by Gautam et al., (2007). In contrary, Rahman (2007) reported negative and significant correlation between age and adoption of improved technologies by the pig farmers of Mizoram. Farmers with higher education and more experience in pig farming, are better aware about the advantages of scientific pig production practices and hence might have adopted them largely. Regarding the family size, non-significant correlation with adoption of new dairy practices was reported by Gautam et al., (2007). With higher annual income, the farmers will be able to purchase the necessary inputs for piggery. Higher income earned by farmers might help them in adopting scientific health care and bio security practices for the pigs and they will be more enthusiastic to adopt new technologies. Similar finding was reported by Pabba et al., (2022) with regards to the adoption of climate resilient agricultural technologies. The better social participation and extension contact might have helped the farmers to fetch more information about the scientific practices and its advantages followed by greater adoption. The positive and significant correlation of extension contact and adoption rate of a technology was also reported by Singh et al., (2021).

CONCLUSION

The adoption index prepared can be used for assessing the adoption of scientific pig production practices by small scale pig farmers in future studies. The highly significant adoption level in the adopted villages compared to non-adopted villages shows the positive effects of extension activities carried out by the ICAR-National Research Centre on Pig. The positive correlation between the independent variables like education, experience in pig farming, family size, herd size, annual income, extension contact and social participation with the dependent variable adoption delineate the determinants to be focussed on in the planning of future extension activities. This study can pave way for planning need based training programs for the small scale pig farmers.

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Research Article

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Mango Growers' Preference of Mango Varieties According to Profitability in Murshidabad District

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ABSTRACT

Murshidabad district is famous for mango cultivation and presently around two hundred traditional mango varieties are produced. The present study was conducted on eighty mango growers randomly selected from five villages under Farakka block of Murshidabad district in May, 2021. The objective of the study was to identify some important mango varieties grown by mango growers and also to find out the relative preferences of the varieties according to profitability. Five varieties of mango namely, Himsagar, Langra, Amrapali, Fazli and Gopalbhog were identified and presented to the respondent in ten pairs. The respondents were asked to select one variety of mango over the other from each pair separately which they consider more profitable. For analysis of data, the method of pair comparisons was followed. According to the perception of the mango growers the most profitable mango variety was Langra followed by Himsagar. Fazli was more profitable than Amrapali but Gopalbhog was least profitable as perceived by the mango growers.

INTRODUCTION

Mango is one of the most popular fruits grown in India. At present, mango produced over 2.3 million hectares with production of 21.01 million metric tonnes per year in the country. Among the major fruits of India, mango is known as "King of fruits" as well as "National fruit of India" (Saadat & Gupta, 2017). It is a unique fruit that demonstrates the great quality and plenty of nutrients it contains. A mango can meet up to 40 per cent of the daily dietary fibre requirements (Divya & Arunachalam, 2020). Mango is very popular because of its broad extent of adoptability, higher nutritive value and richness in variety, delightful taste and exceptional flavour. Mangoes, both raw and ripe, are used to make a variety of foods such as dried mango pulp, pickle, jam, chutney and other food items (Saha & Bhowmik, 2021). Mango has also medicinal property. In India, mangoes are commercially cultivated in Andhra Pradesh, Bihar, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Tamil Nadu, Uttar Pradesh and West Bengal. Mango productions are a vital component of our economy. It helps in increasing food supply, generate job opportunity and earning foreign exchanges (Khagra et al., 2021). The entrepreneurial characteristics of the mango farmers may be improved with training, exposure visit and educational programmes and also by involving them in various development programme regarding entrepreneurial activities to enhance their social- economic status in the rural area (Manivannan & Natarajan, 2020).

In the context of horticultural production in India, West Bengal stands at eighth position and is a progressive state which occupies prominent place in mango cultivation. Mango is grown all over the district of Malda, Murshidabad, Nadia and North 24 Paraganas (Halder, 2020). Besides it is also grown in many other districts like Hoogly, Burdwan, Jalpaiguri and Coochbehar. Murshidabad is a traditional horticulture belt. This district is famous for mango cultivation due to its soil and climatic condition and presently around 200 traditional varieties are produced (Majumder et al., 2016). The specialty of Murshidabadi mango is

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that these saplings are crossbred with flower and fruits. Each variety having its own distinct flavour and aroma is very delicate with very little fibre. But the mango farmers of Murshidabad district usually not getting remunerative market price of traditional varieties. Among these, Himsagar, Fazli, Langra, Amrapali, Gopalbhog, are few of the popular varieties grown extensively in Murshidabad district. The objectives of the present study were to find out the most important mango varieties cultivated by the mango growers in Murshidabad district and to find the relative preferences of mango varieties according to profitability as perceived by the growers.

METHODOLOGY

The study was carried out at Farakka block in Murshidabad district of West Bengal. Purposive as well as simple random sampling methods were followed. The district, block and the villages were purposively chosen. Under the Farakka block, five villages namely Alaipur, Arjunpur, Beniagram, Ballalpur and Bewa were selected. A total of eighty respondents (viz. 16 respondents from Alaipur, 20 from Arjunpur, 21 from Beniagram, 15 from Ballalpur and 8 respondents from Bewa) were selected by random sampling method. The data were collected in the month of May 2021 by personal interview method with the help of interview schedule. After discussion with Assistant Director of Agriculture, five mango varieties namely; Himsagar, Langra, Amrapali, Fazli and Gopalbhog were identified in order to find out the preferences of mango growers relating to profitability.

In order to identify the hierarchy of mango varieties relating to profitability, the method of paired comparisons (Edward, 1969) was followed. In the method of paired comparison, the F-matrix, P-matrix, rearranged P-matrix and Z-matrix were calculated. The five varieties of mango were presented to the mango growers in 10 pairs, in maximum possible combinations. The mango growers were asked to select one variety over the other from each pair separately on the basis of profitability. The frequency in the F-matrix table depicts that number of times each variety is judged more profitable than the other variety by the total number of respondents.

The P-matrix provides the proportion of times the varieties in the column is judged more profitable than the variety of the row. This is acquired by dividing the data of each cell in the F-matrix by the entire number of respondents. The rearranged P-matrix is then made with a variety having the smallest column sum at the left and that with the highest at the right. The Z-matrix represents the normal deviation corresponding to the proportion in the P-matrix table. This is found in the table of normal deviates (Edwards, 1969).

RESULTS AND DISCUSSION

The relative importance of five mango varieties according to profitability was found out based on the responses of 80 mango growers of the five villages. The hierarchy of mango varieties relating to profitability provided a clear picture of relative importance of mango varieties for development of horticultural enterprise in Murshidabad district.

A perusal of Table 4 and figure revealed that Langra was the most profitable mango variety which ranked first followed by Himsagar, Fazli, Amrapali and Gopalbhog respectively. So, Langra was the most lucrative variety as it fetched good market price and best variety for canning and preservation purpose. English

Table 1. F-matrix of five mango varieties judged by the eighty respondents according to profitability

Varieties	Himsagar (A)	Langra (B)	Amrapali (C)	Fazli (D)	Gopalbhog (E)
Himsagar (A)	–	58	29	34	15
Langra (B)	22	–	27	26	6
Amrapali (C)	51	53	–	50	22
Fazli (D)	46	54	30	–	12
Gopalbhog (E)	65	74	58	68	–

Table 2. P-matrix corresponding to F-matrix

Varieties	Himsagar (A)	Langra (B)	Amrapali (C)	Fazli (D)	Gopalbhog (E)
Himsagar (A)	0.500	0.725	0.362	0.425	0.187
Langra (B)	0.275	0.500	0.337	0.325	0.075
Amrapali (C)	0.637	0.646	0.500	0.625	0.275
Fazli (D)	0.575	0.675	0.375	0.500	0.150
Gopalbhog (E)	0.812	0.925	0.725	0.850	0.500
Sum	2.799	3.471	2.299	2.725	1.187

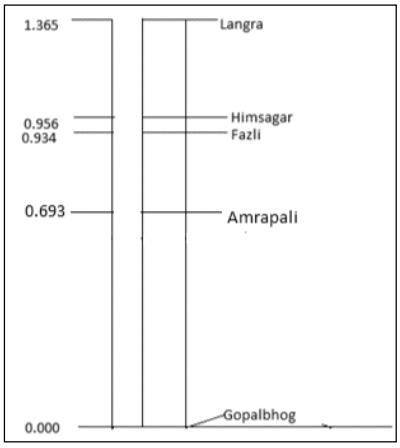
Table 3. Rearranged P-matrix- smallest to highest column sum

Varieties	Gopalbhog (E)	Amrapali (C)	Fazli (D)	Himsagar (A)	Langra (B)
Gopalbhog (E)	0.500	0.725	0.850	0.812	0.925
Amrapali (C)	0.275	0.500	0.625	0.637	0.646
Fazli (D)	0.150	0.375	0.500	0.575	0.675
Himsagar (A)	0.187	0.362	0.425	0.500	0.725
Langra (B)	0.075	0.337	0.325	0.275	0.500
Sum	1.187	2.299	2.725	2.799	3.471

Table 4. Z-matrix -Hierarchy of five mango varieties according to profitability

Varieties	Gopalbhog (E)	Amrapali (C)	Fazli (D)	Himsagar (A)	Langra (B)
Gopalbhog (E)	0.000	0.598	1.036	0.885	1.440
Amrapali (C)	-0.598	0.000	0.319	0.350	0.375
Fazli (D)	-1.036	-0.319	0.000	0.189	0.454
Himsagar (A)	-0.889	-0.353	-0.189	0.000	0.598
Langra (B)	-1.440	-0.421	-0.454	-0.598	0.000
Sum Z	-3.963	-0.495	0.712	0.826	2.867
Mean Z	-0.792	-0.099	0.142	0.165	0.573
Add largest negative deviation	+0.792	+0.792	+0.792	+0.792	+0.792
Rank* (scale value) R	0.0005th	0.6934th	0.9343rd	0.9562nd	1.3651st

*Rank after adding largest negative deviation (+0.792)



translation of the Hindi word Langra is "lame". It is thought that Banaras (now Varanasi) was where Langra Aam first appeared. This mango variety is found to be fibreless, yellowish brown, rich pulp, incredibly juicy and having a strong smell when it ripened. Its size varies from medium to large. This pulpy fruit are very sugary. It was also available in the market up to the month of August, the end season of mango in the market; for this reason, it was most profitable variety in Murshidabad district.

Among the five mango varieties, Himsagar occupied second position in terms of profitability. The preference of mango growers with respect to Himsagar was compatible for its good taste, having yellow to orange flesh with less fibre. In Murshidabad district, locally it is also known as 'Khirsapati'. Though this mango is abundant in the Malda district, especially along the banks of the Mahanadi and Kalindi rivers, it is also found in Murshidabad dotted with old and new orchards. There were numerous zamindar gardens spread across hundreds of acres of land that were started in the early 1700s and continue to produce great quality mangoes. The Geographical Indication Tag (GI) for the "pride of Bengal" was given in 2008 for this mango varieties. This was the significant cause of getting the rank. But these findings were contradictory to the findings of the study conducted by Sampa et al., (2019) as according to them, Himsagar was more profitable mango variety than Langra.

Fazli stood third position according to profitability. The scale values on profitability of Himsagar and Fazli were 0.956 and 0.934 respectively and a perusal of the figure revealed that there was a marginal difference in the scale value. It may be concluded that both Himsagar and Fazli were more or less equally profitable. Fazal Bibi of the village of Arapur is the source of the name Fazli, also known as Fazli Babu. The fruit has a lovely pale-yellow colour, a juicy yet firm flesh, and a delightful aroma. It also tastes sweet having less fibre. The largest and heaviest mangoes in this mango's family range in weight from 700 to 1500 g. The Geographical Indication Tag (GI) for this enormously well-liked mango was awarded in 2008. Similarly, Amrapali scale value was 0.693 but Gopalbhog occupied fifth rank by the mango growers with respect to profitability. Its scale value brought down to arbitrary zero as per rule of interval level of measurement. It did not indicate that Gopalbhog was not profitable and since its scale value brought down to arbitrary zero, it occupied fifth position and this mango variety was also profitable but it was least profitable among the five mango varieties grown in Murshidabad district of West Bengal. Amrapali was created as a cross between "Dasheri" and "Neelum." In Chakdaha, Nadia district, West Bengal, this hybrid mango was originally planted. The flesh inside was a rich orange-red tint. It was still unknown when, where and by whom the variety of Gopalbhog mangoes was invented. However, it can be assumed that this variety may have originated from the famous mango orchards of the Nawabs in Murshidabad. The Gopalbhog mango started to mature from the middle of May. Since May 20, more quantities had been coming to the market. The mango did not stay in the market for very long after ripening. In less than a month, they were no longer available. So, this mango varieties were less preferrable to mango growers. These findings were similar in line with Sampa et al., (2019) as Fazli, Amrapali and Gopalbhog mango varieties were ranked respectively.

According to Saripalle Madhuri (2019), due to lack of profitability, marketing opportunities were one of the key problems faced by the mango farmers while technology and information distribution platforms such as e-choupals had to build, to facilitate the development of traditional crops like mango. Farmers had become more attentive for business prospects for getting profit maximization (Goyal, 2010). According to Sarkar et al., (2022), in terms of profitability, employment had an advantage, but it had some constraints also like, lack of market knowledge, lack of proper transportation, absence of exact sense of waste management and safety and hygiene (Gebre et al., 2020). According to Roy et al., (2022), to safeguard the region's mangoes, good marketing channels and cold storage facilities for delayed marketing were required. As agriculture played a vital role in Indian economy, it

was of utmost importance to analyse the agricultural production and marketing system properly and try to resolve its problems (Sarkar et al., 2018). The characters can be considered important for finding out the quality superiority of this nutritive fruit and for the value chain managers in the farmer-consumer chain for branding (Sardar et al., 2019).

CONCLUSION

It is found that Langra and Himsagar are the most lucrative mango varieties preferred by the mango growers. Since mango enterprise is an important sector of Indian economy, the Department of Horticulture may take necessary initiatives for dissemination of modern technology for marketing of Langra and Himsagar variety in international market for earning foreign exchange. The price and the profit are highly dependent on the market situation. Similarly for maintaining proper quality and taste, proper cultivation procedure as well as grading of mangoes must be known to the mango growers.

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Predictive Factors for Farmers' Knowledge of Social Media for Sustainable Agricultural Development

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ABSTRACT

India is rapidly becoming digitally empowered, transforming the paradigm from paper to digital. Agriculture is not an exception to the availability of information on social media for users, establishing a communication link between farmers, extension agents and agricultural institutions. The study was undertaken in 2021 in the Gandhinagar district of Gujarat State to assess farmers' knowledge about social media. According to the findings, 65.00 per cent of farmers had a high level of knowledge about social media usage. Education, occupation, annual income, innovativeness, scientific orientation, use of ICT tools, use of social media platforms and information-seeking behaviour were positively and significantly correlated. At the same time, age and farming experience were negatively and significantly related to their knowledge of social media. Thus, to harness the outcome of the current trend of the behaviour of the farmers, policymakers working in the field of farmer capacity building might use the research findings to determine the content and approach of ICT programmes. Also, the results can be considered to create more farmer-focused social media platforms.

INTRODUCTION

Agriculture makes the country secure in terms of food, fodder, and other raw materials as feedstock for industries (FAO, 2015). It also serves as the source of livelihood for most of the Indian population. Agriculture contributes a significant figure to the country's overall economic growth and determines the standard of life for 54.60 per cent of the population (Anonymous, 2018). So it is very important to maintain sustainability in terms of growth in the agriculture sector over the long run (Amanjit et al., 2022). The problem with the country's extension system is the lack of human resources in agriculture extension agencies. The National Sample Survey Organization (NSSO, 2014) reported that only 41 per cent of farmers have access to one or more sources of information, while the remaining 59 per cent were ignorant in transferring knowledge to them, which results in a considerable decline in field gaps. The farmers may not be able to contact the extension professional to solve their problems (FAO, 2017).

Nowadays, social media in agriculture is a new upcoming field for information sharing and communication. The most popular social media in the farming community is WhatsApp, followed by Facebook, YouTube, Twitter and LinkedIn (Balkrishna & Deshmukh, 2017). It makes economical to disseminate agricultural information to farmers with the help of social media networks. Most of the respondents believed social media could play an important role in bridging the gap between stakeholders in agricultural innovation systems (Saravanan et al., 2015). A huge majority (95.90%) of the extension professionals said that social media impacts majorly on communication in the agricultural sector (Suchiradipta & Saravanan, 2018). The acceptance of social media has increased; thus, various applications, tools, platforms, functions, and features have been evaluated (Sandeep et al., 2022)

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as such developing awareness and skill of the farmers to use ICT tools for their farming benefits is required (Panda et al., 2019). The potential of social media need to be exploited to bring location specific and commodity oriented transformative changes in the agriculture extension delivery system (Nain et al., 2019).

Access to agricultural information is essential for farmers to increase their capacity to sustain and increase farm productivity. When farmers lack access to trustworthy scientific sources of agricultural information, they frequently rely on their informal social networks (such as their family and friends) and engage in informal agricultural knowledge exchange. Social network theories claim that rather than one's own values and character traits, a person's relationships, networks, and interactions have a greater influence on their behaviour. Interpersonal connection is essential for supporting learning processes because it allows learners to actively construct information by putting concepts into words that are based on the reactions and responses of others. Social media use among the rural population has increased recently. Understanding the roles social media plays in farmer decision-making and agricultural innovation in a broader is crucial. Understanding the factors that affect the information source and social media usage is essential to changing their behaviour. With this backdrop, the study has been conceptualized to study the knowledge level about social media and its association with the characteristics of the farmers and the nature and intensity of the relationship is worked out.

METHODOLOGY

The study was undertaken in the Gandhinagar (230 56' to 230' 01' north latitude and east longitude 730 33' to 720 33') district of Gujarat State, with four talukas, viz., Dahegam, Gandhinagar, Kalol and Mansa. Three villages were selected randomly from each talukas, and from each village, ten farmers were selected purposively those farmers who are using mobile phones and social media applications. In this manner, 120 respondents were chosen for the study. In line with the objectives of the study, the ex-post-facto research design was applied. The employed research design is a systematic experimental inquiry in which the researcher does not directly control on independent variables (Kerlinger & Katz, 1976). A list of variables to be dealt with was prepared based on a literature review related to the subject. Further, experts and research committee members were consulted and finally, the variables that were found to be most relevant to the present study were selected. The selected independent variables were age, education, occupation, farming experience, family size, landholding, annual income, innovativeness, scientific orientation, use of ICT tools and social media platforms for information-seeking behaviour. The level of understanding of how to use social media was chosen as the study's dependent variable. Gujarati version interview schedule was developed for data collection. The farmers who use smartphones were interviewed personally at their homes/workplace from January 2021 to March 2021). Before conducting an interview, the aim and objectives of the study were explained to the respondents in order to get whole-hearted responses and correct information from them. The variables were measured with suitable scales. The data collected were classified, tabulated and analysed. Statistical methods, such as the frequency and percentage, the arbitrary method, and the correlation coefficient, were used. Multiple linear regression analysis was also used to study the effect of independent variables on dependent variables.

RESULTS AND DISCUSSION

Knowledge level on the use of social media

It can be revealed from Table 1 that 97.50 per cent of the farmer knew about social media as a platform for interacting with each other online, 61.67 per cent of them knew about the usage

Table 1. Distribution of the farmers according to their knowledge level on the use of social media

S.No.	Statements	Correct response (%)
1	Social media is a collection of internet-based communities that allow users to interact with each other online.	97.50
2	Social media is used for information, entertainment, online marketing, communication and the transfer of technology.	61.67
3	Among these (Facebook, YouTube, Whatsapp and Twitter), which are the social media sites?	85.82
4	Social Media sites allow the posting/sharing of media content.	81.67
5	Social Media sites can be used for purchasing agriculture inputs.	56.67
6	Social Media sites can be used for the marketing of farm produce.	60.00
7	Social media sites/platforms can be used for social networking, photo sharing, video sharing and video conferencing.	81.67
8	Products can be bought or sold on the Facebook marketplace.	56.67
9	Social media allows users to connect with other farmers' groups worldwide.	76.67
10	Different groups can be created on Whatsapp.	80.83
11	A broadcast list can be created on Whatsapp.	64.17
12	News can be read on Facebook.	85.00
13	A personalized/Independent channel can be created on Youtube.	72.50
14	Which websites provide video conferencing (Google meet, Zoom and Cisco Webex)?	45.00
15	With the help of social media sites, you can share photos of pests and diseases and ask for solutions.	93.33
16	Social media allows farmers to link to agriculture universities and government organizations directly.	91.67
17	With the help of social media sites, you can know the price and arrivals of the commodity in different markets.	59.17
18	With the help of YouTube, you can create a Live Stream.	40.00
19	Basic service on social media is free of cost.	89.17
20	Different social media accounts can be linked to each other.	55.83
21	Social media can be accessed without an internet connection.	97.50

of social media for several purposes and 85.82 per cent of them were aware of the mainstream social media platforms. With the advent of the accessibility of the internet in rural areas, farmers access social media in their day-to-day life for varied purposes. When the farmers were inquired about specific knowledge about the use of social media, it was observed that 81.67 per cent of the farmers knew that social media can be used for posting and sharing media content, social networking and video conferencing, 76.67 per cent of them knew the usage of social media for connecting with farmers worldwide. This indicates that social media platforms are a popular choice of the farmers for sharing content online and networking with fellow farmers.

It can be inferred from Table 1 that 93.33 per cent of the farmers knew about social media's use in sharing photos of pests and diseases and seeking advice, and 91.67 per cent of them knew that social media is a potent mechanism of connecting with agricultural universities and government organization directly, 60.00 per cent of them had knowledge about the use of social media for the marketing of farm produce, 59.17 per cent of them knew social media usage for knowing prevailing market prices and 56.67 per cent of them had knowledge about the use of social media for purchasing agriculture inputs as well as for buying and selling products on Facebook marketplace. The farmers generally knew about the use of social media to purchase agricultural inputs, seek farm-related advice and check market prices.

Some important functions of navigating through social media may aid the extension functionaries directing the farmers, like 97.50 per cent of the farmers knew that social media cannot be accessed without the internet and 89.17 per cent of them knew that basic services in social media are free of cost. Whatsapp's provision of group creation (80.83%) and broadcast list creation (64.17%) was known by the farmers. The ease of linking several social media accounts to each other was known by 55.83 per cent of farmers, 72.50 per cent of them had knowledge about creating a personal channel on YouTube, but only 40.00 per cent of them knew about the facility of Live streaming on YouTube. The farmers (85.00%) knew about the usage of Facebook for news, but only 45.00 per cent of them knew about videoconferencing. The farmers can be sensitised by the importance and use of videoconferencing as it can aid in real-time problem solving and networking.

Overall knowledge level on use of social media

The data regarding the knowledge level of farmers' use of social media is presented in Table 2. The data clearly shows that 65.00 per cent of farmers had a high knowledge level of social media, whereas 34.17 per cent of farmers had a medium knowledge level of the use of social media. According to the preceding data, most farmers had high social media knowledge. The high affordability of smartphones and the low cost of internet data subscriptions could cause high social media awareness. The findings were comparable with Pratik & Vinaya (2021), Pudke et al., (2018) & Shanmuka et al., (2022a & 2022b).

Table 2. Distribution of the farmers according to their overall knowledge level on use of social media

S.No.	Category	Per cent
1	Low (1 to 7 Score)	00.83
2	Medium (8 to 14 Score)	34.17
3	High (15 to 21 Score)	65.00

Relationship between knowledge of farmers about social media with their profile

It can be observed from Table 3 out of twelve independent variables, nine viz.; education (0.315), occupation (0.295), annual income (0.246), innovativeness (0.675), scientific orientation (0.543), use of ICT tools (0.531), use of social media platform (0.768), information-seeking behaviour (0.592) and landholding (0.183) were positively and significantly correlated. It can be inferred that educated farmers who know the use of social media were more likely to be knowledgeable about social media. Even the farmers who were innovative and had a scientific temper knew well about social media and its uses. At the same time, age (-0.573) and farming experience (-0.488) were negatively and significantly related to their knowledge of social media. It was seen that younger farmers had more knowledge about social media. Only one of the twenty variables, the family size (-0.132)—could not be significantly related to the participants' familiarity with social media.

Table 3. Relationship between knowledge of social media with a profile of farmers

S.No.	Independent Variables	('r' value for knowledge)
1	Age	-0.573**
2	Education	0.315**
3	Occupation	0.295**
4	Farming experience	-0.488**
5	Size of family	-0.132
6	Landholding	0.183*
7	Annual income	0.246**
8	Innovativeness	0.675**
9	Scientific orientation	0.543**
10	Use of ICT tools	0.531**
11	Use of social media platform	0.768**
12	Information-seeking behaviour	0.592**

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

Multiple linear regression analysis between knowledge of social media with profile of farmers

It could be observed from Table 4 that the independent variables with the knowledge of social media of the farmers taken on multiple linear regression analysis gave the R^2 (Coefficient of multiple determination) values of 0.702. It means that 70.20 per cent of the farmers' total variation in knowledge of social media is contributed by selected independent variables (predictors). The independent variables like the use of social media platforms were found to be positive and highly significant. The higher utilization of social media may lead to a higher knowledge about social media. Scientific orientation, use of ICT tools, social media platforms, and information-seeking behaviour were positive and significant. While occupation, size of family, and landholding were found to be positive and non-significant, age, education, farming experience, and annual income were found to be negative and non-significant.

Table 4. Multiple linear regression analysis between knowledge of social media with a profile of farmers

S.No.	Independent variables	Regression coefficient	Std. Error	't' Value
1	(Constant)	3.037	4.097	0.741
2	Age	-0.022	0.051	0.438
3	Education	-0.467	0.367	1.272
4	Occupation	0.424	0.492	0.863
5	Farming experience	-0.044	0.047	0.931
6	Size of family	0.602	0.528	1.140
7	Landholding	0.260	0.317	0.821
8	Annual income	-1.44E-06	00	1.158
9	Innovativeness	0.147	0.062	2.383*
10	Scientific orientation	0.299	0.124	2.401*
11	Use of ICT tools	0.465	0.210	2.209*
12	Use of social media platforms	0.720	0.177	4.059**
13	Information-seeking behaviour	0.154	0.059	2.610*

R^2= 0.702; Adjusted R^2 = 0.669; ** = 0.01 level of significance; * = 0.05 level of significance

The extension functionaries can focus on such factors to disseminate information through social media. For instance, farmers with higher information-seeking behaviour may be eager to know about social media and they may be prompt to accept it. In contrast, older farmers who aren't much educated can be dealt with using traditional methods.

Constraints encountered by the farmers in use of social media

It is evident from Table 5 that the farmers encounter many constraints regarding the effective use of social media. The major constraints included inadequate service, inadequate technical knowledge/skill, difficulty in finding relevant information, increased internet data requirements, unsuitable and incomprehensible information, inadequate response, irrelevant posts, fear of security of personal information on social media, language barrier to operating/use of mobile and lack of knowledge about gadgets functions and inadequacy of tools. In order to encourage farmers to utilize social media and bridge the knowledge gap, governments must address these pressing issues.

CONCLUSION

Most respondents had a high to medium level of knowledge about social media. The public extension system can use the study's findings which assist farmers in filling knowledge gaps. Furthermore, the characteristics like education, occupation, annual income, innovativeness, scientific orientation, use of ICT tools, social media platforms, and information-seeking behaviour were positively and significantly correlated to farmers' knowledge about social media. In order to take advantage of the effects of the current trend in farmer behaviour, policymakers should concentrate on those predictors while creating the content and strategy of their programmes. The findings of the study can also be used to develop farmer-friendly social media platforms.

Table 5. Constraints encountered by respondents for effective use of social media

S.No.	Constraints	Rank
1	Inadequate service (network coverage, speed)	I
2	Difficulty in finding relevant information (due to a large number of sources)	III
3	Inadequate technical knowledge/skill	II
4	Unsuitable and incomprehensible information	IV
5	Inadequate response	IV
6	Inadequacy of tools (smartphones, laptops)	VII
7	Lack of knowledge about gadgets functions	VI
8	Language barrier to operating/use of mobile	V
9	Irrelevant posts	IV
10	Increased internet data requirements	III
11	Fear of security of personal information on social media	IV
12	Time spending on social media increased	VIII

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Research Article

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Assessment of Fisheries and Management- Insights from Dal Lake, Kashmir

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ABSTRACT

The present study was done during 2019-20 to assess the current fisheries status of Dal lake in terms of species diversity, trophic status, trends and patterns in fish catch, the lake's physicochemical properties and its management. Shannon-Wiener index used to calculate the species diversity was 2.08 with the species evenness value of 2.19. The water quality analysis revealed that the lake is highly polluted due to various anthropogenic activities like sewage influx, vegetable cultivation, tourism activities, etc. The lake is dominated by omnivorous fishes followed by herbivores and carnivores. The compound annual growth rate results from 1989 to 2019 for capture fisheries showed the positive growth rate of 0.23. A lack of coordination between the different governing bodies has led the Dal lake to its brim of death. It is recommended to restore by controlling the sewage influx and weed growth. Additionally, the existing pattern of governance and management needs to be modified.

INTRODUCTION

In India fisheries and aquaculture form an important sector of employment, livelihood, and food security. The total fisher population of the country is about 28.06 million and inland fisheries is increasingly contributing to the country's nutritional security, with a present yield of over 10.43 million tonnes (Handbook of fisheries statistics, 2020), contributing to nearly 75.25 per cent of the total fish production with an annual growth rate of 7.3 per cent.

Dal lake is an urban lake and is the second largest lake in the state, playing an essential role in the economy through its tourist attraction and as a source of food and water. Sir Walter Lawrence described the lake as Lake Par-Excellence and is considered as the "liquid heart" of Srinagar (Masoodi & Kundangar, 2018). The total area of the lake has reduced from ~32 km^2 in 1859 to 18 km^2 in 2018 (Mushtaq et al., 2018), mostly due to the expansion of settlement areas (Rashid et al., 2017). The lake is an essential source of livelihood for the people involved in fisheries, tourism and vegetable production and marketing. Nine fish species of commercial importance have been reported in Dal Lake, with *Cyprinus* and *Schizothorax* (Kashir gaad/ Snowtrouts) being the dominant genera (Imtiyaz et al., 2017). Besides a main source of fish, the lake also provides vegetables, *Nadroo* (*Nelumbo nucifera*), rhizomes, fodder, water, etc. Once potable, the water quality of the lake has deteriorated (Trisal, 1987; Jeelani & Shah, 2006), reflecting the aggregative impact of many anthropogenic activities such as sewage influx from houseboats, agricultural runoff, encroachment and population pressure (Yaqoob et al., 2008; Qadri & Yousuf, 2008; Khan et al., 2012; Salem & Jeelani, 2017). About 1200 houseboats present in the lake (Fazal & Amin, 2012; Qureshi et al., 2016) act as a considerable source of untreated sewage (Tanveer et al., 2017). The water quality of the lake has further deteriorated due to reduced inflow of streams to the lake (Mushtaq et al., 2020), a probable impact of climate change in the Himalayan region (Parvez et al., 2014). Besides increased organic load, known factors like human settlements, hotels, floating gardens, and even dhobi ghats on the periphery contribute to the lake's slow death (RS, 2008).

In addition to threats to aquatic life, the drastic changes in lake water quality over the last few decades (Kumar et al., 2022)

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have affected ecology of the lake (Ganie & Hashia, 2020). The population of the indigenous *Schizothorax* fish species of the lake has declined considerably due to high pollution and the introduction of common carp species (Kundangar, 2004; Qureshi et al., 2016; Shakir, 2019). Earlier, many scientific studies have been carried in Dal lake about limnology, ecology, fisheries, and socio-economics. To maintain the biological equilibrium and its robust management, it is necessary to assess the level of governance, management, and fisheries aspects of the lake. So, the present study was taken to understand the current status of fisheries and to describe the past dynamics of fish trophic status, species diversity, and catch trends concerning the governance policies in vogue.

METHODOLOGY

The status of fisheries management of Dal Lake was documented by analyzing the data collected from both primary and secondary sources during 2019-20. The primary data was collected from key informants, local leaders from fisher communities and Department of Fisheries (DoF) J&K, by semi-structured personal interview schedules and focussed group discussions. The data was also obtained from the Department of Tourism (DoT) J&K, and the Jammu and Kashmir Lake and Waterways Development Authority (JKLAWDA), the main players involved in the management and governance of the lake. Catch details in terms of quantity and composition were taken from lake fishers and the data repository of DoF, J&K. To understand the nature and future of snow trout fishery, a long-term trend analysis of catch was carried out to predict the production trend.

The published literature between 1975 and 2019 (Trisal, 1987; Wani et al., 2015; Bhat & Dar, 2015; Lone et al., 2017; Amin et al., 2018; Mushtaq et al., 2018) were reviewed to understand the status of water quality, including pollution status and certain ecological aspects of Dal lake. The main aim of this assessment was to quantify the changes in selected water quality parameters that have affected fish diversity and catch composition over the last three decades.

Shannon-Wiener index (1949) was used to estimate the extent of fish species richness and lake diversity for two different time periods (1989-90 and 2018-19). For each fish species in the composition, the trophic level value was obtained from the trophic analysis available online on the fishbase.org website. Based on the trophic level values, fishes were categorised into different types: Omnivores, Herbivores, Detritivores (2-2.9); Mid-level Carnivores (2-3.9); High-level Carnivores (4-4.9); & Top predators (5 & above).

To calculate the growth over multiple periods and its cumulative variations, Compound annual growth rate was calculated at ten years intervals from 1989 to 2019 by using the below formula

$$\text{Compound Annual Growth Rate (CAGR)} = \left(\frac{Ending\ Value}{Begining\ Value}\right)^{\frac{1}{n}} - 1$$

Where n = number of years

RESULTS AND DISCUSSION

Table 1 reveals fluctuations in various water quality parameters of Dal lake probably because of an increase in sewage influx, pollution loads, organic loads and subsequent degradation (Kumar et al., 2022). The major changes were reported around 2006-07 leading to the sharp decline in *Schizothorax* fish production. The dissolved oxygen levels had significantly declined since the 1990s due to excessive growth of weeds and macrophytes, a direct impact of lake pollution (Mushtaq et al., 2018).

At the physiographic level, it was observed that the encroachments of the water channels and consequent clogging have diminished the circulation and inflows into the lake. The water quality of Dal lake was polluted due to of the direct drainage of sewage influx from nearby residential areas, defunct sewage plants, and from inside human habitation, particularly houseboats and lake dwellers. The chloride content of the water had drastically increased since the last two decades from 2 to 2.7 mg/l in 2007, to 10.3 mg/l in 2017 (Mushtaq et al., 2018) which may be due to drainage coming from catchment areas, raw sewage coming from houseboats and nearby settlements and organic runoff from floating gardens of both allochthonous and autochthonous origin (Ahangar et al., 2012; Kumar at al., 2022).

On the other hand, no major change in average annual temperature was reported. The temperature values were found to be in the good range for the growth of plankton except for the winters when the freezing of the lake reduces the growth of aquatic organisms and therefore food availability. Dal lake revealed mesotrophic nature with a moderate primary production level. Qureshi et al., (2016) reported a major contribution of *Schizothorax* to the overall fish catch of the Dal lake before the introduction of common carp in Kashmir in 1957. However, after its introduction, the *Schizothorax* catch declined sharply. During personal interviews and group discussions, similar views were reflected by the key informants and local leaders of fisher communities. The carp fish species had maximum diversity (5 species) in the Dal lake, followed by *Schizothorax* (3 species).

Table 1. Changes in water quality parameters over the years in Dal Lake

Parameter	1974-76	1985	1996-1997	2006-07	2018
Water temperature (°C)	16.4	-	-	15	16.4
pH	7.4-9.5	8.7	8.7	7.8-8.3	7-10
Dissolved oxygen (mg L^{-1})	10.25	8.7	8.6	6.8	7.07
Total alkalinity (mg L^{-1})	69.5	85.6	104	115	101.75
Nitrate (µg L^{-1})	481	483	272	539	400
Ammonia (µg L^{-1})	23.6	37.0	362	438	40
Ortho phosphate (µg L^{-1})	65.5	80.5	135	93	40
Total phosphorus (µg L^{-1})	187.8	211.5	768	615	200
Total dissolved solids (mg L^{-1})	30.2	32.2	119.8	20	-

(*Source:* Abubakr & Kundangar, 2009; Khanday et al., 2018; Dar et al., 2020)

Nine commercial fish species in Dal lake were recorded. The exotic carps were found to be the dominating ones while the indigenous snow trout species showed less contribution to the overall fish catch. Figure 1 shows the contribution of different fish species to the fish catch of the lake with an index value (H-value) of 2.08, signifying the ecosystem diversity of the lake in terms of the available fish fauna. Shannon-Weiner Index estimated the species evenness value of 2.19, mainly due to the dominance of common carp with other fish species like *Schizothorax* being found in lesser numbers. The analysis of trophic metrics depicts that the lake was dominated by omnivore fish species (55.5%) followed by herbivores (33.3%) and carnivore fishes (11.2%), indicating significant gaps between various trophic levels. The trophic level score indicates the relative frequency of the fish among all the trophic levels available in that aquatic system (Dubey et al., 2012; Kumar et al., 2013).

The DoF, J&K stocks the Dal lake every year with fingerlings of common carp fish species at various locations with the help of local anglers. The present area of Dal lake is 18 km^2 (1800 ha), and on average 420,000 fry/year were stocked in the lake over the last few years with a stocking density of 250 fry/ha (DoF, 2022). This data indicates a low seed stocking level of the lake when compared to general recommendations of 300 to 500 fingerlings/ha (DoF, J&K). Moreover, the personal discussion with fishers also revealed similar concerns regarding the stocking of Dal lake. The annual catch from Dal lake, including all stocked and non-stocked fishes, was 450.5 tonnes. Historically, the total fish production of Dal lake ranged from as low as 262.03 tonnes in 2007-08 to a maximum of 475.65 tonnes in 2003-04 (Figure 2). Fish production in Dal lake has exhibited fluctuations in production across the time considered.

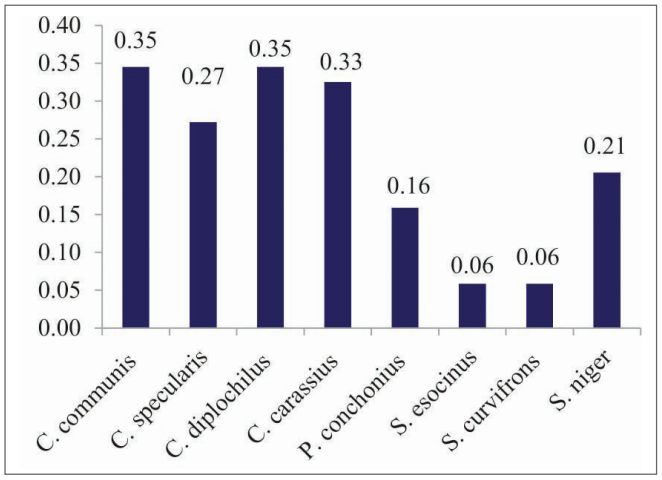

Figure 1. Species-wise contribution in the fish catch of Dal Lake

Based on data of total fish production (carp and *Schizothorax)* from 1989 to 2019, the estimated trend lines showed a severe decline in the catch of *Schizothorax* fish (Figure 2). The main reason for the reduction of snow trout production has been attributed to the water pollution owing to various anthropogenic activities (Qureshi et al., 2016). Pollution has badly affected *Schizothorax* fish production and has destructed the breeding grounds of the native fish. This impact has been very severe since 2007-08 and had a tremendous effect on the total fish production in Dal lake. Inspite of this, the total fish production of the lake has remained more or less constant due to the compensatory increase in performance of common carp fish production that is more resistant to the adverse environmental conditions of the lake.

CAGR was used to determine the growth in fish production in the lake over the time period considered (Table 2). The positive value of 0.23, depicts that in the given time period, there is an increase of 0.23 per cent in the fish catch from 1990-2019 which may be attributed to the considerable increase in the production of common carp. Decade-wise the growth rate was negative from 2000 to 2009, were a decline of 4.52 per cent occurred. The main reason for this reduced growth rate was the significant decline in *Schizothorax* fish production because of excessive pollution and the non-functioning of some sewage treatment plants (STP) at the lake periphery. The growth of *Schizothorax* from 1989 to 1999

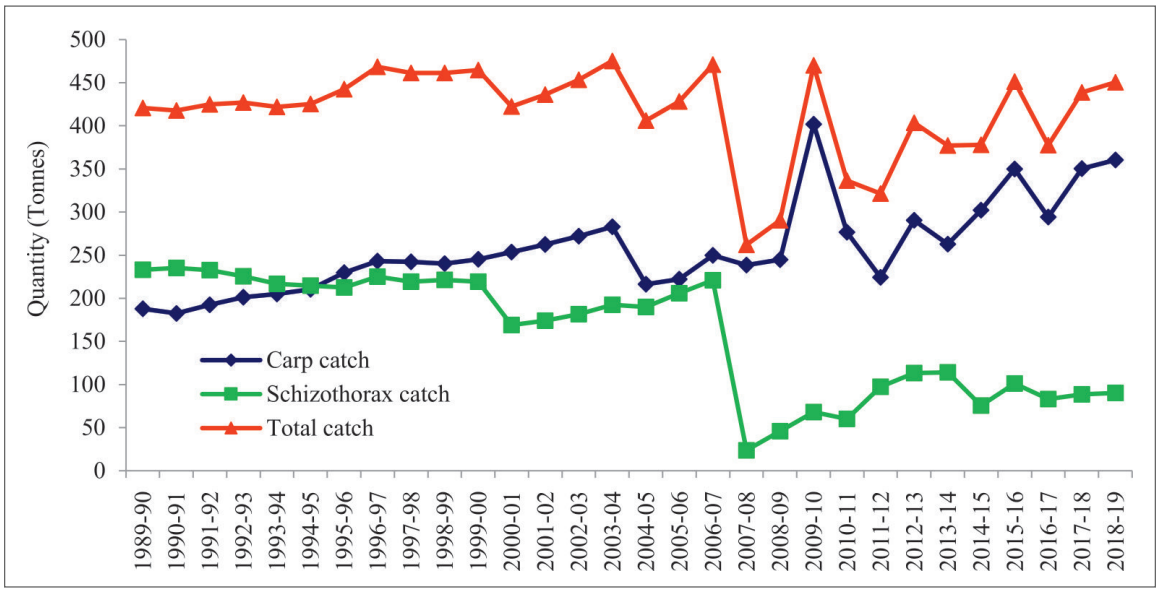

Figure 2. Carp and *Schizothorax* fish production in the lake

Table 2. Decadal CAGR of fish production in the lake

Time period	Total production	Carp production	*Schizothorax* production
1989-99	0.92	2.49	-0.53
2000-09	-4.52	0.19	-14.52
2010-19	4.49	4.22	2.83
1990-2019	0.23	2.20	-3.12

also showed a negative value, but the magnitude of the decline was very less. The fluctuations in the fish catch can be partly explained by poor management and more fishing effort.

The functioning and activities of DoF, J&K as understood during the present study are shown in Table 3. The fishing rights of Dal lake are fully vested in this department. It was observed that the fisheries aspect is being given less priority or at times neglected and remains a major issue regarding governance of the lake. It needs to be addressed in light of recent developments by following the various natural resource management strategies and the same has been reported by Tyagi et al., (2015) for reservoir fisheries management. More focus is given to the tourism sector because of more income from tourism activities in the lakes. Additionally, there is a lack of coordination between the mentioned departments involved in the management of the lake. However these things can be rectified by promoting the participation of all the key players and stakeholders in a single platform for the sustainable growth of the lake and similar findings have been reported by Priyanka & Devarani (2022).

Based on the nature of fishing and conservation status, four types of fishing licenses are issued by the DoF, J&K. These include fishing licenses in protected waters of the lake with a license fee of Rs. 600/annum, fishing licenses in reserved waters of the lake with a license fee of Rs. 500/annum, *Hakreeza* license with a license fee of Rs. 400/annum, *grass* license with a license fee of Rs. 500/annum and *Nadroo* (*Nelumbo nucifera*) licenses with a license fee of Rs. 1000/annum. All these licenses have a validity period of one year (April to March of the next year). The lessee has to follow specific rules and regulations as per the agreement regarding mesh size regulation, ban on fishing and fish marketing during the breeding season, prohibited fishing in sanctuaries, the proper size of fish to be harvested, stocking of seed and engaging only licensed fishers for fishing, etc. mentioned in the revised Fisheries Act 2018 (DoF, 2022).

It was observed that due to the unavailability of a proper fish market, the fishers themselves do fish marketing on the banks of Dal lake and in nearby villages, with fisherwomen selling the majority of the catch. The price of the fish varies as per the season, size of the fish, marketing channel, and market location. Fishers get more prices during winter and less during the summer season because of less availability and good condition of the fish in winter. The cost of fish (Carp and *Schizothorax*) in 2021 in distant markets during winter was Rs. 240 to 280/kg, and in the summer season, it varied between Rs. 180 to 210/kg. If the fishers sell their catch by themselves at the lake periphery, in the winter and summer seasons, they used to get a price was Rs. 220 to 250/ kg and Rs.170 to 190/kg, respectively.

Mainly two types of marketing channels were followed for fish marketing at Dal lake. The first and the shortest channel was from fishers to consumers directly. The second channel started from the fishermen to fisherwomen and then to the consumer. In the second channel, the female household member played a vital role. Almost 90 per cent of the catch from Dal lake was being sold through this channel only.

Most of the fishers were involved in fishing as their primary occupation. There was a lack of occupational diversification among fishers because of less involvement in activities other than fishing. So any fluctuations in the fisheries aspect of the lake will have a direct impact on fishers' livelihood. Iqbal et al., (2020) in their study found that joint ventures and participation of the stakeholders will help in improving the condition of the common resources and their development. In the case of winters, the temperature used to be very less and at times the whole lake may get freeze. From the livelihood perspective, the winter season was very crucial and fishers used to suffer many problems to meet their daily needs. This can be addressed by providing them some alternate livelihood options in the form of ornamental fishery, aqua-shops and aquaponics and can be enhanced by providing fishers hands-on training about the same activities, similar results were found by Sharma et al., (2011). As the lake is already a famous tourist destination, promoting aqua-tourism in line with agri-tourism will also be an emerging livelihood venture for the fishers (Slathia et al., 2015; Krishna et al., 2021). Also, for the better management of the lake, the fishers should be taken into consideration before formulating any scheme or policy.

CONCLUSION

Over the years the water quality of Dal lake has deteriorated causing adverse impacts on it fish fauna. The endemic *Schizothorax* fish populations have declined considerably owing to the pollution and introduction of exotics. At the same time, the total fish production of the lake has not much increased over the last few decades. The lack of proper governance, policy regulations and coordination between government agencies and fishers adds more negative impact to this. As observed, most of the policies have been formulated without considering fishers' perceptions. The DoF

Table 3. Functions performed by DoF, J&K

S.No.	Activities	Remarks
1.	Stocking	Done by DoF annually with an average stocking density of 250 fry/ ha/ year in Dal lake
2.	Monitoring and regulation	Insufficient management (no mesh size relation, fishing by non-license holders)
3.	Conservation	Ban on catching undersized fishes (less than 5 inches) but no ban on broodstock catch, ban season May 1st to June 30th
4.	Marketing	Sometimes the catch is sold at the lake by the fishers' and sometimes to the contractor directly
5.	Collection oflicense fees	Done by DoF

should initiate fish product development, ornamental fishery, aqua-shops, aquaponics, etc., to attract tourists to earn revenue for the fishers. Besides, tourism can also be an alternative livelihood for fishers, providing other means of economic source to the fishers.

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Impact Analysis of Cluster Frontline Demonstrations on Groundnut in Nalgonda District, Telangana

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ABSTRACT

The present study was conducted to analyze the yield gap between improved package of practices and farmers' practice during *rabi* 2016-17 to 2020-21 in CFLDs on groundnut. The highest average pod yield was obtained in CFLDs (2341.6 kg/ha), with 27 per cent more against farmers' practice (1843.6 kg/ha). The average extension gap, technology gap and technology index were 498.0 kg/ha, 658.4 kg/ha and 21.9 per cent, respectively. Sustainability yield index (0.78) and sustainability value index (0.84) averages were high in improved practice over the farmers' practice (0.76 and 0.75). The average gross returns (Rs. 1,28,283.0/ha), net returns (Rs. 71,934.0/ha) and benefit-cost ratio (2.6) were higher in improved practice when compared to farmers' practice. The mean of additional gross returns (Rs. 24,873.0/ha), cost of cultivation (Rs. 4,151.0/ha), net returns (Rs. 28,402.0/ha) with incremental benefit-cost ratio of 6.0 was observed in improved practice. The average yield gap percentages within district and state averages were 64.2 per cent and 45.6 per cent, respectively. The per cent increased horizontal spread of area under groundnut was 14.1 per cent, 23.9 per cent and 27.5 per cent during study period, whereas in 2016-17 and 2018-19 per cent horizontal spread area decreased -52.3 per cent and -15.9 per cent, respectively with cultivation of improved varieties i.e., K-9 and ICGV 3043 against cultivation of old traditional varieties.

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is a major oilseed crop in India, cultivated under both rain-fed and irrigated conditions during *Kharif*, *Rabi* and *Summer* seasons. The groundnut crop contributing around 37 per cent of the total oilseed production in India. The acreage in the country is fluctuating over the years and the area is declined from 87 lakh ha to 47 lakh ha from the last two decades. The farmers are shifting from groundnut to other remunerative crops due to low minimum support price and fluctuations in market prices. The groundnut is cultivated in an area of 4.8 million ha with a production of 6.8 million tonnes with productivity of 1422.0 kg/ha. In Telangana, groundnut occupies an area of 1.0 lakh ha with production of 2.4 lakh tonnes and with an average productivity of 2350.0 kg/ha (Anonymous, 2020). In Nalgonda district, it is being cultivated in 47 per cent of the area under irrigation with 54 per cent production. Productivity of groundnut in Nalgonda under irrigated and rain-fed conditions were 1106.0 kg/ha and 885.0 kg/ha, respectively. Groundnut productive potential was high in Nalgonda due to cultivation in red sandy loams soils, assured irrigation facilities through the sprinkler system, availability of major and minor micronutrients like nitrogen and phosphorus and potash, sulphur, boron, iron and

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zinc (Srinivasarao et al., 2013). A wide yield gap between potential yield and actual yield was observed due to major production constraints *i.e.,* scarcity of labour, adoption of traditional cultivation practices like use of low yielding varieties (Rai et al., 2020 & Mahalae et al., 2014), broad casting method of sowing, poor plant population and no seed treatment (Saravanan et al., 2018), non usage of critical inputs, non adoption of recommended dose of fertilizers (Kumar et al., 2010; Nain et al., 2014; Patil et al., 2018), non- application of gypsum at peg formation (25 DAS), frequent irrigations favoring luxuriant crop growth and non-adoption of IPM and IDM practices (Rai et al., 2013; Tankodara et al., 2018 & Ayyadurai et al., 2021) and more fluctuations in minimum support price (Venkatreddy & Kumarprabhu, 2017).

The technology gap is a major constraint in increasing yield and sustainability due to poor knowledge on the latest improved technologies among farmers in groundnut cultivation (Venkatreddy & Kumarprabhu, 2017 & Pawar Yogesh et al., 2018). Cluster Frontline Demonstrations (CFLDs) is an unique approach with the main objective of conducting demonstration in larger area on the farmers' field and creating awareness on the latest crop production technologies among the farmers (Raghava & Punnarao, 2013; Shaktawat & Chundawat, 2021). In keeping view of this, KVK, Kampasagar had planned and executed Cluster Frontline Demonstrations with improved technologies in groundnut under different farming situations with closer supervision and monitoring of the KVK Scientists which helps in increasing productivity, economic returns, and sustainability and to analyze yield gap and technology gap and impact of technology in groundnut cultivation with the best management practices.

METHODOLOGY

Cluster Frontline Demonstrations (CFLDs) were conducted by Krishi Vigyan Kendra, Kampasagar, Nalgonda District, Telangana with the latest improved crop production technologies in groundnut during five consecutive *rabi* seasons *i.e.* from 2016-17 to 2020-21. The CFLDs were conducted in six selected clusters in Nalgonda district *i.e.* Nandivarigudem, Madugulapally, Indugula, Dindi, Jalthanda and Duggaepally of different farming situations under National Mission on Oilseeds and Oil Palm (NMOOP). The selection of beneficiaries was through Participatory Rural Appraisal (PRA) technique, baseline survey, later active meetings, group discussions, and field diagnostic visits. A total of 300 demonstrations were conducted in five consecutive *rabi* seasons i.e. from 2016-17 (50 No.), 2017-18 (100 No.), 2018-19 (50 No.), 2019-20 (50 No.) and 2020-21 (50 No.).

The improved technology was demonstrated in one acre area of selected farmers' field and adjacent one acre was considered as control plot of same the farmer. To study the yield gap between potential and actual yields, beneficiaries were selected through group discussions. The selected beneficiaries were given pre-seasonal training and briefed about the improved package of practices for successful implementation of CFLDs, and provided the need based critical inputs for an area of one acre *viz*., groundnut seed of K-6 and ICGV 3043, seed treatment with tebuconazole @ 1 g/kg seed, Imidacloprid @ 1 ml/7ml of water for one kg seed, *rhizobium* @ 10 g/kg seed and *Trichoderma viride* @ 10 g/kg seed, pheromone traps @ 10/ha for monitoring of *Spodoptera* moths, spraying of pre-emergence and post-emergence herbicides, and spraying of need based plant protection chemicals was done to control of pests and diseases.

The percent yield comparison of improved practice with local check, district and state averages were calculated and also assessed the yield impact, impact of adoption and horizontal area spread. The technology gap, extension gap, technology index, and economic parameters were compared with farmers' practice.

$$\text{Impact yield} = \frac{\text{Yield of Improved practice} - \text{Yield of Farmer's practice}}{\text{Yield of Farmers' practice}} \times 100$$

Extension gap = Improved practice Yield – Farmers' practice Yield

Technology Gap = Potential Yield – Improved practice Yield

$$\text{Technology Index} = \frac{\text{Potential Yield} - \text{Improved Practice Yield}}{\text{Potential Yield}} \times 100$$

$$\text{Impact on horizontal spread area (change \%)} = \frac{\text{Area after demonstration} - \text{Area before Demonstration}}{\text{Area before Demonstration}} \times 100$$

Sustainability indices were calculated through (Sustainability Yield Index and Sustainability value index) following formulae.

$$\text{SYI/SVI} = \frac{\text{Y-O}}{Y_{max.}}$$

Whereas, Y=Estimated average yield/Net return of practices over the year,

O= Standard deviation,

$Y_{max.}$= Maximum yield/Maximum net return

RESULTS AND DISCUSSION

Adoption gap

The adoption gap is an important factor influencing productivity of groundnut. The yield gap analysis was evaluated

Table 1. Performance of improved technology on pod yield, extension gap, technology gap and technology index in groundnut during *rabi* 2016-17 to 2020-21

Year	No. of Demos	Variety		Yield (kg/ha)		Increase of yield over the control (%)	Extension gap (kg/ha)	Technology gap (kg/ha)	Technology index (%)
		Improved practice	Farmers' practice	Improved practice	Farmers' practice				
2016-17	50	K-9	K-6	2284.0	1520.0	50.3	764.0	716.0	23.9
2017-18	100	ICGV 3043	K-6 & TAG 24	2210.0	1973.0	12.0	237.0	790.0	26.3
2018-19	50	K-9	K-6 & TAG 24	3334.0	2375.0	40.4	959.0	-334.0	-11.1
2019-20	50	K-9	K-6	2130.0	1950.0	9.2	180.0	870.0	29.0
2020-21	50	K-9	K-6	1750.0	1400.0	25.0	350.0	1250.0	41.7
Mean	300	Average		2341.6	1843.6	27.0	498.0	658.4	21.9

through extension gap, technology gap and technology index. The extension gap was ranged from 180.0 to 959.0 kg/ha during the investigation period with an average of 498.0 kg/ha during five consecutive years (Table 1). Need arisen to educate the farmers on adoption of improved technologies as a wide gap between improved practice *vs* farmers' practice was observed. The technology gap varied from -334.0 to 1250.0 kg/ha during the study period (Table 1). The technology gap was higher and reflecting on farmers' due to non cooperation on demonstration of improved technologies and poor extension activities. This might be attributed to different parameters, viz. soil fertility status, crop suitability, and variations among dates of sowing and weather parameters. Similar observations were reported by Kumbhare et al., (2014); Nain et al., (2015); Jyothi & Subbaiah (2019); Pawar et al., (2018) & Rai et al., (2020); Strengthening of extension programs and location-specific on-farm research, encouragement and adoption of the improved package of practices lower the technology gap.

The technology index is dependent on the technology gap, and it is expressed in percentage (%). The higher value of technology index shows lower adoption of improved technologies by the farmers. The technology index of five years in demonstrations ranged from -11.0 to 42.0 per cent with an average of 22.0 per cent (Table 1). The lower technology index was observed (-11.0%) during *rabi* 2018-19 due to the interventions of KVK Scientists, adoption of the improved practices by the farmers. Timely and need based suggestions by KVK scientists, extension personnel, favorable climatic conditions and low incidence of pests and diseases favoured lower technology index. These findings were in conformity with Reager et al., (2020); Pawar et al., (2017 & 2018) in groundnut, and Shaktawat & Chundawat, (2021) in oilseed crops and Singh (2022) in Wheat.

Economic returns

The economics returns mainly depend on yield, variable cost, and fluctuations between minimum support price and market price. The values of input cost and labour wages varied from time to time. The higher average cost of cultivation (Rs. 50,349.0/ha), gross returns (Rs. 1,28,283.0/ha) and net returns (Rs. 71,935.0/ha) were recorded in improved practices with an average benefit-cost ratio of 2.6 when compared to farmers' practice (Rs. 54,500.0, 1,03,410.0 and 43,532.0/ha, respectively) with an average benefit-cost ratio of 1.9. These results were at par with Venkatasubbaiah et al., (2019) & Ayyadurai et al., (2021) who reported the higher net returns and high benefit cost ratio in groundnut. Further, it was observed that on the average of five years, an additional gross returns of Rs. 24,873.0/ha, saving on cost of cultivation for Rs. 4,151.0/ha and net returns of Rs. 28,402.0/ha in improved practice were observed against farmer's practice with an incremental benefit-cost ratio of 6.0 (Table 2). These results were in conformity with that of PawarYogesh et al., (2017) & Saravanan et al., (2018); Reager et al., (2020); Rai et al., (2020); who observed higher benefit-cost ratio through improved technologies in groundnut and Leyak et al., (2021) in mustard and Saravankumar et al., (2020) in urd crop.

Yield sustainability

The higher values of the Sustainability Yield Index (SYI) and Sustainability Value Index (SVI) were observed in improved practice

Table 2. Impact of improved technologies on economics of groundnut during *rabi* 2016-17 to 2020-21

Year	Gross returns (Rs/ha)		Cost of cultivation (Rs/ha)		Net returns (Rs/ha)		B:C ratio		Additional returns in improved practice			
	Improved practice	Farmers practice	Improved practice	Farmers practice	Improved practice	Farmers practice	Improved practice	Farmers practice	Additional gross returns (Rs/ha)	Additional cost of cultivation (Rs/ha)	Additional net returns (Rs/ha)	Incremental B : C ratio
2016-17	111925.8	68400.0	39895.8	40900.0	42030.0	31500.0	2.8	1.7	43525.8	1004.2	10530.0	43.3
2017-18	93525.0	81880.0	49125.0	58125.0	44400.0	23755.0	1.9	1.4	11645.0	9000.0	20645.0	1.3
2018-19	153341.0	131567.0	52663.0	57026.0	100678.0	43652.0	2.9	2.3	21774.0	4363.0	57026.0	5.0
2019-20	133875.0	116204.0	54460.0	57930.0	79415.0	58273.5	2.5	2.0	17671.0	3470.0	21141.5	5.1
2020-21	148750.0	119000.0	55600.0	58520.0	93150.0	60480.0	2.7	2.0	29750.0	2920.0	32670.0	10.2
Average	128283.0	103410.0	50349.0	54500.0	71935.0	43532.0	2.6	1.9	24873.0	4151.0	28402.0	6.0

Table 3. Effect of production practices on Sustainability Yield Index (SYI) and Sustainability Value Index in groundnut during *rabi* 2016-17 to 2020-21

	2016-17		2017-18		2018-19		2019-20		2020-21		Mean	
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Max	2625.0	1830.0	2350.0	2180.0	3800.0	2950.0	2240.0	2140.0	2050.0	1800.0	2613.0	2160.0
Min	1969.0	1200.0	1950.0	1860.0	2625.0	2010.0	2000.0	1860.0	1450.0	1200.0	1998.8	1626.0
Av	2284.0	1520.0	2210.0	1973.0	3334.0	2375.0	2130.0	1950.0	1750.0	1400.0	2341.6	1843.6
SD	328.0	315.0	200.0	110.0	590.0	370.0	120.0	90.0	300.0	200.0	300.0	210.0
CV%	14.4	20.7	9.3	5.6	18.1	15.5	5.7	4.6	17.1	14.3	13.2	11.6
	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP	IP	FP
Net returns Max	44625.0	34770.0	45120.0	35970.0	106400.0	50150.0	78400.0	56000.0	96350.0	75600.0	74179.0	50498.0
Net returns Min	32488.5	21600.0	36270.0	29388.0	77437.5	35376.0	66000.0	42780.0	69600.0	49200.0	56359.2	35668.8
Net returns Av.	42030.0	31500.0	44400.0	23755.0	100678.0	43652.0	79415.0	58274	93150.0	60480.0	71934.6	43532.1
SD	6391.0	5873.0	4915.0	1281.0	15338.0	5880.0	7470.0	7751.0	14608.0	9095.0	9705.0	5706.0
CV%	16.1	23.4	11.7	5.2	16.1	14.0	10.0	15.2	20	15.4	14.3	13.8
SYI	0.75	0.66	0.86	0.85	0.72	0.68	0.90	0.87	0.71	0.67	0.78	0.76
SVI	0.80	0.74	0.88	0.62	0.80	0.75	0.92	0.90	0.82	0.68	0.84	0.75

IP=Improved practice; FP=Farmers' practice

than the farmers' practice. The Sustainability Yield Index was ranged from 0.71 to 0.90 with an average 0.78 in improved practice whereas in farmers' practice ranged was from 0.66 to 0.91 with a mean of 0.79. The Sustainability Value Index in improved practice was ranged from 0.80 to 0.92 with an average 0.84, whereas in farmers' practice SVI ranged from 0.76 to 0.99 with an average of 0.84 (Table 3). The maximum standard deviation and coefficient of variance were observed in improved practice compared to farmer's practice. It might be due to yield variations in the improved practice in farmers' fields. This implies on resulted that the improved technology is more sustainable compared to farmer's practice. Similar results were reported by Reager et al., (2022) in groundnut and Reager et al., (2020) in moth bean.

Impact of horizontal spread of groundnut area through CFLDs

The efforts were made to increase horizontal spread of area through impact of CFLDs in groundnut (Table 4). The results revealed that, CFLDs on groundnut helped in increasing groundnut area with improved practices in cluster villages. The area increase was non-significant (4350.0 ha) during *rabi* 2016-17 and later that it gradually increased up to 6596.4 ha from *rabi* 2017-18 to *rabi* 2020-21 except during *rabi* 2018-19 where the area decreased by 15.9 per cent due to abnormal seasonal conditions and low minimum support price. The incremental increase in area year after year might be due to improved agronomical practices and cultivation of high yielding short duration varieties, and higher market prices to groundnut. The CFLDs organized with improved varieties i.e. K-9 and ICGV-3043 in 5 years slowly replaced the traditional old varieties K-6 and TAG-24 in the district. Similarly, Mahalae et al., (2014) & Patil et al., (2018) also expressed that adoption of HYV in groundnut replaced old varieties.

Table 4. Impact of cluster frontline demonstrations on horizontal spread of area in groundnut during *rabi* 2016-17 to 2020-21

Year	Pre demonstration (ha)	Post demonstration (ha)	Change in area (%)
2016-17	9123.0	4350.0	-52.3
2017-18	4350.0	4965.0	14.1
2018-19	4965.0	4176.0	-15.9
2019-20	4176.0	5175.2	23.9
2020-21	5175.2	6596.4	27.5

CONCLUSION

The Cluster Frontline Demonstrations organized by KVK, Kampasagar had significantly increased yield in groundnut and rapid horizontal spread of recommended improved technologies. The pod yield of groundnut was increased upto 27.0 per cent in improved practices over the farmers' practice. The improved practices showed higher sustainability yield index and sustainability value index. The gross returns, net returns and benefit-cost ratio were higher in demonstrations as compared to the farmers' practice. The additional gross returns, net returns, additional cost with incremental benefit-cost ratio were high in improved practice. The groundnut varieties K-6 and TAG 24 will be replaced by K-9 and ICGV 3043 through large scale demonstrations in long run. CFLDs have made a significant impact on horizontal spread of area under

groundnut in the district over the last 5 years. Integration of improved production technologies showed better yield, good economic returns, yield sustainability and horizontal spread of area in groundnut through demonstrations.

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Research Article

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Forecasting of Vegetable Production in Haryana by Ordinary Least Square Method and ARIMA Model

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ABSTRACT

India has the world's second-largest production of fruit and vegetables. In India, a variety of agro-climate zones with unique seasons allow for the cultivation of a diverse range of vegetables. From this study, it was attempted to estimate the production of vegetables in the upcoming year through means of ordinary least squares (OLS) method and ARIMA (Autoregressive Integrated Moving Average) model using secondary data. This study is based on time series data of vegetables from 1990-91 to 2020-21 in open field condition, which was taken from National Horticulture Board (NHB) website, while the area and production reports on cultivation of vegetables from the Horticulture Department, Haryana state of India. In the current context, it was fetched out that the forecasted value of the vegetables production for the year 2021-22 will be 7540814.31 tonnes in open field condition. Further, for predicting the area and production of vegetables in Haryana, ARIMA (1, 2, 1) was fitted after experimenting with various lags of the moving average and autoregressive procedures.

INTRODUCTION

India has the world's second-largest production of fruit and vegetables next to China. In India, a variety of agro-climate zones with unique seasons allow for the cultivation of a diverse range of vegetables. Vegetables are the best sources of vitamins, dietary fibre, phytochemicals, and minerals. Vegetables with a shorter lifespan and increased yield have given farmers larger financial benefits (Kumar et al., 2021). The primary challenges cited by homestead vegetable growers included a lack of water resources, a high prevalence of pests and diseases, price volatility, high labour costs, high cost of cultivation, labour shortage, lack of timely access to inputs, and no guarantee of premium prices for organic products (Chandran, 2020).

The technique of forecasting allows for future predictions to be made using data from the past and present as well as trend analysis. The projection of crop output is a crucial factor in determining support policies for concerns like food security, efficient land use allocation, technology, and the environment. Verma et al., (2015); Kumar et al., (2016, 2017-a&-b & 2019) and many other studies have been done to improve forecasting utilising various pre-harvest forecasting methodologies, and they encourage forecasters to take a variety of methods into consideration and compare their performance across a variety of series. The current study attempted to predict Haryana's vegetable output in this context, providing the general public, academics, and decision-makers with long-term information on state-wide vegetable production. According to the study of Prakash et al., (2022), to make informed decisions about sweet potato production, marketing, and consumption, sweet potato producers, governmental organisations, and other stakeholders in the sweet potato value chain will benefit greatly from the anticipated price of the crop. Nimbarayn et al., (2022) conducted a study on modelling and forecasting of area, production and productivity of tomatoes. The results revealed that Haryana's tomato productivity won't grow significantly, but India's yield will increase. In the current study,

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an attempt was made to estimate the production of vegetables in the upcoming year through means of ordinary least squares (OLS) method using secondary data and forecasting was done by using the SPSS 26 statistical tool.

METHODOLOGY

This study was based on secondary data (time series data of vegetables from 1990-91 to 2020-21 in open field condition), which was taken from the National Horticulture Board (NHB) website, whereas area and production reports on cultivation of vegetables was obtained from Horticulture Department, Haryana state of India. Ordinary least square (OLS) method was used to forecast the production of vegetables in the upcoming year by using the SPSS 26 statistical tool. OLS is the most prominent method used in estimating the relationship in econometric models. It can be understood from simple regression model, which establishes the connection between two variables, where one is dependent and other is independent variable, related with a linear function (Koutsoyiannis, 2015). It is assumed that the variables are connected with the simplest mathematical form that is explained by the following equation

$$Y = a + b\ X$$

Where, Y = Production, X = Area Here, Y is a dependent variable and X is an independent variable, the parameters are a and b. Our main motive was to get the value of a and b which can be done through simple curve estimation in regression through SPSS 26 (Statistical Package for Social Science).

Box and Jenkins are credited with popularising the univariate ARIMA technique, and models created using this method are regarded to as univariate Box-Jenkins (UBJ) models. Identification, parameter estimation, diagnostic checking, and forecasting are the first three phases in univariate ARIMA modelling (Goyal et al., 2021). The ARIMA (p, d, q) model's basic functional form is:

$$\phi p(B)\ \Delta^d\ y_t = c + \theta_q\ (B)a_t$$

where, y = Agricultural Export, B = Lag operator, a = Error term (Y-y^, where y^ is the estimated value of Y), t = time subscript, ϕp (B) = non-seasonal AR i.e. the autoregressive operator, represented as a polynomial in the back-shift operator, D^d = non-seasonal difference

θ_q (B) = non-seasonal MA i.e. the moving-average operator, represented as a polynomial in the back-shift operator, ϕ's and θ's are the parameters to be estimated.

RESULTS AND DISCUSSION

Forecasting the Production of Vegetables for Year 2021-22

The analysis of data was done through the SPSS 26, where the Ordinary Least Square estimate to forecast the production for the year 2021-22. In the equation for defining the production of vegetables (forecasted), it was assumed that there is a relation between variables with the simplest possible mathematical form. Here in this Function, researchers are interested to see the effect of area on vegetable production by keeping another factor as constant. As it is well known that the production of vegetables does not depend on a single factor than many factors but in this study, the researchers were interested to see the effect of area on vegetable production. By accessing the data of area and production in SPSS 26, the list of model summary and parameter estimates was taken out.

Table 1 shows the model summary and parameter estimates of the linear function. The R square value was 0.937 which is significant at 0.05 level of significance. The value of constant is -197384.526 (Normally it should be positive, but here a turn up with a –ve (negative) sign, so the –ve (negative) part of the production function, since a negative does not make sense in economics as per suggested by Koutsoyiannis, 2015 in his book the Theory of Econometrics. By getting the values of parameters when the calculation was done then the forecasted value of the vegetables production for the year 2021-22 will be 7540814.31 tonnes.

Regression line estimation

The Table 2 shows that the compound function is explaining better other than linear, cubic and quadratic to the overall production function where the value of R Square 0.976 is very significant at

Table 1. Model Summary and Parameter Estimates of Linear Function
Dependent Variable: production

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant (a)	b1
Linear	.937	417.941	1	28	.000	-197384.526	244780.993

Source: Researcher's computation from secondary data

Table 2. Model Summary and Parameter Estimates of Different Functions
Dependent Variable: production

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	.937	417.941	1	28	.000	-197384.526	244780.993		
Quadratic	.967	392.502	2	27	.000	732219.221	70480.291	5622.603	
Cubic	.967	252.112	3	26	.000	702887.026	80983.467	4789.302	17.920
Compound	.976	1162.577	1	28	.000	864762.431	1.081		

Source: Researcher's computation from secondary data

0.00 (significance level). It can be interpreted that the compound function explaining the 97 per cent variability in the production which is the best explanation for the vegetable production function (Figure 1). Through SPSS 26 different plots are drawn for obtaining a line of fit in Figure 1 which depicted the linear (Li), quadratic (Qu), cubic (Cu) and compound (Co) fit of lines. The best fit line is represented by the compound function as shown in Figure 2. The best fit line of compound function representing the data of production which lies close to the lines are best described by the compound function line because the line is closer to the data values of vegetable production in different years. As the result obtained through production estimation it was found that the forecasted value of the vegetables production for the year 2021-22 will be 7540814.31 tonnes. This value was calculated through the coefficient values as shown in Table 3 which comes from SPSS 26 Table and the ordinary least square method equation number 1.

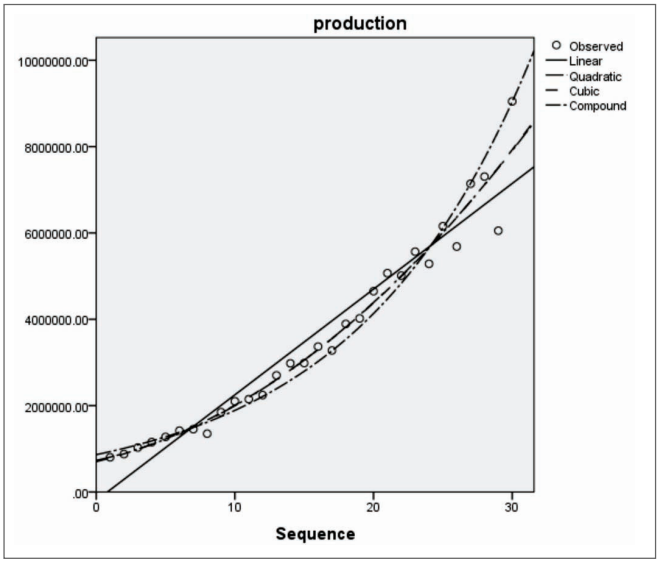

Figure 1. Regression line of diff. functions (Li, Qu, Cu, Co)

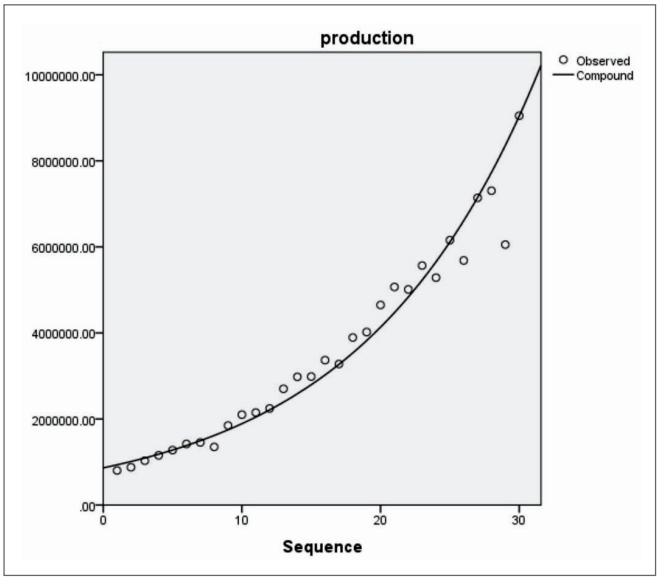

Figure 2. Regression line of compound function

Forecasting by using ARIMA Model

The ARIMA technique will be used to simulate India's exports of agricultural products. On the base of ACF and PACF analyses, the values of the parameters p, d, and q are determined. The area and production data of vegetables was discovered to be non-stationary, and order one differencing was all that was required to produce a suitable stationary series. In Table 3 and 4, the predicted ACF are displayed.

For predicting the area and output of vegetables in Haryana, ARIMA (1,2,1) was fitted after experimenting with various lags of the moving average and autoregressive processes. Past observations are averaged in the ARIMA model, although weights for more recent observations are bigger than weights for previous observations. The Marquardt algorithm (1963) has been used to minimise the sum of squared residuals. For this sort of data, a

Table 3. Autocorrelations: Area of Vegetables

Lag	Auto correlation	Std. error (a)	Box-Ljung Statistic		
			Value	df	Sig (b)
1	.904	.180	27.861	1	.000
2	.820	.291	51.601	2	.000
3	.729	.358	71.026	3	.000
4	.631	.403	86.126	4	.000
5	.547	.434	97.905	5	.000
6	.453	.456	106.320	6	.000
7	.366	.470	112.043	7	.000
8	.268	.479	115.238	8	.000
9	.180	.484	116.740	9	.000
10	.089	.486	117.124	10	.000
11	-.004	.487	117.124	11	.000
12	-.084	.487	117.502	12	.000
13	-.166	.487	119.068	13	.000
14	-.223	.489	122.070	14	.000
15	-.289	.492	127.395	15	.000
16	-.337	.498	135.131	16	.000

a. The underlying process assumed is MA with the order equal to the lag number minus one. The Bartlett approximation is used.
b. Based on the asymptotic chi-square approximation.

Table 4. Autocorrelations: Production of Vegetables

Lag	Auto correlation	Std. error (a)	Box-Ljung Statistic		
			Value	df	Sig (b)
1	.876	.180	26.148	1	.000
2	.793	.286	48.339	2	.000
3	.699	.350	66.188	3	.000
4	.602	.392	79.926	4	.000
5	.527	.421	90.861	5	.000
6	.438	.442	98.703	6	.000
7	.358	.456	104.159	7	.000
8	.252	.465	106.979	8	.000
9	.177	.469	108.435	9	.000
10	.099	.471	108.908	10	.000
11	.021	.472	108.930	11	.000
12	-.049	.472	109.061	12	.000
13	-.126	.472	109.966	13	.000
14	-.176	.473	111.822	14	.000
15	-.227	.475	115.125	15	.000
16	-.275	.479	120.278	16	.000

a. The underlying process assumed is MA with the order equal to the lag number minus one. The Bartlett approximation is used., b. Based on the asymptotic chi-square approximation.

Table 5. Parameter Estimates of ARIMA Model

			Estimates	Std. error	t	Sig.
Area	Natural Log	Constant	-0.004	0.001	-2.788	0.010
		MA Lag 1	1.000	32.015	0.31	0.975
Production	Natural Log	Constant	-0.002	0.001	-1.305	0.203
		AR Lag 1	0.975	1.208	0.807	0.427

Table 6. Diagnostic Checking of Residuals Autocorrelation: Area and Production of Vegetables

Model	No. of Predictors	Model Fit Statistics					
		R-Squared	RMSE	MAPE	Normalized BIC	Ljung-Box Statistics	Sig.
Area (1,2,1)	0	0.969	294106.20	20.68	20.48	19.49	0.244
Production (1,2,1)	0	0.937	564591.00	30.36	26.83	11.83	0.755

Table 7. Forecasted Value of Area and Production of Vegetables in Haryana

Model		2021-22	2022-23	2023-24	2024-25	2025-26
Area-Model_1	Forecast	427242	447120	443544	449366	448265
	UCL	493680	526777	541364	561289	574132
	LCL	367856	377004	359830	355339	344640
Production-Model_2	Forecast	7661519	9190527	8854857	9743716	9845482
	UCL	9427497	11501512	11702035	13206035	13841102
	LCL	6159987	7252040	6569575	7021375	6796828

prediction emphasising the most recent observations appears more logical than a forecast highlighting all previous observations equally. The criteria to estimate the AR and MA coefficients in the model were determined using log likelihood, Akaike's Information Criterion, AIC (1969), Schwarz's Bayesian Criterion, SBC (1978), and residual variance. Table 5 provides parameter estimates for the fitted models.

To determine if random shocks were white noise, Ljung & Box (1978) recommended using the residual ACF, the associated "t" tests, and the Chi-squared test (Table 6). In Haryana, the ARIMA model might be used to estimate and forecast the area and output of vegetables. Vegetable's area and production in Haryana have been determined to be trending significantly increased. For predicting the area and production of vegetables in Haryana, the degree of accuracy attained using ARIMA (1, 2, 1) was judged to be adequate, and residuals were considered to be white noise. Five-steps ahead (out-of-model development period i.e. 2021-22, 2022-23, 2023-24, 2024-25 and 2025-26) forecasted values of area and production of vegetables in Haryana are shown in Table 7.

For each model, forecasts start after the last non-missing in the range of the requested estimation period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, whichever is earlier.

Goyal et al., (2021) in their study found that the moving average and autoregressive procedures were tested with various lags, and ARIMA (0,1,1) was fitted to estimate agricultural export in India. It was discovered that the estimated agricultural export values for the years 2016–17 to 2018–19 were relatively close to the actual values, with percent deviations between the estimated and observed figures ranging from –2 to –4, and forecasted values for the three years ahead—2019–20, 2020–21, and 2021–22—lying within confidence limits based on ARIMA models.

CONCLUSION

The OLS estimation revealed that the forecasted value of the vegetable production for the year 2021-22 will be 7540814.31 tonnes. The best fit line of compound function representing the data of production which lies close to the lines are best described by the compound function line because the line is closer to the data values of vegetable production in different years. The compound function is explaining better other than linear, cubic and quadratic to the overall production function where the value of R Square 0.976 was very significant at 0.00 (significance level). It can be interpreted that the compound function explaining the 97 per cent variability in the production which is the best explanation for the vegetable production function. Further, for predicting the area and production of vegetables in Haryana, ARIMA (1, 2, 1) was fitted after experimenting with various lags of the moving average and autoregressive procedures. Five-steps ahead (out-of-model development period i.e. 2021-22, 2022-23, 2023-24, 2024-25 and 2025-26) forecasted values of area and production of vegetables in Haryana.

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Effect of Social Media Addiction on Mental Health of Emerging Adults

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ABSTRACT

In today's world, many of us rely on social media. Though each has its benefits spending too much time on social media can lead to many mental health issues. So the present study on the effect of social media addiction on mental health of emerging adults was conducted in Dharwad district of Karnataka state during the year 2020-21 to assess the social media addiction and its effect on mental health of emerging adults. One hundred and sixty students were selected randomly from arts and science degree colleges of Dharwad city. Data was collected from the students by using self structured questionnaire, social media addiction scale and mental health inventory which gathered information about social media usage, social media addiction and mental health level of emerging adults respectively. Results found that majority were using 1-3 GB of data per day on social media sites and were posting pictures and videos daily on these sites. Majority were using social media without the knowledge of parents by spending more time than desired by ignoring responsibilities. There was a negative relationship between social media addiction and mental health status and using excessive social media has negative effect which is influencing academic performance.

INTRODUCTION

Emerging adulthood is a developmental period that spans from the late teens to the twenties, with concentration from ages 18 to 29 years. It is a stage of entering higher education, prolonged job instability and marriage which reflects the deviations of this new period of life for young people. Having left the dependency of childhood and adolescence, having not yet entered the enduring responsibilities that are normative in adulthood emerging adults often explore a variety of possible directions (Arnett, 2000).

Social media are interactive technologies that allow the creation or sharing and exchange of information, ideas, interests, and other forms of expression through virtual communities and networks. Smart phones are providing millions of emerging adults throughout the world remarkable access to communication, entertainment, education, knowledge. In fast increasing information society, information and communication technologies (ICTs) play a critical role in all parts of our lives, and they have immense potential to alter the education sector (Singh et al., 2021). According to a study conducted by Pandey et al., (2020), Facebook, Twitter, Youtube, Instagram, and other social media networking sites can be a real-world distraction. The majority of students are spending a large amount of time on social networking sites on a regular basis. Students are viewing social media as having big negative repercussions such as wasting time on unnecessary activities and health-related difficulties, security and privacy issues, as well as lack of originality. With technology advancements, social media platforms such as YouTube, WhatsApp, and Facebook may easily be integrated into delivering content in many formats for agricultural information dissemination as well (Singh et al., 2021).

According to World Health Organization report (2004) Mental health is defined as person's psychological, emotional and social state of wellbeing. It affects how we think, feel, act, handle stress and make choices. It also includes depression, anxiety, hopelessness, disappointment, poor decision making, lack of confidence, unable to concentrate on works and occupied with contradictory thoughts.

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According to Coyne et al., (2019) increased usage of social media was linked to online harassment, poor sleep, low self-esteem, body surveillance, rejections, loneliness, depression, anxiety and despair all of which were linked to mental health difficulties. Greater time spent on social media was connected with mental health problems among late teens and emerging adults. The negative effects of social media are also come to the surface when used it excessively. Logging into others accounts, sharing of irrelevant photos and videos, hacking one's account and lack of privacy in online transactions are some of the biggest concern of internet users. Kelly et al., (2018) found an association between time spent on social media as well as the number of social media platforms used and mental health problems. The results indicated that time spent on social media is correlated with depression and anxiety which leads to more mental health issues. Different aspects of ICT and media were studied by Ravikumar et al., (2015); Nain et al., (2015); Panda et al., (2019); Nain et al., (2019) and reported different stragies to utilize them effectively. Anderson & Jiang (2018) reported that people who deactivated their Face book accounts for a month reported lower depression and anxiety, as well as increased levels of happiness and life satisfaction.

METHODOLOGY

The study was conducted in Karnataka state during the year 2020-21. A survey research was employed to know the usage pattern of social media among emerging adults. The sample for the present study consisted of undergraduate students both boys and girls studying in arts and science stream degree colleges of Dharwad city. Total sample for the study comprised of 160 emerging adults, out of which eighty students from two colleges of arts stream studying I & II year and eighty students from two colleges of science stream studying in I year and II year were selected randomly. A self-structured questionnaire was used to collect the information regarding social media usage of emerging adults like different social media sites used, number of apps used, amount of time spent on social media, GB used per day, purpose of using social media sites, frequency of posting on social media, influence on academic performance, ignoring responsibilities due to over indulgence, whether spending more time than desired and overall impact of social media.

Social Media Addiction Scale (SMAS) consists of 41 items with five point likert scale graded with the frequency expressions in the range of "Always (5)", "Often (4)", "Sometimes (3)", "Rarely (2)", and "Never (1)". The highest point to be taken from the whole of the scale is 205 and the lowest point is 41. Higher the score indicates increased social media addiction. Mental health inventory consists of 54 statements with four alternative answers like Always, Most of the times, Sometimes and Never, rated on four point scale. Out of 54 statements 23 are positive and 31 are negative. For positive statements the scoring is 4,3,2,1 and for negative statements it is reverse order (1, 2, 3 and 4). The score ranges between 54-216. The high scores on mental health inventory is an indicator of better mental health and vice-versa. The data was gathered personally from students through google forms which were sent to their WhatsApp accounts. Participants were informed about the purpose of the study and taken their informed consent before participation. Students were given instruction about how to fill the questionnaires. They were assured about confidentiality of their responses before filling up the questionnaires and the collected data were scored, tabulated and analysed using descriptive statistics of frequency, percentage, inferential statistics of correlation and results have been presented both in tabular and pictorial format.

RESULTS AND DISCUSSION

The distribution of emerging adults based on usage pattern of social media usage was presented in Table 1. With regard to different social media apps used by emerging adults cent percent were using YouTube, followed by Instagram (95.00%), Face book (90.00%), Twitter (75.00%), Skype (58.12%), Messengers (54.30%), Yahoo (51.25%), Quora (43.75%) and LinkedIn (30.00%). Khurana (2015) found that Face book was most used social media app followed by Instagram, Twitter and LinkedIn. Majority of emerging adults spent more time on social media sites to keep in touch with friends and family members. YouTube was used by majority for watching videos instantly and to create their own channels and upload videos which can be shared to many viewers. Face book, Instagram and Twitter were widely used by emerging adults which might be because of quick transfer of messages, video calling options, getting daily updates and option of uploading images and videos. Haneefa (2011) also expressed that Face book and YouTube were most popularly used social networking sites and daily used by emerging adults to chat with their friends online.

With regard to number of apps used where 21.85 per cent of the participants used 1-3 apps, 33.78 per cent used 4-6 apps and 44.37 per cent used 7-9 apps. Similarly Bicen & Cavus (2010) revealed that most of the young students were using more number of social media apps such as Face book, YouTube and WhatsApp regularly and spending four hours per day on these sites. In case of time spent on social media it shows that 50.00 per cent of respondents were spending 3-5 hours on social media followed by 23.34 per cent were spending 1-2 hours, 16.66 per cent were spending >5 hours and 10.00 per cent were spending <1 h on social media. Similar results were found in a study conducted by Manjunath (2013) that majority of emerging adults spend significant amount of time on using social networking sites regularly and average time spent was found to be 4-5 hours. With regard to amount of data used majority (65.60%) were using 1-3GB per day, followed by 23.80 per cent were using 500MB-1GB and 10.60 per cent were using 3-5GB. Majority of the emerging adults were using 1-3 GB of data per day for watching different movies, shows and for posting pictures and videos daily and are posting pictures every day on these social media apps about their daily routines, travelling pictures. In frequency of posting on social media majority were posting daily on social media (37.50%), followed by multiple times a day (31.80%), once a week (20.6%) and very few once a month (10.10%).

With respect to influence on academic performance majority (73.10%) expressed that it has negative influence on academic performance and more than one fourth (26.90%) expressed that it has no influence on academic performance. With regard to usage of social media upon instructed by patents not to use majority

Table 1. Distribution based on pattern of social media usage by emerging adults

Particulars	Purpose	Frequency (%)
Social media apps used	YouTube	160 (100.00)
	Instagram	152 (95.00)
	Facebook	144 (90.00)
	Twitter	120 (75.00)
	Skype	93 (58.12)
	Messenger	87 (54.30)
	Yahoo	82 (51.25)
	Quora	70 (43.75)
	LinkedIn	48 (30.00)
Number of apps used	1-3 apps	35 (21.85)
	4-6 apps	54 (33.78)
	7-9 apps	71 (44.37)
Amount of time spent	<1 h	16 (10.00)
	1 2 h	37 (23.34)
	3 5 h	80 (50.00)
	>5 h	27 (16.66)
Daily usage of data	500 MB- 1GB	38 (23.80)
	1-3GB	105 (65.60)
	3-5GB	17 (10.60)
	>5 GB	-
Posting on social media	Multiple times a day	51 (31.80)
	Once in a while/Daily	60 (37.50)
	Once a week	33 (20.60)
	Once a month	16 (10.10)
Influence on academic performance	Yes	117 (73.10)
	No	43(26.90)
Used social media when parent told not to use	Always	103 (64.40)
	Sometimes	25 (15.60)
	Rarely	16 (10.00)
	Never	16 (10.00)
Frustrated when a social media goes down	Always	131 (81.90)
	Sometimes	19 (11.90)
	Rarely	8 (5.00)
	Never	2 (1.20)
Ignored responsibility	Always	59 (36.90)
	Sometimes	50 (31.30)
	Rarely	29 (18.10)
	Never	22 (13.70)
Spend more time on social media than desired	Yes	126 (78.70)
	No	21.3 (21.30)
Impact of social media	Positive impact	38 (23.75)
	Negative impact	65 (40.60)
	No impact	12 (07.50)
	Both positive and negative impact	45 (28.12)

(64.40%) expressed that they always use social media though instructed by parents not to use, followed by sometimes (15.60%), rarely (10.00%) and never (10.00%). In case of getting frustration when social media sites goes down majority (81.90%) expressed that they always gets frustrated when social networking sites goes down, followed by sometimes (11.90%), rarely (5.00%) and never (1.20%).

With regard to responsibility, 36.90 per cent expressed that they always ignored responsibility due to over involvement in social media, followed by sometimes (31.30%), rarely (18.10%) and never (13.70%). With respect to time spent on social media than desired majority (78.70%) expressed they spend more time on social media than desired and 21.30 per cent expressed they do not spent more time on social media than desired. Bhola & Mahakud (2014) reported that majority of the emerging adults were using social media sites at night though restricted by parents and interacted with the opposite sex. They are ignoring their daily activities/responsibilities, hiding online time from others and using these sites secretly.

In overall impact of social media on well being majority expressed it has negative impact (40.60%), followed by both positive and negative impact (28.12%), positive impact (23.75%) and no impact (7.50%). Bhatt & Arshad (2016) also reported that social media has negative impact on youth and adversely affecting their education, behaviours, relationships and daily routine lives and study time of students.

Results pertaining to social media addiction of emerging adults were presented in Figure 1. It was observed that nearly half 49.30 per cent of the respondents fell under high category of social media addiction, followed by 30.00 per cent fell under medium category of social media addiction and 20.60 per cent fell under low category of social media addiction. The reason could be that all emerging adults are using smart phone, they are using more number of social media apps, they were habituated to use it daily by posting pictures and videos on these sites on daily basis. They are also using more data (1-3 GB) per day in watching movies and shows. Results were in line with Kant (2020) who found that most of the college students were addicted to social media such as Face book, Instagram and WhatsApp. They are more actively participating in online activities by spending significant amount of time on social media sites. According to another study Meena et al., (2012) who revealed that with the ever-increasing popularity of social media, emerging adults are devoting significant time to social networking on websites and are prone to get 'addicted' to such form of online social interaction.

Figure 2 presents the overall distribution of emerging adults by their level of mental health. From the figure it can be observed

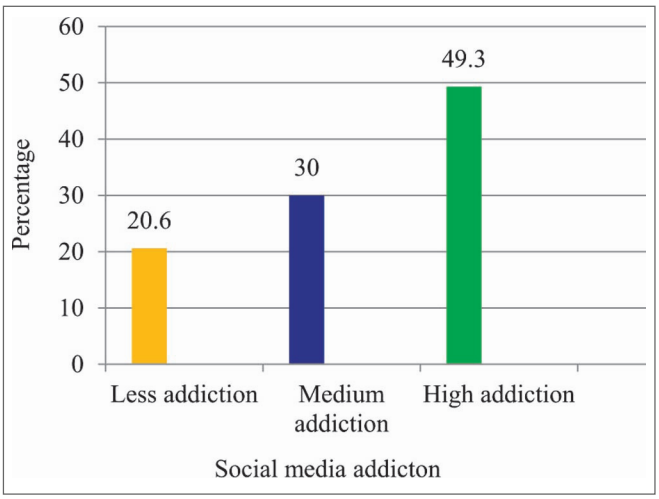

Figure 1. Overall distribution of respondents according to social media addiction

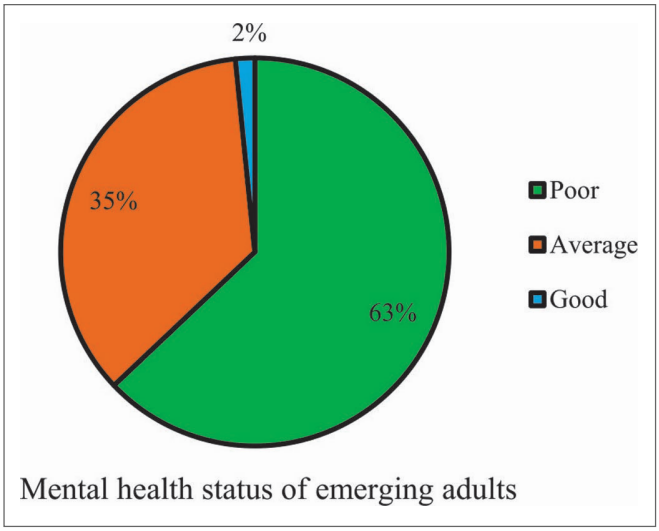

Figure 2. Overall mental health status of the respondents

that 63.00 per cent of the respondents had poor level of mental health followed by 35.00 per cent had average mental health and 2.00 per cent had good level of mental health. The probable reason could be that high involvement in social media, where respondents expressed that high social media is influencing academics in negative way, getting frustration when any of the social media sites goes down and majority expressed that excessive usage of social media is having overall negative impact which all might have resulted in their poor level of mental health.

Table 2. Correlation between social media addiction and mental health status of emerging adults

S.No.	Dependent factors	Social media addiction	Mental health status
1	Social media addiction	1	-0.094
2	Mental health status	-0.094	1

The result from Table 2 shows the relationship between social media addiction and mental health of emerging adults. There was negative correlation between social media addiction and mental health status of emerging adults. It indicated that higher the social media addiction poor the mental health status of emerging adults. It is noticed that emerging adults who are using more of social media sites such as YouTube, Face book, Instagram also spending more time on these sites are highly addicted to it which ultimately resulted in poor mental health status. Similarly Kelly et al., (2018) who reported that there is link between social media use and mental health. Increased usage of social media was linked to online harassment, poor sleep, low self-esteem, and a negative body image, all of which were linked to more of mental health difficulties. According to Guo et al., (2020) & Coyne et al., (2019) observed that late teens and young adults are using android and iphones and greater time spent on social media resulted in poor intra and interpersonal relationship with peers, anxiety, despair, and mental health problems. Similarly Deepa & Priya (2020) pointed out that time spent on social media had impact on mental health. More social media use and quantity of social networking sites used causes melancholy and anxiety in emerging adults.

CONCLUSION

Social media usage is a new addiction for majority of emerging adults in today's generation where, majority were using more number of social media apps for significant amount of time. They were using 3-5 GB of data per day on social media sites and were posting pictures and videos daily on these sites. Majority expressed that they were using social media without the knowledge of parents by spending more time on these sites than desired by ignoring responsibilities. Majority also expressed that using excessive social media has both positive and negative effect and it influences academic performance in negative way. Results found that many of the emerging adults had high level of social media addiction and poor level of mental health and it showed a negative relationship between social media addiction and mental health status of emerging adults. So, there is a need to improve mental health of emerging adults.

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Research Article

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Development of Test and Measurement of Knowledge Level of Sunflower Farmers

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ABSTRACT

A test was constructed to measure the farmers' knowledge level on sunflower cultivation during 2021-22. Relevant items were collected from review of literature and discussed with scientists. For relevancy test, 39 items were sent to 320 experts for their judgement. Based on 45 experts judgement, 18 items (overall mean score > 2.57) were selected for item analysis and administrated to 60 farmers of Chinnakoduru village of Siddipet district. Item analysis was done by item difficulty index, item discrimination index and point biserial correlation and 15 items were finalized for knowledge test. Reliability (Cronbach alpha, Spearman brown coefficient and Guttman split-half) and validity (point biserial correlation) were estimated for standardization of the test and found to be highly significant. The test was administered to 140 respondents in Andhra Pradesh and Telangana states. In Andhra Pradesh, 78.8 per cent and in Telangana 85.0 per cent of respondents were in medium level of knowledge category. The item analysis indicated significant differences in knowledge level of farmers pertaining to most suitable period of sowing sunflower crop during *Rabi*, suitable sunflower hybrids, optimum seed rate, critical period of weed competition, application of fertilizers and bee keeping in sunflower in two states.

INTRODUCTION

In India, oilseeds were cultivated over an area of 28.7 m ha with a production of 38.4 m t and productivity of 1339 kg/ha (Directorate of Economics and Statistics, 2021-22). India produces around 10.4 m t of edible oil from primary (7.0 m t) and secondary sources (3.4 m t) and imports around 12.9 m t of edible oil to meet the domestic demand of edible oil (The Solvent Extractors' Association of India, 2021-22). The huge demand of edible oil is mainly because of increasing population pressure, raised standard of living and high consumption. It is necessary to increase oil seeds production for reducing imports and moving towards self-sufficiency. Sunflower can play an important role to meet over the shortage of oil in the country because of its short duration, photo-insensitive, wide adaptability to different agro-climatic regions and rainfed crop. Sunflower (*Helianthus annus* L.) belongs to the family Asteraceae and the genus *Helianthus*. The oil content in the seeds varies between 35 to 43 per cent. The unsaturated fatty acids such as oleic and linoleic comprise about 90 per cent of the total oil content. Sunflower oil is quite popular as healthy cooking oil because of its nutritional benefits. In India, it is cultivated over an area of 2.90 lakh ha with a production of 2.36 lakh t and productivity of 0.9 t/ha (Directorate of Economics and Statistics, 2020-21). Major sunflower growing states are Karnataka, Odisha, Andhra Pradesh, Maharashtra, Telangana, Bihar, Tamil Nadu, West Bengal, Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and Gujarat. Sunflower production has drastically declined since 2007-08 from 14.63 lakh t to 2.36 lakh t in 2020-21 (Directorate of Economics and Statistics, 2020-21). The production of sunflower crop is low in India and the major reasons were rainfed cultivation, small operational landholdings, lack of varietal replacement, losses due to pests and diseases, and low knowledge level and low adoption of improved varieties, technologies and other management

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practices by farmers. Knowledge plays an important role in increasing the production of sunflower. In order to increase the cognitive domain of sunflower farmers, it is crucial to identify their existing knowledge on the recommended package of practices. For assessing the knowledge level of farmers, there is a need for developing a suitable measurement tool, such as a cognitive scale (Rajkamal, 2001). Standardising the knowledge test is not very usual for assessing knowledge through knowledge tests (Khan et al., 2006). Hence, in the present study a knowledge test was developed, standardised and administered to assess the level of knowledge of Andhra Pradesh and Telangana farmers on different aspects of sunflower production practices. It also included information on knowledge gaps and the transfer of technologies for knowledge items between the two states.

METHODOLOGY

Knowledge test was constructed by using the procedure followed by Lindquist (1951). knowledge test was developed using scientific procedures, including item collection through preliminary screening, item selection based on expert opinions, item analysis (difficulty index, discrimination index), testing reliability and validity of knowledge test and final administration to respondents. Items related to knowledge of sunflower were collected from review of literature, personal experience, books, scientists, research articles, professors and panel discussion. Thirty nine items were collected and sent to 320 experts for relevancy test on three point continuum through google forms, email and personal contact and forty five judges responded within the stipulated time. Out of 39 items, 18 items were selected for item analysis based on the mean score > 2.57. Selected items were administrated to 60 farmers of Chinnakoduru village of Siddipet district for item analysis. Item difficulty index (P_i) and item discrimination index were used for item analysis. P_i was estimated with the same formula used by Kumar et al., (2015) & Sinha et al., (2020) also followed the same procedure.

P_i = Number of respondents giving correct answer / Total number of respondents to whom i^{th} item is administrated (N=60).

Item discrimination index used to discriminates respondents who had rich and poor knowledge on particular item. Total scores of 60 farmers were arranged in descending order and then respondents were split into six equal groups *viz*., G1, G2, G3, G4, G5 and G6 with 10 respondents in each group. The two medium groups G3 and G4 were excluded for item analysis, keeping only four extreme groups G1 and G2 with high scores and G5 and G6 with low scores. Item discrimination index ($E^{1/3}$) was calculated with the following formula used by Sureshverma et al., (2018); Rani et al., (2020) and as follows:

$$E^{1/3} = \frac{(G1 + G2) - (G5 + G6)}{N/3}$$

Where, ($E^{1/3}$) = Discrimination index for i^{th} item, G1, G2, G5 and G6 indicated the frequencies of correct answers given for the respective sub-groups of respondents for an item in the test, N = Total number of respondents of the sample selected for the item analysis.

After estimating the item difficulty and discrimination index values, 18 items were tested for the validity by point biserial correlation (r_{pbis}) based on the procedure followed by Varma (2007). Cronbach alpha, Guttman split-half and Spearman brown coefficient were used for testing the reliability of the scale. Point biserial correlation (Item-total correlation) and experts' opinion were used for testing the validity of the test. Based on RSI and RYI values, Kadapa and Nizamabad districts from Andhra Pradesh and Telangana states were selected respectively. From each district two mandals and four villages were selected based on highest area under sunflower. Thus a total of four mandals and eight villages were selected. From each village, 20 and 15 respondents were selected by random sampling method from Kadapa and Nizamabad districts, respectively. Thus, 80 and 60 respondents were selected from Kadapa and Nizamabad districts. The data were collected with the help of semi-structured schedule by personal interview method. The data were subjected to analysis using SPSS v.20.

RESULTS AND DISCUSSION

The results of the item difficulty index showed that Pi values ranged from 0.50 to 0.65 (Table 1). Items with values < 0.20 and > 0.80 were considered as very easy and very difficult items, respectively. The values of all items were within the range and total items (18) were included in the test for further analysis. An item's discrimination, value describes how well an item determines the value of the item battery. A higher $E^{1/3}$ value indicates that the item has validity. Acceptable range is between 0.30 to 0.70. The results of $E^{1/3}$ values ranged between 0.05 to 0.75 (Table 1). Items with $E^{1/3}$ value lower than 0.11 (0.05 (2^{nd}), 0.05 (9^{th}) and 0.10 (14^{th}) were excluded from the test. Hence out of 18 items, 15 were retained in the final knowledge test. Point biserial correlation coefficient is used to determine the internal consistency of dichotomous or binary items. It indicates the relationship between the overall score and a dichotomized response for each particular item. Thus r_{pbis} revealed information on how well an item measures or distinguishes in respect to the rest of the test. Acceptable range was between > 0.25-0.70. From table 1 items having r_{pbis} value -0.10 (2^{nd}), -0.10 (9^{th}) and 0.08 (14^{th}) were excluded from the test. Therefore 15 items were selected for the final test out of 18 items.

Three criteria for item selection were items having difficulty index, discrimination index and point biserial correlation coefficient values ranging between > 0.25 to 0.70.

Reliability

Reliability was tested by calculating Cronbach alpha (α), Spearman-brown coefficient and Guttmann split-half coefficient. α value for knowledge test was found to be >0.75 for each item with overall α value of 0.78 (Table 3). The results were in conformity with Priyadarshni et al., (2021). Spearman-brown coefficient and Guttman split-half coefficient value was found to be 0.63 for each (Table 2). Paul et al., (2020); Kumar et al., (2016) also used spearman brown coefficient.

Validity

Content validity and point biserial correlation were used for testing the validity of knowledge test. For ensuring content validity

Table 1. Difficulty and discrimination indexes for knowledge items and point biserial correlation in sunflower

Items	Frequency of correct answers given for 4 extreme groups (N=10)				Total frequency of correct answers	Item difficulty Index	Item discrimination index	Point biserial correlation	Item selected for the study
	G1	G2	G5	G6	(N=60)	(P_i)	($E^{1/3}$)	(r_{pbis})	
1.	8	7	3	3	31	0.52	0.45	0.31	Accepted
2.	7	5	5	6	38	0.63	0.05	-0.10	Rejected
3.	9	7	4	2	34	0.57	0.50	0.39	Accepted
4.	10	8	4	2	34	0.57	0.60	0.38	Accepted
5.	10	8	2	1	34	0.57	0.75	0.55	Accepted
6.	10	7	2	3	34	0.57	0.60	0.38	Accepted
7.	10	7	3	3	38	0.63	0.55	0.39	Accepted
8.	10	6	6	2	36	0.60	0.40	0.30	Accepted
9.	7	7	7	6	36	0.60	0.05	-0.10	Rejected
10.	9	8	4	3	33	0.55	0.50	0.29	Accepted
11.	9	9	6	4	39	0.65	0.40	0.29	Accepted
12.	9	9	3	2	34	0.57	0.65	0.46	Accepted
13.	7	8	3	2	33	0.55	0.50	0.28	Accepted
14.	8	6	8	4	39	0.65	0.10	0.08	Rejected
15.	10	9	3	4	35	0.58	0.60	0.40	Accepted
16.	9	8	4	2	37	0.62	0.55	0.36	Accepted
17.	9	8	5	2	31	0.52	0.50	0.32	Accepted
18.	8	7	2	1	30	0.50	0.60	0.43	Accepted

Table 2. Reliability statistics of sunflower knowledge test

Reliability Statistics			
Cronbach's Alpha (α)	Odd number items	α value	0.66
		N of Items	8[a]
	Even number items	α value	0.73
		N of Items	7[b]
	Total N of Items		15
Correlation Between Forms			0.46
Spearman-Brown Coefficient	Equal Length		0.63
	Unequal Length		0.63
Guttman Split-Half Coefficient			0.63

a. Odd number items, b. Even number items

each item was provided to a relevant expert who would assess the item's relevance and appropriateness as well as how well the test represented the universe. The construct validity of the test was then determined by calculating the point bi-serial (r_{pbis}) correlation of each item. Reddy et al., (2017) also followed point biserial correlation for testing the validity. For the final selected items, point biserial correlation values (corrected item-total correlation) were represented in table 3. Varma, (2007) suggested that items have to be atleast r_{pbis} value of 0.15 and good items have r_{pbis} values more than 0.25. Therefore for final knowledge test items in this study were selected based on their significant $r_{pbis} > 0.25$.

From Table 3, it was observed that more than three-fourth (83%) of Telangana farmers had knowledge on the optimum time of sowing sunflower during *rabi* season, whereas in Andhra Pradesh, 56 per cent of farmers had knowledge on optimum time of sowing. Andhra Pradesh farmers had knowledge gap compared to Telangana farmers and there is need for technology transfer on sowing time by conducting farmers meeting and field days. Majority of the farmers of Telangana (83%) and Andhra Pradesh (56%) had knowledge on critical period for weed competition. In case of pests (white fly, *Spodoptera* and head borer) and diseases (necrosis, alterneria leaf blight and powdery mildew), most of the farmers of Telangana (87% and 80%) and Andhra Pradesh (59% and 58%), respectively had required knowledge. There were highly significant differences ($p<0.01$) between the farmers of two states. Hence, there is need for technology transfer on integrated disease management and integrated pest management through intensive campaigns, demonstrations and farmers trainings. Majority of the Telangana (82%) and Andhra Pradesh (66%) farmers had knowledge in case of suitable hybrids (Pro sunny/ Pioneer/ Sumithra/ Sunbreed) for cultivation of sunflower crop. More than three-fourth (80%) of farmers from Telangana and 64 per cent from Andhra Pradesh had knowledge on optimum seed rate in sunflower (2 kg/acre). Farmers of Andhra Pradesh had low knowledge on suitable cultivar and seed rate compared to Telangana farmers and there is need for technology transfer on high yielding varieties through use of ICT's and timely access to quality seeds and other inputs. In case of recommended dose of fertilizers under rainfed and irrigated conditions, farmers from Telangana (82% and 83%) and Andhra Pradesh (65% and 66%) had sufficient knowledge, respectively. Less number of farmers from Andhra Pradesh had knowledge compared to Telangana and hence, there is need for technology transfer on integrated nutrient management. Most of the farmers from Telangana (90%) and Andhra Pradesh (76%) had knowledge

Table 3. Final knowledge test and knowledge level of Andhra Pradesh and Telangana farmers

S.No.	Items	Corrected item-total correlation	α if item deleted	Andhra Pradesh F (%)	Telangana F (%)	Z-value
1.	What type of soil is suitable for sunflower cultivation? a. Light soil, b. Heavy soil, c. Mixed soil, d. Light textured soil	0.32	0.77	53(66)	48 (80)	1.85^{NS}
2.	What is the best season to grow sunflower crop? *a. Kharif, b. Rabi, c.* Summer, *d.* All the above	0.43	0.76	48 (60)	45 (75)	1.90^{NS}
3.	What is the most suitable period for sowing sunflower crop in *Rabi*?	0.33	0.77	45 (56)	50 (83)	3.66**
4.	Can you name any hybrid of sunflower _____	0.57	0.75	53 (66)	49 (82)	2.10*
5.	Do you know about seed treatment? Yes/No If, yes give the details	0.39	0.77	43 (54)	40 (67)	1.55^{NS}
	S.No. | Name of biocontrol agent | Quantity (g/kg) 1. | | | 2. | |					
6.	Do you know about chemicals for seed treatment? Yes/No. If, yes give the details	0.43	0.76	45 (56)	42 (70)	1.68^{NS}
	S.No. | Name of chemicals | Quantity (g/kg) 1. | | | 2. | |					
7.	Do you know the seed rate of sunflower per acre? a. 2 kgs, b. 3 kgs, c. 4 kgs, d. 5 kgs	0.34	0.77	51 (64)	48 (80)	2.16*
8.	What is the critical period of weed competition in sunflower? ____ weeks	0.29	0.77	45 (56)	50 (83)	3.66**
9.	What is the recommended dose of NPK for sunflower under rainfed conditions N: __ kgs/acre**,** P : __ kgs/acre, K: __ kgs/acre	0.31	0.77	52 (65)	49 (82)	2.26*
10.	What is the recommended dose of NPK for sunflower under irrigated conditions N: __ kgs/acre**,** P : __ kgs/acre, K: __ kgs/acre	0.49	0.76	53 (66)	50 (83)	2.37*
11.	Do you know application of Boron improves seed yield and seed weight? Yes/ No. If yes, mention the dosage?	0.32	0.77	51 (64)	47 (78)	1.95^{NS}
12.	List out any three important pests which cause major damage to sunflower and mention their control measures Pests Control Measures i._____ i._____ ii._____ ii._____ iii._____ iii._____	0.44	0.76	47 (59)	52 (87)	3.94**
13.	List any three important diseases which cause major damage to sunflower and mention their control measures Pests Control Measures i._____ i._____ ii._____ ii._____ iii._____ iii._____	0.37	0.77	46 (58)	48 (80)	2.95**
14.	Do you know that honeybee activity in sunflower crop increases yield? Yes/No	0.30	0.77	61 (76)	54 (90)	2.22*
15.	Mention the correct stage of harvesting sunflower crop? a. Lemon yellow colour on the back of head,b. Complete drying of heads, c. Complete drying of plants, d. Shedding of leaves	0.43	0.76	64 (80)	53 (88)	1.35^{NS}
	Overall Cronbach alpha		0.78			

** = Significant at 0.01 level of probability, * = Significant at 0.05 level of probability and NS = Non-significant

on positive effects of bee keeping in increasing yield of sunflower crop. Andhra There is need for technology transfer on bee keeping in sunflower through awareness campaigns, result demonstrations and field days. There were significant differences in knowledge level of farmers between the two states ($p<0.05$) and hence, concerted efforts are required to educate the farmers on suitable hybrids for the region, optimum seed rate, INM and positive effects of bee keeping in sunflower crop. Most of the farmers of Telangana (80%) and Andhra Pradesh (66.3%) had knowledge on suitable soils for cultivating sunflower crop. Majority of the farmers of Telangana (75%) and Andhra Pradesh (60%) had knowledge on the best season for growing sunflower crop. In case of seed treatment with biocontrol agents (Trichoderma @ 5 g/kg seed, Pseudomonas @ 8 g/kg seed, Azospirillum @ 240 g/acre, Phosposolublizing bacteria @ 240 g/acre, and chemicals (Thiram/ Captan/ Metalxyl-6/ Imidacloprid-5), most of the farmer from Telangana (67% and 70%) and Andhra Pradesh (54% and 56%), respectively had sufficient knowledge. More than three-fourth (78%) of Telangana and Andhra Pradesh (64%) farmers had sufficient knowledge that boron (2 g/l) application increases seed yield and seed weight. Majority of the farmers from Telangana (88%) and Andhra Pradesh (80%) had knowledge on correct stage of harvesting of sunflower crop (lemon yellow colour on the back of the head). There were no significant differences in knowledge level of farmers between the two states in these practices. These results were similar with that of Rajan et al., (2021); Rai et al., (2016); Devarani & Bandhyopadhy (2016) & Mandavkar et al., (2013).

CONCLUSION

Sunflower knowledge test was developed and standardised by using reliability and validity. The knowledge level of farmers of Telangana and Andhra Pradesh differed significantly and it was observed that more number of farmers of Telangana had knowledge on sunflower cultivation compared to Andhra Pradesh. In order to increase the knowledge on most suitable period for sowing of sunflower crop during *Rabi* season, critical period of weed competition, pests and diseases, integrated weed management; integrated pest management, suitable cultivar and seed rate, recommended dose of fertilizers under rainfed and irrigated conditions and the benefits of bee keeping in sunflower, intensive transfer of technology had to be taken up by conducting campaigns, farmers meeting, demonstrations and field days.

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Research Article

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Fresh and Dried Fish Consumption and its Contributory Factors: A Study of Malappuram, Kerala

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ABSTRACT

The study investigates fresh and dried fish consumption patterns and factors determining fish purchase among the people of Malappuram district, Kerala. 200 fish consumer households belonging to varied socio-economic backgrounds were surveyed using a structured questionnaire. Garret ranking identified 'convenience perception' (14.92), 'provision of home delivery' (8.62), 'availability of dressing facility' (8.61), 'sensory perception' (7.75) and 'information on fish sold in market' (7.26) as the most important factors influencing fish purchase among the households. The factors identified will guide in preparation of strategies for modern fish business aiding the emerging digital fish market ecosystem in our country. The per capita fish consumption estimated at 2.6 kg/person/month is far higher than the national average. Sardine and mackerel were the two most important species preferred by the respondents. Majority of the families were found to consume dried fishes 1-2 times a week. The study indicated a healthy level of per capita fresh fish consumption while further efforts can be made to improve the dried fish consumption among the households. The results will aid policy makers in designing strategies aimed at bringing fish consumption to recommended dietary intake levels in poorly faring states and territories of the country.

INTRODUCTION

Fish and seafood offer a much healthier diet than any other terrestrial meat products (Bogard et al., 2015). Being a great source of unsaturated fatty acids, amino acids, vitamins and minerals, coupled with its low-fat content (Yaktine & Nesheim, 2007) fish always tops the list as an important cuisine for people all around the world (Burger et al., 1999; Turan et al., 2006) making any diet sustainable, safe and nutritious. On a global basis, fish is considered as the third major source of dietary protein after cereals and milk (FAO, 2020). In major studies (Brunso, 2003; Gross, 2003), consumers have regarded fish as healthier compared to other non-vegetarian foods. Significant contribution of fisheries sector is evident in the fight to end global hunger, achieve food security, and improve nutrition (Bennet et al., 2021). 20 per cent of the total animal protein intake of 3.1 billion people is met by fish with per capita food fish consumption rising from a mere 9.0 kg in 1961 to 20.5 kg in 2018 (FAO, 2020).

According to National Sample Survey Organisation (NSSO) report, the monthly per capita fish consumption of urban and rural

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India is 0.27 kg and 0.25 kg. The ICMR recommendation of fish consumption is 12 kg/year, which is yet to be achieved in India with a predicted per capita fish consumption of 6.6 kg in 2030 by World Bank (Msangi et al., 2013). Government of India has also set a target of 20 MT fish production by the year 2022-23 by laying renewed focus on the sector through a flagship scheme "Blue Revolution" (Shasani et al., 2020). But an entirely different situation exists in Kerala state with a per capita fish consumption of 2.26 kg in rural and 2.21 kg in urban areas (NSSO, 2012). Being a coastal state and leading fish producer of the country, both fresh and dried fish are important items of Kerala diet. Identifying the factors influencing consumption of fish and studying consumption behaviour aids government in alleviating hunger and malnutrition among deprived sections (Sajeev et al; 2021).

Malappuram is one of the most populous districts of Kerala accommodating about 13% of the total population of the state. As per NFHS-5 (2019-20), Malappuram district just behind Wayanad has 29.4 per cent of its children under 5 years reporting stunting which indicates an increase of 3.1 per cent from 2015-16 (NFHS-4). The present study was designed to bring out the existing status of fresh and dried fish consumption among a selected rural-urban, highly non-vegetarian population of Malappuram district, Kerala along with the various factors influencing the fish purchase. Fish consumption is proven to alleviate iron deficiency anaemia and hence the higher incidence of anaemia among women and children of Malappuram in contrast to Kerala figures also enables the district suitable for this study. The socio-personal characteristics of the respondents were also measured. The results can be used for policy making towards achieving recommended fish consumption and for refining existing fish marketing strategies.

METHODOLOGY

A structured pre-tested questionnaire was used and the survey was carried through personal interview of 200 households. Stratified Probability Proportional Sampling technique was used for the study purpose. Each household survey took roughly 50 minutes to complete. Frequency and percentages were used for the analysis of socio-economic characteristics. Henry Garret Ranking Test was done to estimate and analyse the major factors affecting the consumption of fish among the respondents. Using this technique, the participants were asked to specify ranks for all factors ranging from 1 to 5, where 5 ranks the most important and 1 ranks the least important. The results of the rankings thus obtained were converted into percentage score value. Following Henry Garret (1969), the score was computed.

RESULTS AND DISCUSSION

Fish consumption profile of respondents

The per capita fish consumption of the surveyed population was estimated as 2.6 kg/month (Table 1) which is far higher than the national average (0.25 kg/month) and on par with the state average (2.5 kg/month). The study also recorded appreciable per capita consumption in respect of chicken (0.8 kg/month), beef (0.6 kg/month) and mutton (0.4 kg/month). However, pork consumption (0.02 kg/month) was low due to religious taboos and its poor availability in meat markets of the district. The study revealed that nearly half of the respondents (49%) consumed fish once in 2 days followed by 40.5 per cent who consumed fish on a daily basis. Rest 10 per cent and 0.5 per cent consumed fish 2 times a week and weekly once. The quantity of fish purchased at a time was assessed and about 99.5 per cent of the respondents purchased 0.5-1.0 kg of fish at one time. The purchase and consumption pattern of fish explains the high per capita consumption in line with state average.

Table 1. Per capita monthly consumption of fish v/s other meat

S.No.	Items consumed	Per capita consumption (kg/month)
1.	Fish	2.6
2.	Chicken	0.8
3.	Beef	0.6
4.	Mutton	0.4
5.	Pork	0.02

The most frequently purchased fish was sardine among huge majority (91%) of the surveyed respondents followed by mackerel (60%). About 20% of the respondents purchased sole fish while cod fish was purchased by 14 per cent of the respondents (Table 2). The other most purchased species included prawns (8%), squid (8.5%), tuna (6.5%), tilapia (4.5%), pomfret (5.5%), shark (3.5%), Malabar trevally (3%), threadfin bream (2.5%), seer fish (4%), clams (1.5%), pearl spot (1%) and ribbon fishes (0.5%). It is evident that being a coastal district the fish purchased and consumed the most are marine species. Sardine and mackerel were rated as the most favourite fishes of 50 per cent and 17 per cent the respondents thus topping the list. The other species like cod fishes (35%), prawns (20%), sole fishes (10%) and pearl spot (10%) were also widely favoured by the respondents. Majority (97%) preferred to consume fish both at dinner and lunch whereas 2 per cent preferred to have fish for all the three meals of the day and 1 per cent preferred to have fish during dinner and breakfast.

Factors affecting fish purchase and consumption among the respondents

The factors influencing the selection and evaluation of food products including fish broadly includes three categories namely

Table 2. Most purchased fish species in Malappuram, Kerala

S.No.	Fish Species	Purchased by (%)
1	Sardine	91
2	Mackerel	60
3	Sole fish	20
4	Cod fish	14
5	Squid	8.5
6	Prawns	8
7	Tuna	6.5
8	Pomfret	5.5
9	Tilapia	4.5
10	Seer fish	4
11	Shark	3.5
12	Malabar trevally	3
13	Threadfin bream	2.5
14	Clams	1.5
15	Pearl spot	1
16	Ribbon fish	0.5

products, indicators and environment (Sparks & Shepherd, 1994). These factors vary with the consumers and are crucial to understand the important drivers and barriers for fish consumption. Increased health, safety and quality consciousness among Keralites have found to create new drivers and barriers to fish consumption (Sajeev et al., 2019) with changing purchase behaviour and choice of market (Sajeev et al., 2021). To analyse the preference of respondents towards the fish purchase and consumption, Henry's Garret Ranking method was applied. Among the 15 factors analysed; convenience perception ranked as the first and foremost important factor influencing the purchase behaviour of the respondents (Table 3). Convenience means the saving of time, physical or mental energy at one or more stages of overall meal acquisition process. It includes the planning, shopping, storage, preparation, consumption, cleaning and disposal of fish waste as well as leftovers (Gofton, 1995; Olsen et al., 2007; Bech, 2001). Handling, dressing and cooking of fish is inconvenient and time consuming for most modern families (Sajeev, 2021). Hence, the consumers surveyed expressed high priority for convenience perception. The factors convenience and sensory perception were found having very important role in fish purchase and consumption of mainstream population in many studies (Gofton, 1995; Leek et al., 2000; Birch et al., 2012). The availability of home delivery and availability of dressing facility were the second and third important factors regarded by the respondents while purchasing fish for consumption. Sensory perception emerged as the next important factor determining fish purchase and consumption among the respondents. The smell, texture and odour of the fish serve as the important indicators for the sensory perception and evaluation (Prabhakar et al., 2020). Accordingly, information about the fish sold in market and price of the fish were considered important while purchasing the fish. The above finding reveals the immense scope for modern and online fish marts in the district which can deliver cleanly cut and dressed fish to consumer doorsteps.

Price of fish ranked as next important factor affecting fish purchase and consumption of the surveyed consumers (Table 3). The high average retail fish prices nearing Rs. 200/kg prevailing in Kerala during the period of study (2020-2021) was not found acting as a barrier for mainstream population of Malappuram. Price acting as a barrier to purchase of fish was documented earlier (Birch et al., 2012; EUMOFA, 2017; Helsedirektorat, 2020) while the driving effect of affordable fish price in purchase (Prasad and Madhavi, 2014; Bhuyan et al., 2017) was also confirmed earlier. Consumers in Malappuram also accorded importance to safety of fish. Safety and minimising hazardous outcomes have been considered as one of the aspects in the purchase and consumption of fish (Bredbenner et al., 2007). Consumption of unsafe food contaminated with hormones, antibodies or mercury levels can lead to severe health problems to those consuming it. Another important driver was Fish quality which attributes to the product safety, nutritional content, freshness, quality and physical condition of the fish (Bremner, 2000). Quality is a factor related strongly to raw material itself (Grunert, 2002) and also connected to visual cues like muscle structure (Wesson et al., 1979). Consumers of Malappuram also rated 'Knowledge of fish recipes' as an important factor in meal preparation. Food preparation involves the individual's knowledge of preparing food (Gofton, 1995) thus making it important for fish purchase and consumption. The district being one with very famous local cuisines and recipes, this factor assumes much importance. The knowledge of consumer is a multidimensional construct which involves both the familiarity and expertise the consumer has with the product (Alba & Hutchinson, 1980).

Table 3. Factors influencing fish purchase and consumption among the respondents

S.No.	Particulars	Total Score	Contribution (%)
1	Price of fish	9310	6.61
2	Availability of favourite fish	7257	5.15
3	Market accessibility	8861	6.29
4	Health benefits	7110	5.04
5	Safety of fish	8941	6.34
6	Quality of fish	7171	5.09
7	Convenience Perception	21028	14.92
8	Sensory Perception	10928	7.75
9	Knowledge of fish recipes	8964	6.36
10	Place of origin of fish	7051	3.18
11	Source of fish	4482	3.18
12	Production Method	5332	3.78
13	Information on fish sold in market	10236	7.26
14	Availability of dressing facility	12135	8.61
15	Provision of home delivery	12146	8.62
	Total	140952	

Dried fish consumption among the respondents

Dried fish have a longer storage life when compared to fresh fishes and is a great source of protein, essential fatty acids, vitamins and minerals (Siddique & Aktar, 2011). It has a greater demand among the consumers during the lean seasons or the fishing ban time due to its greater shelf-life (Das et al., 2013). The study documented the dried fish consumption pattern among the fish consumers of Malappuram. Among the fresh fish consumers surveyed, 95 per cent had consumed dried fishes and 33 per cent of them consumed it twice a week (Table 4). Further, 27.5 per cent and 21 per cent of the respondents consumed dried fishes once weekly and monthly. However, per capita dried fish consumption was found to be declining in Kerala due to the belief among consumers that dried fish contribute to lifestyle diseases. Fear of the use of harmful chemicals in fish drying was another major reason attributed for decline in consumption (Sajeev et al., 2020).

CONCLUSION

Being rich in essential nutrients and minerals and providing good health, fish has gained immense popularity than any other

Table 4. Dried fish consumption among the selected respondents of Malappuram

S.No.	Characteristics	Percentage
1.	Monthly once	21
2.	Twice a week	33
3.	Weekly once	27.5
4.	Thrice a week	13.5
5.	Never	5

terrestrial meat. Kerala is one of the important fish producing state in India and the fish consumption level is incredibly higher than the national average. The fish purchase and consumption pattern of the consumers in Malappuram was found to be determined by various factors like convenience perception, availability of home delivery and dressing facility, sensory perception and information of fish sold in the market. Integrating the factors influencing fish consumption of a highly fish-eating population like that of Malappuram can help policy makers to design programmes aimed at increasing fish consumption in poorly faring states and territories to the recommended levels of dietary intake. The factors identified can also guide in preparation of modern fish business strategies.

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Research Article

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Attitude of Farmers Toward Intercropping in Haryana

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ABSTRACT

Intercropping is a type of multiple cropping practices that involves the cultivation of two or more crops in definite proximity. The present study was conducted in dry and wet agro-climatic zones of Haryana in March, 2022. Bhiwani and Hisar districts were selected randomly from dry zone and Karnal and Kaithal districts were selected randomly from wet zone with an objective to assess the attitude of farmers toward intercropping. The data were collected personally from 120 respondents comprising 30 from each district through a structured interview schedule. Findings revealed that more than three-fifths of the respondents (50.83%) had a more favourable attitude towards intercropping system whereas 36.67 per cent had a favourable attitude and 12.50 per cent had a less favourable attitude towards the intercropping system. Further, Analysis of the relationship between level of attitude & profile of farmers revealed that education and mass media exposure were found highly significantly associated with the level of attitude of farmers toward intercropping whereas a significant association was found between age, family type, social expectations, inheritance with level of attitude of farmers toward intercropping system. The paper recommends training of farmers on better utilization of mass media and the training will help farmers in increase in their knowledge level by using mass media and with improved knowledge farmers will have more positive attitude towards intercropping.

INTRODUCTION

The term “cropping system” represents a method of maximum crop production in available land in a cropping cycle with minimum natural resource degradation and the adoption of high-intensity cropping systems may be a viable option to increase agricultural sustainability, productivity and production as a whole (Singh, 2015). Intercropping is a type of multiple cropping practices that involves the cultivation of two or more crops in definite proximity. Intercropping can also be referred to as mixed cropping or Polyculture i.e., cultivating two or more crops in the same space at the same time (Meena et al., 2012). By cultivating more than one crop at a time in the same field, farmers maximise water use efficiency, maintain soil fertility and minimise soil erosion in their fields, which are the serious drawbacks of solo-cropping (Kumar et al., 2022).

The concept of the cropping system is as old as agriculture in India. The multiplicity of cropping systems has been one of the important features of Indian farming and it is mainly attributed to the prevailing socio-economic conditions of the farming community (Progressive Haryana, 2019). However, it has been estimated that more than 250 double-cropping systems are followed throughout the country (Singh et al., 2018). India accounts for about 28.00 per cent of the area and 25.00 per cent of global production by intercropping over a dozen pulse crops depending on the resource availability and local needs (Sharma et al., 2017). The greatest

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challenge for agriculture in front of a populous country like India is to produce more farm products, namely food, fodder, fuel and fibre to meet the increasing human and animal needs from the limited availability of cultivable land (Sancley & Mazhar, 2019) Under this situation, one of the important strategies to increase agricultural output is the development of high-intensity sequential cropping and intercropping systems (Maitra et al., 2019).

Agriculture has been the top priority of Haryana for decades. Presently, the main focus of the government is to diversify the cropping pattern of the state and for this diversification, the intercropping will play a major role in utilising the empty space in fields and by cropping different crops in fields. In Haryana intercropping is proving to be beneficial for the farmers as it gives farmers additional income, the fertilizer dose given to one crop is also received by the other crop and this reduces the cost of cultivation and the vacant space in the fields is also utilized. In view of the decreasing land holding and increasing cost, more and more farmers are increasing towards intercropping (Kamboj, 2022).

METHODOLOGY

The study was conducted in two agro-climatic zones i.e., dry and wet zone of Haryana state. Bhiwani and Hisar districts were selected randomly from the dry zone further two blocks Bhiwani and siwani were selected randomly from Bhiwani district while Hisar I and Hansi I blocks were selected from Hisar district. Karnal and Kaithal districts were selected randomly from the wet zone further two block Gharuanda and Indri were selected randomly from Karnal and Kalayat and Kaithal blocks were selected from Kaithal district. Further, from each block a cluster of villages were selected purposely i.e., villages in which farmers were adopting intercropping (Chang and Bamla villages from Bhiwani block, Chanana village from siwani block, kaimri and shadwa villages from Hisar I, Dhani pirwala and Sainipura villages from Hansi 1 block, Kailram and Batta villages from Kalayat block, Titram and keorak villages from Kaithal block, Mubarkabad and Bastara villages from Gharaunda block, Dhanora jagir and Bibipur jattan village from Indri block). Thus, 15 respondents were selected from each block and a whole 120 respondents were selected from the 8 blocks of 4 districts. The data were collected with a well-structured interview schedule and were analysed using MS Excel, OP STAT and Statistical Package for Social Sciences (SPSS) for computing frequency, percentage, Chi-Square and coefficient of contingency. For measuring the profiles of the respondents fourteen variables were selected viz, Age, education, caste, subsidiary occupation, income, type and size of family, land-holding, social participation, extension contact, mass-media exposure, social expectations, food preferences, inheritance. Scores were given for all these independent variables to assess their relationship with attitude (dependent variable). Also, in order to measure the farmers' attitude towards intercropping, various pre developed scales to measure the attitude (Kumar et al., 2015; Yadav et al., 2017; Shitu et al., 2018; Kumar et al., 2020; Gupta et al., 2022) were carefully studied they were given seventeen statements and the responses were obtained on a five-point continuum Likert-type (Thurston,1928) scale representing strongly disagree, disagree, neutral, agree, strongly agree. Further, all positive statements were given scores in order of 1, 2, 3, 4 & 5 with 5 being strongly agree while 1 being strongly disagree whereas all negative statements were given score in the reverse order i.e., 1, 2, 3, 4 & 5 with 1 being strongly agree and 5 being strongly disagree. The scores for all of the statements were added and the respondents were categorized more favourable, favourable and unfavourable based on the total score by dividing the range into three equal parts.

RESULTS AND DISCUSSION

Level of attitude towards intercropping

The result given in Table 1 revealed that more than half of the respondents (50.83%) had more favourable attitude towards intercropping whereas 36.67 per cent had favourable attitude and 12.50 per cent had less favourable attitude towards intercropping.

Table 1. Distribution of the respondents on the basis on their level of attitude towards intercropping

S.No.	Level of attitude	Percentage
1.	Less favourable (48-54)	12.50
2.	Favourable (55-61)	36.67
3.	More favourable (62-68)	50.83

Further the statement wise analysis of attitude of farmers toward intercropping revealed that while farmers generally perceive intercropping as more profitable than conventional farming, gives a positive image to a farm, helps in prevention of soil erosion and increase in efficiency of fertilizers, they were skeptical about intercropping protects the cash crops and were concerned about obtaining information regarding intercropping and training required for intercropping. As from the results it can be said that intercropping is proving to be beneficial for the farmers who were adopting it, in terms of increase in standard of living, increase in income, efficient utilization of natural resources etc. and when something becomes fruitful to human beings, we have a natural tendency to have a more favourable towards that thing and this might explain why majority of farmers had more favourable attitude towards intercropping. The findings were partially supported by Kumawat et al., (2015) stated that the majority ‒of the farmers (64.61%) were found to have ‒‒favourable ‒‒attitude ‒towards recommended production ‒technology ‒of ‒rapeseed ‒and ‒mustard crop ‒whereas 18.47 and 16.92 per cent of farmers were having most favourable and least favourable attitude, respectively towards recommended production technology of rapeseed and mustard crop. Similarly, Brar & Dangi (2011) revealed that more than three-fifth of the respondents (66.67%) had favourable attitude towards kinnow cultivation followed by 16.00 per cent had most favourable attitude and only 17.33 per cent of farmers had least favourable attitude towards kinnow cultivation. Also, Kumar et al., (2021) reported that 69.38 per cent of the respondents were moderately favourable while 19.38 per cent had highly favourable attitude towards groundnut cultivation.

Relationship between profile of the farmers with their attitude towards intercropping

The results of the study showed that independent variables viz education level and mass media exposure were found highly

Table 2. Statement wise attitude of the respondents

S.No.	Attitude statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1.	Intercropping gives a positive image to a farm	4(3.33)	2(1.67)	26(21.67)	55(45.83)	33(27.50)
2.	Intercropping is more profitable than conventional farming	5(4.17)	1(0.83)	7(5.83)	62(51.67)	45(37.50)
3.	Obtaining information regarding Intercropping is difficult	13(10.83)	35(29.17)	20(16.67)	37(30.83)	15(12.50)
4.	Intercropping is too labour-intensive	2(1.67)	2(1.67)	17(14.17)	84(70.00)	15(12.50)
5.	Governmental support to Intercropping is important	2(1.67)	4(3.33)	9(7.50)	46(38.33)	59(49.17)
6.	There is a lack of subsidies for Intercropping	7(5.83)	6(5.00)	21(17.50)	47(39.17)	39(32.50)
7.	Recommended intercropping practices preparation increase production and reduce the cost of cultivation	5(4.17)	6(5.00)	25(20.83)	44(36.67)	40(33.33)
8.	The risk of cultivation is minimized with the adoption of improved production technology	1(0.83)	6(5.00)	46(38.33)	55(45.84)	12(10.00)
9.	Even though Intercropping needs more investment, it is a profitable business	2(1.67)	5(4.17)	35(29.17)	47(39.17)	31(25.83)
10.	Intercropping is the best option to earn money for small farmers	3(2.50)	7(5.83)	23(19.17)	50(41.67)	37(30.83)
11.	Intercropping is also possible to implement by untrained farmers	14(11.67)	40(13.33)	26(21.67)	30(25.00)	10(8.33)
12.	Intercropping protects the cash crops	1(0.83)	10(8.33)	42(35.00)	53(44.17)	14(11.67)
13.	Intercropping helps in the prevention of soil erosion and crust	3(2.50)	12(10.00)	25(20.83)	49(40.84)	31(25.83)
14.	Intercropping helps in increasing the efficiency of fertilizer application	5(4.17)	22(18.33)	18(15.00)	49(40.83)	26(21.67)
15.	Intercropping enhances the biodiversity	2(1.67)	9(7.50)	22(18.33)	58(48.33)	29(24.17)
16.	Intercropping improves weed management	7(5.83)	20(16.67)	20(16.67)	43(35.83)	30(25.00)
17.	Efficient utilization of natural resources in Intercropping	4(3.33)	6(5.00)	18(15.00)	35(29.17)	57(47.50)

*Values in parenthesis denote percentage

Table 3. Association between profile of respondents with their attitude towards intercropping

Socio-economic Variables	Level of attitude of respondents toward intercropping			
	Less Favourable	Favourable	More Favourable	Total (N=120)
Age				
Up to 35 Years	1(2.70)	19(51.35)	17(45.95)	37(30.83)
Between 36 to 50 Years	9(20.45)	16(36.37)	19(43.18)	44(36.67)
Above 50 Years	5(12.82)	9(23.07)	25(64.11)	39(32.50)
Total	15(12.50)	44(36.67)	61(50.83)	120(100)
χ^2 =11.245*; C=0.29				
Education				
Illiterate	2(10.60)	10(52.60)	7(36.80)	19(15.80)
Up to middle	9(31.00)	8(27.60)	12(41.40)	29(24.20)
Secondary and Sr. Secondary	2(4.80)	20(47.60)	20(47.60)	42(35.00)
Graduation and above	2(6.67)	6(20.00)	22(73.33)	30(25.00)
χ^2 =20.792**; C=0.38				
Caste				
Scheduled caste	1(5.00)	5(25.00)	14(70.00)	20(16.66)
Backward Class	2(5.73)	15(42.85)	18(51.42)	35(29.17)
General caste	12(18.46)	24(36.92)	29(44.62)	65(54.17)
χ^2 =7.089; C=0.23				
Subsidiary occupation				
Nil	9(12.67)	30(42.25)	32(45.08)	71(59.17)
Dairy	5(14.28)	10(28.57)	20(57.15)	35(29.17)
Business	1(12.50)	2(25.00)	5(62.50)	8(6.66)
Service	-	2(33.33)	4(66.67)	6(5.00)
χ^2 =2.884; C=0.15				
Annual income (Rs)				
Up to 1,50,000	4(13.33)	10(33.33)	16(53.34)	30(25.00)
Between 1,50,000 – 3,00,000	5(10.42)	19(39.58)	24(50.00)	48(40.00)
Above 3,00,000	6(14.28)	15(35.72)	21(50.00)	42(35.00)
χ^2 =0.552; C=0.06				
Family Type				
Nuclear	3(5.45)	17(30.91)	35(63.64)	55(45.83)
Joint	12(18.47)	27(41.53)	26(40.00)	65(54.17)
χ^2 =8.224*; C=0.25				
Family Size				
Small (up to 4 members)	4(7.69)	20(38.46)	28(53.85)	52(43.33)
Medium (4 to 8 members)	7(16.28)	14(32.56)	22(51.16)	43(35.83)
Large (above 8 members)	4(16.00)	10(40.00)	11(44.00)	25(20.84)
χ^2 =2.341; C=0.13				

Table 3 contd...

Socio-economic Variables	Level of attitude of respondents toward intercropping			
	Less Favourable	Favourable	More Favourable	Total (N=120)
Land holding				
Marginal (1-2.5 acres)	5(21.74)	10(43.48)	8(34.78)	23(19.17)
Small (>2.5-5 acres)	4(9.76)	16(39.02)	21(51.22)	41(34.16)
Medium (>5.1-10 acres)	4(11.43)	11(31.43)	20(57.14)	35(29.17)
Large (above10 acres)	2(9.53)	7(33.33)	12(57.14)	21(17.50)
χ^2 =4.283; C=0.18				
Social participation				
Not a member of any organization	7(15.56)	12(26.67)	26(57.77)	45(37.50)
Member of one organization	5(10.20)	24(49.00)	20(40.80)	49(40.80)
Member of More than one organization	3(11.50)	8(30.80)	15(57.70)	26(21.70)
χ^2 =5.697; C=0.21				
Extension contacts				
Low (1-3)	4(12.90)	11(35.50)	16(51.60)	31(25.80)
Medium (4-7)	7(14.00)	18(36.00)	25(50.00)	50(41.70)
High (8-10)	4(10.25)	15(38.46)	20(51.29)	39(32.50)
χ^2 =0.315; C=0.05				
Mass media exposure				
Low (1-2)	10(34.50)	10(34.50)	9(31.00)	29(24.17)
Medium (3-5)	3(5.90)	20(39.2)	28(54.9)	51(42.50)
High (6-8)	2(5.00)	14(35.00)	24(60.00)	40(33.33)
χ^2 =18.020**; C=0.36				
Social expectations (0-6)				
Low (0-2)	6(21.40)	7(25.00)	15(53.60)	28(23.30)
Medium (3-4)	5(8.30)	30(50.00)	25(41.70)	60(50.00)
High (5-6)	4(12.50)	7(21.90)	21(65.60)	32(26.70)
χ^2 =10.887*; C=0.28				
Food preference (10-28)				
Low consumption (10-15)	5(18.50)	9(33.30)	13(48.20)	27(22.50)
Medium consumption (16-22)	10(12.20)	31(37.80)	41(50.00)	82(68.30)
High consumption (23-28)	-	4(36.40)	7(63.60)	11(9.20)
χ^2 =2.679; C=0.14				
Inheritance				
Grandfather	7(24.10)	8(27.60)	14(48.30)	29(24.20)
Father	6(11.30)	26(49.10)	21(39.60)	53(44.10)
Started by self	2(5.30)	10(26.30)	26(68.40)	38(31.70)
χ^2 =12.435*; C=0.30				

Figures in the parenthesis denote percentage; *Significant at 5 per cent level of significance; **Highly significant at 1 per cent level of significance

significant with the level of attitude towards intercropping, this could be inferred from the reason that education and access to technology helped the respondents to increase their level of knowledge and with increased level of knowledge they have more favourable attitude towards intercropping. While age, family type, social expectations and inheritance were found significantly associated with the level of attitude and caste, subsidiary occupation, annual income, land holding, family size, social participation, extension contacts and food preference were found insignificant with the level of attitude of the respondents towards intercropping.

The findings were partially supported by Kumawat (2015) revealed that the attitude of the farmers was positively and significantly associated with their age, family income, caste, occupation, education level, and social participation, size of land holding, mechanical power, farm implements, material possession, irrigation potentiality and source of information utilization. Chijkwa (2013) in his study reported that gender and literacy level of a farmer had a significant influence on the attitude of a farmer towards intercropping. Maurya et al., (2021) reported that farm skill, comfort expectancy, stimulation expectancy, farm size, economic motivation and affiliation expectancy positively favour their attitude towards agriculture.

CONCLUSION

The results revealed that more than half of the respondents (50.83%) had more favourable attitude towards intercropping and education level and mass media exposure were found highly significant with the level of attitude towards intercropping while age, family type, social expectations and inheritance were found significantly associated with the level of attitude towards intercropping. The study recommends training of more and more farmers on better utilization of mass media for getting reliable information as from the results mass media was found highly significant with the level of attitude. This will help farmers in increase in their knowledge level and they can also realize the true potential of mass media.

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Research Article

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Analysis of Dairy Value Chains in Organized Sectors of Haryana: A Chain Wide Learning Approach

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ABSTRACT

Despite the fact that India is the highest milk producer in the world, dynamic production and consumption pattern of milk furnishes immense scope for analyzing the existing dairy value chains in the country. Value chain analysis is important to understand the prevailing market situation, interrelationships among the core actors, their market participation and issues & challenges involved in the value chain. Main objective of the study is to analyze the value chains of milk in organized dairy sector comprising of co-operative and private dairies of Haryana. Chain wide learning method was employed to analyze the detailed value chain of milk considering the stakeholders from input suppliers to consumers for improving the performance of value chain. The empirical evidences indicated that procurement, chilling and processing costs were higher in the co-operative dairy than the private dairy plant. However, the co-operative plant realized higher producers' share in consumers' price (76.16%) than the private dairy plant (75.15%) with a higher degree of marketing efficiency (3.20). Therefore, attention must be given the mobilize large number of farmers towards organized dairy sector by providing modern technologies and training facilities to strengthen the value chain management practices for tapping the commercial potential of Indian dairy sector.

INTRODUCTION

Agriculture being the soul of Indian economy provides direct or indirect source of necessary income and employment to around 70 per cent of India's burgeoning population. However, livestock rearing and dairying go hand-in-hand with agriculture involving majority of vulnerable segment of the society to ensure continuous flow of income to the rural folk and improving their socio-economic condition. In India, dairying is emerging as an integral part of the economy which is one of the fastest growing sectors of the country with an annual growth rate of around 6 per cent in milk production (Economic Survey, 2021). Currently, India is the global leader of milk production with an annual production of 198.4 million tonnes and per capita availability of 406 gram/day (NDDB, 2021). The phenomenal growth in Indian dairy sector is attributed to the extensive dairy development programs undertaken in the country accompanied with dynamic demand and supply patterns of several value added products (Birthal et al., 2017). Being the largest producer and consumer of dairy products, Indian dairy sector aims for better scientific management practices and technological up-gradation in milk processing and marketing activities (Acharya et al., 2022). Due to the decentralized production and supply of milk, an efficient marketing system helps in ensuring remunerative prices to the producers as well as provides quality milk to the consumers at affordable prices (Kumar & Staal, 2010). Modern marketing channels and strategies serves a prominent role in providing higher profits to milk producers by improving efficacy along the entire supply chain (Janssen & Swinnen, 2019). In India,

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milk market is highly fragmented, comprising of both traditional (consumption at home and traditional milk vendors) and modern (private dairies and cooperatives) segments (Ashwar et al., 2017 & Mandi et al., 2022). Around 60 per cent of total produced milk is marketed through various agencies, out of which 36 per cent of milk is handled by informal sector and rest 24 per cent is disposed off through modern channels (Kumar et al., 2011). However, the dairy sector, due to continuous transformation, is moving towards a coordinated and sustainable supply chain from a traditional marketing system (Birthal, 2008). Therefore, need of the hour is to analyze the entire value chain of milk for understanding the market structure and participation of the core actors along with the constraints & opportunities as the limiting factors for growth of dairy farmers.

Haryana state possesses about 2.5 per cent of country's total bovine population with an annual production of 117.35 lakh tonnes of milk (5.9 per cent of country's total annual milk production (GoH, 2020). In spite of well-structured cooperative network in Haryana, large amount of milk flows through traditional marketing channels and dairy cooperatives face huge competition from the private dairies and milk vendors (Mohapatra & Sendhil, 2020). In this endeavor, a comparative analysis of procurement, processing and marketing of milk in co-operative and private sector dairy plants in Haryana was undertaken in order to analyse the marketing efficiency of existing dairy value chains.

METHODOLOGY

This study is based on the primary data collected from different stakeholders of dairy value chain in the rural households of Haryana. The district Jind was selected purposively as the Jind milk union is the oldest with largest capacity of 1.50 LLPD (GoH, 2020). Another district *i.e.* Karnal was also selected purposively due to existence of a large sized private dairy plant with highest milk handling capacity among the other private dairy plants existing in the state. Two blocks from each district and then two villages from each selected block were also selected randomly. From each block, 60 dairy farmers were selected and were post-stratified into different categories, *viz.*, small, medium and large households on the basis of their Standard Animal Units (SAUs). Total of 242 respondents comprising of 120 dairy farmers, 22 modern milk market agents and 100 consumers were surveyed by means of structured questionnaires.

Tabular analysis was employed to estimate cost of procurement, chilling and processing of milk. Cost of milk procurement was computed by adding the cost of collection of milk at dairy cooperative societies as well as private milk collection centres' level, cost of transportation and cost of milk reception at the respective processing plants (Trienkens, 2011). Procurement cost and chilling cost were calculated by using following formulae:

$$\text{Procurement cost (Rs./litre/day)} = \frac{\text{Total procurement cost}}{\text{Total quantity of milk procured}}$$

$$\text{Chilling cost (Rs./litre/day)} = \frac{\text{Total chilling cost}}{\text{Total quantity of milk chilled}}$$

Total cost of processing of raw milk consists of both fixed cost and variable cost and the estimation procedure of the cost of processing is presented below.

Total cost of processing = Total fixed cost + Total variable cost

Fixed cost of a processing plant comprises of depreciations on buildings and machineries, interest on investments and expenses on salaries & supervision, whereas, variable cost includes cost of raw materials, electricity charges, labour wages, store & maintenance charges, water & steam charges, quality control expenses, cost of weighing & packaging *etc.* Chain Wide Learning (CWL) method was employed for dairy value chain analysis and mapping for understanding the linkages among the small-scale producers with the modern market environment (Vermeulen et al., 2008).

RESULTS AND DISCUSSION

Procurement cost of liquid milk

Table 1 represents the component wise average procurement cost per litre of milk incurred by ten dairy cooperative societies (DCS) and ten private milk collection centres (PMCC). The average cost of milk collection was higher in the case of PMCC (Rs. 0.51/ litre) than the DCS (Rs. 0.42/litre) due to higher fixed expenses, repair & maintenance and electricity charges incurred by the PMCCs than DCS. Wages and salaries account for higher share in the variable costs, followed by electricity charges in case of both DCS and PMCC. The result pattern on the share of fixed and variable cost in total cost of milk collection corroborates the research findings of Vanishree et al., (2018).

The overall quantity of milk transported to the milk processing plants was found to be higher in DCS (935420 litre/ annum) as compared with the PMCC (484510 litre/annum). The annual distance covered for transportation of milk was worked to be 843256.90 km and 435423.24 km in case of DCS and PMCC, respectively. As transportation is directly related to the service distance covered by the DCS or PMCC, the transportation cost of milk by DCS was found to be higher (Rs. 1.13/litre) as compared to the PMCC (Rs. 0.94/litre). The overall cost of milk reception at the milk processing plants was worked out to be Rs. 0.061/litre and Rs. 0.085/litre in case of cooperative and private plant, respectively. The higher overall reception cost in case of private milk plant can be attributed to its lower quantity of milk reception (462.43 litre/annum) as compared to the cooperative plant (862.16 litre/annum). The results obtained regarding the per cent share of fixed and variable costs were similar to the recent study conducted by Doni & Chauhan (2018).

The procurement cost of milk by the cooperative plant was higher (Rs. 1.61/litre) than the private milk plant (Rs. 1.53/litre) ascribed to handling of more quantity of milk. Transportation cost holds the highest share in total cost of procurement of milk (70.10% in cooperative and 61.24 per cent in private dairy plant), followed by cost of collection and cost of reception of milk.

Cost of chilling

The overall chilling cost was estimated to be Rs. 0.53 and Rs. 0.47 per litre in the case of cooperative milk processing plant and private milk plant, respectively (Table 2). The higher chilling cost

Table 1. Total cost of procurement

Cost of collection		
Components of cost	Average cost (000'Rs/annum)	
	Dairy cooperatives	Private milk collection centres
1) Fixed cost		
Depreciation on fixed assets	22.78 (5.68)	18.76 (7.06)
Interest on fixed assets	9.85 (2.46)	4.34 (1.63)
Rent paid	14.67 (3.66)	10.23 (3.85)
Sub-total	47.3 (11.80)	33.33 (12.55)
2) Variable cost		
Wages and salaries	268 (66.87)	164 (61.74)
Repair and maintenance	28 (6.99)	19.86 (7.48)
Electricity charges	45.76 (11.42)	39.21 (14.76)
Stationeries	8.49 (2.12)	6.42 (2.42)
Miscellaneous	3.2 (0.80)	2.8 (1.05)
Sub-total	353.45 (88.20)	232.29 (87.45)
Total cost (1+2)	400.75 (100.00)	265.62 (100.00)
Total milk collected (litre/annum)	954.17 520.82	
Cost of collection per litre of milk (Rs./litre) (A)	0.42	0.51
Cost of transportation (Rs/annum)		
Total transportation cost (Rs./annum)	1055456	455234
Total quantity of milk transported (litre/annum)	935420	484510
Transportation cost (Rs./litre) (B)	1.13	0.94
Cost of reception		
1) Variable cost (lakh Rs./annum)		
Electricity charges	11.42 (21.64)	7.32 (18.71)
Water charges	3.65 (6.92)	2.12 (5.42)
Repair and maintenance	1.92 (3.64)	1.13 (2.89)
Labour wages	4.12 (7.81)	3.87 (9.89)
Miscellaneous cost	1.08 (2.05)	0.76 (1.94)
Sub-total	22.19 (42.04)	15.2 (38.84)
2) Fixed cost (lakh Rs./annum)		
Depreciation on fixed assets	3.62 (6.86)	2.24 (5.72)
Interest on fixed assets	8.54 (16.18)	8.12 (20.75)
Salary to regular staffs	18.43 (34.92)	13.57 (34.68)
b) Sub-total	30.59 (57.76)	23.93 (61.16)
Total cost (a+b)	52.78 (100.00)	39.13 (100.00)
Quantity of milk received (litre/annum)	862.16	462.43
Cost of milk reception(Rs/litre) (C)	0.061	0.085
Total procurement cost (A+B+C) (Rs/litre)	1.61	1.53

Figures within parentheses are the percentages of total cost

Table 2. Cost of chilling incurred by cooperative and private dairy plant

Components of cost	Cooperative dairy plant		Private dairy plant	
	Cost incurred (lakh/annum)	Share (%)	Cost incurred (lakh/annum)	Share (%)
1) Variable cost				
Electricity charges	98.56	25.61	63.46	32.27
Refrigeration charge	82.49	21.43	41.09	20.89
Fuel charges	63.7	16.55	32.23	16.39
Stationary charges	6.91	1.80	1.67	0.85
Cost of testing material	12.45	3.23	5.34	2.72
Repairs and maintenance cost	18.76	4.87	8.54	4.34
Sub-total (1)	282.87	73.49	152.33	77.46
2) Fixed cost				
Depreciation on fixed assets	37.21	9.67	23.04	11.72
Interest on fixed assets	41.14	10.69	12.31	6.26
Salary paid to permanent staff	23.67	6.15	8.97	4.56
Sub-total (2)	102.02	26.51	44.32	22.54
Total cost (1+2)	384.89	100.00	196.65	100.00
Average milk chilled (lakh/annum)	725.54		414.92	
Chilling cost per litre (Rs.)	0.53		0.47	

Table 3. Processing cost of full cream milk

Component of cost	Cooperative dairy plant		Private dairy plant	
	Cost (Rs. /litre)	Share (%)	Cost (Rs./litre)	Share (%)
Variable cost (A)				
Labour charges	0.29	9.73	0.22	9.95
Electricity charges	0.41	13.76	0.37	16.74
Water and steam charges	0.27	9.06	0.19	8.60
Refrigeration charges	0.30	10.07	0.23	10.41
Quality control expenses	0.12	4.03	0.06	2.71
Packaging material	0.41	13.76	0.33	14.93
Storage and stationary	0.31	10.40	0.21	9.50
Sub-total	2.11	70.81	1.61	72.85
Fixed cost (B)				
Depreciation on fixed assets	0.36	12.08	0.26	11.76
Interest on fixed assets	0.20	6.71	0.12	5.43
Expenses on salary and administration	0.31	10.40	0.22	9.95
Sub-total	0.87	29.19	0.60	27.15
Total processing cost (A+B) (Rs./litre)	2.98	100.00	2.21	100.00

in cooperative milk plant could be due to higher quantity of milk chilled per annum. In case of both the plants, the variable cost incurred had a share of 73.49 and 77.46 per cent of the total chilling cost, respectively. Among the variable costs, electricity charge constitutes a major share in case of both the plants, followed by refrigeration charges and fuel cost. The proportion of fixed cost was worked out to be 26.51 and 22.54 per cent of the gross chilling cost, respectively in the case of cooperative and private milk plant.

Processing cost of full cream milk

Total cost incurred by the processing plants for conversion of raw milk into full cream milk along with its manufacturing and packaging forms the total processing cost of full cream milk. The processing cost incurred by both the dairy plants was estimated and presented in the Table 3.

As presented in Table 3, the proportion of total fixed cost to the processing cost of milk was estimated to be 29.19 and 27.15 per cent, respectively for cooperative and private dairy plant. The share of variable cost to the processing cost was 70.81 and 72.85 per cent for cooperative and private dairy plant, respectively. Among the variable costs, electricity charges and packaging material constituted a major share in case of both the plants. Electricity charges comprised 13.76 and 16.74 per cent, respectively in the case of cooperative and private dairy plant. The cost incurred for packaging material was estimated to be Rs. 0.41/litre (13.76%) in the case of cooperative plant and Rs.0.33/litre (14.33 %) in private processing plant. The total processing cost was estimated to be higher (Rs. 2.98/litre) in the case of cooperative milk plant as compared to the private milk processing plant (Rs. 2.21/litre). The share of cost of raw material was highest to the total cost as compared to other cost components, corroborating the earlier findings of Thakur et al., (2020). Nain et al., (2019) also mapped the value chain in case of flowers and vegetables and found that the producer share decreases with length of value chain.

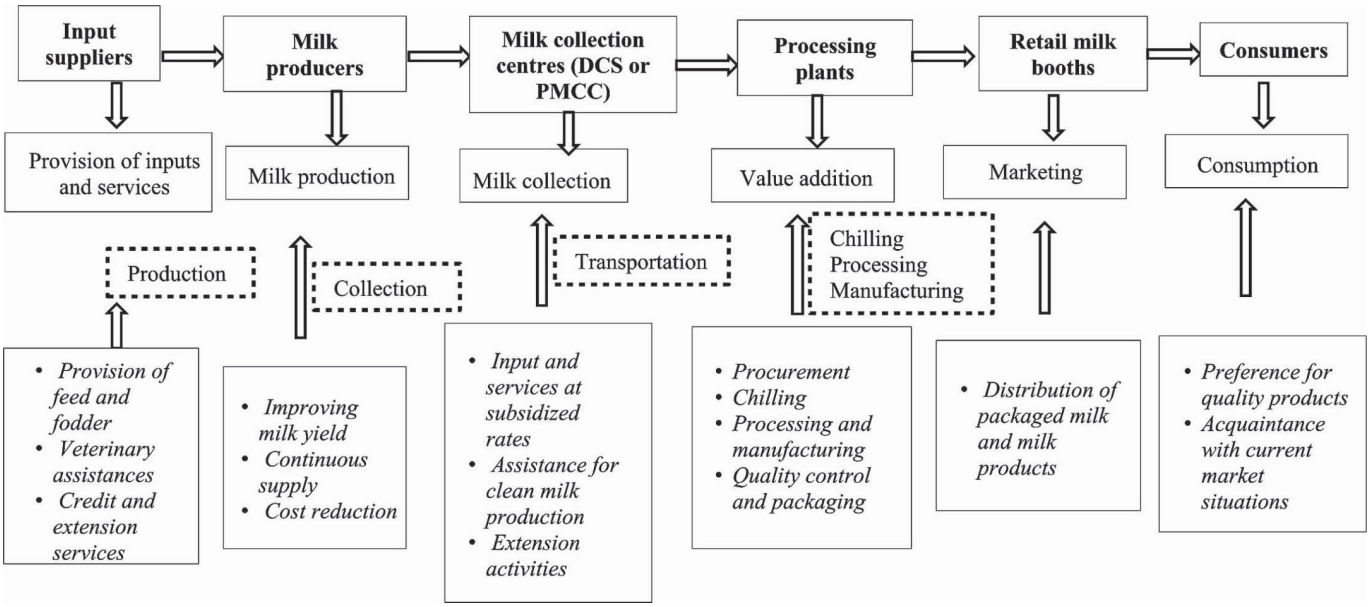
A perusal of the Table 4 revealed that marketing cost of milk for cooperative plant was estimated to be Rs. 5.12/litre, which comprised of procurement cost (Rs. 1.61/litre), chilling cost (Rs. 0.53/litre) and processing cost (Rs. 2.98/litre). The procurement cost, chilling cost and processing cost incurred by the private dairy plant were worked out to be Rs. 1.53, Rs. 0.47 and Rs. 2.21 per litre, respectively and the total marketing cost was estimated to be Rs. 4.21 per litre of milk. Cost of raw material contributed a major share in the total cost incurred by cooperative milk plant and private plant i.e. 89.11 and 90.60 per cent, respectively. The selling price per litre of milk was found to be Rs. 55 and Rs. 54 in case of cooperative dairy plant and private dairy plant, respectively. The analysis indicated that marketing margin realized in case of both the plants were Rs. 7.99/litre and Rs. 9.21/litre, respectively, attributed to higher cost of milk procurement and processing in case of cooperative dairy plant. However, the producers' share in consumers' rupee realized was found to be higher in cooperative plant (76.16%) than the private dairy plant (75.15%) which resulted in higher marketing efficiency in cooperative dairy plant *i.e.* 3.20 as compared to private dairy plant (3.02).

Table 4. A comparative analysis of value chains of full cream milk

S. No.	Particulars	Cooperative dairy plant	Private dairy plant
1.	Cost of raw material (Rs./litre)	41.89	40.58
2.	Procurement cost (Rs./litre)	1.61	1.53
3.	Chilling cost (Rs./litre)	0.53	0.47
4.	Processing cost (Rs./litre)	2.98	2.21
5.	Total cost (Rs./litre) (1+2+3+4)	47.01	44.79
6.	Selling price (Rs./litre)	55	54
7.	Marketing margin (Rs./litre) (6-5)	7.99	9.21
8.	Total marketing cost (Rs./litre) (2+3+4)	5.12	4.21
9.	Marketing cost & margin (Rs./litre) (7+8)	13.11	13.42
10.	Marketing efficiency (1/9)	3.20	3.02

Mapping of dairy value chain

In mapping of the detailed value chain of milk, the important activities carried out by different stakeholders along the value chain from production to consumption were identified (Porter, 1985). Analysis was done with respect to different processes



Bold: Stakeholders; Un-bold: Core activities; *Italic*: Supporting activities

Figure 1. Detailed value chain of milk

involved in the value chain such as provision of inputs and services, milk procurement by DCSs and PMCCs, processing of milk by the milk plants, organization of various awareness programs for clean milk production, *etc*. CWL analytical tool was followed for detailed value chain mapping of milk in the study area including the core and supporting activities of the core actors and their involvement in value chain has been presented in Figure 1.

CONCLUSION

Indian dairy sector has undergone through a sea change transformation to be a self-reliant industry by means of enhanced production, procurement, processing and marketing system. Therefore, analysis of existing dairy value chain by CWL method along with prevalent market structures, participation of core actors with challenges associated at each stakeholder level is essential to improve the efficiency of both input and product markets. Higher marketing margin in case of private plants necessitates establishment of more number of milk collection centres and chilling units. Strong efforts must be taken for effective dairy value chain management in order to improve the risk handling and resilience abilities of the value chain as well as the concerned stakeholders. It is essential to encourage dairy farmers for active participation in the value chain to enable a regulatory environment to bridge the knowledge gap among the farmers. Continuous efforts must be taken to sustain the dynamic production and consumption pattern of milk by means of constructive value chain management practices in order to realize the full potential of Indian dairy sector.

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Leveraging the Critical Incident Technique to Identify the Detrimental Effect of *Cuscuta reflexa* Roxb. on Dairy Animals

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ABSTRACT

The critical Incident technique was deployed to study the detrimental effect of *Cuscuta reflexa* on dairy animals. In the present study, the critical incidences were farmers' fields where *berseem* was infested with *Cuscuta reflexa* and farmers were feeding that contaminated *berseem* to dairy animals. Thus, face-to-face interaction was done with 13 farmers of *Malpur* and *Ganeshpur* village of Bareilly district for the same incidences in the years 2021 and 2022. Based on farmers' response it was observed that due to gradual feeding of *berseem* contaminated with *Cuscuta reflexa* on an average there was a reduction in milk yield of 5.35 L/day in 2021 and 3.35 L/day in 2022 of dairy animals. The annual economic loss was calculated as Rs. 27322/- in 2021 and Rs. 20048.57/- in 2022. The reduction in milk yield (68.67%) shares the maximum percentage of economic loss followed by replacement cost (25.38%), and then treatment cost (5.95%).

INTRODUCTION

Plant poisoning in dairy animals are always a major concern for a veterinarians as well as dairy farmers. There are numerous plants that adversely affect the health of dairy animals and the income of dairy farmers. During the field visit conducted, the researcher came across the twinning or climber parasite i.e. *Cuscuta reflexa* in the *berseem* field and observed that farmers were feeding the *berseem* infested with *Cuscuta reflexa* to their dairy animals. It was also observed that the dairy animals especially buffaloes were eating this feed may be due to its palatability. After the pilot study, it was found that *Cuscuta reflexa* was causing gradual milk yield reduction in dairy animals and due to the same reason; few farmers had sold their animals also. The *Cuscuta reflexa* makes a tangled mask covering the *berseem* (host) plant and it has very low levels of chlorophyll and can slightly photosynthesis, thus dependent on the host plant for nutrition. The *Cuscuta reflexa* belongs to Convolvulaceae family and it is popularly known as dodder in English. The local names of this plant are *akashbel, amarbel, parasari,* etc.

Literature studies also reported that the *Cuscuta reflexa* is having an adverse effect on dairy animals. The study conducted in Udhampur district of Jammu and Kashmir reported *Cuscuta reflexa* Roxb. causes uneasiness, vomiting, anorexia, abdominal pain, and purgation in livestock (Bhatia et al., 2014). Its intake by pregnant animals results in abortion. Another research in southern Aravalli hills of Rajasthan reported that plant juice causes depression with nausea, vomiting, and abortion. Tribals mix the plant with fodder to kill the enemy's livestock (Katewa et al., 2008). Similar finding was reported by C. Alagesaboopathi, 2012 in Salem District of Tamil Nadu (Alagesaboopathi, 2012). Thus, based on farmers' perception and literature supported findings that *Cuscuta reflexa* Roxb. is adversely affecting dairy animals. The first-ever attempt has been made to conduct the study with the objective "Leveraging the Critical Incident Technique to identify the detrimental effect of *Cuscuta reflexa* Roxb. on dairy animals". The first attempt has been made to calculate the economic losses i.e. reduction in milk yield, treatment cost, and replacement cost occurring due to feeding of *berseem* contaminated with *Cuscuta reflexa*. The critical incident technique was used to calculate the

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economic losses due to feeding of *berseem* contaminated with *Cuscuta reflexa* to dairy animals.

METHODOLOGY

The critical incident technique (CIT) was first described by John C. Flanagan in 1954 and it is a well established qualitative research tool used in many areas of the health sciences, including nursing (Kemppainen, 2003; Keatinge, 2002 & Chamber, 1988), medicine (Holmwood, 1997 & Altmaier et al., 1997), dentistry (Henzi et al., 2007) and their respective education systems.

CIT is a research tool that facilitates the investigation of significant occurrences (events, incidents, processes, or issues) identified by the respondent, the way they are managed, and the outcomes in terms of perceived effects (Chell, 1998). In another word, CIT is a set of procedures designed to systematically gather information concerning specific incidents (events or occurrences) that lead to either effective or ineffective behaviour concerning a particular activity (Swan, 1975). Many of the researchers opine that CIT is an exploratory method that is suitable when the purpose of research is to enhance knowledge of a phenomenon about which relatively little has been documented. The present investigation has made an attempt to analyze the economic losses occurring among farming community due to feeding of *berseem* infested with *Cuscuta reflexa*. In the study, critical incidents were characterized as farmers' *berseem* field in which *Cuscuta reflexa* appeared and they were feeding contaminated *berseem* to their dairy animals. Hence, only those farmers were selected for present investigation, where such cases had been reported. Following five basic steps of CIT: 1) identifying general aims; 2) planning; 3) collecting the data; 4) analyzing the data, and 5) interpretation and reporting of results, the present study was carried out.

Under *identifying general aims*, it has been observed that *Cuscuta reflexa* was present in the *berseem* field and it was very difficult for farmers to separate it from the *berseem*. Owing to prevailing high cost of wheat straw, they were feeding the *berseem* contaminated with *Cuscuta reflexa* plant. It has been observed based on dairy farmers' response that there was a reduction in milk yield of buffalo due to feeding of *berseem* contaminated with *Cuscuta reflexa*. Also, the literature suggested that *Cuscuta reflexa* Roxb. causes uneasiness, vomiting, anorexia, abdominal pain, and purgation in livestock. Its intake by pregnant animals results in abortion (Bhatia et al., 2014). Therefore, an attempt has been made to study the poisonous effect of *Cuscuta reflexa* Roxb. on dairy animals as perceived by farmers.

During the planning stage, the following aspects were addressed. Firstly, "the situations to be observed" in which the villages having an infestation of *Cuscuta reflexa* in *berseem* were identified. Then the dairy farmers were identified whose *berseem* field was infested with *Cuscuta reflexa* by the help of a resource person. Those identified farmers were interviewed about the detrimental effect of *Cuscuta reflexa* feeding to their dairy animals. The question regarding when *Cuscuta reflexa* appeared in *berseem field*, how long they were feeding the *berseem* infested with *Cuscuta reflexa*, why they were feeding and what else they were feeding etc. asked during the investigation. Further, visit to every farmer's *berseem* field infested with *Cuscuta reflexa* was also conducted to confirm the situation. Secondly, "the observer" i.e. experts who were working on the poisonous plants for dairy animals, were the scientists from the extension education division and pharmacology division in the study. Thirdly, "the method of data collection" under which personal interview method along with experts' consultation has been made for collecting the data as done earlier by Mishra (2022).

In step 3, *collecting the data*, the semi- structured interview schedule was prepared with the help of an expert team and then administered to the farmers as used by other researchers (Shamna, 2022). The face-to-face interaction was done to collect the data from dairy farmers regarding the effect of *berseem* infested with *Cuscuta reflexa* feeding on dairy animals. The data collection was done in the years 2021 as well as 2022 to cross-check the effect of feeding *berseem* contaminated with *Cuscuta reflexa* to dairy animals. Two villages of Bareilly district i.e. *Malpur* and *Ganeshpur* were identified where *berseem* contaminated with *Cuscuta reflexa* was found and farmers were feeding the same to dairy animals. From *Ganeshpur* village, 3 dairy farmers were affected and from *Malpur* village, 10 dairy farmers were affected. Hence, 13 dairy farmers were studied to identify the poisonous effect of *Cuscuta reflexa* Roxb. on dairy animals as perceived by farmers. This study is the first ever to calculate the economic losses occurring to farmers due to feeding *berseem* contaminated with *Cuscuta reflexa* at field. Step 4, *analyzing the data* and step 5, *interpretation and reporting the results* have been explained under results and discussion section.

RESULTS AND DISCUSSION

Analyzing the data

The data on the social profile of dairy farmers were collected and compiled. It was found that on an average the dairy farmers were 44 years old with 20 years of experience in dairy farming. Although, on an average, their educational qualification was poor with 5-6 members in the family. In the year 2021, 10 dairy farmers and 11 dairy animals were affected due to the feeding of *berseem* contaminated with *Cuscuta reflexa*. It has been observed that buffalo were mainly affected as in this region buffalo rearing was more preferred than the cow. The calf and heifer had not shown many symptoms except diarrhoea in a few cases. Based on farmers' perception, it has been found that due to continuous feeding of *berseem* contaminated with *Cuscuta reflexa*, there was a gradual reduction in milk yield of buffalo. It has also been perceived that some of the farmers had replaced their buffalo because of reduced milk yield. Extra expenditure on treatment costs was also involved.

The average lactation order and lactating stage of incidences faced by dairy animals were 3.25 (numbers) and 2.9 (months) respectively. The average months of pregnancy observed was 1.4 months among incidences faced by buffaloes. Before feeding the *berseem* contaminated with *Cuscuta reflexa*, the average milk yield of buffalo was 8.3 l/day whereas after feeding the contaminated *berseem* the milk yield reduced to 3.35 l/day. Thus, due to continuous feeding of *berseem* contaminated with *Cuscuta reflexa* for two months (March & April) there was a reduction in milk yield of 5.35 l/day. The change in milk yield between before

Table 1. Detrimental effect of *Cuscuta reflexa* ingestion on milk yield of Buffalo during 2021

HH (no.)	Age (yrs)	Exp (years)	Education (Class)	Family size (Nos.)	Incidence cases (Nos.)	Lactation order (Nos.)	Lactating stage (month)	Pregnancy status (months)	Effect on milk yield (L)		Reduction in milk volume (L)	Economic milk loss @ 40 (Rs/day)
									Before feeding	After feeding		
1.	48	22	8	6	1	4	3	1	9	5	4	160
2.	51	20	7	7	1	3	4	2	7	3.5	3.5	140
3.	42	22	2	6	1	2	5	1	7	2	5	200
4.	35	15	2	6	Nil	Nil	0	0	Nil	Nil	Nil	Nil
5.	55	20	0	8	1	4	1	0	10	5	5	200
6.	40	18	8	4	1	2	2	0	8	2.5	5.5	220
7.	38	12	7	5	1	5	3	0	9	6	3	120
8.	58	32	12	7	1	3	4	2	14	3	11	440
9.	45	25	5	5	2	4	2	0	6	2	8	320
10.	32	12	2	4	1	1	2	0	5	2	3	120
11.	55	23	8	6	1	4.5	3	1	8	2.5	5.5	220
12.	38	18	5	6	Nil	Nil	0	0	Nil	Nil	Nil	Nil
13.	40	21	8	5	Nil	Nil	0	0	Nil	Nil	Nil	Nil
Average	44.38	20	5.69	5.76	11	3.25	2.9	1.4	8.3	3.35	5.35	214

Table 2. Detrimental effect of *Cuscuta reflexa* ingestion on milk yield of Buffalo during 2022

HH No.	Cases of incidence	Lactating Stage (month)	Pregnancy status (Nos.)	Effect on milk yield (L)		Reduction in milk volume (L)	Economic milk loss @ 40 (Rs/day)	Remark on incidences faced
				Before feeding	After feeding			
1.	1	4	0	5	0	5	200	Repeated
2.	Nil	0	0	Nil	Nil	Nil	Nil	Replaced but not fed
3.	1	4	1	6	2	4	160	Replaced and fed
4.	1	5	0	8	4	4	160	Fed in 2022
5.	Nil	0	0	Nil	Nil	Nil	Nil	Not fed in 2022
6.	Nil	0	0	Nil	Nil	Nil	Nil	Not fed in 2022
7.	Nil	0	0	Nil	Nil	Nil	Nil	Not fed in 2022
8.	Nil	0	0	Nil	Nil	Nil	Nil	Replaced but not fed in 2022
9.	Nil	0	0	Nil	Nil	Nil	Nil	Replaced but not fed in 2022
10.	1	1	0	5	3	2	80	Replaced and continued feeding
11.	2	4	1	8	2.5	5.5	440	Repeated
12.	1	2	0	6	2	4	160	Fed in 2022
13.	2	3	1	6	3	3	240	Fed in 2022
Overall Average	9	3.28	1	6.28	2.75	3.92	205.71	

feeding and after feeding was calculated with the help of paired t-test and it was found that there is significant reduction in milk yield due to feeding of *berseem* contaminated with *Cuscuta reflexa* with t value 4.63 ($p<0.001$) as seen in table no. 3. Therefore, the average economic loss due to the *berseem* contaminated with *Cuscuta reflexa* at the rate of Rs. 40 per litre was Rs. 214 every day.

From Table 2, it can be inferred that 9 dairy animals faced the incidences of *berseem* contaminated with *Cuscuta reflexa* in the year 2022. In 2021, a total of 10 incidences were seen at the farmers' household level whereas, in 2022, 7 farmers' households were found affected. It has been observed that 5 households had replaced their dairy animal due to the reduced milk yield. Among 5 households, three didn't feed *berseem* contaminated with *Cuscuta reflexa* next year after replacing the animal but two households continued. Although, 4 households had been observed feeding *berseem* contaminated with *Cuscuta reflexa* both the years 2021 and 2022. The reason may be a lack of awareness about the *Cuscuta reflexa* and the high cost of wheat straw.

The average lactating stage and pregnancy status of incidences faced by dairy animals were 3.28 (numbers) and 1 month respectively in the year 2022. Before feeding the *berseem* contaminated with *Cuscuta reflexa*, the average milk yield of buffalo was around 6.28 l/day whereas after feeding the contaminated *berseem* the milk yield was reduced to 2.75 l/day. Thus, due to continuous feeding of *berseem* contaminated with *Cuscuta reflexa* for two months (March & April) there was a reduction in milk yield of 3.92 l/day. A significant difference in milk yield between before feeding and after feeding was found at paired t-test 3.46 ($p<0.002$) as seen in table no.3. Therefore, the average economic milk loss due to the *berseem* contaminated with *Cuscuta reflexa* at the rate of Rs 40 per litre of milk was Rs. 205.71 every day.

The different parameters considered for calculation of economic losses due to feeding of berseem contaminated with Cuscuta reflexa were milk yield reduction, treatment cost and replacement cost for those who replaced their animal due to the same incidence. Thus, in the year 2021, the economic loss due to reduced milk yield was Rs. 15252, due to treatment cost was Rs. 1570, and replacement

Table 3. Effect on milk yield of dairy animals due to feeding of *berseem* contaminated with *Cuscuta reflexa* by t-test

Particular	Milk yield	Mean	Variance	Pearson correlation	Paired t test value
2021	Before feeding	6.384	17.92	0.785	4.63 (p< 0.001)
	After feeding	2.576	3.78		
2022	Before feeding	3.38	11.42	0.868	3.46 (p<0.001)
	After feeding	1.26	2.27		

cost was Rs. 21000. Therefore, the total annual economic loss for the year 2021 was Rs. 27322 as seen in Table 4. However, the total annual economic loss in the year 2022 was Rs. 20048.57 which includes reduced milk yield (Rs. 18,777.14) and treatment cost (Rs. 1271.42) due to berseem contaminated with *Cuscuta reflexa.*

Interpretation and reporting the results

During the field visit of documentation of toxic plants for dairy animals as perceived by farmers, it has been observed that in the *Malpur* and *Ganeshpur* village of Bareilly district, the *berseem* field was found infested with *Cuscuta reflexa*. After a pilot study, it was observed that the farmers' were feeding the *berseem* contaminated with *Cuscuta reflexa* which had resulted in gradual milk yield loss and in a few cases the animals could not recover, and thus, farmers replaced their animals. Thus, the critical incident technique was used to study the detrimental effect of *Cuscuta reflexa* on dairy animals. In the present study, the critical incident was selected farmers who were feeding the *berseem* infested with *Cuscuta reflexa*. The data was collected from the selected farmers for two years 2021 and 2022. Through deep interaction and field study, it has been found that the farmers due to lack of awareness and due to the high cost of wheat straw, they were feeding contaminated *berseem* to dairy animals. Thus, the annual economic loss for the year 2021 was Rs. 27322 and for the year 2022 was Rs. 20048.57. The gross economic loss for both the years (2021 & 2022) was Rs. 47370.57. The reduction in milk yield (68.67%) shares the maximum percentage of economic loss followed by replacement cost (25.38%) and then treatment cost (5.95%) as seen from Table 5. The study conducted in Haryana revealed that the total investment made on dairy animal, the major proportion was covered by investment on feed and fodder, followed by concentrates and labours (Ghalawat, 2022).

Table 5. Major determinant of economic losses due to feeding contaminated *berseem* to dairy animal

S.No.	Determinant	Average cost	Share (%)
1	Milk yield loss	21843.07	68.67
2	Replacement cost	8076.92	25.38
3	Treatment cost	1892.30	5.95
	Total	31812.30	

CONCLUSION

There are numerous poisonous plants that if ingested by dairy animals may affect their health adversely depending upon the amount consumed and toxicity of the plants. It was observed that *berseem* was infested with *Cuscuta reflexa* and farmers were feeding that contaminated *berseem* to dairy animals which cause the reduction in milk yield and affecting farmers' pocket ultimately. Hence, awareness regarding *Cuscuta reflexa* poisoning among dairy farmers should be created to prevent the adverse effect of *Cuscuta reflexa* on the health of dairy animals. It may be suggested that farmers should ensure the feed and fodder should be free from any toxic component which may harm the animal.

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Table 4. Gross economic loss incurred during both the years (2021 & 2022)

Household number	Economic milk loss (Rs)		Replacement cost (Rs)	Treatment cost (Rs)		Annual economic loss (Rs) 2021	Annual economic loss (Rs) 2022	Gross Economic loss (Rs)
	2021	2022		2021	2022			
1	9920	12400	Nil	500	1000	10420	13400	23820
2	8680	Nil	20000	2000	Nil	30680	Nil	30680
3	12400	9920	15000	1000	1500	28400	11420	39820
4	Nil	9920	Nil	Nil	500	Nil	10420	10420
5	12400	Nil	Nil	2000	Nil	14400	Nil	14400
6	13640	Nil	Nil	2000	Nil	15640	Nil	15640
7	7440	Nil	Nil	1500	Nil	8940	Nil	8940
8	27280	Nil	38000	4000	Nil	69280	Nil	69280
9	39680	Nil	20000	500	Nil	60180	Nil	60180
10	7440	4960	12000	1500	1500	20940	6460	27400
11	13640	54560	Nil	700	800	14340	55360	69700
12	Nil	9920	Nil	Nil	1100	Nil	11020	11020
13	Nil	29760	Nil	Nil	2500	Nil	32260	32260
Average	15252	18777.14	21000	1570	1271.42	27322	20048.57	47370.57

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Research Article

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Income Diversification: A Way Towards Attracting Rural Youth in Agriculture

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ABSTRACT

Attracting and retaining rural youth in agriculture (ARYA) is operational in different Krishi Vigyan Kendras (KVKs) in Bihar and Jharkhand. Six KVKs of Bihar (Aurangabad, Vaishali, East Champaran, West Champaran, Bhojpur and Bhagalpur), and four KVKs of Jharkhand (Ranchi, Chatra and Gumla East Singhbhum) were selected from 2017 and onwards for implementation of ARYA. Present investigation was done in 2020 and compared it with 2016-17 data i.e. before ARYA. The main aim of this project was to attract and involve unemployed rural youth in farming based enterprises. Results showed that among different enterprises, total 3687 number of rural youths trained out of them, 903 youths established their own enterprises and 700 youths run the enterprises sustainably. It has been concluded that poultry farming and nursery raising in Bihar and goat farming in Jharkhand attracted much more rural youth for its income generation.

INTRODUCTION

Agriculture is the primary source of income for rural youths of Bihar and Jharkhand. Almost 80 per cent of state's population engaged in agriculture production system. Bihar ranks 4th in vegetables production and 8th in fruits production in India (Bihar state report, September, 2021). There is good opportunity for diversified farming along with agriculture. Nowadays peoples are not interested in farming based enterprises, due to inadequate irrigation facility with marginal and low land holdings. The agricultural economy is highly dependent on climate with low investment in agricultural practices and mono cropping with paddy as dominant crop, results lowers output and less income. The state has numbers of unemployed rural youth that are migrating to urban area in search of employment. At present, small and marginal farming scale decreases due to increasing cost of cultivation, less profit from market and degrading natural resources, agriculture based entrepreneurship development has become an important area of research (Singh et al., 2014; Ray et al., 2022). Small land holding and less access to land has been one of the major factors towards poor economic condition in the rural area (Dagar & Upadhyay, 2022). By conducting different capacity building programme related to the sector, skill of the youth entrepreneur might be enhanced where they lack the required proficiency (Arunkumar et al., 2021).

Bihar's agriculture will get better advantage if the state involves young population and convince them into agriculture sector by making them rewarding and economically satisfying. At present more than 50 per cent of total population is young and can be involved in agricultural activities. "If we tap this huge demographic dividend by making agriculture exciting for the younger generation a far better result can be achieved," told by well-known scientist and father of green revolution, M.S. Swaminathan. The leadership qualities of KVK professional contribute significantly by administrative control, academic qualification and area of specialization (Sinha et al., 2021).

Long term involvement, initiative, number of employees, entrepreneurial experience and annual income on the part of trainees contribute to the success of any enterprise in agricultural sector (Kobba et al., 2021). Similarly the trainees should be encouraged to participate in the training programmes to express themselves, for which special sessions may be arranged (Kobba et al., 2020). Agriculture along with livestock rearing is the twin occupation mainly in rural household since prehistoric era. Animal husbandry

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can give impetus for generating sustainable employment, food security and rural development. A proverb "Try not to become a man of success, but rather try to become a man of value." said by Albert Einstein. This message conveys those people who want to make more of themselves, along with new creation and product in any form to stand out. By keeping these in view, the main objective of this project was to attract and involved more and more unemployed rural youth towards farming based enterprises.

METHODOLOGY

Bihar and Jharkhand each are divided into three agro-climatic Zones. The three agro-climatic zone of Bihar are zone-I (North-West Alluvial plains), zone-II (North-East Alluvial plains) and zone-III (South Bihar Alluvial plains). East Champaran, West Champaran and Vaishali district of Bihar come under Zone-1 and Bhagalpur, Bhojpur and Aurangabad comes under Zone-III. Jharkhand's agro-climatic zones are central and north eastern plateau zone, western plateau zone and south eastern plateau zone. The KVKs namely Ranchi, Chatra, Gumla comes under western plateau and East Singhbhum under south eastern plateau.

During 2017, "ARYA" project was started only in East Champaran and Gumla district of Bihar and Jharkhand respectively. Later, it was extended to ten Krishi Vigyan Kendra (KVKs) of Bihar (Aurangabad, Vaishali, Bhagalpur, East Champaran, West Champaran and Bhojpur) and Jharkhand (Ranchi, Chatra, Gumla and East Singhbhum). Data related to different enterprises against income and its impact on unemployed rural youth were collected involving these KVKs in prescribed format. Key data regarding different enterprises during 2020 were collected by interacting wide range of people interlinking them with KVK. Altogether, 13 enterprises were identified and data regarding income were collected before and after establishment of these enterprises and observed their impact on livelihood security. The information and data about entrepreneurship development, youth trained and income generated were collected by participatory rural appraisal (PRA) and rapid rural appraisal (RRA) etc. as suggested by Grandstaff & Messerschmidt (1995) & Chandra et al., (1997).

RESULTS AND DISCUSSION

The rural youths of Bihar and Jharkhand under "ARYA" successfully adopted different enterprises to get extra income for their livelihood and family security. The KVK under different districts adopted various enterprises are shown in Table 1. On prioritization of enterprises Lac cultivation (Ranchi and Gumla) and pig farming (Chatra and Gumla) were the enterprises adopted by rural youths of Jharkhand only. While, low-cost polyhouse nursery and duck farming were adopted by rural youths of East Singhbhum. However, quail farming and banana fibre extraction unit as an enterprise has been started in Vaishali and fish farming in Bhagalpur district of Bihar. Mushroom production has been considered as best enterprises by 06 KVKs followed by apiary (Beekeeping) by 05 KVKs and poultry farming by 04 KVKs.

The rural youths of Bihar and Jharkhand trained, established and run the enterprises sustainably along with average capacity of farm enterprises are shown in Table 2. From the table it can be observed that, maximum nos. of Bihar's rural youth trained under poultry farming followed by nursery raising. However highest number of rural youth established and run their enterprises sustainably for mushroom production in Bihar. Likewise, during 2015-16, NABARD offices of Bihar and Jharkhand started training on different enterprises viz. poultry farming, goat rearing and pig farming involving 300 SHG women for its livelihood security. Singh et al., (2010), recorded that 63 and 43 per cent trainee adopted the beekeeping and mushroom cultivation respectively for its income generation in Punjab.

Mushroom production unit

The nutritional advantage of mushroom together with its capacity of income and employment generation, scientist strongly promoted white button mushroom cultivation in the state. Its cultivation can be popularized among landless and unemployed rural youth by interlinking them with different farm science centre and SAU. From the Figure 1 it can be observed that, among different district under mushroom production, Aurangabad's rural youth got highest net return/year and it was lowest in Bhojpur district after training under ARYA. Similarly, average annual income of the sampled trainees was $ 1690 in mushroom cultivation (Singh et al., 2010).

Livestock enterprises

Bihar is traditionally a consumer state for non-agricultural produce, mainly of eggs and fish. Consumer's demand of eggs,

Table 1. List of economically viable enterprises identified in Bihar and Jharkhand under "ARYA"

S.No.	Name of enterprises	Name of KVKs	Total No. of KVKs
1.	Mushroom production	Aurangabad, Vaishali, East Champaran, West Champaran, Bhojpur and Chatra	6
2.	Poultry farming	Aurangabad, East Champaran, Bhagalpur and West Singhbhum	4
3.	Beekeeping	West Champaran, Bhojpur, Vaishali, Ranchi and Gumla	5
4.	Goat farming	Aurangabad, Ranchi and Gumla	3
5.	Nursery Raising	West Champaran, Bhagalpur and Vaishali	3
6.	Lac Farming	Ranchi and Gumla	2
7.	Pig farming	Chatra and Gumla	2
8.	Seed production	Chatra	1
9.	Low-cost polyhouse nursery	East Singhbhum	1
10.	Banana fibre extraction	Vaishali	1
11.	Quail farming	Vaishali	1
12.	Duck farming	East Singhbhum	1
13.	Fish farming	Bhagalpur	1

Table 2. Number of youth trained, enterprises established and run sustainably under "ARYA" in Bihar and Jharkhand

Name of enterprises	No. of Rural youths trained	No. of youths established their own entrepreneurial units	No. of youth running the entrepreneurial units in a sustainable manner	Avg. size of each entrepreneurial units (No. of bags/beehives/ seedlings etc.)
Bihar				
Mushroom production	322	170	117	1700
Poultry Farming	391	119	100	1200
Beekeeping	173	35	17	155
Banana fibre extraction	175	2	2	1 machine
Quail farming	275	10	10	
Fish farming	160	60	57	4000 fingerlings
Nursery raising	371	32	25	6075
Goatery	125	40	38	25
Total (A)	1992	468	366	
Jharkhand				
Mushroom production	135	30	15	40
Poultry Farming	180	25	18	50
Beekeeping	119	91	62	27
Low-cost poly house	220	25	19	48 sq. ft
Seed production	125	14	20	2 ha
Duck farming	186	25	14	100
Goatery	291	77	61	40
Pig farming	223	28	25	39
Lac farming	216	120	100	32
Total (B)	1695	435	334	
Sub-Total (A+B)	3687	903	700	

meats and milk increases day by day therefore, to fulfill this demand it is necessary to adopt animal-based farming enterprises. The birds involve in poultry farming are chicken, duck, quail and pigeon etc. The growth rate of 44.72 per cent per annum in poultry production draw attention and create opportunity for rural youth (business-standard.com, Feb, 2020). The eggs and meats are rich in protein, vitamin and minerals content. Their waste material is used as a source of farm manure. Poultry birds includes mainly 6 different types of chicken in which poultry birds are in highest demand (93% of total poultry population of world) followed by ducks and turkeys. Poultry producer companies members has more knowledge gain than non-members towards space requirement, quality of land for poultry shed, nutrients feed source and knowledge about vaccination (Patel et al., 2022). From the Figure 2 it can be seen that highest increase in net income/year after ARYA in Aurangabad and lowest in East Singhbhum district.

Goat farming

Bihar is the 5th largest state in terms of goat population accounting 7.63 per cent of total India's goat population. The state's 42.6 per cent people are below poverty line and hence there is major scope of goat farming to minimize the vast gap between demand and supply of meat. There is no recognized goat breed in Bihar, but Bengal breed is well-suited in Bihar. The Black Bengal gives birth to twins, triplets, quadruplets normally in a single gestation. It is reared mainly for meat purpose, as these breeds give very less milk. Another goat breed suitable in Bihar is Barbari. However, in Jharkhand mainly two goat breeds Sirohi and Totapuri are chosen for its farming at commercial level. With low investment, it can be made profitable business for small and marginal farmers and unemployed rural youth. Therefore, it can be popularized among them to adopt goatery as a farm enterprise. From the Figure 3 it can be observed that among three districts, Aurangabad's rural youth much benefitted from goat farming than others. Likewise, Kumar (2007) also studied about commercial goat farming, an emerging enterprise in India for income generation from small land holdings. Lack of veterinary services followed by inadequate credit facilities are the major constraints in Rajasthan, Banswara district in goat farming (Sharma & Kumar, 2022).

Beekeeping

Apiculture has certain migratory path for honey production and colony production in Bihar (Singh et al., 1998). Its popularity increases day by day in rural area as it does not need full time laborers. Honey has good medicinal and food value. However, bee wax used in pharmaceutical, cosmetic industry and in candle making that gives extra income to the rural people. Bee venom helps in curing arthritis, rheumatic and pains. Therefore, it is beneficial for adopting beekeeping at commercial level to get good income. From the Figure 4 it can be observed that highest increase in net income/ year was in Ranchi and lowest in Vaishali district after training under ARYA. They positively influenced the livelihood security of rural youth. Similarly, Singh et al., (2010) recorded average annual income of the sampled trainees of beekeeping was $ 1800.

Pig farming

As compared to other livestock species piggery unit give faster economic return to the farmer, due to its faster feed converting efficiency after broiler. It occupies significant status among tribal population of Eastern Indian states like Jharkhand, West Bengal,

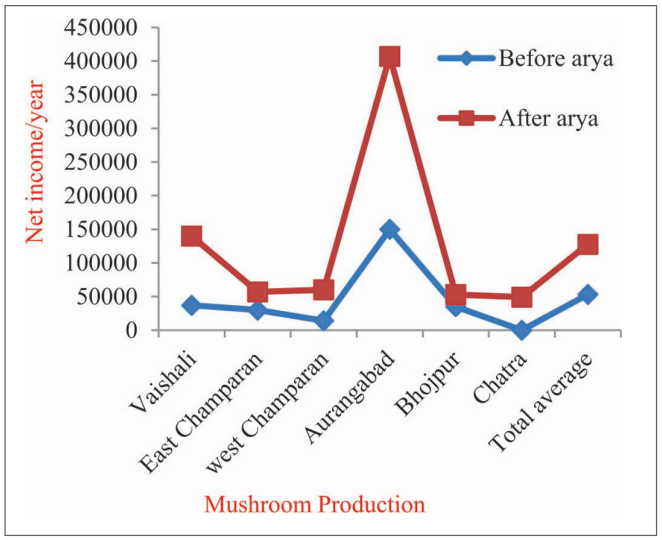

Figure 1. Net income before and after "ARYA" under mushroom production during 2020

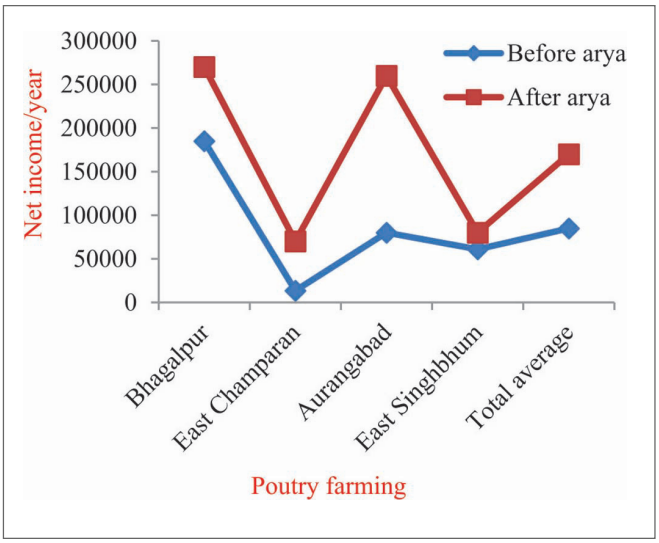

Figure 2. Net income after "ARYA" under poultry farming during 2020

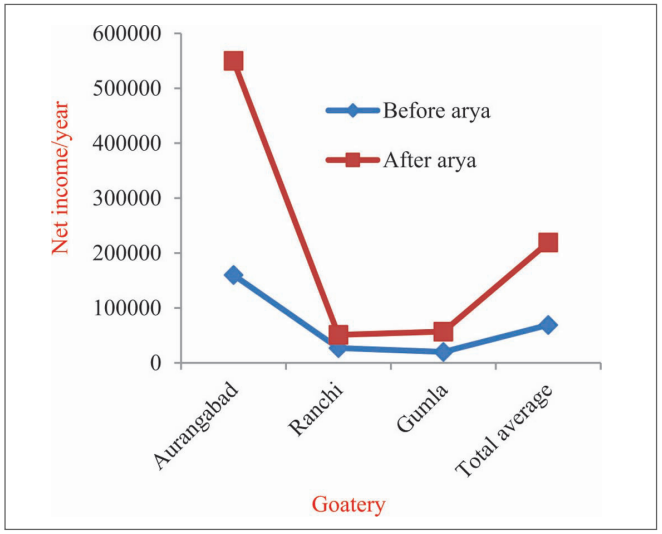

Figure 3. Net income before and after "ARYA" under goatery during 2020

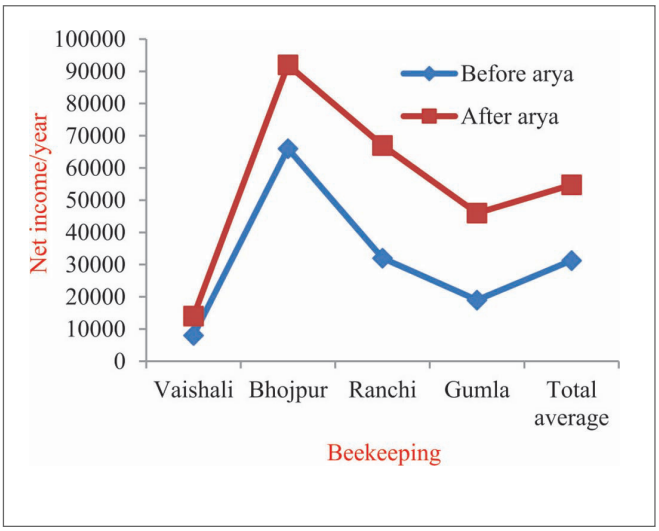

Figure 4. Net income before and after "ARYA" under Beekeeping during 2020

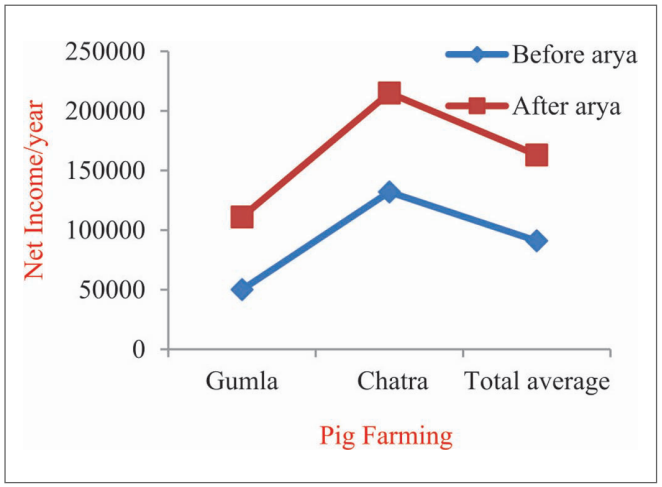

Figure 5. Net income before and after "ARYA" under Pig farming during 2020

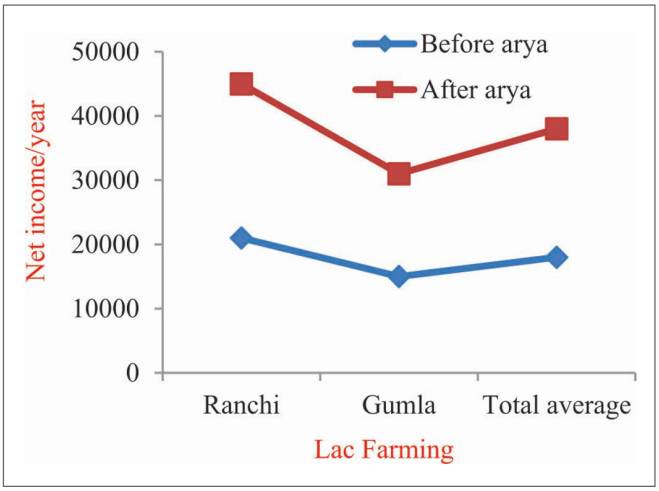

Figure 6. Net income before and after "ARYA" under Lac farming during 2020

North Eastern state and Orissa. Share of country's pig population was 9.35 per cent by Jharkhand and 6.31 per cent by Bihar (Chauhan et al., 2016). The poor tribal of these states favored pork as main and preferential diet in bulk. Pig mainly reared by the rural poor of the lowest socio-economic strata for their livelihood security. They reared pig without following any scientific techniques for housing, feeding and vaccination. Therefore, ARYA scheme started training to rural people of Chatra & Gumla district (Jharkhand) for scientific pig breeding and meat production to get maximum income. It can be observed that the income of the rural youth increased almost 2-2.5 times after training under the project (Figure 5).

Lac cultivation

Lac is the resinous secretion of a number of lac insect mainly, *Kerria lacca*. It is produced mainly in Jharkhand which contributes about 39 per cent of total lac production in India. There is much more availability of host trees as Palas (*Butea monosperma*), Kusum (*Schleichera oleosa*) and Ber (*Zizyphus mauritiana*) that create good opportunity to start its cultivation scientifically to get maximum return. Entrepreneurs mainly took lac as a subsidiary business but it provided much more income in low agriculture activity season (Magry et al., 2017). Total 28 per cent of agricultural income is contributed by lac production in Ranchi District told by a survey report done by Jaiswal et al., (2006). Therefore, lac is a very important alternative for entrepreneurship development in Jharkhand. From the Figure 6 it can be observed that increase in net income after ARYA was almost doubled in both district of Ranchi and Gumla.

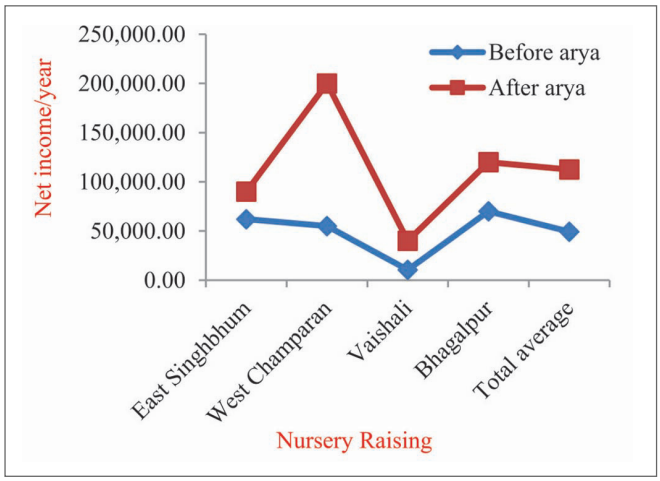

Figure 7. Net income before and after "ARYA" under Nursery Raising during 2020

Nursery raising

Nursery is a place where plants are grown and multiplied for further use in the main field. It is a pre requisite to meet the demand of quality seedlings and nursery management is a tool to carry out the various activities in successful way (Krishnan et al., 2014). There is great scope of nursery raising and its management for commercial cultivation of any horticultural crops in the state. Keeping in view, the training under ARYA was given in the selective district to enhance economical status of rural youth. The increase in net income under Nursery raising after ARYA was presented in Figure 7.

Economic impact of different enterprises on income diversification after ARYA

From the Figure 8 & 9 it can be clearly observed that highest increase in average net income/year and average percentage increase in income after training under "ARYA" in banana fibre extraction enterprises followed by quail farming and poultry farming.

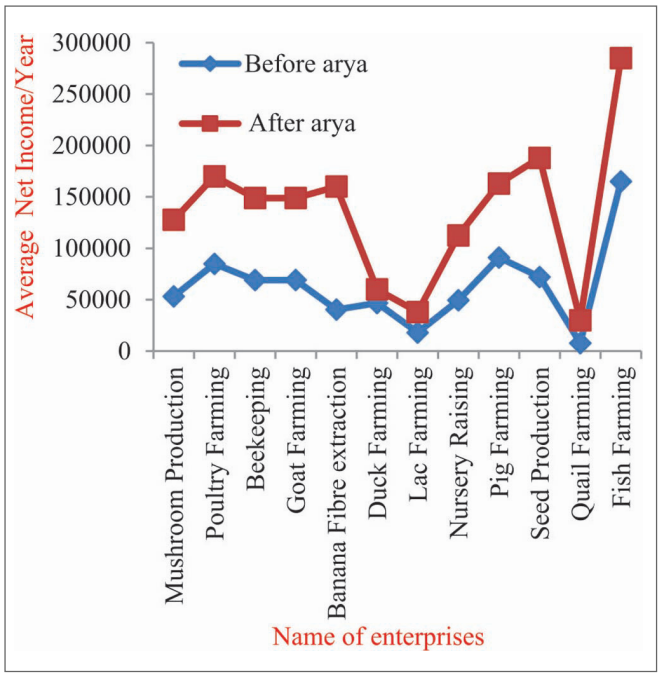

Figure 8. Average net income before and after "ARYA" against different enterprises during 2020

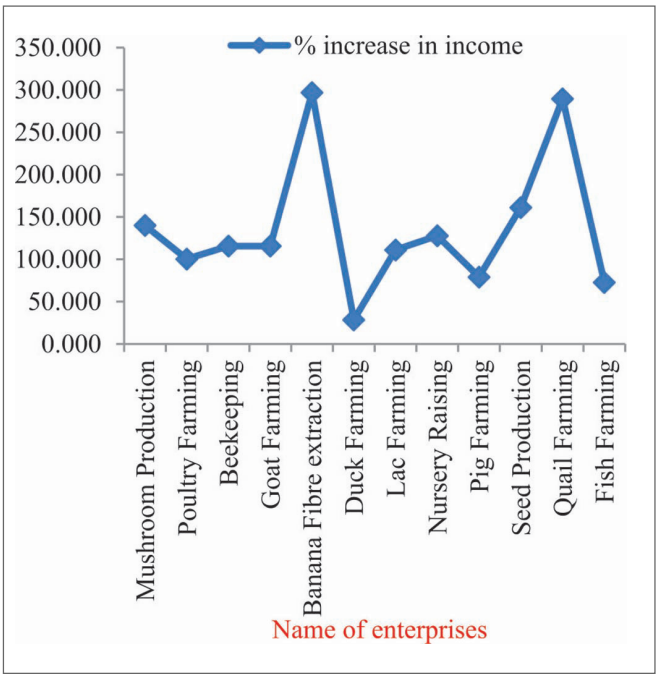

Figure 9. Average percentage increase in income after "ARYA" against different enterprises during 2020

However, the lowest percentage increment in total income was under duck farming. Likewise, training on beekeeping and mushroom cultivation was given by farm science centre, Punjab and trainers increases its income by 24 and 49 per cent, respectively (Singh et al., 2010).

CONCLUSION

It was concluded that "ARYA" project shows positive impact on attracting and motivating unemployed rural youths of Bihar and Jharkhand. After successful training and intervention by different KVKs, rural youth adopted and established different enterprises for their income diversification and livelihood security. Mushroom production unit was established by most of the rural youth to fetch maximum income. Among 13 enterprises, running under Bihar and Jharkhand, Banana fibre extraction unit give maximum net return/year and lowest in case of duck farming as an enterprise. Therefore, all enterprises discussed above are beneficial for landless, small & marginal farmers and unemployed rural youth. By adopting these they fetch maximum return with low investment.

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Performance and Prospects of Wheat Market Outlook in India

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ABSTRACT

The study used secondary data on wheat demand and supply and assessed its market performance (1980-2019). Additionally, it compared the market outlook of wheat for 2020-30. The study reported that the wheat supply and demand increased by 3.14 and 2.71 times, respectively, from 1980 to 2020. Production and food demand contributed about 90 per cent each to the supply and demand growth. Spatially, the west, north and east zones remained the primary contributor (>95%) to the market supply of wheat. West zone performed better in area (1.32%) and production growth (3.82%), while the north zone registered highest yield growth of 2.8 t/ha during last 40 years. The same period registered a growth of 9.69 per cent in the net trade of wheat. On the demand side, although the per capita consumption of wheat registered a negative growth (-1.45%), the food demand grew by 2.51 per cent per annum in the past four decades. Market outlook of wheat suggested that the wheat surplus during 2020-30 would be between -3.4 to 32 million tonnes with an average of 20 million tonnes.

INTRODUCTION

Globally, there is a rising concerns on how to feed the growing population with depleting resources and shrinking food production system. Chatterjee et al., (2022) reported a massive loss of agricultural output in the Indian market which was poised to affect market equilibrium of demand and supply. The problem is significant for India as it supports 18 and 37 per cent of global human and livestock population from meagre 2.4 per cent of global land and four per cent of global freshwater resources. For the Indian government, rice and wheat are the obvious choice to address the food security concerns. Wheat, being integral to the National Food Security Act (NFSA), most of the earlier researches emphasized on its production and overlooked other dimensions of supply. Additionally, only a few studies looked comprehensively into its demand and supply sides. Despite the availability of various crop demand and supply outlooks, there exists scarcity of literature comparing them. Timely awareness and training programmes for imparting adequate knowledge to farmers about different recommended wheat cultivation practices and adequate use of different social media such as WhatsApp group of farmers has been advocated (Kumar et al., 2022). Mechanism to create a valuable synthesis between local and research awareness probably leading to a more appropriate modern technology, and increase key stakeholder capacity to interact with new technology has been emphasised for higher productivity (Nain et al., 2012). Against this backdrop, the paper has analyzed the historical performance and compared different outlooks on the demand for and supply of Wheat in India and discussed future strategies for maintaining the demand and supply balance in the country.

METHODOLOGY

The study used secondary data from 1980-2019 and projections of market situation between 2020-30, on elements of demand and supply of Wheat. Area, production, productivity,

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stock change and net trade are supply elements (equation 1), while food, feed, seed, supply chain losses and industrial usage are demand elements (equation 2).

Aggregate Supply = Production + (Beginning Stock – Closing Stock) - (Net Trade) ...(1)

Aggregate Demand = Food Demand + Feed Demand + Seed Demand + Industrial Demand + Supply Chain Wastages ...(2)

The data was compiled from the FAO's food balance sheet (FBS) from 1980 to 2019; NSSO's household consumption expenditure survey (32nd to 68th rounds) and the official website of the Directorate of Economics and Statistics (DES), Government of India (GoI). For performance measurement, it used trends and pattern analysis. The trends were estimated using compound annual growth rate (CAGR) which was calculated as-

$$\text{CAGR}\ (\%) = [\{\frac{Var_{final}}{Var_{initial}}\}^{(\frac{1}{t})} - 1] * 100$$

Similarly, the pattern of supply was analyzed using spatial dynamics in area, production and productivity (APY) of Wheat and Mean Absolute Percentage Error (MAPE) was estimated to compare various outlooks on Wheat. MAPE was calculated as-

$$\text{Mean Absolute Percentage Error} = \frac{1}{n}\sum_{i=1}^{n} | \frac{\text{At} - \text{Ft}}{\text{At}} |$$

Where, At = Actual/true Value, Ft = Predicted value, n = Number of times the summation iteration happen

Additionally, to analyze the spatial pattern of wheat supply, the study delineated India into six zones, namely East (*Assam, Bihar, Jharkhand, Odisha and West Bengal*), West (*Chhattisgarh, Gujarat, Madhya Pradesh, Maharashtra and Rajasthan*), North (*Haryana, Punjab, Uttar Pradesh and Uttarakhand*), South (*Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana*), Hills (*Himachal Pradesh and Jammu and Kashmir*) and North-Eastern (*Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura*).

RESULTS AND DISCUSSION

Performance of supply side elements in wheat market

The historical trends over the last four decades in the aggregate supply of Wheat in India suggested about three times increase in the domestic supply of Wheat. Also, during the same period, the domestic supply grew by three per cent per annum. Further, a glance at the sources of domestic supply of Wheat suggested that production alone had contributed more than 90 per cent to the domestic supply of Wheat. Also, the negative values of stock variation indicated that the ending stock was less than the beginning stock for the year, which meant the offtake of Wheat from the food grain management and distribution system was higher than the procurement of Wheat. Higher offtake than the procurement indicated a higher supply of Wheat to the consumers and, thereby, greater availability. Among the different components of the domestic supply of Wheat in India, net trade (export minus import) had attained a maximum compound annual growth rate (CAGR) of 9.69 per cent per annum (Table 1). In comparison, domestic production and stock variation registered a CAGR of 3.07 and 2.28 per cent per annum. The spatial pattern in the area, production and yield of Wheat during 1980-81 to 2020-21 indicated that the northern, western and eastern regions together account for more than 95 per cent of the total cropped area and production in the country. In the growth of the cropped area, except for the northeast and southern zones, all the other zones witnessed positive growth. The western region registered an area growth of 1.32 per cent per annum, followed by the northern (0.68% per annum) and eastern zone (0.47% per annum) zones.

Table 1. Performance of supply-side elements of the wheat market in India

Year	Production (Mt)	Stock variation (Mt)	Net trade (Mt)	Aggregate supply (Mt)
1980-81	31.83	3.20	0.02	35.20
1985-86	44.07	-0.63	0.12	43.32
1990-91	49.85	-9.38	0.08	40.39
1995-96	65.77	-1.00	1.14	63.63
2000-01	76.37	-1.00	1.15	74.22
2005-06	68.64	1.02	0.82	68.83
2010-11	80.80	-0.76	-0.04	80.09
2015-16	86.53	-2.68	0.65	83.20
2019-20	103.60	7.72	0.64	110.67
Absolute growth	3.25	2.41	-3.68	3.14
CAGR (%)	3.07	2.28	9.69	2.98

For the production, a pattern like that of area growth was seen, with the only distinction being the growth rate. The western zone attained growth in wheat production by 3.82 per cent, while the northern and eastern regions attained 2.50 per cent and 2.23 per cent growth during the same period. On observing the growth in the yield of Wheat in India, one can observe that the country has enhanced its wheat yield by 1.62 t ha^{-1} in the past four decades. Further, the northern and western regions remained the top performing zones in augmenting their wheat yield as they witnessed the yield increment of 2.08 t ha^{-1} and 1.91 t ha^{-1}, respectively. In terms of percentage growth in yield during the same period, the western, southern and northern zones gained 2.47, 2.15 and 1.81 per cent growth, respectively (Figure 1).

Performance of demand side elements in wheat market

The per capita food demand has a crucial role in determining the food demand of a commodity. Despite the four-fold increase in the per capita income, the shreds of evidence from different rounds of Household consumption expenditure survey by NSSO suggested that the per capita consumption (PCC) of Wheat remained almost sticky between 4-5 kg per month in both the rural and urban areas over the period after a decline during 1977-1987 (Figure 2). Yadav and Singh (2022) reported the importance of cereals as a staple food in the Indian dietary system. Therefore, the stickiness in the PCC of Wheat could be due to its low-income elasticity as it is a staple component of the Indian dietary system. Over the same period (1980-81 to 2019-20), the overall food demand for Wheat in India increased more than twice. The increased total food demand despite the stagnating per capita consumption was due to population expansion. The growth in the aggregate

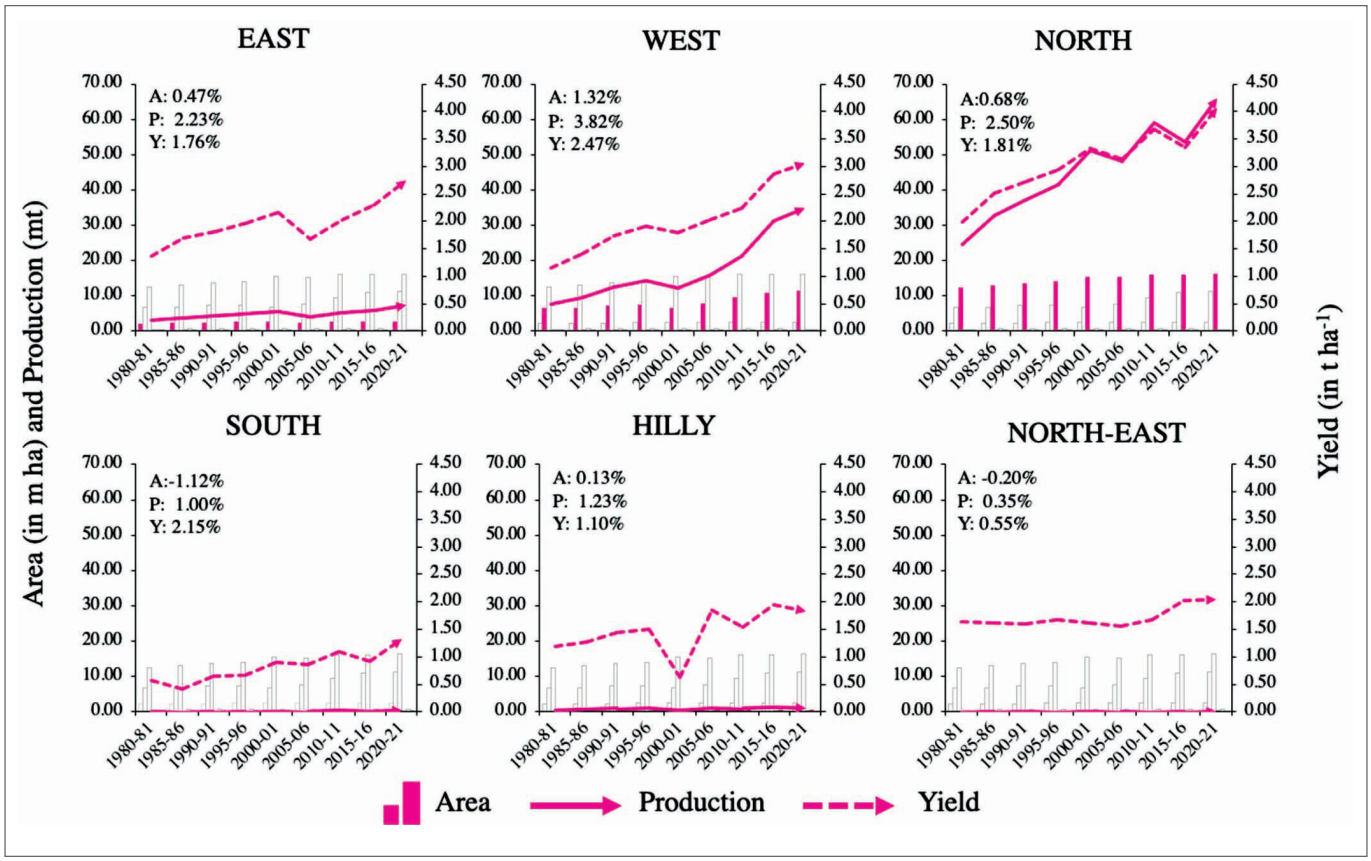

Figure 1. Spatial variation in area, production and yield of Wheat in India (1980-81 to 2020-21)

domestic demand for Wheat showed that the aggregate domestic demand had increased more than twice that of its 1980-81 level during 1980-81 to 2019-20.

During the same period, it had grown at the rate of 2.58 per cent per annum to reach its current level of 95.24 million tons (2019-20). Of the aggregate wheat demand, food demand consisted about 90 per cent of the total demand, while the feed and seed (one to three per cent) and waste, industrial and other (SWIO) demand was seven to nine per cent of the total domestic demand. Further, Wheat's demand and supply data revealed that domestic production alone fulfilled 70 to 90 per cent of the domestic food demand in the past four decades. However, between 1980–1981 and 2019–2020, the demand for Wheat as a feed increased nine times (Table 2).

A significant amount of Wheat had been diverted over the years for feeding livestock and poultry. Also, the same period witnessed a stagnating per capita consumption demand and rising feed demand for Wheat, which indirectly indicated dietary diversification of Indian consumers' food baskets and their transition from cereal-based diets. Vij & Mann (2022) reported a

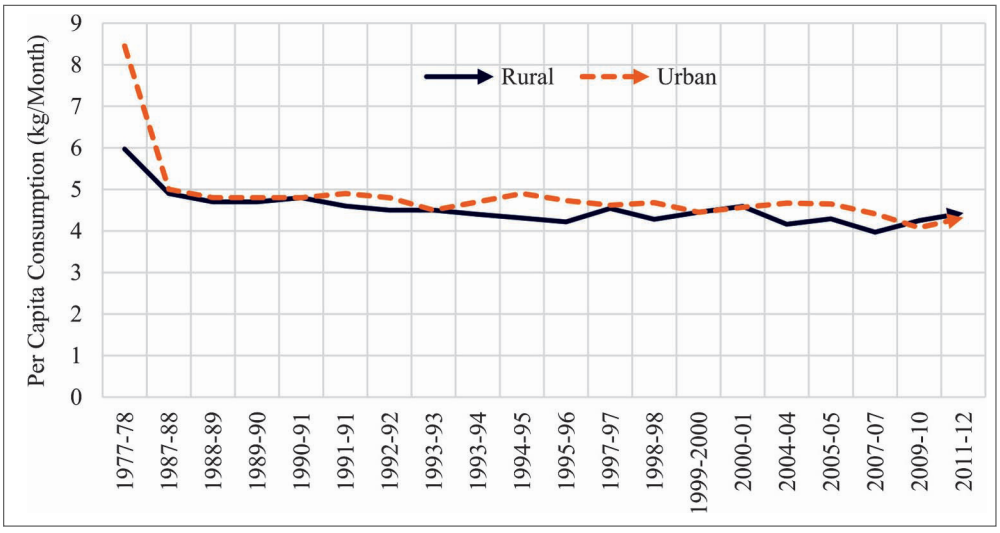

Figure 2. Stickiness in the per capita consumption of Wheat in India

Table 2. Trends in the composition of aggregate demand during 1980-81 to 2019-20 in India

Year	Demand components			Aggregate demand
	Food	Feed	SWIO	
1980-81	31.35	0.38	3.47	35.21
1985-86	37.98	0.53	4.80	43.32
1990-91	35.88	0.60	3.92	40.39
1995-96	58.37	0.79	4.47	63.63
2000-01	68.44	0.92	4.86	74.22
2005-06	62.21	1.19	5.44	68.83
2010-11	72.52	2.97	6.11	81.60
2015-16	77.85	2.50	8.20	88.56
2019-20	82.51	3.50	9.23	95.24
Absolute growth (X)	2.63	9.16	2.66	2.71
CAGR (%)	2.51	5.84	2.54	2.58

similar transition in Punjab. Earlier, several studies reported that, as the income of consumer increases, he/she starts to consume high-value products like milk, meat, eggs etc.

The historical pattern of demand and supply of Wheat in India suggested the growth in the components of demand and supply and the prominent regions supplying Wheat to the domestic wheat markets; however, the pattern of future growth in demand and supply of Wheat in the country is the central question. Hence, the next section is devoted to Wheat's futuristic demand and supply in India.

Market outlook of wheat in India: 2021-2030

To understand the direction of future demand and supply of Wheat in India, we took five projections (Mittal, 2008; Shinoj et al., 2014; Kumar & Joshi, 2016; NITI Aayog, 2018; & OECD-FAO) as these studies projected demand for and supply of Wheat for at least one year during the decade 2021-22 to 2030-31. Of these five studies, NITI Aayog and OECD-FAO provide projections for the maximum number of years from 2021 to 2030. All the projections demonstrated the surplus supply over the domestic demand for Wheat in India. Out of these projections, the projection by Kumar & Joshi (2016) was the most comprehensive as they based their demand projection on the different demand use of the commodity, while their supply projections were based on input usage and output price responsiveness of supply. Contrastingly, the projections by Mittal (2008) were the most conservative among all and underestimated the wheat demand for India during the 2021-2030 duration.

Further, the demand and supply outlook by the NITI Aayog & Shinoj et al., (2014) were close (with about five per cent MAPE) to the projections of Kumar and Joshi for the end of the decade. On the other hand, the OECD-FAO's outlook on demand matched the demand outlook provided by Kumar and Joshi, while their supply outlook had more than 10 per cent higher MAPE. The domestic demand and supply projections indicated that at the beginning of the decade, the domestic supply would range from 91.60 to 132.88 million tones, increasing to more than 135 to 150.99 million tones by the end of the decade (Table 3).

Similarly, the domestic demand for Wheat was predicted to be between 64.30 and 107.69 Mt and 114.60 and 120.12 Mt, respectively, at the start and at the end of the decade. Although these projections were favourable for wheat demand and supply balance in the decade 2021-30, the current wheat production system in India is experiencing the looming challenges of terminal heat stress due to rising temperature, land degradation in the form of salinization and alkalinization, plateauing yield of the most productive lands, expanding population, locust swarm attack during the crop growth stage of wheat crop in western states like Rajasthan and Gujarat etc. Therefore, in the next section, we discussed the future of the Wheat market in India.

Prospects of wheat market in India

Under business-as-usual scenarios, i.e., if the current trends in the demand and supply of Wheat would sustain by the end of the decades, India would be in a position to sponsor its domestic demand of Wheat from its supply sources. The historical growth in per capita consumption of Wheat between 1977-78 to 2011-12 indicated that even after a substantial rise in consumer income, the PCC of Wheat had not changed proportionately. It points to either a minor decline or stagnant PCC of Wheat for food consumption which constitutes the largest share of aggregate demand

Table 3. Future demand and supply of Wheat in India under business-as-usual scenarios

Years	Kumar & Joshi (2016)		Mittal (2008) / Shinoj et al., (2014)*		NITI Aayog (2018)		OECD-FAO	
	Demand	Supply	Demand	Supply	Demand	Supply	Demand	Supply
2020-21	98.30	104.16	-	-	-	107.18	105.39	127.39
2021-22	-	-	64.30- 66.80	91.60	97.12	109.50	107.69	130.24
2022-23							108.29	131.40
2023-24	-	-	-	-	-	-	110.44	134.14
2024-25							111.32	135.61
2025-26	-	-	102.01*	121.89*	-	-	113.26	138.15
2026-27			65.90-69.10	97.90	-	-	114.31	139.83
2027-28	-	-	-	-	-	-	116.08	142.23
2028-29	-	-	-	-	107.08	127.31	117.24	144.04
2029-30	-	-	-	-	108.62	130.00	118.90	146.37
2030-31	114.60	124.56-132.48	-	-	-	-	120.13	148.29
2032-33	-	-	-	-	113.46	138.82	-	-

*Projections of Shinoj et al., (2014)

for the commodity. Thus, the source of future growth in demand for Wheat would be coming from population growth. However, the availability of newer food products like a variety of fast foods like loaves of bread, maggie, pasta, pizza, burgers, sandwiches etc. which are majorly consumed in the urban centres and their penetration into the lower middle to lower strata of the society and rural areas are expected to enhance the home away food demand of Wheat. Further, with increased availability of new wheat-based products and rising consumer income, the satiety in the consumers due to frequent consumption of the traditional wheat product (TWP) may reduce the consumption of Wheat for TWP.

Similarly, the higher consumer earnings, as reported by the earlier studies, would lead to a transition in the food consumption basket from traditional staples to high-value products like animal fats and proteins. Under this paradigm, the feed demand for Wheat would be expected to rise. Kumar and Joshi, 2016 reported a two-fold increase in feed demand for Wheat between 2010 to 2030 from 3.89 to 6.59 million tonnes. However, the production of Wheat for animal consumption has to be thoroughly understood from the point of view of resource use as alternative nutritionally enriched and less input-intensive animal feed crops exist.

Additionally, as the glaciers melt due to rising temperature, the northern, western, eastern and hilly regions are expected to have higher irrigation water availability in wheat growing seasons in future. However, the states like Punjab and Haryana have higher wheat yields; nevertheless, there exists a yield gap among other states in the above zones. Therefore, in such zones, particular emphasis should be given to technology (improved seeds, irrigation infrastructure, soil conservation and so forth), markets, institutions and infrastructure to maintain the resilience of future wheat supply. Further, the resource degradation (land and groundwater) might check the horizontal expansion of the f wheat production system and provoke forced crop diversification. Therefore, Wheat being an essential ingredient of the National Food Security Act (NFSA), efforts must be channelized towards increasing the productivity of Wheat in the potential zones to maintain the sustainability of wheat supply. Additionally, the agricultural extension system has a more significant role in transferring climate-smart production technologies and educating the farmers on mitigation strategies to add resilience to the production system to sustain productivity growth and supply of Wheat in future.

CONCLUSION

The market outlook of Wheat suggested that India would have adequate Wheat to feed its continuously growing population. However, the emerging supply side (weather aberrations, resource depletion, growing incidences of biotic and abiotic stresses etc.) and demand side shocks (population growth, changing taste and preferences, growing income etc.) may put constraints on the future wheat market in India. Amidst the horizontal expansion of the food production system, yield increment would be a significant driver to ensure future food supply. Therefore, technological upgradation and its transfer are crucial for future food supply. Hence, higher investment in research and development and a robust agricultural extension system is essential.

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Research Article

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Developing Research Managers and Leaders through Management Development Programme in National Agricultural Research and Education System in India

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ABSTRACT

To develop research managers and leaders in NARES, it is substantially important to enable existing and proposed managers to expand their understanding of the principles, techniques and approaches involved in management. To achieve this goal, ICAR-NAARM, offered a course "Management Development Programme on Leadership Development" for more than one decade. To assess and evaluate the performance of the participants in their respective institutions, the respondents and their reporting officers interviewed to determine whether programme has produced the desired effect. A total of 150 respondents and their reporting officers gave their views for this study. Based upon mean score and standard deviation, most of the respondents were average (62.67%), below average (19.33%) and above average (18%) before training, knowledge levels after training indicated, most of the respondents were average (66%), below average (17.33%) and above average (16.66%) whereas changes in knowledge levels indicated that, most of the respondents having average (63.33%), below average (18.66%) and above average (18%). For Behaviour, feedback received from the participants after 6 months and more period and the overall satisfaction level was around 3.89 out of 5.0, whereas overall results was around 3.42 out of 5.0.

INTRODUCTION

Human Resource Development (HRD) is a methodical way to improve and strengthen employee competencies through organisational development (Mittal, 2013). Since HRD has progressed so far, achieving the goal of improving job-related learning patterns, knowledge, and outcomes at the individual and hierarchical levels requires a significant investment in training and development activities (Marsick & Watkins, 1990). Regular assessment and training are necessary to keep employee competencies and development plans up-to-date (Noe, et al., 2011; Leonard & Wibawa, 2020; Garin et al., 2022; Sharma et al., 2021). Managers and leaders are frequently noticed in the context of the development of human resources (New, 1996; Hall & Moss, 1998; Feldman, 2002), it revealed that in the absence of organisational guidance they are expected to commence development. Organizations can take several forms of leadership and management growth. A variety of formal interventions, including coaching, mentorship, formal programmes, and feedback programmes, may be used to organise it (Garavan et al., 2008). However, organisations are aware of the necessity to rely on, support, and encourage their leaders to develop self-directed leadership (Derue & Ashford, 2010). Developing leadership skills requires, formal leadership development programme which provides a more structured kind of experience (Day & Dragoni, 2015; Ponnusamy et al., 2014; Ruben et al., 2018; Zulfqar et al., 2021). Training helps to build leadership skills since it offers a set of systems experiences that helps gain new knowledge in leadership terms and opportunities for new talents and skills (Lacerenza et al., 2017). Participants in leadership training, typically exposed to new leadership principles, which helps leaders to perform their jobs more effectively (Lord & Hall, 2005; Baron et al., 2019). Leaders can grasp, amplify, and

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anticipate settings, events, or reactions through experiential learning, which improves their ability to act and adapt to leadership roles (Daloz, 2005; Avolio et al., 2009; Rao et al., 2021). These assertions are supported by empirical research, which shows that those who receive leadership training reported that they having higher levels of leadership competence (Mumford et al., 2000a; Hirst et al., 2004; Christina et al., 2017).

Management Development Program is one of the most desired methods of developing leadership and managerial skills within an organization (Gareth & Sharon, 2005). Managers and Leaders in the creation of high-performance organisations considered a powerful group (Ronan & Thomas, 2012, Marcelo et al., 2009). The employees who attend the Management Development Programs (MDPs) are interested and active to participate in the programs (Nurita et al., 2015). The employee-training program is most important for an organization to increase profitability and productivity, decrease the cost of labour, improve quality, and adequately manage the workforce (Shahrooz, 2012; Omer, 2015). Management Development Programme (MDP) is a highly interactive program focused on the development of personal and group leadership skills and knowledge to expand managerial ability in an organization. To assess the effectiveness and relevance of training impacted, Kirkpatrick's four levels of appraisal models were employed for this study.

METHODOLOGY

This study is based on the data collected through qualitative (direct observation, discussion, interview) and quantitative (questionnaires) from research and academic professional engaged in the Indian Council of Agricultural Research and Agricultural university of India. The respondents of the study included the research and academic professionals working in different capacities viz. Principal Scientists/Professors, Heads of the division, Project Directors/Coordinators, Zonal Directors, Deans, and other similar Research Management Professionals attended the "Management Development Programme on Leadership Development" conducted by ICAR-NAARM on the learning and performance of participants in their professional career. The survey was carried out during 2016-2021 and the research tool utilised was a self-completion questionnaire that ensured respondents' confidentiality. To assess the effectiveness and relevance of training impacted, course contents provided, and teaching methods followed in the programme, the respondents and their reporting officers were interviewed for the purpose. A total of 150 respondents and their reporting officers were given their views for this study. The methodology used for this purpose was Kirkpatrick's Evaluation Model i.e. four levels of the training evaluation model. Kirkpatrick's four levels of appraisal models i.e. Reaction, Learning, Behaviour and Results are extensively employed in the appraisal of educational programs. Each level has an impact on the next level. These four main variables that were studied in this study were overall evaluation of training, perceived effectiveness of training, the perceived value of training, and perceived trainer performance. A five-point Likert scale was used to score each of the questionnaire items that were utilised to create the study's scales, which indicated whether the respondent agreed or disagreed (1 for strongly disagree to 5 strongly agree).

RESULTS AND DISCUSSION

Reaction

Reaction level measures, how the participant reacted and was trained in the program. Measuring how committed they were, how they reacted, and contributed to the training program helps to understand how well they received it. It also facilitates composing improvements to future training programs, by identifying the most important topics that have been missing. Trainee attitudes about the training represent the attitudinal component of efficacy. Under this study, feedback was received from the participants at the end of each training programme during 2016-21 and the Overall satisfaction level in the reaction component is around 4.39 out of 5.0. Different parameters of reaction like course content, coordinator's skill and support, relevance to needs of participants, overall learning from the course, expectations from the course mostly fulfilled, recommendation of this programme to others, additional knowledge was gained due to the programme, training methodologies used were interesting and relevant for the purpose, learned skills to be used and supporting and other services provides the ratings of 4.19, 4.73, 4.37, 4.43, 4.26, 4.57, 4.51, 4.35, 4.62 and 3.67 respectively out of 5.0 (Figure 1).

Patel (2010) indicated that 91 per cent of Institutional training assessments gathered reaction data, albeit this isn't always documented in the research as frequently as it is done in practice. Aside from its popularity, reaction data is an important evaluation approach, when assessing training success, it might be a pre criteria to other intended training results (Hughes et al., 2016; Sitzmann et al., 2008). Reactions may therefore play a major role in a training evaluation since they revealed how satisfied a trainee is with the instruction, show indications of the trainee's willingness to learn, and can lead to other outcomes. Given the prevalence and importance of trainee's responses, it is critical to ascertain, leadership training improves employee responses. Popular media has promoted the notion that employees despise training (e.g., Kelly, 2012), training references revealed that training frequently elicits favourable responses (Nain & Kumar, 2001; Brown, 2005; Nain et al., 2006), which viewing training as a kind of organisational support. The factor analysis of the items revealed three distinct factors for all of the items. Internal reliability was acceptable for the components, with coefficients alpha of 0.80, 0.76, and 0.72 for perceived trainer performance, perceived training usefulness and perceived training efficiency, respectively.

Learning

Training sessions have specified learning objectives, and it is helpful to measure before and after training. Before the training evaluation, trainees determine their levels of skills, attitudes, and knowledge, when the training is finished, evaluate the trainees a second time to measure what they have learned. According to Kraiger et al., (1993), the types of learning outcomes include affective, cognitive, and skill-based outcomes. Affective learning refers to the acquisition or modification of internal states. Cognitive learning is the result of a shift in intellectual or metal-based skills over time. The acquisition of technical or motor abilities is referred to as skill-based or psychomotor learning. Leadership development

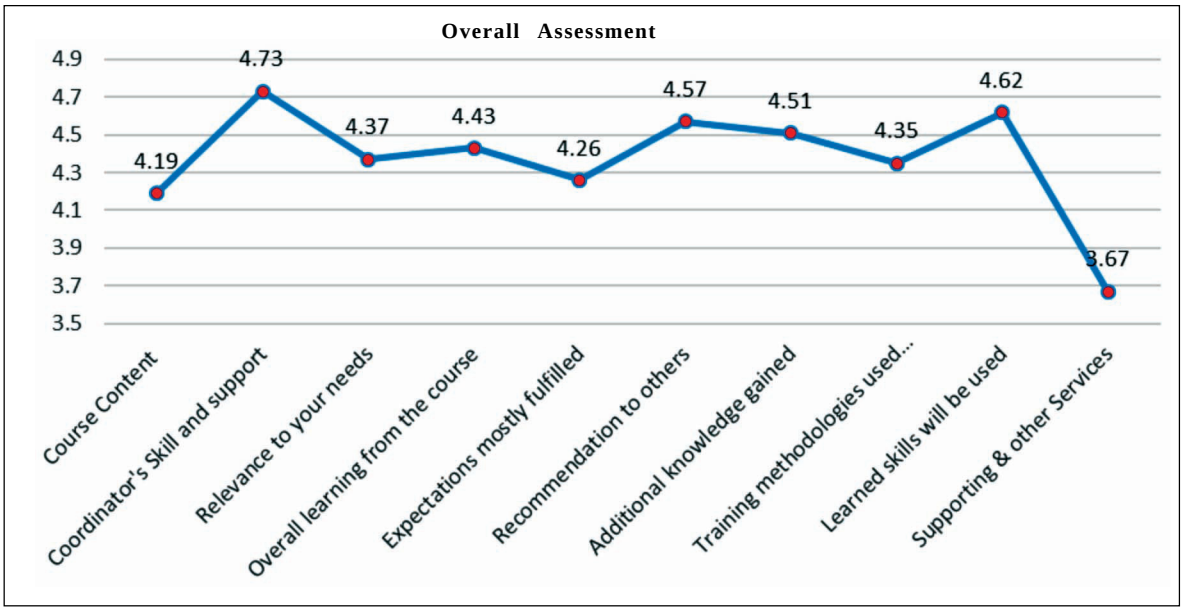

Figure 1. Reaction Assessment of MDP

programmes, by definition, are intended to improve trainees' abilities to involve in leadership roles and processes by providing additional information (Day, 2000). Knowledge acquisition and learning may occur during training, according to adult learning theory, since instruction modifies pre-existing schemas or mental representations of the world and challenges preconceptions (Mezirow & Taylor, 2009; Nain & Trikha, 2009; Chen, 2014; Patel et al., 2020). The respondents' knowledge level was divided into three categories based on their mean score and standard deviation: below-average, average, and above-average knowledge level (Table 1).

The respondents were classified, based upon mean score and standard deviation and it was indicated that most of the respondents before training were Average i.e. 11.05 to 20.51 (62.67%) category, whereas other respondents classified as below average i.e. <11.05 (19.33%) and Above average i.e. >20.51 (18%) similarly, the respondents were classified for post training and it was indicated that most of the respondents were under the category of Average i.e. 22.40 to 28.24 (66%), whereas other respondents classified as below average i.e. <22.40 (17.33%) and Above average i.e. >28.24 (16.66%). It was indicated that out of 150 respondents, most of the respondents changes in after and before training had an average of 4.01 to 15.09 (63.33%), whereas other respondents were classified as below average i.e. <4.01 (18.66%) and Above average i.e. >15.09 (18%) knowledge level category working in NARES.

Behaviour

Behaviour describes, what the trainee does and the extent to which they utilise the knowledge and skills they gained during on-the-job training (Baldwin & Ford, 1988; Kirkpatrick, 1959). Behaviour can change when conditions are favourable and also inform where people might need help. One of the most obvious goals of leadership training is to help leaders make good behavioural changes at the place of working (Day, 2000). Transfer evaluation is therefore essential for measuring the effectiveness of leadership training. The failure of targeted behaviours to transfer to the workplace has been identified by some researchers as a "transfer problem" (Baldwin & Ford, 1988; Goldstein, 1986). Some research has shown that learning does not always translate into transfer (May & Kahnweiler, 2000). Based upon feedback received from the participants after six months and more, overall satisfaction level is around 3.89 out of 5.0. Different parameters of behaviour like the extent to which training address training needs, the extent the learning helps to job, the extent of application of learning to the job, the extent of improvement in job performance, and the

Table 1. Degree of knowledge (before training, after training and Changes in training)

Degree of Knowledge level	Knowledge Score	Frequency (N=150)	Percentage
Before Training (Mean= 15.78 and S.D.= 4.73)			
Below Average	≤11.05	29	19.33
Average	11.05 to 20.51	94	62.67
Above Average	≥20.51	27	18
After Training (Mean= 25.32 and S.D.= 2.92)			
Below Average	≤22.4	26	17.33
Average	22.4 to 28.24	99	66
Above Average	≥28.24	25	16.66
Changes in Training (Mean= 9.55 and S.D.= 5.54)			
Below Average	≤4.01	28	18.66
Average	4.01 to 15.09	95	63.33
Above Average	≥15.09	27	18

comparison of pre and post-training scenario in performance provides the ratings of 3.94, 4.05, 3.73, 4.16 and 3.57 respectively out of 5.0 as mentioned in Figure 2.

Results

Kirkpatrick (1959) defines results as evaluating methods that demonstrate the training program's effect on accomplishing organisational goals such as costs, profits, turnover, and performance. Results are typically defined in terms of the value of the training vs the expense of the programme. (e.g., ROI) (Arthur et al., 2003). DiPietro (2006) looked at the return on investment (ROI) of a leadership training programme, in terms of organisational outcome, and Kawakami, et al. (2006) looked at how supportive the work environment was after leadership programme, which is a subordinate result. Some research has observed no improvement in results criterion after receiving such programme. For example, Lee et al., (2010) discovered that following leadership training, subordinates' self-reported emotional tiredness did not decrease. The majority of studies support the improvement of outcomes brought about by leadership development, however, this one is in the minority (Burke & Day, 1986). Theoretically, results caused advancements in learning and transfer (Kirkpatrick, 1959; Tharenou et al., 2007; Wright et al., 1999).

Based upon feedback received from the reporting officer of participants after 6 months and more of the training programme during 2016-21, the overall result satisfaction level was around 3.42 out of 5.0. Different parameter of results is like extent to which training address training needs, the extent the learning helps to job, the extent of application of learning to the job, the extent of improvement in job performance, and the comparison of pre and post-training scenario in performance provides the ratings of 3.43, 3.6, 3.28, 3.75 and 3.06 respectively out of 5.0 as mentioned in Figure 3. As a result, according to Kirkpatrick (1959), outcomes can be categorised when analysing training effectiveness, and the approach has been utilized in various leadership training meta-analyses (e.g., Burke & Day, 1986; Arthur et al., 2003), to evaluate training effectiveness.

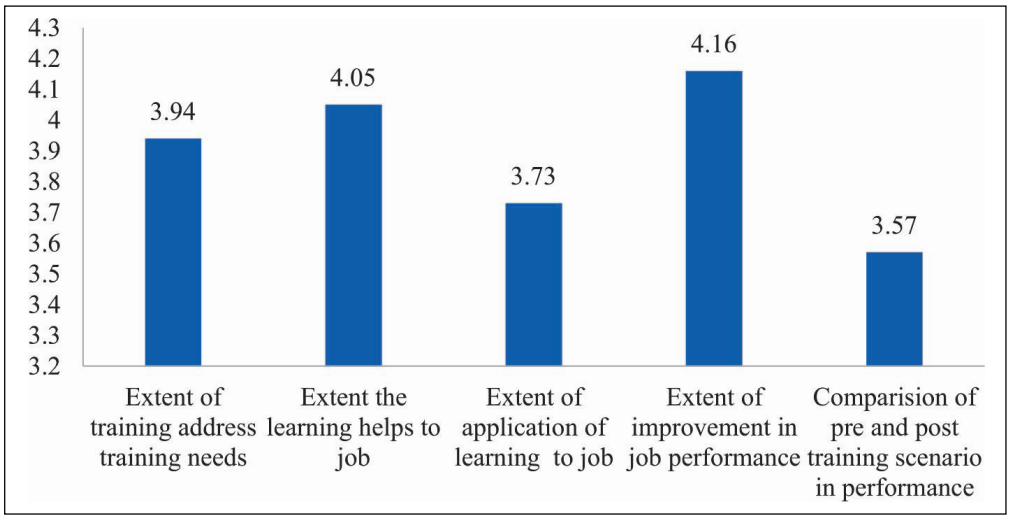

Figure 2. Individual officers (self) ratings of MDP

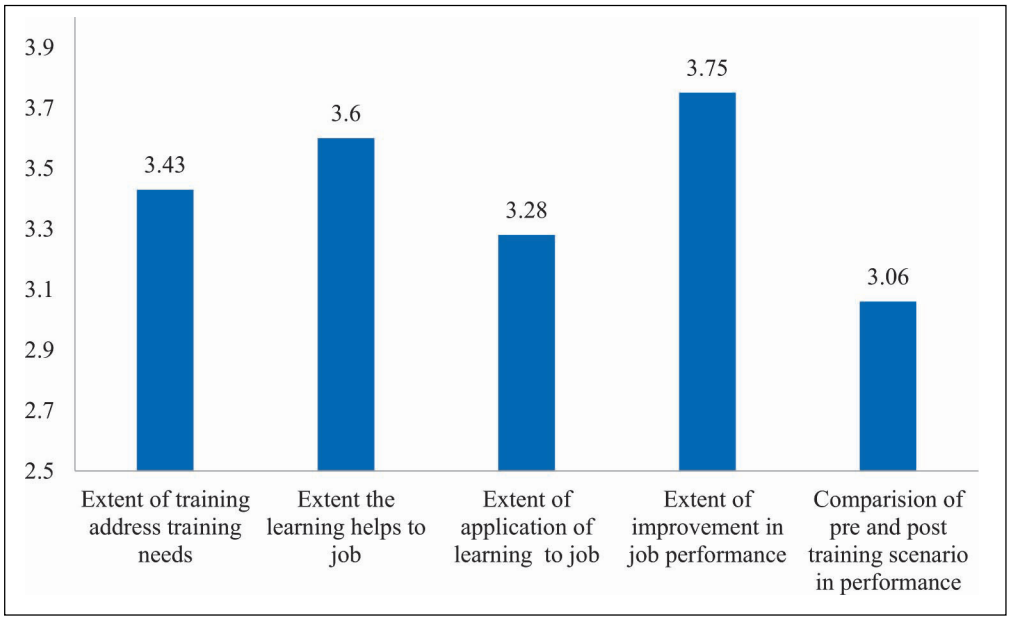

Figure 3. Reporting officers ratings of MDP

CONCLUSION

Based upon four criteria (reactions, learning, behaviour, and results) of Kirkpatrick model, the study concluded that the strength and quality vary upon design, delivery, and implementation characteristics. Feedback received from the participants after the training programme and the overall satisfaction level of reaction is around 4.39 out of 5.0. The study high lightened the knowledge level of participants and information on the sample composition of pre and post training evaluations based upon the knowledge level of the participants at the time of entry and completion of the course. For Behaviour, feedback received from the participants after 6 months and more periods of the training programme and the overall satisfaction level was around 3.89 out of 5.0(77.8%), whereas overall satisfaction level of results is around 3.42 out of 5.0(68.4%).

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Research Article

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An Appraisal of Cluster Frontline Demonstrations on Mustard Crop in Sawaimadhopur District of Rajasthan

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ABSTRACT

The study attempted to analyse the overall effectiveness of the Cluster frontline demonstrations (CFLDs) conducted by the Krishi Vigyan Kendra, Sawaimadhopur, from 2018–19 to 2021–22 using Integrated Crop Management technologies on mustard. A combination of experimental and before-after research designs was used, and 492 beneficiaries were selected for conducting the CFLDs. The obtained results from both the demonstrated and local check plots were compared, and the average yield of the improved mustard variety Giriraj from the demonstrated plots was significantly higher than that from the local check plots during these years. On average, extension and technology gaps were recorded as 4.82 q/ha and 5.99 q/ha, respectively. The average technology index was 21.79 per cent, and the lowest was noticed in the last season of the demonstrations, indicating the increased adaptability and efficiency of recommended technologies in field conditions. The average net returns and benefit-cost ratio from the demonstrated plots outperformed the local check plots in all four seasons. Overall, the CFLDs positively impacted the mustard growers of that particular area and motivated them to adopt the recommended practises for higher yield and profitability.

INTRODUCTION

India is bestowed with diverse agro-climatic and soil conditions which enable the cultivation of different kinds of oilseed crops. In terms of acreage, production, and value, the oilseeds are the next to food grains in the Indian agricultural economy (Sangwan et al. 2021). In India, oil seed production is given significant importance due to the enormous disparity between supply and demand, which led to the purchase of vegetable oil worth millions of rupees yearly (Layek et al., 2021). Among the various oilseeds grown in India, mustard is considered the third most important crop after groundnut and soybean (Kumar et al., 2020). In India, Mustard covers 6.69 million hectares of area with a productivity of 1511 kg ha^{-1}. Among the various mustard-producing states of India, Rajasthan ranks first in terms of total acreage, covering 2.72 million hectares with a production of 4.51 million tonnes in 2020-21. (Directorate of Economics & Statistics, 2021).

Integrated crop management (ICM) incorporates suitable crop production practices for yield and productivity enhancement, comprising of tillage, integrated nutrient management, integrated weed management, integrated nutrient management, and integrated pest management practices. ICM is mainly beneficial from the perspective of small and marginal farmers as it is a sustainable long-term approach, aiming to utilize the on-farm resources judicially in a suitable and collective manner. Cluster frontline demonstration (CFLD) is a popular extension activity for demonstrating the potential of newly released technologies in the farmer's fields at different localities in a given farming system by organizing farming and extension activities for the farmers.

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Sawaimadhopur district is a prominent mustard-growing region in Rajasthan. Though in 2021, the area under mustard for this particular district increased to 190487 ha from 149696 ha in 2020 but the productivity exhibited a downward trend, i.e. 1871 kg/ha in 2020 to 1784 kg/ha in 2021 (Commissionerate of Agriculture, Rajasthan, 2021). Such an alarming decline in mustard productivity could severely impact the overall mustard production for the state. All though the agricultural research institutes have made much progress in improving the production technologies of the mustard crop, the farming community is yet to harness the benefits of these developments. Therefore, Krishi Vigyan Kendra, Sawaimadhopur, took an initiative to introduce the Integrated Crop Management practices of mustard cultivation through Cluster frontline demonstrations to increase the productivity and reduce the cost of cultivation for attaining high economies of scale by the mustard growers. The present study aims to evaluate the effectiveness of the KVK-conducted CFLDs on mustard from 2018-19 to 2021-22.

METHODOLOGY

The CFLDs were conducted in 5 blocks (Sawaimadhopur, Chauthka Barware, Gangapur City, Bauli, and Khandar) of the Sawaimadhopur district of Rajasthan during the 4 consecutive *rabi* seasons from 2018-19 to 2021-22 as mustard is the major rabi season crop in these blocks. A combination of experimental (control-treatment) and before-after research designs was used for the present study. Before conducting the CFLDs, a baseline survey was done in the selected blocks to identify the existing cultivation practises followed by the mustard growers. A total of 492 mustard growers with a cumulated land holding of 293 ha. were identified for conducting the CFLDs as per their interest and participation during the baseline survey, interactive meetings, and awareness campaigns. The farmer's existing mustard cultivation practises were considered as the local check plot. In selected plots for CFLDs, the recommended ICM practises were adopted as per the recommended Package of Practices for Zone V and Zone III-B of Rajasthan for mustard crop. Each and every one of the selected beneficiaries was trained to adopt the recommended ICM technologies for mustard cultivation, and the demonstrations were laid out in an area adjacent to the plots, where the mustard was being grown with the prevailing cultivation practises / variety by the beneficiaries. The details of the recommended ICM technologies are presented in Table 2. The data regarding the crop yields were immediately collected from the check plots as well as the demonstration plots to identify the yield gaps. The economic parameters were worked out by considering the inputs' prevailing market prices and the mustard's minimum support price for the particular year. The effectiveness of the conducted CFLDs was assessed by using the formulas suggested by Samui et al., (2000).

The information from the beneficiary farmers regarding the adoption of recommended technologies, varietal replacement, and horizontal spread of recommended variety was collected with a structured and pre-tested interview schedule at the end of the four consecutive CFLDs. A two-way ANOVA was used to determine whether the mean results obtained from the demonstrated plots for different parameters (grain yield, cost of cultivation, and net returns) of mustard cultivation, significantly differed from local check plots or not.

RESULTS AND DISCUSSION

Yield performance and gap analysis

Cluster Frontline Demonstrations of recommended technologies covered 30 ha, 50 ha, 193 ha, and 20 ha areas in 2018–19, 2019–20, 2020–21, and 2021–22 years, respectively. The average yield of Demonstrated plots was 21.50 q ha^{-1}, 21.27 q ha^{-1}, 21.17 q ha^{-1}, and 22.08 q ha^{-1} for the four consecutive cropping seasons, which was significantly higher than farmers' practice by 31.98 per cent, 26.44 per cent, 26.39 per cent and 30.96 per cent respectively, during this entire period. The average yield of demonstrated plots was higher due to the adaptation of recommended ICM practices like line sowing, seed treatment, weed management, and disease management practices. The average yield of the mustard crop in demonstrated plots also outperformed the district yield by 34.03 per cent, 32.61 per cent, 13.14 per cent and 18.01 per cent (Table 1). In the adopted villages, such a positive impact on the yield performance of mustard was observed due to the proper adoption of integrated crop management technologies and suitable mustard variety Giriraj. Jha et al., (2021) also reported similar yield enhancement of mustard crops under CFLDs. The study also revealed a wide gap between the potential yield and the yield obtained from the local check plots for the mustard crop. Such yield disparity of mustard in this region was due to a lack of awareness regarding the suitable mustard variety and a lack of knowledge about improved agronomic practices and fertilizer scheduling by the farmers.

An extension gap of 5.21 q ha^{-1}, 4.45 q ha^{-1}, 4.42 q ha^{-1} and 4.24 q ha^{-1} was observed in the respective years from 2018-19 to 2021-22 (Table 1). Sensitizing the farmers to adopt improved mustard production technologies using extension activities like training, field days, *Kisan goshthis*, *Kisan melas*, awareness programmes, result demonstration initiatives, etc., can reduce the galloping trend of the extension gap in mustard production. The resulting technology gap depicted the disparity between the potential yield and the yield obtained from the demonstrated plots of mustard. Table 1 shows that the technology gap was highest in 2020-21, at 6.33 q ha^{-1}, and lowest in 2021-22, at 5.42 q ha^{-1}. The observed technology gap may be attributed to various factors related to dissimilarity in crop management practices, soil fertility, and climatic factors. In the last year of the demonstration, the technology gap was the least due to the better performance of the improved mustard variety and the adoption of recommended ICM technologies with different interventions.

The technology index in Table 1 depicts the feasibility of the adopted ICM technologies in the farmer's field. A higher technology index value indicates the inadequate transfer of proven technology among farmers, and a lower technology index value signifies the greater feasibility of any technology in the farmers' field. In this study, the technology index value ranged from 19.20 to 23.01 per cent. Further, on average, the technology index during these four study years was found to be 21.79 per cent, which shows the efficacy of ICM interventions and the adoption of demonstrated

Table 1. Yield performance and gap analysis of mustard crop grown under CFLDs and prevailing farmers' practices**.**

Year	Crop Yield (q ha^{-1})			% increase over local check plots	Extension gap (q ha^{-1})	Technological gap (q ha^{-1})	Technology index (%)
	Potential yield (q ha^{-1})	CFLD plots (q ha^{-1})	Local check plots (q ha^{-1})				
2018-19	27.5	21.50	16.29	31.98	5.21	6.00	21.81
2019-20	27.5	21.27	16.82	26.44	4.45	6.23	22.64
2020-21	27.5	21.17	16.75	26.39	4.42	6.33	23.01
2021-22	27.5	22.08	16.86	30.96	5.22	5.42	19.70
Average	-	21.0	16.68	25.89	4.82	5.99	21.79
Total	-	-	-	-	-	-	-

(CFLD= Cluster Frontline Demonstration)

technologies to increase the yield performance in farmers' fields. Singh et al., (2020) also reported the similar trend of technology index in case of pigeon pea cultivation under CFLDs in Gorakhpur.

Impact of cluster frontline demonstrations on adoption of ICM mustard technologies

It was clear that once the yield potential of the recommended mustard variety Giriraj was realized, all 492 beneficiaries switched from previously adopted hybrid varieties realised by private sector companies and local mustard seed companies to this variety (Table 2). An upward trend was observed in the number of adopters of seed rate (190.47%), sowing method (251.92%) and spacing (446.26%) of the mustard crop. Out of 492 farmers, a total of 366 farmers adopted the recommended practices regarding the seed rate, sowing method, and spacing after the CFLDs as they started using seed-cum fertilizer drill for simultaneous seeding and fertilization process while maintaining proper spacing. The remaining beneficiary farmers could not afford the machine due to their low income and low utility perspective of such modern equipment in their small/marginal lands, and they were dependent upon normal seed drills and broadcasting methods for the sowing of mustard. Regarding the recommended seed treatment practice before sowing, adopters increased by 169.76 per cent as it prevents the attacks of painted bugs at the seedling stage of mustard plants. A similar trend was observed in the adoption of recommended time of sowing, with an increase of 54.23 per cent in the total number of adopters. All of the beneficiary farmers started following the proper time of sowing, which is from September 15th to September 30th, as beyond this period, the temperature starts decreasing, which hampers the germination of mustard seeds. The soil moisture remains highest during the period, which is more conducive for sowing operations in rain-fed areas. In the case of weed management, only 153 farmers adopted the pre-emergence spraying of pendimethalin as per the recommended dose, while the major chunk of the beneficiary farmers could not adopt the practice due to the unavailability of water for effective spraying of the chemical. Due to the highly positive impact of nutrient management interventions suggested in CFLDs, there was a 532.20 per cent hike in the number of adopters of the recommended fertilizer application practices. Before conducting the demonstrations, the majority of the beneficiaries were ignorant of the benefits of the micronutrients, and they used to apply phosphoric fertilizer (DAP) at the time of sowing and nitrogenous fertilizer (urea) after irrigation at a single dose, which used to induce more vegetative growth as compared to the desired reproductive growth of the plants. Regarding irrigation management interventions, there was only a 22.62 per cent change in the number of adopters. The scarcity of irrigation water was the major reason behind such a low adoption rate. Those who had adequate irrigation facilities irrigated the crop at two stages, i.e., one at the time of flowering and the second one at the time of pod formation, and those who had limited water resources irrigated the crop 65–70 days after sowing. Overall, the adoption rate was satisfactory for all of the recommended ICM practices after the demonstration period, which was indicative of the beneficiary farmers' positive utility perception and satisfaction level.

Table 2. Impact of CFLDs in adoption of recommended mustard cultivation technologies

Particulars	Recommended ICM technologies	Change in No. of adopters	Impact (% change)
Variety	Improved variety - Giriraj (DRMR IJ 31)	492	**
Seed Rate	5 kg/ha	240	190.47
Seed Treatment	Seed Treatment with Mencozeb @ 2 g/kg seed & Imidacloprid 48% FS 6 ml kg^{-1} seed	292	169.76
Time of Sowing	15th to 30th September	173	54.23
Spacing	30 cm X 10 cm	299	446.26
Method of Sowing	Use of seed cum fertilizer drill	262	251.92
Weed Management	Pre-emergence spray of pendimethalin (30 EC) @ 3.3 lt. ha^{-1}	153	**
Fertilizer management	Application of nitrogen, phosphorus, zinc and sulphur @ 80 kg, 40 kg, 5 kg and 40 kg/ha basic and application of nitrogenous fertilizer in two split doses	314	532.20
Irrigation Management	One at the time of flowering, another one at the time of pod formation, i.e. 65-70 days after sowing	50	22.62

(**As the initial number of the beneficiary was 0, the impact was calculated from the absolute change in the number of the beneficiaries rather than percentage change)

Economic analysis

From the economic analysis of mustard production (Table 3) it can be concluded that due to additional use of herbicide, seed treatment, application of micronutrients, and incorporation of insecticide, the cost of mustard cultivation was higher in demonstrated plots compared to local check plots in all four cropping seasons. The average gross and net returns were significantly higher in demonstrated plots compared to local check plots due to higher grain yield, indicating the importance and economic feasibility of the recommended production technologies. An additional return of Rs. 17139 ha^{-1} in 2018-19, Rs. 17827 ha^{-1} in 2019-20, Rs. 17661 ha^{-1} in 2020-21, and Rs. 22316 ha^{-1} in 2021-22 were recorded from the demonstrated plots. The pattern of benefit-cost ratios of mustard production under CFLDs was recorded as 4.01, 4.25, 4.22, and 4.64 for the consecutive cropping seasons, which were higher in comparison to the local check plots under farmers' practice, i.e., 3.43, 3.67, 3.66, and 3.89, respectively. The higher benefit-cost ratio of the demonstrated plots proved the economic viability of the recommended ICM technological interventions with additional return on each rupee invested for the production purpose, and the farmers were highly convinced regarding the utility of the recommended package of practices for mustard production. The findings were confirmatory with the study of Meena et al., (2020) as under the variety Giriraj, higher additional returns and effective gain was obtained from the demonstrated plots as compared to the plots under farmer practice with local mustard variety.

Impact of CFLDs on horizontal spread of high yielding mustard variety- Giriraj

The current study aims to assess the impact of CFLDs on the horizontal spread of the improved mustard variety, Giriraj, among the adopted blocks. Table 4 shows that the CFLDs helped to significantly increase the area under the Giriraj variety from 30 ha to 31879 ha. Giriraj (DRMR IJ 31) was introduced in these villages as it is a bold-seeded variety with an average yield of 22–27 q ha^{-1} and is suitable for irrigated conditions. The oil content of the variety is 39–42 per cent, the test weight is 5.6 g, and the maturity duration is 137–153 days. The possible reasons might be the suitable agronomical attributes of the particular variety, like higher oil content and yield, etc. By incorporating proper crop management practices with such an improved high-yielding variety, farmers could generate higher returns, and hence there was a gradual increment in the total area under cultivation. The replacement of local mustard variety due to the adoption of ICM technologies was also reported by Kumar et al., (2021) & Vishal et al., (2022).

Table 4. Impact of CFLDs on horizontal spread high yield variety-Giriraj

Year	Average yield (q ha^{-1})	Change in area (ha)	Impact (% change)
2018-19	21.50	30	-
2019-20	21.27	1905	6350
2020-21	21.17	13570	701.29
2021-22	22.08	16374	105.60

Effect of ICM technologies on selected Economic parameters

The statistical analysis (Two-way ANOVA) was carried out to compare the dependent variables (yield, cost of cultivation, and net returns) separately year-wise as well as treatment-wise (local check plots and demonstrated plots) for their interaction effect. From Table 5, it was established that in the case of yield and net returns, there was a significant difference across the different years of study. In the case of treatment effect and interaction effect between year and treatment for all the dependent variables, the results from demonstration plots were significantly higher at the 1% level of confidence. Such findings lead to the conclusion that the treatments (ICM technologies) not only differed significantly from the local mustard production practices, but they were also behaving somewhat differently in different environments prevailing throughout the years.

Further clarification of interaction effect can be visualized in Figure 1, from which we can conclude the mean of the yield parameter was higher in the demonstrated plots over the controlled plots for all four years, and in the control plot it slightly increased in 2019-20 from the previous year and almost remained the same for the next consecutive years. In case of cost of cultivation, the mean values for the demonstrated plots were on the higher side as compared to the control plots. The cost of cultivation did not differ significantly in the control as well as in the demonstration plots until 2020-21, but in 2021-22, the cost of cultivation increased significantly in the demonstration plots while it decreased significantly in the control plots. The average net return was always higher in demonstrated plots as compared to controlled plots, and it had a significant growth trend during the study years. Despite a significant increase in the mean cost of cultivation for the demonstrated plots, the mean net return was also significantly hiked for 2021–2022. Hence, we can conclude that the recommended ICM technologies in the demonstrated plots had a significantly positive impact on several parameters of mustard production over the farmers' existing practices of mustard production in the control plots.

Table 3. Economic analysis of mustard production technologies under CFLDs

Year	Average cost of cultivation (Rs ha^{-1})		Average gross return (Rs ha^{-1})		Average net return (Rs ha^{-1})		Additional return (Rs ha^{-1})	Benefit-cost (B:C) ratio	
	DP	LCP	DP	LCP	DP	LCP		DP	LCP
2018-19	22096	20307	88648	69720	66551	49412	17139	4.01	3.43
2019-20	22102	20246	94128	74446	72026	54199	17827	4.25	3.67
2020-21	22114	20229	93692	74146	71578	53917	17661	4.22	3.66
2021-22	22111	20154	102672	78399	80561	58245	22316	4.64	3.89

(DP= Demonstrated plots, LCP= Local Check Plots)

Table 5. Two-way ANOVA analysis for comparing the means of dependent variables across the year and plots (Tests of Between-Subjects Effects)

Tests of Between-Subjects Effects						
Dependent Variable: Yield						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Year	125.636	3	41.879	18.726	.000	.057
Plot	2345.010	1	2345.010	1048.595	.000	.531
year * Plot	39.766	3	13.255	5.927	.001	.019
Dependent Variable: Cost of Cultivation						
year	1070350.022	3	356783.341	2.950	.032	.009
Plot	573841654.148	1	573841654.148	4745.138	.000	.837
year * Plot	19513802.068	3	6504600.689	53.787	.000	.148
Dependent Variable: Net returns						
year	18319187554.447	3	6106395851.482	137.795	.000	.309
Plot	38871709521.541	1	38871709521.541	877.168	.000	.486
year * Plot	1238324841.293	3	412774947.098	9.315	.000	.029

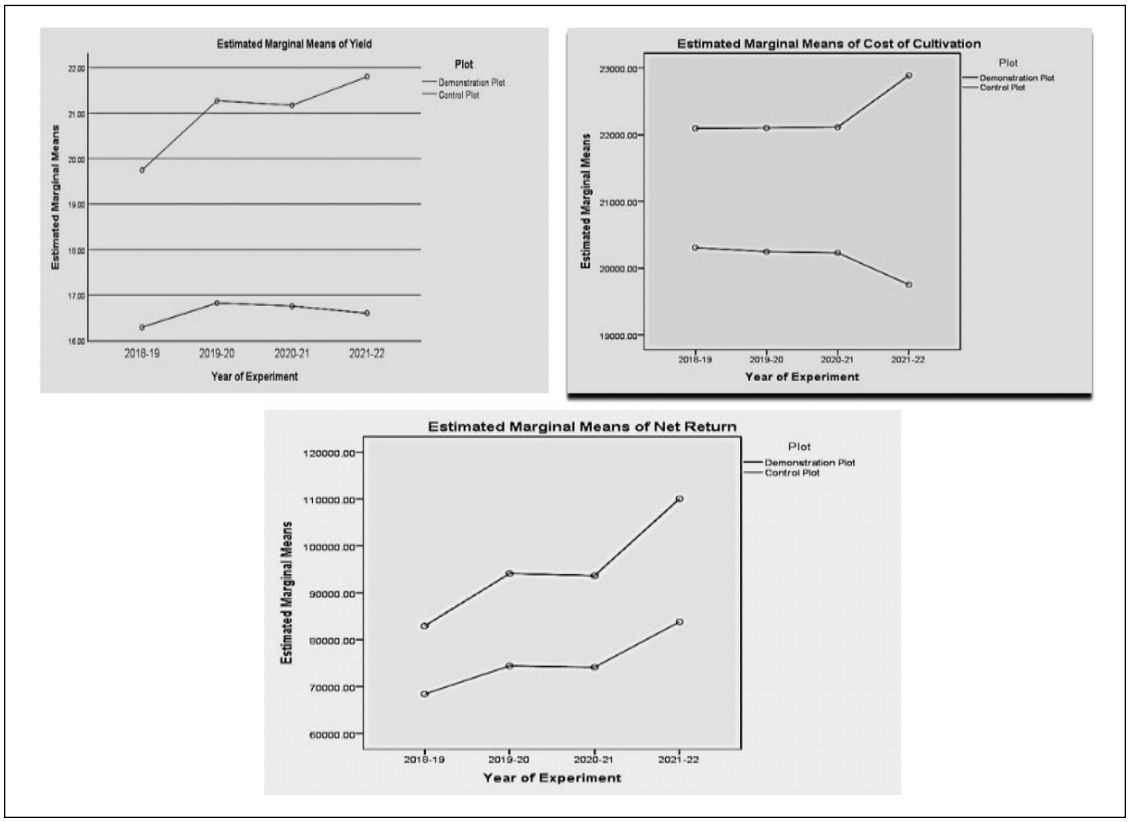

Figure 1. Estimated marginal means of yield, cost of cultivation and net returns

CONCLUSION

Based on the assessment of the conducted CFLDs, it can be concluded that the crop yield and economic return were significantly higher in the demonstrated plots than in the local check plots. The resulting technological gap was attributed to dissimilarity in climatic and soil fertility factors, and the lowest technology index at the end of the last cropping season of the CFLD denoted the efficacy of technological interventions in increasing the mustard yield in demonstration plots. Such superior yield performance motivated the beneficiary farmers to adopt the improved mustard variety (Giriraj) and the recommended ICM technologies by replacing the existing cultivation practices. The extension agencies engaged in transferring various agricultural technologies to farmers' fields must prioritize cluster frontline demonstrations on a large-scale basis for disseminating flagship production technologies of the National Agricultural Research System (NARS).

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Extent of Adoption of Available Components in the IFS Units of Kerala

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ABSTRACT

Integrated Farming Systems (IFS) have shown to be an important way to improve the intake of safe and micro nutrient rich foods, particularly for households of Kerala. The productivity and profitability from a unit directly depends on the components adopted. Keeping this in mind, the present study was carried out with an objective to measure the extent of adoption of various components among the existing integrated farming system units of Kerala during 2021-22. Three districts Kollam, Thrissur and Kannur were selected randomly. From each district four panchayat were randomly selected and fifteen IFS units were selected randomly from each identified panchayat, thus making the total sample size 180 integrated farming system units. To measure the extent of adoption of available components in the IFS units, a composite index was developed. The result revealed that majority of the IFS farmers exhibited low level adoption of available components in their units and among the components, dairy and crop component had the highest adoption rate.

INTRODUCTION

Kerala is known for its richness of and biodiversity. The varied agro ecosystems have enabled Kerala to host large number of crops and allied enterprises. However, unfortunately, the conventional agricultural systems are currently facing tremendous pressure in terms of new agrarian structure, land reforms and increasing impacts of climate change (Viswanathan, 2014). This has adversely affected the food security and generic resource base of the state compelling the households to increase their dependence on markets for their everyday needs. Majority of the farmers in Kerala are either marginal and small or even landless with fragmented land holdings (GOK, 2019). Attaining self-sufficiency in food production in this peculiar condition is indeed a challenge and it can be achieved only through a noble, sustainable approach and Integrated Farming Systems (IFS) shows a way forward. Integrated Farming System is broadly defined as a system comprising of several mutually cohesive and complementary agro based enterprises. It ensures maximum productivity from unit area and enables to reap maximum profit, without disturbing the ecological and socio economic balance (Mamatha et al., 2019). These enterprises not only supplement the income of the farm families but also provide year round employment for the family members (Behera et al., 2001). Integrated farming system also reduces the cost of production by recycling the residues in the field and helps to conserve water, soil health and other nutrients (Singh & Riar, 2014). Even though these systems are made up of integration of various components, which are complementary to each other, in terms of adoption and profitability of various crops and other components, area wise variations can be noted among each unit. So that, no common model can be suitable for all the conditions. The optimization of each component is crucial for increasing overall productivity and profitability of the system. Hence for designing an IFS unit in a profitable and sustainable way, selection of the components plays a crucial role. The selection of different components in a unit is primarily based on its complementarity to each other and the ability to meet the diverse needs of the growers (Sheikh et al., 2021). It must be ensuring that the interactions among them are as compatible as possible with minimum competition. Understanding the interconnections and

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dependences among existing components, will aid in the development of a unit, as it gives a clear idea about how the output from one component is more productively utilized as an input in another. Keeping this in view, the present investigation was formulated to reveal the facts about extent of adoption of identified components in the IFS units of Kerala. It will explore the possibilities for developing new models and examine whether existing models could be scaled up. This further reflects into the structural and functional dynamics of Integrated Farming Systems, which enables the research and extension systems to set or modify their priorities and select proper and specific delivery mechanisms.

METHODOLOGY

Kerala state was purposively selected and three districts (Kollam district from Southern Kerala, Thrissur district from Central Kerala and Kannur district from Northern Kerala) were selected randomly. From each district, 2 Agro Ecological Units (AEU) were randomly selected. A list of panchayats in each AEUs of study was prepared and two panchayats with potentially active IFS units were selected randomly from each AEU. A comprehensive list of farmers those who had adopted Integrated Farming System, was prepared separately for each panchayts. On the basis of the lists, 15 Integrated Farming System units were selected randomly from each identified panchayat, thus making the total sample size 180 IFS units.

Integrated Farming System is an effective fusion of several agro based enterprises such as crops, aquaculture and animal husbandry and so on. To get an idea about the structure and functioning of the existing unit, various components available in each unit should be analyzed thoroughly. For that a final composite index was developed using the indicators for measuring rate of adoption.

Through reviewing the literatures and discussion with experts, various components prevailing in the study area were identified. In order to ascertain the extent of adoption of these enlisted components, a composite index was developed with help of selected indicators. Based on the availability, nine components were identified in the study area. The identified components were: Crop, Dairy, Poultry, Fisheries, Apiculture, Mushroom, Composting, Biogas and Azolla. Under each selected components appropriate indicators were chosen by referring relevant literatures and expert's opinion. The indicators chosen under each dimension were thought to make a significant contribution in measuring the adoption of various components in the IFS units. The development of a valid and reliable index necessitates careful examination of each indicator. Thus, these indicators were distributed to scientists and experts via Google forms as well as direct methods and they were requested to rate the relevancy of each indicator on a three-point scale, i.e. 'Most relevant,' 'Relevant,' and 'Least relevant,' with scores of 3, 2, and 1 respectively. The relevancy weightage (RW) was calculated for each indicator by using the following formula:

$$\text{Relevancy weightage} = \frac{\text{Most Relevant Responses} * 3 + \text{Relevant Responses} * 2 + \text{Least Relevant Responses} * 1}{\text{Maximum Possible Score}}$$

By using the above formula, the indicators with Relevancy Weightage (RW) of > 0.75 were considered for inclusion in developing the final index. Finally, a total of 25 indicators were retained for the data collection. To bring the values of indicators to a comparable range, normalization was done using maxi- min methodology suggested by UNDP (2006). Post normalization, separate Principal Component Analysis (PCA), as suggested by Dunteman (1989), was done considering 25 selected indicators and using IBM SPSS 26 version software.

Principal Component Analysis (PCA) method was used to construct indices for the selected indicators. It was used for grouping variables that were highly correlated into principal components (Gupta et al., 2020). Principal components were described as the part of multivariate procedures wherein linear combinations of correlated indicators are involved to maximize the variance accounted for in the original set of indicators (Chakravarty, 2017). Twenty five indicators for developing the adoption index were subjected to Principal Component Analysis and first nine principal components were selected with eigen values greater than 1. The eigen value for the selected nine principal components were 4.30, 3.13, 2.35, 2.05, 1.87, 1.47, 1.36, 1.16, 1.07. The values of first principal component in the rotational component matrix were taken as final weightage. The normalized values of each indicator were multiplied with its respective weightage. The multiplied values of indicators were summated for each respondent to obtain the final composite index.

RESULTS AND DISCUSSION

Categorization of IFS farmers based on extent of adoption of available components

The respondents were finally categorized, based on composite index values obtained into low, medium and high adoption levels using the cumulative square root frequency method as follows:

Table 1. Distribution of respondents based on extent of adoption of available components

Categories of adoption (Adoption Index Score)	Kollam (%)	Thrissur (%)	Kannur (%)	Total (%)
Low (<0.32)	36.67	40.00	43.33	40.00
Medium (0.32 – 0.60)	41.67	33.33	36.67	37.22
High (>0.60)	21.66	26.67	20.00	22.78
Total	100	100	100	100

According to the preceding Table 1, most (40 %) of the IFS farmers exhibited low level adoption of available components in their units, followed by medium level adoption (37.22%). Only less than one fourth (22.78%) had shown high level adoption. Same trend was noticed in Thrissur and Kannur district also. Nearly two fifth of the respondents in both in Thrissur (40%) and Kannur district (43.33%) were had low level adoption followed by medium with respective percentages 33.33 per cent and 36.67 per cent. A slight change was noticed from the general trend in Kollam district, as most (41.67%) showed medium level adoption followed by low level (36.67 %). Across all districts, less than three ten of total respondents (21.66% in Kollam, 26.67% in

Thrissur and 20% in Kannur) only exhibited high level adoption of available components. According to the findings of Ghouse & Hassan (2020), distance to the market, economic motivation, risk orientation, family size, innovativeness and scientific orientation, were the factor that influencing crop diversification. Lacks of resources, less demand, difficulty in time management for multiple activities were also attributed to the low adoption of certain components. These findings were at odds with that of Akshitha & Dolli (2020), who found that nearly half of the respondents from each selected districts (46.67% Belagavi and 40% for Vijyapur) belonged to medium level of adoption

Component wise extent of adoption in IFS units

An adoption index score was derived based on the extent of adoption of specified components in each dairy based IFS unit. The selected components were ranked based on their score. The component wise extent of adoption among IFS units is shown in Table 2.

Table 2. Component wise extent of adoption among IFS units

S.No.	Components	Total no. of units with specific component (n=180)	Adoption index score	Rank
1	Crop	180	1	1
2	Dairy	180	1	1
3	Poultry	158	0.87	3
4	Fisheries	95	0.53	5
5	Apiculture	55	0.31	7
6	Mushroom	11	0.06	8
7	Biogas	62	0.34	6
8	Compost	115	0.64	4
9	Azolla	159	0.88	2
	Mean score	0.62		

The Table 2 showed that among the selected agricultural components, dairy (1) and crop (1) component had the highest adoption rate. Following that, greater adoption was observed in azolla (0.88), poultry (0.87) and compost (0.64). Least adoption was noticed for mushroom (0.06), apiculture (0.31), biogas (0.34) and fisheries (0.53). Crop, azolla, poultry and compost were the most widely used components in dairy based IFS units. These componets were inextricably linked to dairy, both in terms of feed and waste management. In Kerala, majority of the farmers were marginal and using their homesteads for various agricultural activities,usually prefer components which requires less space, care and investment and multiple use. Small farming families, landless labourers and people with income below the poverty line rear chickens with low inputs and harvest the benefits like egg and meat via scavenged feed resources (Sonaiya, 2004). In addition to being a good source of human nutrition, poultry is a dependable source of regular cash income also. Poultry manure provides vital input for sustainable organic farming. Crop residues and grains provide the feed for the poultry (Roy & Kadian, 2013). Thus, the direct and strong linkage of azolla and compost with both crop, dairy and poultry sectors, may be the reason for its higher adoption rate. It was also critical to highlight that none of the existing IFS units in the study area possessed all selected components.

Possible reasons for non adoption was enlisted through discussion with farmers and experts and scored based on their responses. The mean score for each reason was calculated and ranked in such a way that one with the highest mean score being the most important reason.

Table 3. Reasons for non adoption of identified components in IFS units

S.No.	Reasons	Mean score
1	More financial investment needed	2.78
2	Not profitable	2.56
3	Marketing difficulties	2.48
4	Difficulty in time management	2.29
5	Lack of resources	2.14
6	Less demanding	2.06
7	Lack of awareness	1.94
8	Prejudice of the respondents	1.51

Need of more financial investment (2.78) was ranked as the main reason for non-adoption followed by not profitable (2.56). Table 3, denoted the least adopted components in IFS. By comparing these two observations, it may be concluded that the high initial investment needed to set up a component hinders the majority of farmers from adopting it. As an impact of COVID-19, just like other sector, agriculture sector was also hit and the financial situation of farmers remained precarious. A study conducted by Habanyati et al., (2022) reported that as part of COVID-19 lockdown farmers in Kerala were faced a lot of difficulties such as farm labor shortages, input shortages, machinery shortages, poor access to credit as well as consultancy and movement restrictions and this affected the financial condition of farmers. As a result, most of them were hesitant to implement new programmes or technology unless they received financial assistance from the government. For crop and dairy component, Government procurement centres were there like Vipani, VFPCK, Supplyco and MILMA. However, for other components farmers themselves needed to find out the market. Next important reason noted was difficulties in time management (2.29). Due to labour shortage and high wage rate which existed in Kerala, majority of the farm operations in the IFS units were carried out by the farmer himself or with the assistance of family members, farmers may have faced difficulty in managing all activities due to a lack of sufficient workers. Some componets necessitate a strong resource base such as water resources, nector yielding cropping systems and appropriate infrastructure, such as clean and sanitary production and processing units. This indicated that lack of resources (2.14) limited the applicability of some components in some areas. The other possible reasons were found to be less demanding (2.06), lack of awareness (1.94) and prejudice of the respondents (1.51). A study conducted by Mishra et al., (2020) among the apiculture farmers of Arunachal Pradesh, highlighted the need of more extension activities in the form of training and other advisory services for the adoption of improved apiculture practices. Since the adoption of some components were found to be low, more Government support should be provided in terms of financial and technological assistance to enhance the adoption of those components.

CONCLUSION

Integrated Faming System is a viable option for ensuring nutritional as well as livelihood security of Kerala. Along with the

benefits of sustainability and livelihood security, IFS also helps to mitigate the risks associated with mono cropping system. From this study, it can be summarized that, most (40%) of the IFS farmers in the study area exhibited low level adoption of identified components in their units, followed by medium level adoption (37.22%). Among the selected agricultural components, dairy and crop component had the highest adoption rate. Following that, greater adoption was observed in azolla (0.88), poultry (0.87) and compost (0.64). The reasons like high initial investment, marketing difficulties, lack of sufficient resources, less demand, difficulty in time management for multiple activities etc., can be attributed to the low adoption of certain components.

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Enrichment Programme Efficacy on Core Life Skills: A Quasi Experimental Study Among University Students

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ABSTRACT

The present study was conducted in 2021, with an objective to examine the impact of enrichment programme on core life skills of undergraduate students. The study consisted of 60 first year undergraduates of Punjab Agricultural University enrolled in 2021-2022 academic session havinglow level of overall life skill. Life Skills Assessment Scale by Nair et al., (2010) was used to collect the data on measuring variable. One group quasi experimental research design was conducted by using module based online training sessions for the intervention. Evaluation of pre-intervention data highlighted that all the student participants were in low level life skill with none at average and high levels, whereas, in post-intervention evaluation, more students were found at average and high levels with merely few of them remained in low level of life skill. Dimension-wise analysis indicated significantly improved in each dimensions of life skills with non-significant gender differences after attending enrichment programme. The study recommends that life skills education should be an integral part of the university curriculum mainly at graduation level for optimal development of required psychosocial skills among 21st century youngsters enabling them to lead a successful living.

INTRODUCTION

With the technological advancement in 21st century, human life has undergone substantial change globally and these changes primarily have an impact on youth development. Currently, India is on the verge of being the world's youngest nation with the highest youth population (Verma et al., 2017). In this quick-paced modern world, the youth of today encounter many more choices and demands than ever before (Chavan, 2012). Studies found that socio-emotional development of emerging adults is dependent on social media networking for better social health (Dhanwal et al., 2022), but sometimes it also causes more conflict and frustration, mental health issues, and behavioural disorders (Pedrelli et al., 2015). As the time goes by, such kind of problems are bound to increase. There is an urgent need of promoting socio-personal development and successful living, and in this regards life skills education acts as facilitator that focuses on teaching culturally and developmentally appropriate psychosocial skills through participatory learning that is needs- and outcome-based (UNICEF, 2003 & UNICEF, 2015).

Life Skills are abilities for adaptive and positive behavior that enable individuals to deal effectively with the demands and challenges of everyday life (WHO, 1997). These are combination of several psycho-social competencies that assist in translating knowledge into action for positive functioning, healthy living and productive life (Emanuel, 2008 & Saravanakumar, 2020). World Health Organisation has enlisted ten core life skills which fall under three main categories: thinking skills, social skills, and emotional skills. Thinking skills include self-awareness, problem-solving, creative thinking, critical thinking, decision making; social skills include empathy, interpersonal relationship, effective communication; and emotional skills include stress management and coping with emotions.

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By practicing and developing these life skill skills can lower the risk and capitalise on constructive and adaptable behavior (Munsi & Guha, 2014 and Prajina, 2014). In order to prepare youngsters for overcoming developmental obstacles, the higher education system can play a mentoring role in helping them acquire information, skills, attitudes, and values. Experts claim that curriculum courses offered during the first year of college life can remarkably influence future progress and inspire them to grow continuously (Tinto, 1993). Numerous studies suggested that life skill education at any level can bring a positive change in the trainee (Roodbari et al., 2013). Although considerable studies have been made in the past decades showing the effectiveness of life skills for empowerment of school students regardless of their socio-personal profile (Bharath & Kishore, 2010 & Sulfikar, 2016 & Josephine, 2015) but there is a dearth of studies indicating its effectiveness for students in higher education (Nair & Fahimirad, 2019). Therefore, this study aimed to assess effectiveness of enrichment programme on life skills among undergraduate students.

METHODOLOGY

A one-group pretest-posttest quasi-experimental study was conducted in the year 2021 among the purposively selected cohort sample of 60 students (30 males and 30 females) having low level of life skills. The respondents were aged between 18-20 years and enrolled in the first year of undergraduate programmes for the academic session 2021-22 at Punjab Agricultural University, Ludhiana. A self-structured information sheet and Life skills assessment scale by Nair et al., (2010) was used to collect baseline data. The scale consists of 100 items in the form of the statements in built with a 5-point scale for measuring life skills in ten dimensions which were self-awareness, empathy, effective communication, interpersonal relationship, creative thinking, critical thinking, decision making, problem solving, coping with emotions and stress.

Online questionnaire of Life Skill assessment scale was prepared through google form and shared to 300 students from constituent colleges of Punjab Agricultural University along with attached consent form to participate in the interventional study. Out of 300 questionnaires, 230 returned and only 165 responded questionnaires were considered satisfactory. Out of 165 students, 60 respondents who scored low at overall life skill as per the norms of the test were selected for the intensive online intervention program. There were three essential phases of the research for data collection namely pre-testing phase, intervention phase (for 3 months) and a post-testing phase (after a gap of one months from the second phase).

The selected 60 students during pre-testing phase were further categorized into three small groups with 20 students in each group (10 males and 10 females) with the purpose to check the attendance and to facilitate discussion during the intervention sessions. The intervention was given to students for a period of three consecutive months (one session per week for each group) by using developed need based training module covering all the ten dimensions of life skills where respondents were at low level. The intervention was to be imparted through twelve online sessions (one introductory session, ten sessions based on dimensions, and one booster session two weeks following the core session). Participants received the 4 hours per week of intervention for each life skill, which comprised of online session of 60 to 90 minutes depending on the input content (ppt. and interactive exercises), psycho-educational texts, and remaining activity packages (activity sheets, readings and videos). The free of cost intervention sessions were presented via online platform (Google meet) by the beforehand trained researcher in life skills education. An informed consent was obtained from every participant after a brief explanation regarding the study. Confidentiality of the respondents was maintained during the research. The obtained data were analyzed using the Statistical Package for the Social Sciences software version 16.0. Descriptive analysis (frequency and percentage) was done to find out the distribution of sample across different levels of life skills. Independent t-test and paired *t*-test was applied as inferential analysis to study the differences in the respondent's mean scores of life skills (pre- and post-intervention).

RESULT AND DISCUSSION

Table 1 projects the pre and post-assessment mean scores of study participants across various dimensions of life skills. It was clearly depicted that significant differences were observed in all dimensions with higher mean scores during post-intervention assessment. Similarly, in case of overall life skills, the pre-assessment mean scores was found to be (289.93 ± 16.28) which were significantly improved to (355.93 ± 27.28) after receiving

Table 1. Comparison of pre and post-assessment mean scores of total respondents across various dimension of life skills

Dimensions of life skills	Pre-Test		Post-Test		t-value
	Mean	SD ±	Mean	SD ±	
Self-awareness	31.55	1.74	38.75	3.43	25.438*
Empathy	33.17	2.16	40.25	3.61	19.22*
Effective communication	24.27	2.12	29.75	3.69	12.45*
Interpersonal relationship	32.62	2.03	38.35	3.25	14.85*
Creative thinking	23.87	2.69	30.45	3.39	15.38*
Critical thinking	33.65	2.21	40.97	3.96	16.81*
Decision making	32.25	2.59	38.32	2.81	15.96*
Problem solving	28.77	3.04	36.28	3.28	17.98*
Coping with emotion	29.33	2.46	36.48	3.87	16.44*
Coping with stress	20.67	2.03	26.33	3.26	15.54*
Overall life skills	289.93	16.28	355.93	27.28	24.97*

* $p<0.01$

intervention. The overall table shows that intervention had a positive impact on all dimensions of life skills. From these results, it could be concluded that along with proper assessment of their training needs, capacity building efforts through hand on-trainings in combination to social media exposure acts as great way to bring optimal behavior change among young adults (Sanjeev et al., 2021 & Ray et al., 2022). In support to these results, Choudhary & Rani (2019) also found that Life Skills Intervention Program showed a significant improvement in life skills of experiment group and recommended the integration of such enrichment program in the educational curriculum for improving the life skills of students. Numerous studies support the effectiveness of educational training that helped learners to develop required skills to solve interpersonal social issues (Malik, 2003 & Malik et al., 2010 & Balda & Turan, 2010 & Balda et al., 2010).

Table 2 depicted significant improvement ($p<0.01$) in all dimensions of core life skills among participants across both the gender as they scored significantly higher in the post-test after receiving intervention as compared to the pre-test. Further, the difference in mean scores of both female and male respondents was found to be statistically significant across all dimensions of life skills. Assessment of overall life indicated that the mean scores was improved after intervention with significant difference ($p<0.01$) in pre and post intervention means scores of female respondents. In support of the results, Pathania & Chopra (2017) also reported that the intervention had significant impact on improvement in various dimensions of life skills. Overall view of the table revealed that there is a significant effect of enrichment program on life skills of students and even after a gap of one month, children showed improvement in their skills and were able to retain the gained skills.

The pre-assessment data indicated non-significant gender difference in most of dimensions of life skills except interpersonal relationship, decision making and coping with stress dimensions (Table 3). The mean scores of female participants were found to have significantly higher in interpersonal relationship ($p<0.10$), decision making ($p<0.10$) and coping with stress dimensions ($p<0.10$) as compared to boys. Similarly, assessment of post-intervention data also revealed non-significant gender difference in self-awareness, effective communication, interpersonal relationship, creative thinking, decision making and problem solving skills. Significant gender differences were found in empathy, critical thinking, coping with emotions and coping with stress skills. The post-assessment means scores of female participants were found to have significantly better in empathy ($p<0.10$), coping with emotions ($p<0.10$) and coping with stress ($p<0.10$) skills as compared to boys who scored higher in critical thinking ($p<0.10$) skill. Overall analysis of dimensions of life skills revealed that girls

Table 2. Within group comparison across various dimensions of life skills

Dimensions of life skills	Females n_f=30					Males n_m=30				
	Pre-assessment		Post-assessment		t-value	Pre-assessment		Post-assessment		t-value
	Mean	SD±	Mean	SD±		Mean	SD±	Mean	SD±	
Self-awareness	31.77	1.91	39.43	3.39	10.783*	31.33	1.56	38.07	3.39	9.893*
Empathy	33.47	2.24	41.33	3.61	10.133*	32.87	2.06	39.13	2.95	9.529*
Effective communication	24.47	2.21	29.43	3.68	6.329*	24.08	2.05	30.07	3.57	7.970*
Interpersonal relationship	33.3	2.22	38.7	3.34	7.375*	31.93	1.6	38.00	2.94	9.933*
Creative thinking	23.83	2.69	29.83	3.17	7.905*	23.90	2.73	31.07	3.47	8.895*
Critical thinking	33.6	2.25	40.1	3.96	7.817*	33.70	2.22	41.83	3.64	10.444*
Decision making	32.8	2.88	37.87	2.29	7.547*	31.70	2.18	38.77	3.05	10.329*
Problem solving	28.67	2.86	36.27	3.28	9.565*	28.86	3.26	36.3	3.21	8.907*
Coping with emotions	29.7	2.14	37.3	4.14	8.932*	28.96	2.74	35.67	3.14	8.819*
Coping with stress	20.77	2.34	27.07	3.41	8.344*	19.77	1.55	25.6	2.89	9.737*
Overall life skills	292.37	17.88	356.97	27.59	10.762*	287.10	14.32	354.5	27.16	12.023*

*p<0.01

Table 3. Gender wise comparison of pre and post- assessment mean scores of respondents across various dimensions of life skills

Dimensions of life skills	Pre-Assessment					Post-Assessment				
	Females n_f=30		Males n_m=30		t-value	Females n_f=30		Males n_m=30		t-value
	Mean	SD±	Mean	SD±		Mean	SD±	Mean	SD±	
Self-awareness	31.77	1.91	31.33	1.56	0.977^{NS}	39.43	3.39	38.07	3.39	1.554^{NS}
Empathy	33.47	2.24	32.87	2.06	1.080^{NS}	41.33	3.61	39.13	2.95	2.585*
Effective communication	24.47	2.21	24.08	2.05	0.709^{NS}	29.43	3.68	30.07	3.57	0.684^{NS}
Interpersonal relationship	33.3	2.22	31.93	1.6	2.742***	38.7	3.34	38	2.94	0.862^{NS}
Creative thinking	23.83	2.69	23.9	2.73	0.100^{NS}	29.83	3.17	31.07	3.47	1.445^{NS}
Critical thinking	33.6	2.25	33.7	2.22	0.173^{NS}	40.1	3.96	41.83	3.64	1.762***
Decision making	32.8	2.88	31.7	2.18	1.668***	37.87	2.29	38.77	3.05	1.292^{NS}
Problem solving	28.67	2.86	28.86	3.26	0.240^{NS}	36.27	3.28	36.3	3.21	0.036^{NS}
Coping with emotions	29.7	2.14	28.96	2.74	1.166^{NS}	37.3	4.14	35.67	3.14	1.718***
Coping with stress	20.77	2.34	19.77	1.55	1.951***	27.07	3.41	25.6	2.89	1.801***
Overall life skills	292.37	17.88	287.1	14.32	1.260^{NS}	356.97	27.59	354.5	27.16	0.349^{NS}

*p<0.01 ***p<0.10 NS- Non Significant

reported to have better social and emotional skills but slightly lower cognitive skills than their counterparts. The differences in cognitive and social performance of males and females could be the result of gender roles expectation of society and cultural.

Further, non-significant difference was found in pre and post assessment mean scores of overall life skill of male and female participants. Sandhu (2014) also reported non-significant gender difference in overall life skill. Observable, from the above statistics, most students seem to have benefited from life skills lessons across both the genders. Girls for instance showed better improvement in most of the dimensions of core life skills as compared to boys after participation (Ndirangu et al., 2013). Goyal & Jain (2016) also supported the significant effectiveness of intervention programme on empowerment of participants. Empowerment is a state of wellbeing as well as mindfulness that not only need to act differently, but also different thinking pattern, self-management, and self-confidence (Priyanka et al., 2019). Accordingly, overall results of the study proved that intervention on life skills could act as a good support system for youth empowerment to take positive action and improve significant psycho-social skills required to lead healthy and productive life.

CONCLUSION

Life skills education also serve as an efficacious tool for empowering the youth's abilities to make them responsible for making healthier choices, resisting negative pressures and abstain from risky behaviours. The results of the study revealed that the life skills based enrichment programme has a significantly positive effect on psycho-social competencies of the graduate students. Non- significant gender difference in most of the dimensions of core life skills among graduate students at pre and post-intervention phase indicate alike need and effectiveness of programme. Incorporation of LSE as a subject in higher education curriculum that appeals more to the affective domain of the learners than cognitive domain to bring attitudinal change in life is recommended. The pedagogy of LSE has to be included in the teacher training curriculum for pre-service teachers as well as refresher course should be encouraged for in-service teachers to update their knowledge about core life skills as well as incorporate life based practical teaching methodologies for effective learning of life skills by university students.

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Perception of Urban Consumers on Dairy Farming and Milk Consumption in North India

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ABSTRACT

Increasing commercialization of dairy farming, diversity of products, consumer awareness and unlimited access to various information might have influenced the perception of consumers which finally affect their purchasing behaviour. Present study attempts to study the perception of consumers on dairy farming and milk consumption by analysing primary data collected from 270 milk consuming households using a Perception Index constructed for the purpose. The overall perception index was estimated to be 68, indicating that consumers have a favourable perception of milk consumption and dairy farming. Consumer households had higher positive perception on nutrition and health effects of milk (79.33) and economic benefits of dairy farming (77.56). However, they were concerned about milk safety (53.54) and ethical aspects (57.03). Stringent quality control, inspection and monitoring are required for ensuring safe milk so that the apprehensions in the mind of consumers can be removed. Efforts also needs to be directed towards animal welfare.

INTRODUCTION

Dairy farming has been an integral part of the Indian agriculture since ages. It occupies a significant position owing to its major share in Gross Domestic Product of livestock sector besides being a source of livelihood for millions of rural households (Das et al., 2020; Gupta & Sharma, 2010; Lalrinsangpuii et al., 2016). In addition to income, dairy also ensures food and nutritional security of households (Smith, 2013). Milk and milk products are an essential constituent of traditional Indian diet. They serve as a major source of protein primarily for the vegetarian population, children and pregnant women.

Traditionally, dairying was practiced for subsistence but the Operation Flood, which provided the impetus for India's white revolution, gave a significant boost to commercialization and the farmers started focusing on increasing the productivity of their dairy farm. High milk yielding crossbred, artificial insemination, scientific methods and better-quality fodder were introduced for making the country self-reliant in dairy production (Sarveswara & Rao, 2021). Since then, the dairy production systems are continuously changing with sustained economic growth, growing urbanization and improved technologies. Commercial dairy farms have no doubt helped in ensuring milk self-sufficiency of the country, however, critics argue that intensive dairy farming have its own demerits too (Kirchhelle, 2018). Sole emphasis on milk production may lead to compromises with the environment, food safety and animal welfare (Cornish et al., 2016; Polsky & von Keyserlingk, 2017; Fraser et al., 2013) but the Economic, socio-psychological, marketing and technical constraints dominates the scenario Singh et al., (2017).

Besides change in production system, the preferences of consumers are also changing owing to changing lifestyles and rising health consciousness (Chen, 2009). The dairy market now offers a variety of milk like cow milk, desi cow milk, organic milk, low

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fat milk etc. in order to cater the specific requirements of the consumers. Additionally, a number of products including health drinks, fortified foods and dairy analogues are also available in the market. All these changes clubbed with instances of milk adulteration and access to huge amount of verified as well as unverified information may influence the perception of consumers on dairy farming and milk consumption (Maiti & Saha, 2022). Purchasing decisions of consumers are usually based on their perceptions. This process is particularly critical for dairy products for which the consumers' perception may change rather swiftly (Atabek & Atabek, 2019). A detailed examination of the contemporary consumers' perception of milk and its importance is essential for development of dairy sector. This kind of study may reveal the priorities of general public as well as identify potential areas of concern that, if not addressed, could jeopardize the future viability of the dairy sector (Cardoso et al., 2016). With this backdrop, the present study attempts to assess the perception of urban consumers on dairy farming and milk consumption.

METHODOLOGY

Multistage random sampling technique was used in the study. At the first stage, North India was purposively selected as it is the major milk consuming region of the country. North India consists of four states (Punjab, Haryana, Himachal Pradesh, Uttarakhand, Uttar Pradesh) and four union territories (Jammu & Kashmir, Chandigarh, Ladakh and Delhi). A list of Tier-1, Tier-2 and Tier-3 cities of North India was compiled and one city was randomly selected from each tier. New Delhi, Ludhiana and Karnal were the randomly selected cities from Tier-1, Tier-2 and Tier-3, respectively. Thereafter, three clusters were randomly selected from each city. Finally, 30 milk consuming households were randomly selected from each cluster thus constituting a total sample size of 270 milk consuming households.

Perception for the study was operationally defined as the way milk consumers feel, understand, and interpret the utility and quality of milk as well as the effect of dairy farming on economic, environmental, and social aspects. The attitude of respondents towards dairy farming and milk consumption was assessed by using a perception index which was constructed based on a five-point Likert scale developed for the purpose. Five parameters – nutrition and health effects (the extent to which milk is perceived as a nutritious and healthy food), safety concerns (the level to which available milk is believed to be safe for consumption), economic benefits (perceived importance of dairy farming in relation to the country's economy), ethical concerns (the level to which contemporary dairy farming practices are regarded as ethical), and environmental effects (the degree to which dairy farming practices are considered as environmental friendly) – were used in the study. A total of 32 statements were selected through expert opinion for assessing the perception out of which 10 statements related to nutrition and health effects, 6 from safety concerns, 4 from economic benefits, 7 from ethical concerns and 5 from environmental effects were considered as the most relevant. During survey administration to the respondents, these statements were rated on five-point continuum strongly disagree (1), disagree (2), neither agree nor disagree (3), agree (4), and strongly agree (5). Thereafter, Perception Index was calculated by using the following formula (Chatterjee & Mondal, 2022):

$$\text{Perceived attributes of perception index} = \frac{\text{Sum of actual score obtained}}{\text{Sum of maximum possible score}} \times 100$$

$$\text{Perception index} = \frac{\text{Nutrition and health effects + safety concerns + economic benefits + ethical concerns + environmental effects}}{5}$$

Data were collected by personally interviewing the respondents using a pretested structured schedule between February, 2022 and April, 2022. The responses were recorded and tabulated before carrying out required statistical analysis.

RESULTS AND DISCUSSION

Findings related to the perception of milk consumers on milk and dairy farming are presented in Table 1. The value of overall perception index for dairy farming and milk consumption was calculated as 68. A higher perception index score indicates that dairy farming and consumption of milk were positively perceived by the consumers. Consumer households had a more favourable perception of the nutrition and health effects of milk (79.33), economic benefits of dairy farming (77.56) and its environmental effects (72.64) than of the milk safety (53.54) and dairy related ethical issues (57.03).

Nutritional and health effects of milk

Majority of the respondents perceived that milk is essential for the proper development of children as well as for maintaining strong teeth and bones. They agreed that milk should be consumed by pregnant women and it is essential for leading a healthy life. Moreover, they believed that milk neither have any negative health effects nor its regular consumption is linked with diabetes and heart disease. Milk has been considered as a complete and healthy food (Upadhyay et al., 2014; Herber et al., 2020; Rai et al., 2020) and the findings of this study corroborates it. However, some of the respondents did not consider fat present in milk as healthy. Conducting research in this area followed by subsequent dissemination of scientific facts may help in clarifying the doubts of consumers. Respondents had neutral perception regarding linkage of milk with obesity and necessity of milk consumption for adults.

Safety concerns regarding milk

Unlike perception on nutritional and health benefits of milk, perception of consumers on milk safety was not very positive. Most of the respondents felt that a major amount of milk available in the country is unsafe for consumption and milk adulteration is a serious problem during festivals. They also perceived milk contamination due to antibiotic and pesticide residues as an emerging problem. However, they were neutral on considering milk as one of the most adulterated food products. Among organized and unorganized sector, respondents agreed that branded and packed milk are safe and adulterant free but they didn't trust milk vendors selling loose milk. The consumers generally perceive packaged food items of reputed brands as safer than the unpackaged products

(Gavaravarapu et al., 2009) while even packaged products have been found adulterated (Rai et al., 2020). Moreover, instances of adulteration by milk vendors especially in the urban areas have also been reported (Gupta et al., 2013; Singh et al., 2016).This indicates that strict actions are required on urgent basis for ensuring availability of pure and non-adulterated milk.

Economic benefits of dairy farming

The importance of dairy farming to India's economy was acknowledged by the respondents. They unanimously agreed that it is an important source of income for small and marginal farmers and dairy exports benefit the economy. They also felt that government should promote dairying as it provides employment and livelihood. They believed that dairy farming is a tool for development of rural areas and it guarantees sustainable livelihood for the rural communities. This shows that consumers are aware of the economic significance of dairy farming and support Government efforts for its promotion.

Ethical concerns related to dairy farming practices

Although respondents firmly agreed that milk consumption raises some ethical concerns, they also held the opinion that there

Table 1. The attributes of milk and dairy farming as perceived by the milk consumers

S.No.	Attributes perceived by respondents	Mean perception scores	Standard deviation	Perceived attributes index
Nutrition & Health effects				
1.	Milk is essential for proper development of children.	4.50	0.50	89.93
2.	Milk should be consumed for maintaining healthy teeth and bones.	4.49	0.50	89.70
3.	Regular consumption of milk is essential for leading a healthy lifestyle in the modern world.	4.56	0.50	91.19
4.	Milk consumption is necessary even for adults.	3.12	0.81	62.37
5.	Regular consumption of milk & milk products can't lead to obesity.	3.00	0.82	60.00
6.	Regular consumption of milk & milk products can't lead to diabetes.	4.53	0.50	90.59
7.	Regular consumption of milk & milk products can't lead to heart disease.	4.50	0.50	90.07
8.	Milk consumption is necessary for pregnant women.	4.01	0.82	80.15
9.	Fat present in milk is healthy.	2.49	1.12	49.78
10.	Milk does not have any negative health effect.	4.48	0.50	89.56
	Average nutritional & health effects index			79.33
Safety Concerns				
11.	Majority of the milk available in India is safe for consumption.	1.44	0.50	28.81
12.	Antibiotic and pesticide residues are not emerging as a problem in the case of milk.	2.05	0.82	41.04
13.	Milk adulteration is not a serious problem during festivals.	2.11	0.82	42.22
14.	Milk is not one of the most adulterated food products.	3.03	0.83	60.52
15.	Branded and packed milk are safe and adulterant free.	3.40	1.06	68.07
16.	Milk vendors in India are not reliable and they adulterate milk with harmful chemicals.	4.03	0.79	80.59
	Average safety index			53.54
Economic benefits				
17.	Government should promote dairying as it is an important source of income and employment.	4.04	0.81	80.74
18.	Dairy helps in providing income to the small and marginal farmers.	4.51	0.50	90.30
19.	Dairy does not promote rural development and ensures sustainable rural livelihood.	2.44	1.11	48.74
20.	Export of milk and other dairy products positively adds in the Indian economy.	4.52	0.50	90.44
	Average economic benefits index			77.56
Ethical Concerns				
21.	There is no harm in rearing dairy animals for commercial purpose.	4.01	0.84	80.30
22.	Rearing of old cattle is not a burden for family.	3.01	1.37	60.15
23.	Sufficient space is available for animals in dairy farms.	1.98	0.83	39.56
24.	Artificial insemination should be done for improving milk yield.	3.03	0.80	60.59
25.	Male dairy animal should not be reared as they are not profitable.	1.50	0.50	29.93
26.	Animals/ Breeds having lower productivity should not be reared.	2.40	1.13	48.00
27.	There is an ethical concern in drinking milk of dairy animals.	4.03	0.79	80.67
	Average ethical concern index			57.03
Environmental effects related to dairy sector				
28.	By-products of dairy are important for organic agriculture and for generating renewable energy.	4.53	0.50	90.59
29.	Dairy farming has no negative effect on environment.	3.03	0.82	60.52
30.	Poor handling of dung and other waste does not degrade local resources	4.04	0.81	80.74
31.	Milk has less water footprint than plant-based foods.	3.02	0.82	60.44
32.	Dairy farming does not contribute to greenhouse gas emissions.	3.54	1.12	70.89
	Average environmental effects index			72.64
	Overall Perception Index			68.02

is no harm in raising dairy animals for commercial purposes. This demonstrates the necessity to balance increased productivity with consideration for animal welfare. Moreover, consumers felt that sufficient space is often not available for animals in dairy farms. They deemed it unethical to abandon male animals even if they didn't generate returns and supported rearing of breeds with low productivity too. Nevertheless, they have mixed perception regarding rearing of old cattle and use of artificial insemination for improving milk yield. These results indicate that society in general cares about animal welfare. Treatment of animals in modern farms has often been identified as a cause of concern mostly by the consumers in western countries and majority of them did not support dairy practices responsible for loss in animal welfare (Hotzel et al., 2017; Boogaard et al., 2011). However, it might be interesting to study whether consumers would also be willing to pay more for improved levels of animal welfare.

Environmental effects of dairy farming

Consumer assessment of dairy farming's effects on the environment was largely favourable. They unanimously agreed that by-products of dairy farming are crucial for organic farming and they can be used to produce sustainable energy. They contend that improper handling of dung and other waste doesn't degrade local resources. Dairy production was not considered as a source of greenhouse gases. They were indifferent on negative environmental effects of dairy farming and water footprint of milk. This might be due to limited awareness of the detrimental effects of dairy farming on the environment. Lack of awareness of the association between food consumption and environment has also been reported in some of the past studies (Macdiarmid et al., 2016; Hartmann & Siegrist, 2017).

CONCLUSION

The overall perception of milk consumers on milk consumption and dairy farming was positive. They perceived nutrition and health effects of milk favourably but they rated milk and dairy farming relatively lower on safety and ethical aspects. Some of the consumers were concerned about the fat present in milk and did not consider it as healthy. Scientific studies recommending the right amount of milk fat in the context of present lifestyle may help in driving out this fear. Milk adulteration was a serious concern and greater importance needs to be given to it at all levels, including production, marketing, extension services, and policy advocacy. Dairy sector has a significant place in country's economy thus government programs supporting it are justified but focus needs to be directed towards animal welfare also along with increasing production. It may be promoted by implementing certification system for welfare farms in near future. Further, increased awareness of the environmental impact of dairy might provide a boost to sustainable practices.

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Socio-Economic Upliftment of Tribal Women through FPO in Bastar District of Chhattisgarh

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ABSTRACT

The study was carried out in Bastar district of Chhattisgarh state during 2021-22. The findings depicted that on the basis of their membership period in Bhumigadi Mahila Krushak Farmer Producer Organization (BMKFPO); the 37.28 per cent increase (Rs. 11653/-) was recorded for the member of BMKFPO since last four years whereas 36.81 per cent (Rs. 11456/-), 32.97 per cent (Rs. 10203/-) and 31.62 per cent (Rs. 9420/-) increase in income were recorded for the member of FPO since last three years, two years and one year respectively. The significance level of differences in income of respondents before and after joining the BMKFPO, Bastanar; P value were recorded as 0 (p=0, p=<0.05) for income generating activities and overall annual income and 0.002 (p=0.002, p=<0.05) for the non-FPO activity (wages) and found highly significant. It is inferred that the FPO module had assisted respondents in raising their income from various income generating activities and in their overall income.

INTRODUCTION

The Central and State Governments have been taking various initiatives for socio-economic upliftment of tribal population of the country. The Tribal Sub Plan Strategy (TSP Strategy) implemented since 1974-75 and these efforts have brought out some improvements for scheduled tribes in terms of various indicators relating to literacy, health, livelihood, etc. as reflected in Census 2011. However, there are still considerable gaps in the human development indices between Schedule Tribes and general population (Samir, 2015).

The government affirmed that farmer producer organizations (FPOs) are the most appropriate institutional form around which farmers can mobilize and build their capacity to collectively leverage their production and marketing (GoI, 2013).

The FPOs has helped farmers to be more aware of the benefits of collective and sustainable agriculture. The real benefits happen only when communities are empowered. In India, women have never been part of the main stream society and they are still considered as a great liability. Gandhiji said “to construct the society and create a hunger free India, empowerment of women is vital”. In context to the women empowerment through women’s education, uplifts in their living standard, giving opportunities to fight against poverty, cuts out gender inequality, facilitates women entrepreneurships are the prerequisite for the development of the economy.

It has two implications; women’s participation remains limited to field engagement and have no control over the income of the produce and they have limited negotiating power once they take their produce to the local mandi. So, there was a felt need for the farmers to be collectivized and exposed to the market-oriented farming. The fundamental goal of FPOs is to advance empowerment and serve the common goods. FPO is to ensure better income for the producer farmers through an organization of their own (Kumari et al., 2022). The tribal women can be empowered by participating in Farmer Producer Organizations (FPOs) and improve their living situations in the rural areas with overall income security. This

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initiative has been in operation from 2014 in the country and one of the FPO *Bhumigadi Mahila Krushak Farmer Producer Organizations (BMKFPO)*, Bastanar Block was registered in 2017 under the Company Act of 2013 and promoted by National Rural Livelihood Mission (NRLM) (Anonymous, 2019). There are 4,659 tribal women shareholders all together in this FPO, with 180 PGs (Producer Groups) in the cluster.

The present study majorly emphasized increase the area, production, productivity, income and adaptation behavior of the tribal women's of Bastanar divisionas well as found out the contribution of Bhumigadi Mahila Krushak Farmer Producer Organization in upliftment of socio-economic status of the tribal women entrepreneurs.

METHODOLOGY

The study was based on ex-post facto design. Out of seven blocks of district Bastar in Chhattisgarh state; the tribal dominated Bastanar block was selected purposively on the basis of presence of headquarter of Bhumigadi Mahila Krushak Farmer Producer Organization (BMKFPO), Bastanar. Top twelve villages having maximum tribal women shareholders of BMKFPO namely; Bade Kilepal Number Three; Bastanar; Bade Kaklur, Kodenar, Paralmeta, Burgum, Kapanar; Turangoor; Bodenar; Lalaguda; Tangiyajhodi and Irpa were selected purposively. A list of tribal women shareholders of BMKFPO, Bastanar was obtained. Out of total 1043 shareholders, proportionately, 15 per cent tribal women shareholders were selected randomly from each selected villages. Hence, a sample size of 156 respondents was obtained for the present investigation. The independent and dependent variables having relevance to the objectives of the present study were selected and the null hypothesizes were formulated accordingly to test it. The primary and secondary data were collected through personal interview method by the investigator from the locale of the study with the help of pre-tested well-structured schedule. The collected data was compiled, tabulated, analysed and interpreted by using of suitable statistical tools and techniques *viz.* Frequency, Percentage, Percent Change and Paired sample test-t Chandel (2004) & Supe (2007). The percentage change was calculated by using the following formula:

$$\text{Per cent change} = \frac{\text{Final value-Initial Value}}{\text{Initial Value}} \times 100$$

The paired sample t-test gives a hypothesis examination of the difference between population means for a set of random samples whose variation were often tested in a before-after situation and it was calculated by using following formula:

$$t = \frac{\sum d}{\sqrt{\frac{n(\sum d^2) - (\sum d)^2}{n-1}}}$$

Where, Σd = Sum of the difference in income
n = Total number of samples

RESULTS AND DISCUSSION

The study revealed that the majority of the tribal women shareholders of BMKFPO, Bastanar (73.08%) belonged to the middle age group (29-43 years), 26.28 per cent were possessed their education up to primary level, having small family (50%) with < 5 members, small farmers (60.90%) with 1-2 hectare land, low income group (71.15%) with annual income ranging between Rs. 35259/- to Rs.47663/-, having membership in BMKFPO since 2 years (48.72%), having maximum exposure to the mass media mobile (73.07%), active participation in specific activity nutrient management trainings (80.13%), having medium risk oriented (66.67%) and having medium credit oriented (84.62%). The similar results are also concurred with the findings of Kirar (2007) & Anonymous (2021).

Income from income generating activities of the Bhumigadi Mahila Krushak FPO

It is revealed from the data presented in Table 1 that the majority of tribal women shareholders of BMKFPO (82.05%) were associated with the FPO for minor millet production & marketing activity and earning an average income around Rs. 13135/- from this single activity of the FPO whereas 69.23, 63.46, 55.77 and 26.28 per cent tribal women shareholders of the BMKFPO were engaged with the FPO for the other income generating activities *viz.* turmeric production & marketing (Rs. 2262/-), amchoor processing & marketing (Rs. 2450/-), tamarind collection & marketing (Rs. 1430/-) and vegetable production & marketing (Rs. 5350/-) respectively. Further, women shareholders of BMKFPO (48.08%) were also found engaged with non-FPO activities (wages) for their income earning on an average Rs. 16834/- annually. The results implies that the tribal women shareholders of BMKFPO, Bastanar were earning overall annual income on an average Rs. 41461/- annually including the income from the income generating activities of the FPO. The results are at par with the results of Darshan et al., (2017).

Table 1. Income from income generating activities of BMKFPO, Bastanar during 2021-22

S.No.	Income generating activities of BMKFPO	Average Income (Rs.)	Percentage
1.	Minor Millet Production & Marketing	13135/-	82.05
2.	Amchoor Processing & Marketing	2450/-	63.46
3.	Tamarind Collection & Marketing	1430/-	55.77
4.	Vegetable Production & Marketing	5350/-	26.28
5.	Turmeric Production & Marketing	2262/-	69.23
6.	Non-FPO activities (Wages)	16834/-	48.08
7.	Overall Annual Income	41461/-	100.00

Increase in income through various FPO activities vis a vis membership period

It is apparent from the Table 2 that the maximum increase of 493.70 per cent average increase in income (Rs. 1881/-) of the tribal women shareholders of BMKFPO was recorded through engagement in turmeric production & marketing activity of the BMKFPO and 81.61 percent average increase in income (Rs. 1101/-) was recorded through amchoor processing & marketing activity whereas 75.67 per cent, 61.22 per cent and 55.34 per cent average increase in income of tribal women shareholders of BMKFPO were recorded through the tamarind collection &

Table 2. Increase in average income of women Shareholder of BMKFPO through various income generating activities of FPO

S.No.	Various activities	Average Income before Membership	Average Income after being Member	Difference in Income	% increase in Income
1.	Minor Millet Production and Marketing	8147/-	13135/-	4988/-	61.22
2.	Amchoor Processing and Marketing	1349/-	2450/-	1101/-	81.61
3.	Tamarind Collection and Marketing	814/-	1430/-	616/-	75.67
4.	Vegetable Production and Marketing	3444/-	5350/-	1906/-	55.34
5.	Turmeric Production and Marketing	381/-	2262/-	1881/-	493.70
6.	Non-FPO Activity (wages)	16645/-	16834/-	189/-	1.14
7.	Over All Annual Income	30779/-	41461/-	10682/-	34.71

marketing (Rs. 616/-), minor millet production & marketing (Rs. 4988/-) and vegetable production & marketing (Rs. 1906/-) activities of the BMKFPO. Further, only 1.14 percent average increase in income (Rs.189/-) of tribal women shareholders of BMKFPO was recorded through non-FPO activity i.e. wages only. The results implies that the average increase in overall income (Rs. 10682/-) of tribal women shareholders of BMKFPO was 34.71 percent through put together all the income generating activities of the BMKFPO in Bastar district.

It is clear from the data presented in Table 3 that there was 37.28 per cent average increase in income of tribal women shareholders of BMKFPO, Bastanar for those respondents who became the member of BMKFPO since last four years and they were earned Rs. 11653/- more through the involvement in the income generating activities of the BMKFPO whereas 36.81 per cent average increase in income were recorded for those tribal women shareholders who became the member since last three years and earned Rs. 11465/- more. Further, 32.97 per cent (Rs. 10203/-) average increase in income was recorded for those tribal women shareholders of BMKFPO were became the member of FPO since last two years and only 31.62 per cent (Rs. 9420/-) increase in income was recorded for those tribal women shareholders of BMKFPO who were became the member since one year. The results were found to be concurred with the findings of Arputhamani (2013); Sakthi et al., (2015) & Sofia Khan (2019). The result explained that the older tribal women shareholders of BMKFPO were more benefitted and getting much increased income in comparison with the younger one members of the BMKFPO. The results from the present investigation were found to be concurred with the findings of Pervez et al., (2018).

Impact of BMKFPO, Bastanar on income of tribal women shareholders

From the Table 4, it is depicted that the mean differences between the income from various income generating activities of BMKFPO *viz.* minor millet production and marketing (Pair 1), Amchoor Processing and Marketing (Pair 2), tamarind collection and marketing (Pair 3),vegetable production and marketing (Pair

Table 3. Average increase in income on the basis of their membership period

Membership Period	Frequency	Average Annual Income (Before)	Average Annual Income (After)	Difference in Income	% Change in income
Member since 1 year	26	29792/-	39212/-	9420/-	31.62
Member since 2 year	76	30942/-	41145/-	10203/-	32.97
Member since 3 year	39	31124/-	42580/-	11456/-	36.81
Member since 4 year	15	31255/-	42908/-	11653/-	37.28

Table 4. Paired sample test 't'

	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1	4987.82	2956.422	236.703	5455.401	4520.240	21.072	155	0
Pair 2	1101.090	1095.960	87.747	1274.424	927.755	12.548	155	0
Pair 3	615.686	584.342	46.785	708.104	523.268	13.160	155	0
Pair 4	1907.050	1564.531	125.263	2154.494	1659.610	15.224	155	0
Pair 5	1881.530	401.865	32.175	1945.084	1817.970	58.478	155	0
Pair 6	189.788	738.338	59.114	306.562	73.0148	3.211	155	0.002
Pair 7	10683.000	3636.288	291.136	11258.068	10107.900	36.694	155	0

Where, Pair 1 = Before & after income from activity Minor Millet Production and Marketing,
Pair 2 = Before & after income from activity Amchoor Processing and Marketing,
Pair 3 = Before & after income from activity Tamarind Collection and Marketing,
Pair 4 = Before & after income from activity Vegetable Production and Marketing,
Pair 5 = Before & after income from activity Turmeric Production and Marketing
Pair 6 = Before & after income from activity Non-FPO Activity (wages)
Pair 7 = Over all annual Income

4), turmeric collection and marketing (Pair 5), non-FPO activity (wages) (Pair 6) and over all annual income (Pair 7) of the tribal women shareholders of the BMKFPO before and after joining the BMKFPO, Bastanar. The Table 4 denotes the differences in standard deviations (SD) and standard error (SE) of means for the respective pairs (Pair1 to Pair 7).

The paired sample test 't' was computed by dividing the paired differences mean of various pairs by the SE of respective pairs resulted 21.072, 12.548, 13.160, 15.224, 58.478, 3.211 and 36.694 were recorded for the pair no. 1, 2, 3, 4, 5, 6 and 7 respectively. The degree of freedom (df) have been calculated as 155 (n-1) as the same tribal women shareholders of BMKFPO, Bastanar had shared their perceptions about the before and after income from various generating activities and their overall annual income. Further, the probability has been presented finally in the column titled sig. (2-tailed) value were recorded as 0 (p=0, p=<0.05) for pair no. 1, 2, 3, 4, 5 and 7 whereas sig. (2-tailed) value was recorded as 0.002 (p=0.002, p=<0.05) for the income of the tribal women shareholders of the BMKFPO, Bastanar through non-FPO activity (pair no. 6).

Further, it is implicated by the i.e. results presented in the Table 4 since the p value is less than 0.05 (p=0, p=<0.05), the null hypothesis $H0_1$ is rejected for the pair 1 i.e. income generating activity minor millet production and marketing. Hence, it is concluded that there is significant difference between before and after joining BMKFPO among the income of tribal women shareholders through the income generating activity minor millet production and marketing. Similarly, the p value is less than 0.05 (p=0, p=<0.05), the null hypothesis $H0_2$ is rejected for the pair 2 i.e. income generating activity amchoor processing and marketing. Hence, it is concluded that there is significant difference between before and after joining BMKFPO among the income of tribal women shareholders through the income generating activity amchoor processing and marketing. The p value is less than 0.05 (p=0, p=<0.05), the null hypothesis $H0_3$ is rejected for the pair 3 i.e. income generating activity tamarind collection and marketing. Hence, it is concluded that there is significant difference between before and after joining BMKFPO among the income of tribal women shareholders through the income generating activity tamarind collection and marketing.

Hypothesis $H0_4$ is rejected for the pair 4 i.e. income generating activity vegetable production and marketing. Hence, it is concluded that there is significant difference between before and after joining BMKFPO among the income of tribal women shareholders through the income generating activity vegetable production and marketing. The null hypothesis $H0_5$ is rejected for the pair 5 i.e. income generating activity turmeric production and marketing. Hence, it is concluded that there is significant difference between before and after joining BMKFPO among the income of tribal women shareholders through the income generating activity turmeric production and marketing. The null hypothesis $H0_6$ is rejected for the pair 6 i.e. income generating activity non-FPO activity (wages). Hence, it is concluded that there is significant difference between before and after joining BMKFPO among the income of tribal women shareholders through the income generating activity non-FPO activity (wages). Since the p value is less than 0.05 (p=0, p=<0.05), the null hypothesis $H0_7$ is rejected for the pair 7 i.e. overall annual income. Hence, it is concluded that there is significant difference between before joining BMKFPO and after joining BMKFPO among the overall annual income of tribal women shareholders. The results are found to be concurred with the findings of Arputhamani (2013); Pervez et al., (2018); Dewangan (2018) & Sofia Khan (2019).

CONCLUSION

It is inferred that the FPO module had assisted to the tribal women shareholders of BMKFPO, Bastanar in increasing their income from 61.22 per cent to 493.70 per cent from various income generating activities of the FPO and 34.71 per cent increase in their overall income which is a major attribute of their socio-economic status in the study area. It is also depicted that the trend of increase in the income of tribal women members was associated with; length of membership i.e. low increase in income for less period membership and high change in income for long period membership. FPOs helped to the farming communities in addressing productivity issues, collective farming, getting the machinery, agricultural inputs at lowest cost, developing the ability to compete with large corporate enterprises in bargaining, access to the direct marketing of their produce and all these directly reflect significant increase in their income from the various income generating activities of the FPO.

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Assessment of Knowledge and Adoption of Drip Irrigation in Cotton Crop among Farmers of Haryana

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ABSTRACT

The study was set about in the state of Haryana to gauge the knowledge and adoption level of the drip irrigation system (DIS) in the cotton crop amongst the farmers. The research highlighted that more than two-thirds of the farmers (68.33%) had a high level of knowledge of DIS. The socio-economic factors such as the family income, size of the landholdings, exposure to the mass media, education level and the socio-economic status of the respondents were significantly correlated with the overall levels of knowledge and adoption of DIS by the farmers. On a whole, more concentrated efforts are the call of the hour to increase the knowledge levels and adoption of micro irrigation techniques on a wider scale.

INTRODUCTION

Cotton is considered one of the dominant cash crops in our country and is also a way to earn livelihood for millions of farmers and people associated with its cultivation. The importance of cotton as a cash crop can be accorded to the fact that it is considered a source of income for the people associated with its trade, processing etc. (Jeya, 2020; Ranadive et al., 2020). The role that cotton production plays in industrial and agricultural sector development has accorded it the status of “white gold”. Also, providing the rudimentary raw materials to the cotton textile industry and the inevitable need for the cash crop has given it the status of “King of the Fiber Crops” (Navya & Nayka, 2021). In India, the major cotton- producing states are Maharashtra, Gujarat, Telangana, Rajasthan and Haryana. The overall area under production is 120.69 lakh hectares and the production is projected at 362.18 lakh bales for the years 2021-22 (PJTSAU, 2022).

At the global level, India has the largest area under cultivation with 120.69 lakh hectares which is 37 per cent of the global area under cultivation. Although, the yield is pretty low with 469 kg per hectare as compared to USA and China with 951 kgs and 1892 kgs per hectare respectively. The global production of cotton is expected to increase by 9 per cent from the previous season with the consumption also estimated to be 25.6 million tonnes (ICAC, 2022).

Over the years, India has significantly increased its Cotton production. The kick start of the technology mission on cotton by GoI in 2000 has led to an increase in yield through the use of HYVs, technological transfer, farm management practices and induction of Bt cotton. The fundamental changes that have happened in the Cotton ecosystem have shown remarkable results throughout the country (The Cotton Corporation of India Limited, 2022). As far as the state of Haryana is concerned, the agriculture department has set a target of increasing the area under cotton cultivation up to 19 lakh acres. The major districts in the state of Haryana taking up cotton production are Sirsa, Fatehabad, Hisar, Bhiwani, Palwal etc. (Hindustan Times, 2022). The encouraging results that have been gathered from various studies and reports have showcased that the production of cotton is increasing at a burgeoning rate. The study was an endeavour to delve into the aspects of knowledge and succeeding adoption of drip irrigation systems among cultivators in the state of Haryana.

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METHODOLOGY

The present investigation was carried on in the districts of Sirsa, Fatehabad, Hisar and Bhiwani which happen to be the leading cotton-producing areas in the state. From the Sirsa district, Keharwala, Mammer kheda, Dukra and Raipur villages were selected and similarly, Pili Mandori and Khara Kheri from Fatehabad district; Mangali Surtia, Dhani Jatan and Gawar from Hisar district and Sirsi, Chahar Khurd, Chahar Kalan, Nangal, Bidhwan and Dariyapur from Bhiwani district were selected. Sixty respondents were taken randomly from these villages of selected districts. A total of 21 questions were meticulously framed and centred around the total increase in yield as compared to the conventional method, water efficiency, knowledge regarding subsidy schemes, usage of the fertilizers, checking of drip filter, usage of water-soluble fertilizer, less weed, overall improvement in the health of the soil, attack by pink ball worms etc. The respondents' replies were segmented into having full proper knowledge, partial or limited knowledge and no knowledge with score of 3, 2, 1 respectively.

The total score was calculated for every individual framer by summation of the knowledge points and was categorized as high, moderate and low. Similarly, to compute the adoption level of drip irrigation concerning cotton production we developed an elaborative index and the score of each farmer was calculated based on area under drip irrigation, year of installation of DIS, cropping intensity, higher yield, less weeds intensity, income, reduced labour requirement, inclusion of cash crops, percentage of area under drip irrigation to total area, disease control and softened soil.

Scores were assigned for each response given by the farmers on various aspects of drip irrigation and scores achieved by each respondent were classified as high, moderate, and low levels of knowledge and adoption. The data was analyzed using different statistical tools like chi-square test and coefficient of contingency. Significant inferences were contemplated to draw valid conclusions as per objectives of the study.

RESULTS AND DISCUSSION

Knowledge level of farmers about drip irrigation

The overall knowledge levels were assessed with respect to drip irrigation and cotton production. 68.33 per cent farmers had high knowledge, followed by 26.67 per cent having a moderate knowledge level about drip irrigation (Table 1). Sharma & Kathpalia (2022); Mahendrakar et al., (2018); Jadhav et al., (2018) & Kumar et al., (2020) showed similar level of knowledge. The results on the same lines with medium knowledge levels were also put forth by Shambhrakar et al., (2018) in the Vidarbha region, Deepika et al., (2020) in Tamil Nadu and Khade et al., (2012) for the deshi varieties of cotton. In the study undertaken by Kumar et al.,

Table 1. Knowledge level of respondents about drip irrigation

Level of Knowledge	Frequency (%)
Low (30-38)	3(5.00)
Moderate (39-47)	16(26.67)
High (48-57)	41(68.33)

Table 2. Association of socio-economic variables with knowledge level about drip irrigation.

Age (years)	Low	Moderate	High	Total
Up to 35 years	02(08.00)	05(20.00)	18(72.00)	25(41.66)
36 to 50 years	01(04.55)	11(50.00)	10(45.45)	22(36.67)
Above 50 years	00(00)	00(00)	13(100)	13(21.67)
Total	03(05.00)	16(26.67)	41(68.22)	60(100)
χ^2=12.47**; C=0.41				
Caste				
General	02(03.64)	13(23.64)	39(70.91)	55(91.67)
Backward	01(20.00)	02(40.00)	02(40.00)	05(08.33)
χ^2=02.93; =0.21				
Land Holding (Acres)				
2.5 to 5.0	01(16.67)	04(66.66)	01(16.67)	06(10.00)
5.1 to 10.0	02(10.00)	07(35.00)	11(55.00)	20(33.33)
10.1 to 25.0	02(05.89)	03(08.82)	29(85.29)	34(56.67)
χ^2=14.17*; =0.44				
Type of family				
Nuclear	01(05.26)	04(21.05)	14(73.69)	19(31.67)
Joint	02(04.88)	12(29.27)	27(65.85)	41(68.33)
χ^2=0.44; C =0.08				
Size of family (members)				
Small (upto 4)	03(15.79)	05(26.31)	11(57.89)	19(31.67)
Medium (5 – 8)	00(00)	11(28.21)	28(71.79)	39(65.00)
Large (above 8)	00(00)	00(00)	02(100)	02(03.33)
χ^2=02.65; C=0.20				
Education level of the respondents				
Primary	01(12.50)	02(25.00)	05(62.50)	08(13.33)
Middle	00(00)	12(63.16)	07(36.84)	19(31.67)
Senior secondary	01(05.88)	01(05.88)	15(88.24)	17(28.33)
Graduation and above	01(06.25)	01(06.25)	14(87.50)	16(26.67)
χ^2=19.39**; C=0.49				

Table 2 contd...

Age (years)	Low	Moderate	High	Total
Annual Income of family (Rs.)				
Medium (3.1-6.0L)	01(05.88)	09(52.94)	07(41.18)	17(28.33)
High (Above 6.0 L)	02(04.65)	07(16.28)	34(79.07)	43(71.67)
χ^2= 08.71**; C=0.35				
Social participation				
Nil (0)	03(05.88)	10(19.61)	38(74.51)	51(85.00)
Low (1)	00(00)	06(66.67)	03(33.33)	09(15.00)
χ^2=08.33**; C= 0.34				
Mass media exposure				
Low (upto 9)	03(23.08)	02(15.38)	08(61.54)	13(21.67)
Medium (10-17)	00(00)	09(34.62)	17(65.38)	26(43.33)
High (above 17)	00(00)	04(19.05)	17(80.95)	21(35.00)
χ^2=13.15**; C =0.42				
Socio economic status				
Medium (19-24)	03(08.82)	15(44.12)	16(47.06)	34(56.67)
High (25-31)	00(00)	01(03.85)	25(96.15)	26(43.33)
χ^2=16.45**; C= 0.48				

Figures in parentheses denote percentage; *and **Significant at 5% and 1% level

(2019) in Haryana found that farmers involved in cotton production in Haryana have medium knowledge levels of the inputs used. Kumari et al., (2022) reported that more than three-fifths of farmers had high knowledge levels of drip irrigation systems. Medium knowledge level that farmers possess might be because farmers long have been exposed to various communication channels including social media (Laxman & Mazhar, 2022).

Level of adoption of drip irrigation

With reference to the adoption level of drip irrigation, more than two-fifths of the respondents had a higher level of adoption followed by low (31.67%) and 23.33 per cent having medium levels (Table 3). Although the works done in the early phase of research on Bt-cotton analyzed that the majority of respondents (81.97%) had a low level of adoption (Deshmukh et al., 2007). The reason might be due to the costly seeds, lack of information regarding seed cost, proper knowledge etc. which were tackled during the early decade of 2010 (Shah, 2012). Even in the current times, the respondents also do respond to a lower adoption level of Bt cotton due to lack of agricultural labour, high cost of seed, quality seed etc. (Yadav et al., 2019; Sharma et al., 2021). The overall adoption level of different modern practices of cotton cultivation like preparatory tillage, crop variety, sowing techniques etc. were known to almost all the respondents in Bhal area of Gujarat (Joshi et al., 2008). The related work on the adoption of various technologies by Quim (2009) with reference to Bt-cotton did put forth the results of increased yield and net profit margins. Adoption of the knowledge and technology is a conscious decision to fully use the innovative mechanizations at their disposal. Rajput & Chinchmalatpure (2016) in their research on Bt-cotton cultivators constructed the fact that almost three-fourths of the respondents had medium to high extent of adoption of cultivation practices of Bt-cotton. The impact of the adoption of the varied crop management techniques and practices like Bt-cotton hybrids, fertilizer use, seed etc. led to the overall enhancement of the yield by 138 per cent in the Mansa district of Punjab (Singh et al., 2022). The institutionalized adoption of INM practices like phosphoric and potassium fertilizer was observed in the medium category in research conducted by Shambhrakar et al., (2018). A seminal study by Kathage & Qaim, (2012) investigated the profit gains, better household standard, greater consumption expenditure with the adoption of the Bt technology and its interrelated nuances.

Table 3. Adoption level of respondents about drip irrigation

Level of adoption	Frequency (%)
Low (12-14)	19(31.67)
Moderate (15-17)	14(23.33)
High (18-21)	27(45.00)

Association of socio-economic factors with the knowledge and adoption level

Regarding the association of socio-economic factors with knowledge level about drip irrigation, it was found that respondents belonging to the above 50 years age group (100%), having higher exposure to mass media (80.95%), high Socioeconomic status (96.15%), high annual income (79.07%), education up to senior secondary level (88.24%), larger family size (100.00%), medium land holding (75.00%), belonging to the nuclear family (73.67%) and from general caste (70.91%) had high level of knowledge (Table 4). The cumulative knowledge levels were found to be greatly associated with that age structure, education qualification level, size of land holding, annual income, exposure to media and social and economic status of the farmers as arrived through Chi-square results. The study taken forward investigating the knowledge levels of farmers in Gujarat indicated that almost three-fourths (81.11% each) of the respondents had medium to a high level of extension participation and mass media exposure (Sardhara et al., 2020). Bhagat et al., (2002); Nain & Bhagat (2005); Nain & Chandel (2013); Rao et al., (2019); Navya & Nayka (2021) demonstrated the direct relationship between education levels and the adoption levels. Sharma et al., (2018) studied association of socio-economic variables with the level of awareness of farmers and showed that majority of the farmers had high level (71.67%) of awareness regarding effect of climate change on water resources.

Table 4. Association of socio-economic variables with adoption level of drip irrigation

Age (years)	Low	Moderate	High	Total
Up to 35 years	13(52.00)	03(12.00)	09(36.00)	25(41.66)
36 to 50 years	05(22.73)	10(45.45)	07(31.82)	22(36.67)
Above 50 years	01(07.69)	01(07.69)	11(84.62)	13(21.67)
Total	19(31.67)	14(23.33)	27(45.00)	60(100)
χ^2=19.36**; C=0.49				
Caste				
General	19(34.55)	10(18.18)	26(47.27)	55(91.67)
Backward	00(00)	04(80.00)	01(20.00)	05(08.33)
χ^2=09.99**; C=0.37				
Size of land holding (acre)				
2.5to 5.0	04(66.66)	01(16.67)	01(16.67)	06(10.00)
5.1 to 10.0	09(45.00)	09(45.00)	02(10.00)	20(33.33)
10.1 to 25.0	06(17.65)	04(11.76)	24(70.59)	34(56.67)
χ^2=23.10**; C =0.53				
Type of family				
Nuclear	10(52.63)	01(05.26)	08(42.11)	19(31.67)
Joint	09(21.95)	13(31.71)	19(46.34)	41(68.33)
χ^2=07.80*; C =0.33				
Size of family (members)				
Small (upto 4)	11(57.89)	01(05.26)	07(36.84)	19(31.67)
Medium (5 – 8)	08(20.51)	13(33.34)	18(46.15)	39(65.00)
Large (above 8)	00(00)	00(00)	02(100)	02(03.33)
χ^2=10.28*; C=0.38				
Education level of the respondents				
Primary	05(62.50)	00(00)	03(37.50)	08(13.33)
Middle	08(42.11)	08(42.11)	03(15.79)	19(31.67)
Senior secondary	02(11.76)	03(17.65)	12(70.59)	17(28.33)
Graduation and above	04(25.00)	03(18.75)	09(56.25)	16(26.67)
χ^2=17.14**; C=0.47				
Income of the family (in Rs.)				
Medium (3.1-6.0L)	05(29.41)	10(58.82)	02(11.77)	17(28.33)
High (Above 6.0 L)	14(32.56)	04(09.30)	25(58.14)	43(71.67)
χ^2=18.66**; C=0.48				
Social participation				
Nil (0)	19(37.25)	08(15.69)	24(47.06)	51(85.00)
Low (1)	00(00)	06(66.67)	03(33.33)	09(15.00)
χ^2=12.19**; C= 0.41				
Mass media exposure				
Low (upto 9)	09(69.23)	01(07.69)	03(23.08)	13(21.67)
Medium (10-17)	07(26.92)	09(34.62)	10(38.46)	26(43.33)
High (above 17)	03(14.29)	04(19.05)	14(66.66)	21(35.00)
χ^2=14.75**; C =0.44				
Socio economic status				
Medium (19-24)	16(47.06)	11(32.35)	07(20.59)	34(56.67)
High (25-31)	03(11.54)	03(11.54)	20(76.92)	26(43.33)
χ^2=11.51*; C= 0.40				

Figures in parentheses denote percentage; *and **Significant at 5% and 1% level

Multiple socio-economic factors were having an impact on the level of drip irrigation adoption (Table 4). Most of the respondents in the age group of 50 years and above (84.62%) and the ones in the age group of up to 35 years (36%) had higher levels of drip irrigation adoption. A non-significant association was found between the caste of the respondents and the adoption levels. The results reported that the adoption level was higher in the general castes (47.27%) as compared to other caste groupings. A significant association was found between the size of landholding and the adoption levels. More than three-fifths of the medium farmers (70.59%) had a higher drip irrigation adoption level whereas two-thirds of the small landholders had low levels of adoption of DIS. It was reported that as the landholding size increased, the farmer's level of adoption also saw an upward trend. The size of the family also showed to have affected the drip irrigation adoption level with large family sizes showcasing a high level of adoption (100%). Another element of exposure to mass media is also shown to have a similar influence on the adoption of DIS by the farmers. The higher levels of exposure led to higher adoption levels by the farmers. The farmers having lower exposure to the mass media platforms had lower adoption levels (69.23%) as well. The socio-economic status of the respondents had also an immense impact on the adoption levels. The higher socioeconomic status of the farmers (76.92) led to higher adoption of the Drip Irrigation System. Similarly, lower SES has led to abysmally lower adoption levels. Kaarthikeyan & Suresh (2019) have highlighted in their

research that the costs involved in the DIS, the landholding of the farmers and the water source tend to be the leading factors behind the adoption levels of the Drip Irrigation System. Arya et al., (2019) investigated post-adoption behavior of farmers towards soil and water conservation technologies and found that twenty one percent dis-continued the adoption of technologies and 23 per cent were adopting with certain technological gap. Mohan et al. (2012) in their seminal work have gone on to explain the positive impact of drip irrigation and the improved socioeconomic condition because of education levels, Kisan credit card and land holding sizes. Jumanne (2016) put forth that the farmers' age, education levels and other economic factors have influenced technology adoption. Similar results reported by Verma & Sharma (2017) in Rajasthan where it was reported that varied variables such as education levels, annual income, mass media exposure etc. had a positive and significant relationship with drip irrigation adoption. The research put forth by Sharma et al., (2021a) revealed that except for education, socio-economic status and caste, other variables such as annual income, age, size of land, media exposure and social participation had a positive correlation with the adoption level of the respondents.

CONCLUSION

The usage of drip irrigation technology has proved to be a harbinger of change in the status of the farmers. The knowledge levels were found high among most of the farmers sampled whereas almost half of the respondents were found to have a high level of adoption of the DIS. Increased funding, better subsidization policies, integrated training programmes, coordinated contact extension activities and better exposure to the mass media will be a new dawn for the entire agriculture scenario in the country. The technological progress coupled with the structural assistance will go a long way to strengthen the position of farmers in particular and the agriculture in general where the sustainable use of resources will benefit for ages to come.

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Farmers' Varietal Preferences and Impact of Farmers Participatory Wheat Seed Production in North Western Himalayan Region

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ABSTRACT

This paper examines the impact of farmers' participatory seed production (FPSP) of improved wheat varieties suitable for North Western Himalayan region. A wide gap exists in wheat productivity in hills and plains region of Uttarakhand, with productivity in the plains being nearly double that in the hills. Before undertaking large seed production, farmers' preference with respect to different improved wheat varieties was recorded. The Wheat Preference Index (WPI) for VL 804, VL *Gehun* 829, VL *Gehun* 907 and VL *Gehun* 953 was found to be 3.64, 3.99, 4.59 and 4.61, respectively. The WPI of variety VL *Gehun* 953 (4.61) ranked highest majorly because of its higher productivity and superior seed quality. The cumulative growth of these varieties through FPSP was found to be 4777.2 ha in *rabi* 2021 from 457.2 ha in *rabi* 2016. The area diffusion effect of these improved wheat varieties through farmers participatory seed production was thus 10.4 times. In the year 2019-20, 145.8 quintal of seed of improved wheat variety was procured which is 10.4 times higher than the amount procured in 2015-16. Farmers earned 8.7 to 23.1 per cent higher economic gain from seed production of VL wheat varieties.

INTRODUCTION

Wheat is most important *rabi* cereal crop of North-western (NW) Himalayan states. In Uttarakhand, wheat occupies 42.4 per cent of the total area and contributes 49.4 per cent to the total cereal production (Anonymous, 2020). Of the total wheat area in the state, 45 per cent is in the hills and 55 per cent lies in the plains. A wide productivity gap, however, exists between the hills and plains, which is attributable to a host of factors ranging from inadequate availability of quality seed to limited use of other inputs and small-fragmented land holdings to rainfed growing conditions (Mittal et al., 2008; Raghuvanshi & Ansari, 2020; Subrahmanyeswari & Chander, 2022).

As per an estimate, quality seed alone contributes to 15-20 per cent in total crop production which can be further raised up to 40-50 per cent with good management practices (Singh et al., 2013; Natarajan et al., 2009). However, producing quality seeds suitable to different agro-climatic conditions in sufficient quantity and making it available at affordable prices at the right time and place has always been a challenging task (Hanchinal, 2012; Singh & Agarwal, 2018). A mechanism to create a valuable synthesis between local and research awareness probably leading to a more appropriate modern technology, and increase key stakeholder capacity to interact with new technology is the solution (Nain et al., 2012; Shitu et al., 2018). In India, more than 70 per cent seed usage, particularly for food crops, is through FSS (Farm Saved Seed) which results in low SRR (Seed Replacement Rate) (Ayyappan & Kochhar, 2010), and the situation in Uttarakhand hills is not much different. For achieving the desired level of SRR, production of adequate quantity of seeds of improved varieties is a pre-requisite. Nearly all the certified seed, be it of hill varieties or plains varieties, is produced in the plains, with majority of it undertaken by professional seed growers for the government seed agencies. The concept of 'seed village', which is a widely adopted

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and successful model for enhancing availability of quality seed, is being implemented in selected village clusters in the plains to complement the state seed agencies in meeting the quality seed requirement of hills varieties, particularly wheat, and by that means contribute to improving the SRR of wheat in the hill regions of the state. The farmers are the best evaluator but a scientific level evaluation is recommended for validation of the parameters for universal use (Sardar et al., 2019). Timely awareness and training programmes for imparting adequate knowledge to farmers about different recommended wheat cultivation practices and adequate use of different social media should be promoted for quick dissemination of information regarding wheat cultivation (Kumar et al., 2022). Research and large-scale demonstrations have revealed that the rate of adoption of improved cultivars by farmers in difficult and resource-poor regions of the world is positively influenced by the inclusion of farmers' preferences in the breeding objectives (Faisal et al., 2020). The present study reports the impact of farmer participatory seed production (FPSP) in a tribal village in the plains on the income of the farmers, and the resultant increase in the diffusion of VL wheat varieties in the state.

METHODOLOGY

Considering the importance of quality seeds in enhancing crop productivity, *Jhankat* and *Nakulia* villages of Udham Singh Nagar district, Uttarakhand were selected for undertaking farmers participatory seed production of improved wheat varieties suitable for hill region. Seed of improved wheat varieties VL 804, VL *Gehun* 829, VL *Gehun* 907 and VL *Gehun* 953 were distributed among selected farmers based on the area to be planted for seed production. All the varieties were highly resistant to yellow and brown rusts. A buyback arrangement was made to procure the produced seed by the ICAR-VPKAS at 20 per cent higher rate than the prevailing local market rate.

Spread of improved wheat varieties as a result of FPSP was analysed from *rabi* 2015-16 to *rabi* 2020-21. A total of 60 farmers engaged in seed production of wheat varieties were selected for the purpose of data collection. Six major traits, *viz*. productivity, maturity period, taste (quality of *chapati*), seed quality, rust resistance and tolerance to lodging were selected by reviewing the literature and consultation with experts and farmers for assessing the farmers' preferences. The weighted score for each identified trait was worked out based on the scoring given by farmers, other than the respondents, through focused group discussions. Weighted score for each identified trait was worked out using the rating given by the selected ten farmers on the scale of 1-10 based on their perceived significance of those quality parameters for seed production.

The preference of the farmers was measured by using the Wheat Preference Index (WPI). To calculate WPI, the farmers were asked to score the wheat varieties for various traits using 1-5 scale. These scores of individual farmers were added together to arrive at the total score of a particular trait for a variety. Further, to calculate the weighted score, each score was multiplied by the weight for each trait. Thereafter, the weighted scores were summed up to obtain an aggregate weighted score for each trait. The wheat varieties were then finally ranked according to the WPI (Sharma et al., 2017).

$$WPI = \frac{\sum_{k=1}^{m}\sum_{j=1}^{6}\sum_{i=1}^{n} W\,ijXijk}{\sum_{k=1}^{m}}$$

Where WPI = Wheat Preference Index

Wij = weight of the j^{th} characteristic of the i^{th} wheat variety,

Xijk = farmers' preference score assigned towards j^{th} characteristics of i^{th} wheat variety by k^{th} farmer,

i = wheat variety ranging from 1 to n

j = characteristics of wheat variety ranging from 1 to 6

k = number of respondent farmers ranging from 1 to m.

RESULTS AND DISCUSSION

Preference analysis

The individual weightage of the selected traits showed that yield had the highest weightage (0.21) followed by seed quality (0.18) and maturity period (0.17). Interestingly, rust resistance obtained the lowest weightage (0.14), implying that the farmers did not regard rust as a major threat to wheat crop, which in turn may be attributed to the fact that all the four varieties evaluated were resistant to rust (Gupta & Kant, 2012; Jethi et al., 2021), and (2) prophylactic/therapeutic spray of fungicides in wheat to manage rust and Karnal Bunt diseases is a regular practice in *Jhankat* and *Nakulia* villages.

The Wheat Preference Index (WPI) for VL 804, VL *Gehun* 829, VL *Gehun* 907 and VL *Gehun* 953 was found to be 3.64, 3.99, 4.59 and 4.61, respectively. The WPI of variety VL *Gehun* 953 (4.61) ranked highest and was followed by VL *Gehun* 907 (4.59). This revealed that farmers preferred VL *Gehun* 953 most for seed production among all the improved varieties demonstrated in farmers' fields.

Farmers' Preference for different traits was worked out with the help of weighted score on different traits of improved wheat

Table 1. Weighted score and wheat preference index (WPI) of improved wheat varieties selected for FPSP

Varietal traits	Individual weightage	VL *Gehun* 804	VL *Gehun* 829	VL *Gehun* 907	VL *Gehun* 953
Productivity	0.21	42.21	47.88	56.07	59.64
Maturity period	0.17	45.9	31.79	48.11	47.43
Seed Quality	0.18	43.02	50.4	49.14	49.32
Rust resistance	0.14	27.16	36.26	38.5	37.52
Tolerance to lodging	0.15	20.85	30.9	43.35	43.05
Taste (*chapati* quality)	0.15	39.15	42.6	40.65	39.90
		218.29	239.83	275.82	276.86
WPI		3.64	3.99	4.59	4.61
Rank		IV	III	II	I

varieties, *i.e.*, VL 804, VL *Gehun* 829, VL *Gehun* 907 and VL *Gehun* 953. Data in Table 1 revealed that farmers preferred VL Gehun 953 mainly for its productivity and seed quality. The criteria for preference of VL *Gehun* 829 were its taste (WS 42.6) and seed quality (WS 50.4). VL *Gehun* 829 received less preference score of 31.79 for maturity period as it matures relatively late. In the study area, wheat is followed by paddy which is grown in two seasons - *kharif* and *zaid*, and farmers, therefore, prefer timely sown and early maturing wheat varieties. Although on semi-medium, medium and large farms, paddy is planted mainly during *kharif* season, *zaid* season planting is also common (Raghav & Sen, 2015).

Spread of improved wheat varieties through FPSP

Spread of improved wheat varieties produced under FPSP was analysed from *rabi* 2015-16. Seed procured through FPSP is distributed to farmers of hills and other regions through different developmental programmes like Tribal Sub-Plan (TSP), Scheduled Caste Sub-Plan (SCSP), North Eastern Hills (NEH) component and other outreach programmes. A proportion of seed (@ 10% in the first year and @ 5% in the second year) was assumed to be retained by the farmers from the total produce for seed for the next crop and farmer-farmers exchange, leading to the spread of the cumulative growth to 4777.2 ha area from 457.2 ha. The area diffusion effect of these improved wheat varieties through different developmental programmes was 10.4 times (Table 2).

Economic gain from seed production

It is evident from Table 2 that there is a progressive increase in the area under FPSP of improved wheat varieties over the years. In year the 2019-20, a total of 145.8 quintal seed of improved wheat varieties was procured, which is 10.4 times higher than the quantity procured in 2015-16 (Table 3). Farmers received 20% higher rate for the seed than the MSP for the grain. It is evident from the data of 5 years that farmers earned 8.7 to 23.1 per cent higher economic gain from seed production of VL wheat varieties. Similar results were also reported by Thejashree & Umesh (2020). ICAR-VPKAS is the main institutional player for procuring seeds under FPSP whereas non-institutional channels included local traders and other farmers. A large amount of seed produced was sold as grain to the local traders, in spite of the fact that the procurement price was 20 per cent higher than MSP/prevalent market price. This was mainly because farmers have long-standing commercial relationships with the local traders, who are also readily accessible to the farmers. Besides, the farmers receive payment at once and in full, which is used by the farmers to meet their immediate cash requirement. Whereas, in seed procurement through institutional channels, the payment is often delayed as only partial payment is made at the time of procurement and remaining payment is released only after grading and quality testing.

CONCLUSION

A perennial shortage of quality seeds of hill wheat varieties exists in Uttarakhand, which adversely affects wheat productivity in the hills. Development of seed villages has emerged as a viable proposition to help mitigate this problem to an extent. Quality seed produced under the FPSP programmes benefits the farmers of the seed villages as well as the farmers who receive this seed at a reasonable price. Farmers Participatory Seed Production programme undertaken by ICAR-VPKAS has led to increased availability of quality seed of hill crop varieties. Upscaling of FPSP programme in the future by taking into consideration farmers' preferences for crop varieties will act as the major driver of improved crop productivity in the hills. The overall impact of the initiative will be visible in terms of increased crop production, enhanced technical knowledge, seed entrepreneurship development and improved socio-economic status of the farmers in the plains as well as hills.

Table 2. Spread of improved varieties procured under FPSP

Year	Seed procured under FPSP (q)	Estimated area covered by procured seed (ha)	Total production from the area covered by procured seed (q)	Estimated area covered by Farm saved and Farmer-Farmer exchanged seed (q) @ 15% of total production				
				2017	2018	2019	2020	2021
2015-16	14.1	14.1	564	56.4	112.8			
2016-17	73.3	73.3	2932		293.2	586.4		
2017-18	83	83	3320			332	664	
2018-19	141	141	5640				564	1128
2019-20	145.8	145.8	5832					583.2
Cumulative growth		457.2		513.6	919.6	1838	3066	4777.2
Total cumulative growth up to *rabi* 2021-22 (ha)						4777.2		
Area diffusion effect						10.4 times		

Table 3. Year wise seed production and seed disposal of improved wheat varieties under FPSP

Cropping seasons	2015-16	2016-17	2017-18	2018-19	2019-20
Area under FPSP (ha)	42.4	16	14.8	13	62.9
Total production (q)@ 40 q/ha	1696	640	592	520	2516
Seed procured under FPSP (q)	14.1	73.3	83	141	145.8
Economic gain by seed procured by ICAR-VPKAS (Rs.)	25380	146600	166000	282000	320760
Economic gain if seed sold as grain in local market (Rs.)	19352.25	107201.3	129604.5	233496	252598.5
Percent difference	18.03	23.1	15.3	8.7	14.2

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Research Tool

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Knowledge Test for Rainfed Farmers on Natural Resource Management Practices

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ABSTRACT

Natural resource management (NRM) aims on efficient and sustainable utilization of natural resources. One of the greatest challenges facing the world is meeting the rising demand for food with a sustainable natural resource base. Agriculture, a sector being dependent on natural resources, it is high time to make farmers aware on the importance of NRM which require measuring the knowledge level of farmers on NRM practices for the better dissemination of NRM technologies. The study attempted to construct a knowledge test to measure the knowledge level of rainfed farmers during 2021. Items about NRM were collected from relevant literature and through consultation with experts. One pilot study was conducted in Lingaipalle village of Mahabubnagar district of Telangana for item analysis during September 2021. Item analysis provided item difficulty index, item discrimination index and item validity index. Based on the criteria, a total of 18 items were selected in the final test. To administer the knowledge test, one mark for each correct answer and zero mark for each wrong answer was assigned. Finally, the reliability of the test using split-half method found to be 0.749 indicating that the knowledge test is highly reliable for the present study.

INTRODUCTION

One of the greatest challenges facing the world is meeting the rising demand for food with a sustainable natural resource base. Agriculture, a sector being dependent on natural resources, it is high time to make aware farmers on the importance of natural resource management. To address the increasing concerns about degradation of natural resources and the sustainability of agricultural production potentials, various national and international organisations have initiated research and development programmes for Natural Resource Management (NRM). Natural Resource Management aims on efficient and sustainable utilization of natural resources. Efforts in this direction include the development and dissemination of low-cost technological options ensuring integrated management of both soil and water resources, the development of ecologically sound and sustainable cropping systems and options for the conservation and management of natural resources. In many regions lack of technological awareness and increasing food demand are taking a heavy toll on the productive resource base. Major challenges in agriculture include water scarcity and soil degradation coupled with less productivity of crops. Studies shows that there is a link between poverty and environmental degradation. Moreover, degradation of resource base adversely affects the capabilities of the community and further increases their vulnerabilities to various risks such as drought, flood etc. There is a strong nexus between sustainable production and natural resource management. Hence, strategies to enhance the livelihood security of the farmers should address the ways to enhance the productivity of their natural assets. At the same time, technology transfer to be more efficient, it is very much important to understand the existing knowledge level of farmers on NRM practices and to quantify them for the better dissemination of

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NRM technologies. Effective adoption of NRM practices can only be achieved if farmers have sufficient knowledge on NRM practices. Dympep & Singh (2017) developed a test to measure knowledge of farmers on mitigation and adaptation practices of climate change in hill agricultural system. Similarly, Srinivas et al., (2014, 2019) constructed knowledge test to measure the knowledge of agriculture officers on IPM, INM and IWM practices and to measure the level of knowledge of tribal farmers on seed banking respectively. Archana et al., (2017) constructed knowledge test to measure the knowledge of watershed farmers towards natural resource management practices. But so far, a very few studies have been conducted in this line. With this background, the present study has been made an attempt to construct a standardized knowledge test on NRM practices to measure the knowledge level of rainfed farmers. According to Roy & Mondal (2004), a knowledge test is a set of questions, each of which has a correct answer, to which people respond. In this study, knowledge has been defined as the understanding of the farmers about the NRM practices, its importance and practical knowledge based on their experience. Construction of such knowledge test by using scientific procedure will help to know the existing knowledge gap among the farmers and adopt suitable extension strategies based on their knowledge level.

METHODOLOGY

Standard methodology used by Sarkar et al., (2014) & Priyadarshni et al., (2020) was followed in this study to develop the knowledge test on natural resource management practices. Similar procedure was followed by Kumar et al., (2016); Kaur et al., (2020); Vijayan et al., (2022) to develop knowledge test. The test consisted of following steps - item collection, relevancy test using jury opinion, item analysis based on difficulty and discriminatory index and reliability test. Items about natural resource management with a special focus on water management and farm implements and machinery were collected from relevant literature, consultation with experts in concerned subjects and pilot studies conducted in the area of investigation. A total of 42 items were selected covering most of the aspects related to NRM. Necessary care was taken to check that the selected items were based on the knowledge that farmers possess. Items were subjected to scrutiny by an expert panel of judges to determine the relevancy and screening for inclusion in the final test (Kline, 1986). Total forty-two items were sent to forty experts in concerned subjects. The experts were asked to judge the relevancy of test items, their difficulty level and content validity of each test item. The relevancy of test item was judged on a five-point continuum from most relevant (5) to not at all relevant (1). Finally, 26 items were selected whose mean relevancy score is above 2.5. One pilot study has been conducted in Lingaipalle village of Mahabubnagar district of Telangana for the item analysis. For this, sixty respondents were selected randomly. Item analysis provided following information- item difficulty index and item discrimination index. Item difficulty index is defined as the proportion of farmer respondents giving correct answer to that particular item. Here underlying assumption is that difficulty is linearly related to the level of respondents' knowledge about the subject. The difficulty level is calculated using the following formula:

$$P_i = n_i/N$$

Where, P_i= Difficulty index for i^{th} item
n_i= Number of respondents correctly answered the i^{th} item
N= Total number of respondents to which i^{th} item were administered

Further, the discrimination power of all the items are worked out using $E^{1/3}$ method to find out the item discrimination. In this method, respondents are divided into six equal groups, each having ten respondents and they are arranged in descending order of their magnitude of their knowledge scores as obtained from them. The middle two groups are eliminated. Only four extreme groups i.e. the groups with highest and lowest scores are considered in order to calculate the 'Discrimination Index'.

The following formula is employed to calculate item discrimination index.

$$E^{1/3} = \frac{(S_1 + S_2) - (S_5 + S_6)}{(N/3)}$$

Where, S_1, S_2, S_5 and S_6 are the frequencies of correct answers in G_1, G_2, G_5 and G_6 respectively and N= Total number of farmers in the sample of the item analysis.

RESULTS AND DISCUSSION

The relevancy of test through jury opinion resulted in the selection of 26 items whose mean relevancy score is above 2.5 and these items are further administered to 60 respondents who are not included for the final study. To administer the knowledge test to a respondent, one mark for each correct answer and zero mark for each wrong answer is assigned. Thus, maximum possible score is 26 and minimum is zero. The score obtained by 60 respondents are summed up and arranged in descending order to divide them in 6 equal groups with 10 respondents each. The range of the score of 6 groups are presented in the Table 1. For the purpose of further item analysis, out of six groups the middle two groups are eliminated.

Item analysis was done by determining item difficulty index and discrimination index. Here, the items with difficulty index score between 0.3 to 0.95 and discriminatory value of more than 0.25 were selected for final test based on the recommendation of Althouse (2000) and presented in Table 2. If the difficulty index value is more, it implies that the item is very easy to answer. If more number of farmers is answering the item correct, this item cannot provide distinguishing information between farmers who are knowledgeable on the content versus those who are not.

Table 1. Range of scores obtained by the respondents (G1= Group 1, … G6= Group 6)

Group Number	G1	G2	G3	G4	G5	G6
Score range	2-5	6-8	9-10	11-12	13-15	16-23
Number of Respondents	10	10	10	10	10	10

Table 2. Difficulty index, Discrimination index of test items

S.No.	Items	P_i	$E^{1/3}$
1	Are you aware about different farm implements and machinery suitable for rainfed agriculture	0.8	0.45
2	Do you think that the yield will be enhanced if you use various implements and machinery	0.775	0.525
3	Do you think that the expenditure in farming will be more if you use different farm implements	0.75	0.45
4	Do you know that farm implements and machinery are important interventions for timely completion of farm operations	0.725	0.525
5	Find the odd one among the following a) 6-Row planter b) Mini dal mil c) Castor sheller d) Groundnut stripper	0.225[x]	0.375
6	Do you know about various rain water harvesting structures for enhancing water storage capacity at farm level	0.725	0.525
7	Do you think that the same yield will be obtained even if you judiciously use water	0.725	0.675
8	Do you know that drought tolerant varieties help in achieving optimum yield despite of less rainfall	0.55	0.75
9	Do you know that farm ponds are one of the most important water harvesting structure in rainfed areas	0.725	0.825
10	Do you know that desilting and widening of farm ponds are important for improving water storage capacity	0.275[x]	0.225[x]
11	Are you aware that desilting and widening of catchment channels will improve water storage capacity	0.25[x]	0.15[x]
12	Find the odd one a) Sprinkler irrigation b) Drip irrigation c) Farm Pond	0.3	0.45
13	Are you aware of different micro irrigation methods	0.325	0.375
14	Do you know that drip irrigation helps in saving water & obtaining higher yield	0.35	0.45
15	Do you know that drip irrigation helps in reducing labour cost	0.275	0.225[x]
16	Do you think that installation of drip irrigation is expensive	0.625	0.975
17	Do you think that the maintenance of drip system is very difficult	0.6	0.9
18	Have you heard the term watershed	0.175[x]	0.225[x]
19	Are you aware about contingency plans in agriculture	0.325	0.375
20	Do you know that horse gram is suitable crop for rainfed areas	0.375	0.525
21	Are you aware about different varieties developed by ICAR-CRIDA	0.425	0.375
22	Whether in-situ moisture conservation and contour cultivation can improve the yield of crops	0.375	0.225[x]
23	Do you think lifesaving irrigation from water harvesting structure during prolonged dry spells can increase the yield considerably	0.4	0.75
24	Whether mulching in field can retain more soil moisture	0.275[x]	0.225[x]
25	Do you think that timely sowing of plants will give better yield	0.375	0.675
26	Do you think that row to row and plant to plant spacing enhances crop yield	0.175[x]	0.375

Similarly, if the value is less implying that it is very difficult to answer by the farmers. Finally, the item number 1, 2, 3, 4, 6, 7, 8, 9, 12, 13, 14, 16, 17, 19, 20, 21, 23 and 25 were selected based on their respective difficulty index and discriminatory power. Thus, a total of 18 items are selected in the final knowledge test. Then another pilot study is conducted to determine the reliability of the test. Split-half method is used to find the reliability of the knowledge test developed for the study. In this method, all the 18 items are first randomly arranged and then divided into two equal halves with one set containing the odd items and the other set containing the even items. Further, co-efficient of correlation between two sets of scores is calculated and is found to be reliant with a r value of 0.749 indicating that the knowledge test is highly reliable for the present study.

CONCLUSION

Awareness and knowledge about the technology significantly contribute towards the effective transfer of technologies and understanding the knowledge level of farmers is also very important as it influences the adoption of technologies to a great extent. A reliable and valid knowledge test is required to measure the knowledge level of individual farmers. In the present study a knowledge test on natural resource management practices is developed and standardized. Better knowledge on NRM practices are critical inputs in farming activities in rainfed areas. The knowledge test developed in this study could be used for assessing the knowledge level of farmers on NRM practices across the country. Knowledge test is essential to identify the lacunae existing in the technology transfer programs. Further, this knowledge test can pave a way for planning need-based training for the farmers by addressing the existing knowledge gap.

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Research Note

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Constraints in Adoption of Climate Resilient Agricultural Technologies in Telangana

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ABSTRACT

The two major agrarian challenges of the modern era are climate change and food security. Unquestionably the best way to address these issues is adaptation through climate resilience. Making the nation's most susceptible areas climate resilient is the goal of the ICAR effort known as "National Innovations in Climate Resilient Agriculture" (NICRA). Since the inception of the project, several climate resilient technologies have been demonstrated across the country. The investigation was undertaken to isolate the constraints in the adoption of these technologies in Telangana state using a sample size of 200 respondents from four villages in two districts. The findings of Garrett ranking analysis revealed that more interest to follow conventional practices, inadequate institutional financial support, inadequate services through CHCs and insufficient effort on the part of the officials to provide services to all farmers during the busiest season were the predominant constraints to the adoption of climate resilient agricultural technologies by farmers.

INTRODUCTION

Climate change is affecting agricultural sector in India (Vijayabhinandana et al., 2022). Climate change and extreme hazards like floods and severe droughts lead to substantial crop losses, volatility of food prices, and livelihood insecurity (Ghanghas et al, 2015; Meena et al., 2022). Climate change has a variety of effects on agriculture, including decreased crop productivity, incidence of pest and diseases and change in cropping pattern (Ashoka et al., 2022). Climate change has also become a global issue requiring attention and action because to increasing temperatures, extensive glacier melt, variations in the increased frequency of catastrophic events, and more (Pabba et al., 2022). Due to rising in temperature, agriculture production is expected to decline by 2050 in Himalaya region and will lead food insecurity (Bharat et al., 2022). It is set to compound the daunting complex challenges already being faced by agriculture. The phenomenon of climate change is often less understood and more experienced, especially in rural communities (Babu, 2019). In particular, People in rural areas are highly vulnerable to climate change because residents there rely so heavily on natural resources like agricultural land and nearby water supplies. (Pravallika & Mazhar, 2021). Indian agriculture is particularly sensitive to climate change and variability and it a changing climatic and economic environment, faces the simultaneous problem of feeding a billion people. (Kirwa et al., 2020). Practices that enhance-resilience by reducing vulnerability could be the best adaptation options available for climate change. Because of this, the nodal agency, the ICAR introduced a significant network project in February 2011 i.e., National Initiative on Climate Resilient Agriculture recently changed as National Innovations in Climate Resilient Agriculture (NICRA). It aims to promote Climate Resilient Agricultural (CRA) technologies to enhance the resilience of Indian agriculture (Pabba et al., 2021).

In this context, it is essential to ensure that the interventions of NICRA are in full use by the farmers at the grass-root level. Various studies have shown that the farmers' decision of non-adoption or partial adoption could be rational due to the existing conditions that restrain adoption (Rodriguez, 2005). Lack of

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knowledge about cultivation practices, lack of availability of seeds in the market, resistance to change the conventional practices, lack of adequate information on CRA technologies and weather status to plan their farming activities, and high cost for construction of well or farm pond were some of the constraints faced by the NICRA beneficiaries (Jasna, 2014; Ravikumar et al., 2015; Nyasimi., 2017; Mohokar, 2019;). Farmers' are facing several constraints while adopting climate resilient technologies to the fullest. With the help of proper planning, suitable strategies, and efficient utilization of available resources it is possible to overcome the constraints (Shelar et al., 2022). The implementing agencies need to prevent such obstacles encountered by the farmers to enable full scale adoption of the technologies both in the short run and long run. The purpose of the current study was to analyze the factors constraining the adoption of CRA technologies.

METHODOLOGY

The study was carried out in Telangana's Suryapet and Khammam districts, which were purposively chosen. The NICRA has been implemented in these districts since it was first introduced, hence the research locations were chosen purposively. The locations for the study were susceptible to climatic change. As the project has only been carried out in these villages of the respective state, Boring Thanda, Kotha Thanda, and Nandyalagudem are the three villages of Suryapet district and Nacharam village of Khammam district, were purposefully chosen. The study used an ex-post facto research design because the manifestations of the variables was presumed to have already happened and additional manipulation was not possible. To analyze the constraints faced in the adoption of CRA technologies being promoted under the NICRA project, a sample of 50 respondents were chosen randomly from every village, making a total of 200 respondents. With the aid of a systematic interview schedule, primary data was gathered.

With the help of Henry Garrett's Ranking Technique, rankings given by respondents were evaluated. When respondents were asked to rank the specified constraints, the results of their ranking were converted into score values with the help of the following formula suggested by (Garrett, 1979).

$$\text{Percent position} = \frac{100\ (Rij - 0.5)}{Nj}$$

Where, Rij = Rank given for the i^{th} variable by j^{th} respondents, Nj = Number of variables ranked by j^{th} respondents

With the help of Garrett's Table, scores were created using the predicted percent position. The scores of each individual were then totaled for each constraint element, and the sum of the scores as well as the mean values of the scores were determined. It was decided that the constraint factor with the highest mean value was the most important one.

RESULTS AND DISCUSSION

Constraints faced by the farmers in adopting CRA technologies

The major constraints elicited by the farmer's in the selected NICRA villages under socio-personal constraints were more interested to follow conventional practices as they did not want to take any new risks and follow the same old conventional practices followed by the constraint inability to accept new practices because out of fear that the farming in drought conditions is unpredictable which ranked second. Increasing labor scarcity is one of the major constraints in agriculture because most of the available labor was participating in the government programs like MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) and younger generations in villages were interested in activities other than agriculture ranked third. Whereas inability to take the risk and small size of the farm ranked fourth and fifth respectively by the farmers in adopting climate resilient agricultural technologies as the land is getting fragmented over the generations, the small size of the farm was also opined as a constraint. Results are presented in Table 1.

Table 1. Constraints faced by the farmers in adopting CRA technologies

S.No.	Constraints	Garrett mean score	Ranks
Socio-Personal			
1	Inability to take risks	51.78	IV
2	Inability to accept new practices	61.48	II
3	Small size of the farm	23.09	V
4	More interested to follow conventional practices	66.46	I
5	Increasing labour scarcity	59.60	III
Financial constraints			
1	High cost of inputs	41.67	IV
2	Higher investment cost on farm implements	45.33	III
3	Inadequate institutional financial support	78	I
4	Lack of market access	31.33	V
5	Lack of savings	50.67	II
Technological constraints			
1	Lack of awareness about climate change	30.67	IV
2	Lack of timely information related to CRA technologies	42.67	III
3	lack of timely availability of improved seed	38.33	II
4	Inadequate services through CHCs	59.67	I
Others/ Situational constraints			
1	Poor information accessibility and utilization of weather based agro advisory services	58.72	II
2	Lack of support from line departments	36.85	IV
3	Inability of the officials to provide services to all farmers during the peak period	65.40	I
4	Insufficient need based trainings on CRA technologies	45.41	III

Among the major constraints faced by the farmer's under financial constraints. Inadequate institutional financial support was ranked first as agriculture operations are time bound, farmers have expressed the difficulty of non-availability of timely financial support due to which they could not purchase the seed, fertilizer, and other inputs in time and so this was viewed as an important constraint. It was followed by a lack of savings as most of the income generated by the farmers in the study area was through agriculture which was sufficient to meet their livelihood and very less was left out for savings and to meet the unforeseen expenditure. Higher investment cost on farm implements was ranked third because to perform various agricultural operations right from sowing to harvesting, farm implements suitable for dry land like rotavator, planters, seed cum ferti drill, crop threshers are expensive and it is difficult to provide subsidy to all the farmers. The high cost of inputs which ranked fourth, the ever-increasing cost of the inputs such as seed, fertilizers, and plant protection chemicals was also a major constraint faced by the farmers restraining them from adopting climate resilient technologies, and lack of market access was ranked fifth among financial constraints faced by the farmers

Under the domain of technological constraints, inadequate services through CHCs were ranked first by the majority of the farmer's because services offered through Custom Hiring Centre's are not adequate to meet the needs of the farmer's at the village level. Lack of timely availability of improved seed was ranked second as a major constraint may be due to the shortage in availability of quality inputs, traders sell the inputs at high cost resulting in non-adoption of input-intensive CRA technologies. Lack of timely information related to CRA technologies and lack of awareness about climate change were ranked fourth and fifth major constraints faced by the farmers among technological constraints while adopting climate resilient technologies. Among the major constraints faced by the farmer's under the others/ situational constraints, Inability of the officials to provide services to all farmers during the peak period was ranked first whereas poor information accessibility and utilization of weather based agro advisory services by the farmers was ranked as second major constraint faced by the farmers probably due to the lack of awareness, hands on experience in utilizing ICT platforms, etc. lack of adequate trainings on CRA technologies based on need was reported the third main constraint that farmers must overcome probably due to the inadequate trainings provided covering various sections of the respondents. The lack of support from line departments was the fourth major constraint faced by the farmers could be due to the lack of convergence of various line departments in the project implementation.

CONCLUSION

The farmer's faced multiple constraints and challenges while adopting climate resilient agricultural technologies. Major constraints faced by the farmers such as interest to follow conventional practices, inability to accept new practices, inadequate institutional financial support, lack of savings, inadequate services through CHCs, lack of timely availability of improved seed, Inability of the officials to provide services to all farmers during the peak period etc., shall have to be looked into for the adoption of CRA technologies with efficacy by the farmers. The present study could aid in redesigning the previously implemented interventions and frame suitable strategies which could resolve the constraints that farmers encounter and promote community mobilization for a higher rate of adoption of CRA technologies.

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Constraints in Adoption of Laser Land Levelling Technology in Haryana

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ABSTRACT

The study analyzed perceptions of farmers about laser land levelling and constraints faced by them in adoption of this resource conservation technology in Sirsa and Karnal district of Haryana. Mean percent score tool of statistics was used to rank perceptions and constraints of farmers. It was noticed that 97.00 per cent respondent farmers believed that there is reduction in irrigation cost. 80.00 per cent believed that laser land levelling adoption helped in better weed management. Also, it was examined that major constraint was non-availability of machines due to shorter window between two consecutive crops. Study of diffusion revealed that fellow farmers and relatives were major source of diffusion. 86.25 per cent of laser land levelling service provided by private players showing dominance of private investment. It was also observed that laser land levelling is a scale neutral technology because it was adopted by all categories of farmers and not biased towards large farmers. It was observed that under scheme Rashtriya Krishi Vikas Yojana (RKVY) laser leveller along with tractor and operator at a custom hiring centre (CHC) was provided at nominal rate Rs. 1075/day while Cooperatives provided laser leveller at rupees 575 per acre.

INTRODUCTION

Water scarcity along with rising temperature pausing a serious threat to agricultural livelihood and food security. Melting of glaciers are accelerated by global warming and ground water table is showing declining trend over last two decades. Declining ground water table will hamper sustainability of agriculture sector. In northern plains of Haryana and Punjab Rice-Wheat is major cropping pattern which includes water thirsty crops. Continuous upliftment of ground water for irrigation caused serious problem of water scarcity in this region. So, it felt imperative need for some resource conservation technology which can in efficient utilization of water resource. Laser land levelling is ultimate technology for climate smart agriculture. But farmers have varying perceptions regarding its potential benefits which leads to constraints in its adoption and various constraints in adoption of laser land levelling in Punjab (Larson et al., 2016).

Social network played a vital role in diffusion of technology (Nain et al., 2019). Lagged adoption of peer group effected farmer's decision to adopt laser levelling very seriously. Also, merely knowledge of technology didn't guarantee its adoption. It was observed that 98.00 per cent of farmers were in contact with at least one other fellow who has adopted laser land levelling. Still, 40.00 per cent of farmers did not adopt the technology at all. Reasons for this might be lack of credit, their land might not be suitable for laser land levelling or they wanted some more convincing results from their fellows. Further, credit constraints for laser land levelling were studied in depth and it was found that two third of farmers borrowed credit more than the cost of laser land levelling (for example- amount borrowed for fertilizer Rs. 10000 could be used to laser level 13 acres of field). Study did not find any significant impact on adoption process by type of relationship a farmer has like a relative or plot neighbourer or a

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knowledgeable farmer who had adopted earlier. But still study concluded that large and knowledgeable farmers created large spill over effect in adoption and most of farmers follow them. Adoption of laser land levelling in Karnal was out of total 621 respondents, 339 (about 55.00%) were found adopters of laser land levelling (LLL) and out of these 339 adopters only 103 (30.00%) respondents had adopted laser land levelling on full-scale while remaining 236 (70.00%) of respondents had adopted laser land levelling on partial scale (Aryal et al., 2018) . Hence, keeping all previous researches in mind study focused on assessing constraints in adoption of this resource conservation technology.

METHODOLOGY

The study was conducted in Karnal and Sirsa districts of Haryana. Purposive and multistage random sampling technique was used for the selection of districts and villages on the basis of highest area under paddy-wheat and cotton-wheat pattern, respectively in Haryana. From each districts, two blocks were selected at random. Further, twenty (20) adopters were taken randomly from each selected block. To work out the constraints, diffusion pattern, perception of farmers regarding technology, different category of farmers, etc. of laser land levelling practices in paddy-wheat and cotton-wheat cropping pattern for crop year 2019-20 were collected by conducting personal interview from selected paddy-wheat and cotton-wheat growers on pretested interview schedule. For analysis, multiple responses of targeted farmers were recorded on three point continuum scale, having three weights i.e., very serious constraint with score 3, serious constraint with score 2, somewhat serious constraint with score 1. Then, these scores for each constraint from all respondent farmers in adoption of laser land levelling technology were added and analyzed through two statistical techniques namely mean score and mean per cent score.

RESULTS AND DISCUSSION

Among sampled farmers 30 per cent of adopters were from small farmer category while 25.00 per cent of farmers belonged to large farmer category. Whereas, 23.75 per cent farmers belonged to marginal farmers and 22.50 per cent of sample farmers belonged to medium category respectively. It showed that adopters were equally from each category of land holding size showing scale neutrality and non-biasedness of laser land levelling towards large farmers. Lybbert et al., (2012) in their study observed similar results. There were different costs of hiring of laser leveller under various agencies. Private individuals charges Rs. 800-950 per hour. While, custom hiring charges from cooperatives society was Rs. 575 per acre. Under Government scheme *i.e.* Rashtriya Krishi Vikas Yojna, Engineering Department provided laser leveller at Rs 1075 per day in the study area.

Constraints in adoption

The perusal of Table 1, more than eighty per cent farmers stated that non- availability of machine due to shorter window between two consecutive crops was major constraints followed by orthodox mind set of farmers because they don't know potential benefits and also reluctant to change (76.70%), high cost of levelling (73.60%), lack of training for operation of machine (52.20%), lack of awareness (44.20%) and last one is small size of holding (40.60%) were identified some of the major constraints which inhibiting the adoption of laser land levelling at more faster rate among the famers of the state. Thakar et al., (2009); Kumar et al., (2017) & Gireesh et al., (2019) found that lack of knowledge and non-availability of machines were some major constraints in adoption of laser land levelling. Gill (2014) & Far et al., (2014) also reported high cost of levelling and small size of holding are the major constraints in their respective study on laser land levelling.

Table 1. Constraints in adoption of laser land levelling

Constraints	Mean Score	Mean Percent
Non–availability of machines due to shorter window between two consecutive crops	2.4	81.10
Orthodox mindset because lack of knowledge of potential benefits	2.3	76.70
High cost of levelling	2.2	73.60
Lack of training for operation of machine	1.6	52.20
Lack of awareness	1.3	44.20
Small size of holding	1.2	40.60

Perceptions of adopters regarding laser land levelling technology (multiple responses)

The results of the Table 2 revealed that 97 per cent of the respondent farmers believed that there was a reduction in irrigation cost due to adoption of laser land leveller followed by 80per cent of farmers believed that it helps in better weed management, 70 per cent of the respondents believed that laser leveller increased the productivity of various crops while 37.50 per cent farmers believed that laser leveller helped in reduction of fertilizer cost. Only 22.50 per cent of respondent farmers stated that due to the adoption of laser leveller there is uniform crop stand resulted better yields with lesser amount of fertilizers. Singh et al., (2020) reported that reduction in various cost like fertilizers, weed management, etc. were the major benefits of laser land technology. Ahmad et al., (2001); Kumar et al., (2010) & Nain et al., (2019) also found productivity enhancement as the main perception of farmers regarding the benefits and use of new technology in their respective studies.

Diffusion pattern of laser land levelling technology in Haryana

It is evident from the Table 3 that 50 per cent of farmers came to know about technology from fellow farmers followed by 27.50 per cent of respondents came to know about the technology from their friends or relatives, 10 per cent of farmers from

Table 2. Perceptions of adopters regarding benefits of laser land levelling in Haryana (Multiple response)

Particulars	Frequency (%)
Reduction in irrigation cost	76 (97.00)
Better weed management	64 (80.00)
Increase in productivity	56 (70.00)
Reduction in fertilizer cost	30 (37.50)
Uniform transplanting in less time and labour	18 (22.50)

Table 3. Diffusion pattern of laser land levelling technology and available providers of technology in Haryana

Particulars	Frequency (%)
Fellow farmer	40 (50.00)
Friends/relatives	22 (27.50)
Co-operative society	08 (10.00)
Kisan mela	07 (08.75)
Others (seminars, campaigns, TV, radio)	03 (03.75)
Types of laser land levelling service providers	
Private (other farmer)	69 (86.25)
Self-owned	08 (10.00)
Government	02 (02.50)
Cooperative	01 (01.25)

cooperative society and 8.75 per cent of farmers in Kisan Mela. Other sources (seminars, campaigns, TV, radio) had least role in the diffusion of this technology with the per cent contribution of 3.75 per cent in the study area. Aggarwal et al., (2010) & Jat et al., (2021) found that diffusion of the technology was mainly through fellow farmers and friends/relatives. Baliwada et al., (2017); Kumari et al., (2019) & Mishra et al., (2022) also reported that fellow farmers, friends and relatives played major role in the diffusion of new technology in their respective research.

Contribution of various sectors/agencies in providing laser land levelling service was evident from the table that 86.25 per cent of laser land levelling service provider were private players showing dominance of private sector. Whereas, only 10.00 per cent of respondent farmers have self-owned laser leveller, while cooperative sector and government agencies have only 2.50 and 1.25 per cent share in laser land levelling service respectively. Hosseini et al., (2014) in their research "The perception of farmers about laser land levelling as an appropriate technology in agricultural sector of Iran" found that self-owned, private, government and cooperative are the types of laser land levelling service providers. Naresh et al., (2014); Das et al., (2014); Kumar & Kumar (2019) supported the results through similar findings in their respective research.

CONCLUSION

The laser land levelling is a scale neutral resource conservation technology adopted by all categories of farmers. Majority of farmers believed that it helped in reduction of irrigation cost and improvement in fertilizer use efficiency. Therefore, agricultural extension workers should disseminate benefits of laser land levelling towards farmers. Also, Government should promote schemes like Rashtriya Krishi Vikas Yojna under which custom hiring centers (CHCs) are made in each district to promote mechanization. There is need to encourage the farmers' cooperatives at block/village level through providing government financial assistance in the form of subsidy (up to 90%) on laser land leveller along with tractor so that accessibility of laser land leveller may be increased during peak hours.

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Constraints Affecting the Teachers' Job Satisfaction of Odisha University of Agriculture and Technology, Odisha

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ABSTRACT

The study was conducted in three campuses of Orissa University of Agriculture and Technology, Bhubaneswar viz. Bhubaneswar, Chiplima and Bhawanipatna in 2019 to find out constraints affecting the job satisfaction along with the suggestions for improving the job satisfaction of teachers working in the University. Ninety respondents from these three campuses were selected for the study using a random sampling procedure. Data was collected from the respondents by implementing personal interview method. Majority of the respondents state that the constraints like lack of enough teaching staff, duty related workload, insufficient staff quarters and shortage of lands for research and practical classes were prominent in hampering their job satisfaction. The suggestions for solving the constraints predominantly suggested were teachers' recruitment for workload optimization, adequate staff quarters, sanctioning adequate funding along with lands for research.

INTRODUCTION

University is regarded as the ultimate source of knowledge generation and wisdom creation for the purpose of training the manpower needed different sets of society and life (Khalid et al., 2012). As an centre of culture and academic excellence, it is engaged in exploring, generating, and transmitting knowledge, thus demanding for shouldering more responsibility for students than that of before (Johal et al., 2010). According to Handage & Chander (2021) the capability of the universities to impart a multi-competencies skillset instead of single one in the students to be able to do justice to their targeted profession. It becomes an obligation for teachers to synchronise with the different learning styles of each student owing to their multi-dimensional personalities (Sharma et al., 2021).

Considering university as an organization, it is of inevitable requisite of a dynamic climate for the job satisfaction of the faculties which can be properly ensured by efficient human management protocols leading to enhanced performance levels of the employees (Mohanlal, 2016). The state agricultural university possess a distinctive functioning system owing to the diversity in their roles and responsibilities. The faculty moves beyond playing a singular role of a teacher, a scientist or an extension worker (Borah, 2019). Thus, the stability of agri-education imparted by the State Agricultural Universities (SAUs) banks on the teachers which makes the matter of their content from job a matter of concern. The spirit of job satisfaction has great impact on individual performance, thus conceptualized as how individuals are gratified with their jobs, which is determined by the contrast of expectations and reality (Garbyal, 2018). Contented employees lead a healthy organizations by advancing over any ordeals they face where they values their responsibilities and thus encharged to carry out their duties with sheer dedication and act as prominent cogwheels in the organizational productivity (Ramannanavar, 2018). Nwalieji et al., (2013) depicted that the inhibitions to labour force contentedness in local governance were fuelled by the issues like poor results of extension services, impoverished levels of staff remunerations, relegation of state agri-departments, systemic corruption and dried resources. Abuhashesh et al., (2019) inferenced that the contentedness of employees was influenced by their wages and

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work nature itself. Soni (2014) inferenced that the absence of occupational gratification for the teachers would affect their duty performance which necessitates a vibrant ecosystem accommodating an administrative-teaching fraternity linkage for constraint management by evolving novel approaches with an option of reciprocate feedback.

In this context, a comprehensive study was undertaken with an objective to identify the constraints affecting the job satisfaction along with the suggestions for improving it of the teachers of Orissa University of Agriculture and Technology, Bhubaneswar, Odisha. Null hypothesis of this study is 'There is absence of any constraints affecting the job satisfaction of teachers of the University and so there are no suggestions for improving it". The result of this study will be helpful in policy advocations for improving the job satisfaction of the teachers of the University.

METHODOLOGY

The study was conducted in three campuses of Bhubaneswar, Chiplima and Bhawanipatna of the Orissa University of Agriculture and Technology. The teaching personnel employed by the University were taken as respondents. A total of 90 respondents were taken by selecting 30 respondents in each of the three campuses by following disproportionate random sampling method. For identifying the problems, some of the statements regarding the problems that are frequently faced by the Teachers were provided under four point continuum via., 'To a Great extent', 'To a moderate extent', 'To a least extent' and 'Not at all a problem' with the scores of 4, 3, 2 and 1 assigned to them respectively. Appropriate ranks were alloted to them on the basis of mean of total sum of scores for each of the problem statements where high mean scores where high score indicates great extent of the problem and vice-versa. Personal interview method was implemented for the purpose of data collection from the respondents.

The statements containing the suggestions that are regularly suggested by teachers were given to mark under four point continuum as 'needs great attention', 'needs moderate attention', 'needs least attention' and 'does not need any attention' with a scores of 4, 3, 2 and 1 respectively. Later the scores were added for each statement by all the teachers and the statement showing high score was regarded as the suggestion that needs greater attention. Similarly, all the statements were ranked based on the scores acquired.

RESULTS AND DISCUSSIONS

The result provided in Table 1 presents a brief information about the problems experienced by the teachers. Then after ranking the problems based on their corresponding mean scores, the problem "More work load due to less teachers" comes first owing to its mean score of 3.73. The items following it were "Insufficient staff quarters", "Deficiency of land for conducting research", "Lacks of funds for conducting research and practical classes", "Lack of LCD facility in classrooms", "Lack of laboratory facilities", "Insufficient number of computers with high-speed internet facility", "Non-cooperation among teachers", "Lack of permissions to pursue post-doctoral programme" and "Lack of permissions to participate in seminars/conference/training programme".

According to the teachers, due to lack of enough number of teachers at different cadres, the workload of the university either coming from department or from student level has been a burden on the teachers working in different departments. There is also the concern of insufficient staff quarters which affects them a lot since majority do live with their family comprising of five to eight members. There is the shortage of lands for conducting any research ventures and conducting practical classes in the mode of demonstrations for which the students were much deprived of practical knowledge as well as difficulty in advancing research and innovation development for the farmers of the state. Also, there is less focus on bringing in new technologies, persistence with age-old existing facilities, frequent power cuts and shortage of funds for conducting own research or practical experiments for the students. The results yielded from the investigation were in supportive to that of Nisha & Sudeepkumar (2011); Fazely (2016) & Köse et al., (2020).

Table 1. Extent of problems experienced by teachers.

S.No.	Statement	Mean Score
1.	Lack of permissions to pursue post-doctoral programme	2.63
2.	Non-co-operation among teachers	2.72
3.	More work load due to less teachers	3.73
4.	Lack of permissions to participate in seminars/ conference/training programme etc.	2.46
5.	Lack of LCD facility in classrooms	3.14
6.	Insufficient staff quarters	3.56
7.	Lack of laboratory facilities	3.02
8.	Lack of funds for conducting research	3.15
9.	Insufficient number of computers with high-speed internet facility	2.84
10.	Deficiency of land for conducting research and practical classes	3.25

From Table 2, after ranking the suggestions based on the corresponding means scores, the statement "Recruitment of teachers for optimizing work load of faculty members" tops it followed by "Adequate staff quarters for families of teachers", "Sanctioning adequate funding for conducting research projects", "Provisions of lands for conducting research and practical classes", "Creating good working atmosphere for performing work timely", "Establishing adequate infrastructural facilities", "Upgradation of library for accommodating more advanced books and extending its operation to 12 hours a day", "Deputing teachers to participate in seminars/conferences", "Prompt e-system and e-service delivery for quicker and transparent administration" and "Deputing teachers to pursue Post-Doctoral Programme to centres of excellence".

It was inferred that the suggestions made by most of the teachers was recruitment supported by time-to-time career advancement scheme for filling up the vacant posts would address the problems of workload optimization. The suggestion of staff quarters was also of great importance so that with their professional life they can ably maintain their family personal life that would also lead to more satisfaction. There should also be efforts for garnering resources and support for improving the infrastructural setup and bring new technologies for keeping the organization in the line of changing times.Therefore, it is of utmost relevance that

Table 2. Suggestions for improving the job satisfaction of teachers

S.No.	Statement	Mean Score
1.	Creating good working atmosphere for performing work timely	2.82
2.	Recruitment of teachers for optimizing work load of faculty members	3.30
3.	Adequate staff quarters for families of teachers	3.16
4.	Deputing teachers to pursue Post-Doctoral Programme to centres of excellence	2.36
5.	Deputing teachers to participate in seminars/ conference/training programme etc. on regular basis	2.46
6.	Sanctioning adequate funding for conducting research projects	3.03
7.	Establishing adequate infrastructural facilities	2.71
8.	Upgradation of library for accommodating more advanced books and extending its operation to 12 hours	2.57
9.	Prompt e-system and e-services delivery for quicker and transparent administration	2.32
10.	Provisions of lands for conducting research and practical classes	2.94

there should be proper consideration to these suggestions and provide weightage to them in importance on priority basis thus making the organization efficient enough to fulfill their objectives of imparting education in agricultural and allied sciences. The findings were quite different to that of Kumar (2020) but in line to Garbyal (2018).

CONCLUSION

The efficiency of the university depends on the job satisfaction of the teachers. Majority of the respondents state that the constraints that hamper the professional surroundings were as the lack of enough teaching staff, duty related workload, insufficient staff quarters and shortage of lands for research and practical classes has been prominent in hampering their job satisfaction. Therefore, efforts must be executed in the line of suggestions like teachers' recruitment for workload optimization, adequate staff quarters, etc for the betterment of the teachers. Further studies on the constraints affecting job satisfaction of teachers of different universities are encouraged to obtain a generalized picture of the job satisfaction of the teachers of the university by taking on different universities of different regions of the nation.

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Impact of Sowing Technologies of Wheat Cultivation in Ferozepur, Punjab

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ABSTRACT

A field experimentation was carry out with four different sowing methods on different three locations of district of Ferozepur (Punjab) during 2021-22, to detect the most applicable method of wheat sowing after rice crop in district Ferozepur of Punjab state. The experiment was carried out including Broadcasting + Mulcher, PAU Happy Seeder, Zero Till Drill and Super Seeder. The utmost grain yield was obtained by PAU Happy Seeder (54.45 q/ha) sowing method as compared to Brodcasting + Mulcher (51.85 q/ha), Super Seeder (49.15 q/ha) and Zero Drill (45.95 q/ha). However, the ratio of benefit-cost was higher by PAU Happy Seeder (3.71:1) as compared to as compared to Brodcasting + Mulcher (3.51:1), Zero Drill (2.76:1) and Super Seeder (2.38:1). The better net return obtained from PAU Happy Seeder Rs. 120602.50/ha as compared to Brodcasting + Mulcher (109548.75/ha), Super Seeder (95236.25/ha) and Zero Drill (93055.00/ha). The grain yield by PAU Happy Seeder method of sowing was higher as well as it successful to produce better net return and benefits of cost ratio. PAU Happy Seeder technology provided timely sowing operation of wheat and scope against burning of paddy residue in Punjab.

INTRODUCTION

India is in the second leading producer of wheat cultivation in the worldwide with an average annual production of 109.52 Mt (million tonnes) in current years (Anonymous, 2022). It accounts for in the order of 11.79 per cent of world's wheat production. Punjab is an important wheat cultivating state in the country and produces 18.262 Mt of wheat with yield level of 5.188 tonnes per hectare (Anonymous, 2020). About 19 per cent of the wheat production and 11 per cent of rice production in India comes only from Punjab, which accounts for just 1.5 per cent of the geographical area of the country. Disorganized lifting of ground water in Punjab transversely the past several decades has in hazard of extinction the viable of not only the environment but also of the agronomy of paddy crop. It was reported that the ground water diminishing by 0.6 m per year in Punjab (Hira et al., 2004) and in adding up to the water-hassle, agricultural practices such as wide-ranging and unwarranted use of chemicals and fertilizers have degrade the soil fertility and ground water quality. Numerous obstacle allied with plough based conventional production practices in Rice-Wheat system including deteriorating feature productivity, flinch farm profits due to rising energy and labour costs, rising irrigation water calamity and current challenges of climate change are primary to a foremost hazard to food security (Jat et al., 2009). Surface maintenance of crop residues as mulch is known as assorted outcomes. These retain soil water, judicious thermal regime, curb weeds and improve soil health, and end result irrigation water saving. The advantages of saving irrigation water by straw mulch are as much as 70–300 mm in summer crops for equivalent yield (Jalota et al., 2007). Straw mulching in crops also decrease water evaporation (Jalota & Arora, 2002). Planting of wheat with Happy seeder in the presence of rice residue not only saves pre-sowing irrigation, but also reduces 45 mm post-sowing soil water evaporation losses (Sidhu et al., 2009; Singh et al., 2011a,b).

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Crop residue hold on to also leads to considerable enrichment in sustainability index (Alvarez & Steinbach, 2009; Jat et al., 2011; Jat, 2013). However, conserving technologies in wheat crop are of partial implementation in Punjab, due to complicatedness in sowing operation as compared to conventional method. Observance these position in view a trial was performed to analyse the achievability of direct drilling of wheat in the presence of heavy loads of paddy residue. The recommended technologies for in-situ management of loose paddy residue include straw management system on combine harvesters, zero till drill, PAU Happy Seeder, Super Seeder, rotavator tillage, rice straw chopper and cutter-cum-shredder etc. (Singh et al., 2020; Gupta et al., 2021). Therefore, it is essential to study the economics of different wheat sowing practices for wheat establishment in farmer's association form for large scale adoption in district Ferozepur of Punjab. Objective of the study was to study the impact of incorporation, residue removal and surface maintenance on wheat yield and the economic index was coordinated.

METHODOLOGY

A field experiment was convoyed during *rabi* 2021-22 on different three locations of district, Ferozepur (Punjab), to find out the most appropriate method of wheat sowing after paddy crop in Ferozepur district of Punjab state. The area is characterized by semi arid- arid type of climate with hot and dry early summers from April-June followed by hot and humid period during July - September and cold winters during December-January. The experimentation was carried in randomized complete block design with three locations. In the area combine harvesting of rice and wheat is now a common practice leaving large amount of residues in the fields. Farmers commonly practices burning the paddy residue onto their fields to get rid of it and to make certain timely sowing of the wheat crop as delayed sowing decreases the final grain yields (Singh & Sidhu, 2014). To elucidate the concern, the field experiment was carried out with five sowing methods i.e. T1- Broadcasting + Mulcher, T2- PAU Happy Seeder, T3- Zero Till Drill and T4-Super Seeder. In the followed treatment T1 the practice after combine harvesting the crop residue in field the mulching operation done with help of mulcher after broadcasting of wheat. In T2 after the operation of combine harvesting of paddy crop, the loose straw of the crop were unvaryingly distributed to the whole field and sowing was done with the help of PAU Happy Seeder. In T3 the loose straw of the crop were collected by baler and sowing was done with the help of zero till drill. In T4 after combine harvesting of paddy crop, the loose straw of the crop were uniformly distributed to the whole field and sowing was done with the help of Super Seeder.

The observations on plant height, yield and yield attributes (effective tillers/m^2, grains/ear and ear length) were recorded at maturity. Statistical analysis of the noted data in direction to study the outcome of diverse sowing techniques and wheat on the yield of wheat was prepared with SPSS version 22 Software. Evaluations were based on a $p = .05$ level of significance. Statement on grain and straw yield of each crop was recorded and statistically analysed. The cost of cultivation of each method was worked out and net return of sowing method was calculated on prevailing market prices. The benefit-cost ratio of each sowing method was also calculated.

RESULTS AND DISCUSSIONS

All the sowing technologies unsuccessful to generate any significant outcome on the plant height, ear length and Number of grains per ear of the wheat crop (Table 1). Whereas, the 1000 grain weight was significantly higher with the PAU Happy Seeder (40.59) which was statistically at par with Super Seeder method (38.96) and zero drill method (39.28) but significantly differ with Broadcasting + Mulcher (38.34) method (Table 1).

Along with the different sowing methods highest grain yield was obtained with the PAU Happy Seeder (54.45 q/ha) method which was significantly higher from broadcasting + Mulcher method (51.85 q/ha), super seeder method (49.15 q/ha) and zero drill method (45.95 q/ha) method. The different planting methods maximum straw yield was also obtained with the PAU Happy Seeder (61.85 q/ha) method which was significantly higher from

Table 1. Growth and yield of wheat crop by different planting methods

Sowing Technology	Plant height (cm)	Ear length (cm)	No. of grains/ ear	1000 grain weight	Grain yield (q/ha)	Straw yield (q/ha)
Broadcasting + Mulcher	95.45[a]	10.76[b]	49.49[b]	38.34[a]	51.85[c]	57.08[c]
PAU Happy Seeder	94.45[a]	10.82[b]	49.79[b]	40.59[c]	54.45[d]	61.85[d]
Zero Drill	92.67[a]	10.74[b]	49.40[b]	39.28[b]	45.95[a]	53.70[a]
Super Seeder	95.33[a]	10.79[b]	49.61[b]	38.96[b]	49.15[b]	56.83[b]
Sig. (p=0.05)	0.004	0.987	0.986	0.002	0.000	0.000

Table 2. Economics of wheat crop as influenced by different planting methods

Sowing Technology	Yield (q/ha)	Straw yield (q/ha)	Input Cost (Rs.)	Gross return of grain (Rs)	Gross return of straw (Rs)	Total Gross return (Rs)	Net Return (Rs)	Benefits of cost ratio
Broadcasting + Mulcher	51.85	57.08	31250.00	103700.00	37098.75	140798.75	109548.75	3.51
PAU Happy Seeder	56.45	61.85	32500.00	112900.00	40202.50	153102.50	120602.50	3.71
Zero Drill	45.95	53.70	33750.00	91900.00	34905.00	126805.00	93055.00	2.76
Super Seeder	49.15	56.83	40000.00	98300.00	36936.25	135236.25	95236.25	2.38

broadcasting + Mulcher method (57.08 q/ha), Super Seeder method (56.83 q/ha) and zero drill method (53.70 q/ha). The result confirms the findings of Gautam *et al*. 2020, who reported that the wheat crop shown with Happy Seeder gave comparative higher yield. These results were in conformity with the verdict of Singh and Sidhu, 2014. They reported Happy Seeder will be provided a healthier option for management of crop residue in rice-wheat cropping system. Paddy straw contains significant quantities of nutrients; their continuous application will have positive outcome on fertilizer management in rice-wheat system. In present study, though the grain and straw yield obtained by PAU Happy Seeder was significantly at par with Super Seeder, Broadcasting + mulcher and zero drill but in the long run the yield may increase in case of Happy Seeder due to above mentioned reason.

Along with the intact different sowing technologies the maximum gross return was obtained with the PAU Happy Seeder method (Rs. 153102.50) treatment followed by Broadcasting + mulcher method (Rs. 140798.75) followed by Super Seeder (Rs. 135236.25) and zero drill (Rs. 126805.00). Gross returns between these sowing technologies were high due to superior grain yield obtained. Least gross return was acquired with the zero drill (Rs.126805.00) sowing method. Whereas, the net return was maximum in PAU Happy Seeder sowing technology (Rs.120602.50) followed by broadcasting + mulcher (Rs. 109548.75), Super Seeder (Rs. 95236.25) and zero tillage methods (Rs. 93055.00. However, the benefit cost ratio was also higher with PAU Happy Seeder (3.71:1) as compared to Broadcasting + mulcher (3.51:1), zero drill method (2.76:1) and Super Seeder (2.38:1). Higher B:C ratio with PAU Happy Seeder was also due to its lesser cost of cultivation as compared to Super Seeder method of sowing. Benefit cost ratio of zero tillage method (2.76:1) of sowing was also higher from the Super Seeder method (2.38:1). Due to the lesser cost of cultivation in zero tillage method the B:C ratio was higher as compared to incorporation and conventional method of sowing.

CONCLUSION

PAU Happy Seeder technology provided the facility of wheat sowing in opposition to burning of paddy residue. This technology saved time because the PAU Happy Seeder can be brought into the field without delay after the rice harvest and is environment friendly. Among the different sowing methods maximum grain yield was obtained with the PAU Happy Seeder Broadcasting + Mulcher and Super Seeder as compared to zero tillage, whereas, higher B: C ratio was obtained by PAU Happy Seeder. Thus PAU Happy Seeder can play an essential character in retaining soil and ecological fitness in Punjab.

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Occupational Stress and Role Performance-expectation Gap Amongst Teachers of OUAT, Bhubaneswar

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ABSTRACT

The study was conducted in two colleges of Odisha University of Agriculture and Technology, Bhubaneswar viz. College of Agriculture and College of Agricultural Engineering, Bhubaneswar in 2019 to measure occupational stress of teachers working in the university. Total hundred number of respondents viz. sixty from college of agriculture and forty from college of agricultural engineering were selected following complete enumeration method. Data was collected from the respondents by implementing personal interview method. Profile characteristics of respondents, distribution of respondents according to student's behaviour, distribution of respondents according to occupational stress, association of occupational stress with the profile characteristics of teachers, the gap between role performance and role expectation of teachers were measured. Educational qualification and present job experience found to be positively correlated with occupational stress of teachers. The maximum gap between the role expectation and role performance of teachers of OUAT was found for the factor; opportunity to earn money, wealth and property followed by delegation of authority, whereas minimum gap was observed in case of job security. Total deviation of 23.97 per cent was found between role expectation and role performance of teachers of OUAT.

INTRODUCTION

University being a unique institution are engaged in exploring, generating, and transmitting knowledge where it calls for taking more responsibilities for students than before (Malik & Bjorkqvist, 2018). So, with respect to imparting agricultural education in the field of agricultural and allied sciences, the role of state agricultural universities becomes vital in this aspect. The state agricultural university possess a distinctive system of functioning owing to the diversity in their roles and responsibilities whereby there is elevation of faculties beyond the singular roles of scientists, trainers or teachers (Borah, 2019). According to Jayasingh et al., (2022), the stability of agri-education imparted by the State Agricultural Universities (SAUs) banks on the working rigours of the teachers and that is why it becomes inevitable not to be ignorant towards the content and satisfaction derived from executing their roles assigned to their job, which forms an important component under human resource management of the concerned university as an organization.

Stress is a predicament of constriction that births from the behest for the accommodation or accumulative behaviour both really as well as perceptionally (Win & Aung, 2020). With respect to teachers, it confers about the anti-pathetic mental state which are contemplated in the repugnant requisites to their vocation (Meng et al., 2018). The prevalence of work-related stress is increasing among academics (Tquabo et al., 2021). The manifestations of occupational stress were scaled by the contents mulled over prostration, stress affiliated health disorders, regarded work stress, efficiency, professional contentedness and pondering for job switch (Wang et al., 2020). Harmsen et al., (2019) pointed

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that under the scope of general health point, occupational stress attributes to physiological disorders, reduced welfare and under incessant psycho-mental torment. Stress is explained as an interactive process which occurs between teachers and their teaching environment leading to excessive demands being placed on them and resulting in physiological and psychological distress (Malik et al., 2017). Rana & Soodan (2019) implied the prominent impact of personal as well as occupational stress on the contentedness and health of the teaching fraternity. Kaur & Kumar (2017) stated that the stress rising from the professions are of a great prominence amongst the school teachers of urban arena.

Now-a-days, the teaching and research organizations, particularly the Agricultural Universities and Research organizations are facing new challenges in the context of changing agricultural, social and economic scenario. In this context, a comprehensive study was undertaken with an objective to measure the relationship between profile characteristics and occupational stress and the gap between role expectation and role performance of the teachers of Orissa University of Agriculture and Technology, Bhubaneswar. The result of the study will be helpful in policy advocations for reducing the occupational stress of the teachers of the University.

METHODOLOGY

For the investigation all the faculties working in the main campus of the OUAT i.e., total of 100 respondents comprising 60 from College of Agriculture and 40 from College of Agricultural Engineering were taken by complete enumeration for measuring occupational stress following procedures by Cooper et al., (1988). A structured schedule was developed based on the literature reviews, consultation with experts, supervisor's guidance and the results yielded from a conducted pilot study to evaluate the occupational stress of the faculties of the University. The response of respondents was appraised on seven-point continuum namely, Very Much Satisfaction (VMS), Much Satisfaction (MS), Some satisfaction (SS), Undecided (U), Some Dissatisfaction (SD), Much Dissatisfaction), Very Much Dissatisfaction (VMD) respectively. The score for all statements were added to get occupational stress scores of teachers. Mean and standard deviation was calculated. The classification of respondents into 'no stress', 'mild stress' and 'severe occupational stress' were done by following cumulative square root frequency method and the percentage of respondents belonging to each level of stress was calculated. Personal interview method was implemented for the purpose of data collection from the respondents. Association of socio-personal profile of teachers with their occupational stress were calculated by using Pearson's product moment correlation.

To analyze such differences, a method was employed to detail out the role performance and role expectation related to their particular occupation of the teaching respondents. 14 statements were taken to measure relationship between role expectation and role performance of respondents. Role expectation of the respondents was indicated by 14 number of statements and role performance of respondents was measured by using a four-point continuum indicating 'always', 'moderate', 'seldom' and 'never' where the scores assigned to those are 3, 2, 1 and 0 respectively. As the total number of respondents were 100 and the highest score on the continuum was 3, the maximum score expected for a single statement was (100*3=300) and for 14 number of statements the maximum score expected was (14*300=4200). In the procedure of analyzing deviations, for example with respect to statement-1, 83 respondents belonged to 'always' and 17 respondents belonged to moderate level of role expectation; as the score of always was 3, so role performance score for always category was (83*3=249) and as the score of moderate category was 2, so the role performance score for moderate category was (17*2=34) and the total score obtained (a)) was (249+34=283). Likewise, the role performance scores for all the 14 statements were calculated and summated to obtain the total score of role performance for the 14 number of statements which was 3193.

The deviation of role performance from the role expectation for statement-1 = Maximum score expected - score obtained = 300-283 = 17

Total deviation of role performance from the role expectation = Expected Maximum Score (total) -Total Score Obtained = 4200-3193 = 1007

The percentage of total deviation of role performance from the role expectation = Expected Maximum Score (total) -Total Score Obtained / Expected Maximum Score (total) = 23.97%

Likewise, the deviation from the role expectation is calculated for all the 14 statements by heeding to the steps followed in the procedure above mentioned indicating to the point that the more is the deviation, more is the occupational stress of the teachers.

RESULTS AND DISCUSSION

Occupational stress of the teachers of the University

The data presented by the Figure 1 revealed that only 10 per cent of the respondents do not face any kind of stress whereas mild level and severe level of stress faced by the teachers were 80 per cent and 10 per cent respectively while performing their duties. The existence of such levels of stress as opined by major section of the respondents can be attributed to various range of factors comprising of status accrued to job sphere, work freedom,

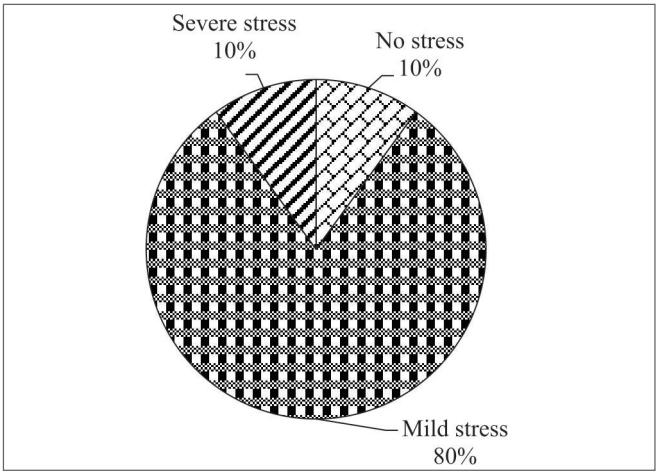

Figure 1. Distribution of respondents according to occupational stress

job security, opportunities for promotion, incentives and many more. These results were in the lines of the finings of Reddy & Poornima (2012) along with Praveen Kumar et al., (2022).

Association of occupational stress with the profile characteristics of the teachers

From the Table 1 it was observed that, there exists a positive and significant association between the educational qualification, present job experience of respondents and their occupational stress level. It means the respondents having Ph.D. degree have more occupational stress than respondents having M.Sc. degree and the respondents having more job experience have more occupational stress than the respondents having less job experience. Again, it is noted that there is a significant but negative association between the family background of the teachers and their occupational stress. It means the respondents having urban family background have less occupational stress than the respondents having rural family background. The other variables i.e. age, family type, family size has no significant association with the occupational stress of teachers.

Being in the educational qualification of PhD by majority, it's pretty obvious the weight of professional burden would be eventually more on them owing to their capabilities and job experience. With the shouldering of more responsibilities at both personal and professional level would automatically invite the stress in the way proportionally. The results displayed analogy to the findings of Kabito & Wami (2020); Valkov & Peeva (2020) & Praveen Kumar et al., (2022).

Table 1. Association of socio-personal profile of teachers with their occupational stress

S.No.	Independent Variables	'r' value
1	Age (X_1)	0.114 ^{NS}
2	Family type (X_2)	0.125^{NS}
3	Family size (X_3)	-0.044 ^{NS}
4	Family background (X_4)	-0.616*
5	Educational qualification (X_5)	0.789**
6	Present job experience (X_6)	0.574*

**Significant at 1%; *Significant at 5%; NS=Non-significant

Role expectation-performance of the teachers of the University

From the Table 2 the maximum gap between the role expectation and role performance was found for the factor opportunity to earn money, wealth and property followed by delegation of authority. Whereas minimum gap was observed in case of job security. Gap was also existed in less magnitude in other areas like opportunity for higher study, scope to show merits and excellence and freedom from risk. However, it was observed from the table that total deviation from the role expectation was only about 23.97 per cent. So, we may conclude that although there existed a gap between role expectation and role performance of the respondents but the gap was not so severe.

It is quite evident from the profile characteristics that belonging to large family size into joint family structure, it was quite obvious the burden of responsibilities of them eventually falls on them to fulfill their basic amenities for their nourishment and development yet restricted by the professional duties in the University system does restricts them to go for more of wealth acquirement opportunities which are quite limited in the university premises. Along with that the slow snail pace of the career advancement scheme of the faculties also pours oil to the heat of the occupational stress too. This stress gets successively added with the delegation of authority as under the constraints of limited resources, they have to manage their all assignments at all costs. These finding were quite analogous to that of Sliskovic & Maslic Sersic (2011).

CONCLUSION

The teachers experienced occupational stress. The profile characteristics contributed significantly to the stress level of teachers. The maximum gap between the role expectation and role performance of teachers of OUAT was found for the factor; opportunity to earn money, wealth and property followed by delegation of authority, whereas minimum gap was observed in case of job security. Gap was also existed in less magnitude in other areas like opportunity for higher study, scope to show merits and excellence and freedom from risk. The consequences of the study would be supportive to the policy formulations for the betterment of the teachers to reduce their stress levels. The

Table 2. Role expectation and role performance of the respondents

S.No.	Role Expectation	Total score obtained	Deviation from the role expectation
1.	Status, respect and prestige as a person	283	17
2.	Scope to show merits and excellence	290	10
3.	Freedom of work	285	15
4.	Job security	299	1
5.	Participation in decision making	198	102
6.	Freedom from external pressure	184	116
7.	Delegation of authority	192	108
8.	Praise and recognition for good work	194	106
9.	Freedom for writing scientific papers	204	76
10.	Opportunity to earn money, wealth and property	7	293
11.	Opportunity for mental and physical comfort	196	104
12.	Freedom for risk	288	12
13.	Opportunity for higher study	292	8
14.	Opportunity for future promotion	281	19

important step in organizational level stress management is to conduct a needs diagnosis which is the prevalence of stress among employees. The next phase of needs diagnosis is to establish corrective managerial action goals.

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Research Note

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Awareness of Paddy Residue Utilization in Karnal and Kurukshetra Districts of Haryana State

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ABSTRACT

Study was conducted in 2021-22 to assess the awareness level of farmers regarding utilization of paddy residue in Karnal and Kurukshetra districts of Haryana state. A well structured and pre-tested interview schedule was developed according to the objective of the study. Two blocks were selected randomly from each district. Further, one village from each block was also selected randomly. So, four villages were selected to collect data. Further, from each selected village, 75 male paddy growing farmers having more than 5 acres of land were selected through snowball technique. Thus, total 300 respondents were interviewed. Present study concluded that all respondents (100.00%) were aware about straw baler machine and feeding the livestock, followed by making cattle shed roof (96.33%), hey rake (93.67) and mulching in the field (93.67). Study also concluded that sufficient time to sow next crop because it takes one and half months to decompose, paddy straw management delays wheat sowing and paddy residue burning is cheap option were major reasons for paddy residue burning.

INTRODUCTION

Increasing population spurt the food demand in across the world which leads increase the food production and for maintaining a sustainable agricultural production it is essential to recycle the nutrients from the crop residue after harvesting. (Hou et al., 2019 & Nagendran, 2011). India being an agriculture dominant country generates around 500-550 million tons (MT) of crop residues every year (IARI, 2012) and still a surplus of 140 MT out of which 92 MT burned each year. Traditional uses of crop residues are animal feed, fodder, fuel, roof thatching, packaging and composting. Residues of cereal crops are mainly used as cattle feed. While, paddy residue used as domestic fuel or in boilers for parboiling rice. Farmers use crop residues either themselves or sell it to landless households or intermediaries, who further sell them to industries however, a large portion of unused crop residues burnt in the fields which results the pollution in the atmosphere and also affects the soil productivity by burning the essential nutrients inside the soil. There are many management alternatives for crop residue management (Gadde et al., 2009 & Pathak et al., 2011). The Government of India is taking many lucrative and punitive approaches to mitigate residual crop burning for sustainable agriculture. So, keeping in view the importance, the present research was carried out to assess the awareness level of farmers regarding utilization of paddy residue in Karnal and Kurukshetra districts of Haryana state.

METHODOLOGY

To assess the awareness of farmers towards paddy residue burning, Karnal and Kurukshetra districts of Haryana state were selected purposively because these are paddy growing districts. Two blocks from each district were selected, randomly. Further, one village from each block was selected randomly. So, total 4 villages were selected to collect the research data. From each selected village, 75 male paddy growing farmers having more than

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5 acres of land were selected through snowball technique. Thus, a total of 300 farmers were interviewed in 2021-22 to assess the awareness level of respondents. While, 15 farmers were also selected from the each village among the 75 to impart training so that training organized for the 60 farmers with the help of KVK Scientist by the interviewer and after that only 54 respondents found who practiced the crop residue burning and reasons were recorded accordingly. A well structured and pre-tested interview schedule was developed in accordance with the objectives of the study. Expert suggestions and available research based literature were also used for the preparation of the interview schedule. Collected data processed, tabulated and analyzed using frequency, percentages and weighted mean score.

RESULTS AND DISCUSSION

The source of general information of the respondents regarding paddy residue is TV (94.67%), followed by internet/ social media on mobile phone (84.67%), newspaper (rank 47.67%), While, relatives, friends and magazines found 11.00, 8.67 and 0.67, respectively as source of information regarding utilization and disadvantages of paddy residue. Timely and authentic information motivate the farmers about the innovations. Results are discord with the result of Choudhary et al., (2022a) who reported that only one-third respondents use TV and ICTs as source of information. It was found that majority of the respondents (56.34%) had more than 15 years farming experience. There is positive relationship between experience and adoption of technology. Pradhan et al., (2021) also concluded positive relation of experience with dependent traits.

Awareness regarding utilization of paddy residue

Data in Table 1 showed the awareness about utilization of paddy residue. In case of awareness of CRM machines all respondents (100.00%) were aware about Straw Baler, followed by Hey Rake machine (93.67%), Super Seeder (87.00%) and Straw Reaper (80.33%). While, only 79.67 per cent were about the Happy Seeder. Awareness level of farmers may be high due to campaigns and trainings etc. organized at village level under scheme of crop residue management. However, in case of awareness about utilization of paddy residue in any form at farm/home it was found that 100.00 per cent were aware about feeding the livestock, making cattle shed roof (96.33%), mulching in the field (93.67%), making cattle bed during winter season (92.67%). It was found that about fifty per cent respondents were aware about growing mushroom. Results are accordance of Roy & Kaur (2014) & Kumar et al., (2017) who concluded that majority of the farmers were aware about using paddy straw as animal feed in Punjab state of India. 53.67 per cent were aware about making cardboard in case of utilization of paddy residue in industries/factories, followed by packaging fruits, fuel in rice & liquor factory, making biogas and generating electricity i.e. 46.00, 41.33, 20.33 and 18.67, respectively. Results got support from the study of Roy and Kaur (2015) who reported that a few farmers used straw in other activities, while Muliarta (2019) reported that farmers did not knowledge about use of straw. 58.00% were aware about advantage i.e. increase soil fertility, followed by reduce environment pollution (52%), no fear of accidents (47%) and save time for sowing of the next crop (40.33%). Only, about one-fourth respondents i.e. 24.33 per cent found that it helps to increase yield of next crop. While, Choudhary et al., (2022b) reported that about fifty per cent farmers' perception was that stubble burning is the leading cause that results in a decline in soil fertility. However, Ramanjaneyulu et al., (2021) added that crop residue increase soil fertility, enhances crop productivity and conserves the environment also. Nain et al., (2017) & Rejulla et al., (2017) also described lack of awareness of development schemes among farmers.

Table 1. Awareness regarding utilization of paddy residue

Awareness about CRM machines to avoid paddy residue burning	Frequency (%)
Super Seeder	261 (87.00)
Happy Seeder	239 (79.67)
Straw Reaper	241 (80.33)
Hey Rake	281 (93.67)
Straw Baler	300(100.00)
Awareness about utilization of paddy residue in any form at farm/ home	
Feeding the livestock	300(100.00)
Making cattle shed roof	289 (96.33)
Making cattle bed during winter season	278 (92.67)
Mulching in the field	281 (93.67)
Growing mushroom	156 (52.00)
Awareness about utilization of paddy residue in industries/factories	
Making cardboard	161(53.67)
Generating electricity	56 (18.67)
Packaging fruits	138 (46.00)
Making biogas	61 (20.33)
As a fuel in rice & liquor factory	124 (41.33)
Awareness about advantages of utilization of paddy residue	
Reduce environment pollution	156 (52.00)
Save time for sowing of the next crop	121 (40.33)
Increase yield of next crop	73 (24.33)
No fear of accidents	141 (47.00)
Increase soil fertility	174 (58.00)

Reasons for paddy residue burning

Data presented in Table 2 showed the reasons for paddy residue burning and found that farmers don't have sufficient time to sow next crop because it takes one and half months to decompose major reason and ranked first with weighted mean score (WMS) 2.00, followed by paddy straw management delays wheat sowing (WMS 1.98), paddy residue burning is cheap option (WMS 1.96), paddy residue (except for Basmati variety) are harder to chew by animals (WMS 1.94), farmers are not satisfied with adoption of machines (WMS 1.92) and use of combine harvester machine leaves large straw after harvesting (WMS 1.90). Main reason of burning is not sufficient time for sowing next crop so it may be the major reason and study also got support from the study of Kumar (2017) & Anuradha et al., (2021). While, Rohilla et al., (2021) concluded that information on smart agricultural practices should be disseminated through effective means among farming households. While, rapid way of controlling weeds, insects and crop disease, labor shortage and high labor cost for manual

Table 2. Reasons for paddy residue burning by the respondents

Reasons for paddy residue burning	WMS	Rank
Framers don't have sufficient time to sow next crop because it takes one and half months to decompose	2.00	I
Paddy straw management delays wheat sowing	1.98	II
Paddy residue burning is cheap option	1.96	III
Paddy residue (except for Basmati variety) are harder to chew by animals	1.94	IV
Farmers are not satisfied with adoption of machines	1.92	V
Use of combine harvester machine leaves large straw after harvesting	1.90	VI
It is a rapid way of controlling weeds, insects and crop disease	1.88	VII
Labor shortage and high labor cost for manual harvesting	1.85	VIII
Lack of adequate space/ market for storage	1.75	IX
Difficulty in collection of crop residue from field as it is bulky to lift and load	1.74	X
High transportation cost due to more distance from field to storage yard	1.72	XI
Poor financial condition to buy or have machines on rent	1.68	XII
Lack of awareness about environmental issues among farmers	1.35	XIII
Foul smell of crop residue due to insects and pests	1.27	XIV
Not owning milch animals	1.20	XV

harvesting, lack of adequate space/ market for storage, difficulty in collection of crop residue from field as it is bulky to lift and load, and high transportation cost due to more distance from field to storage yard ranked in descending order. Poor financial condition to buy or have machines on rent, lack of awareness about environmental issues among farmers, foul smell of crop residue due to insects and pests and not owning milch animals were not serious reason to for paddy residue burning among the farmers. Low reason may be due to continuous awareness crop residue program and campaign by state agriculture departments and state agricultural university. Bhavana et al., (2021) concluded that there is a strong need for other innovative approaches for the effective substitution of crop residue burning.

CONCLUSION

Study concluded that majority of farmers are aware about crop residue management machines and utilization of crop residues at farm or home. There are various programmess, technologies, schemes, interventions, rules and regulations; however, crop residue management is still a major issue so, there is strong need to modification in all for the effective substitution of crop residue burning and it is time to make strategy and focus about awareness and utilization of crop residues in other fields also. So, researchers, extension workers and policy makers need to be engaged for management of crop residue management for sustainability and resilience of agriculture.

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