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MAHARASHTRA SOCIETY OF EXTENSION EDUCATION
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Editorial

Maharashtra Society of Extension Education (MSEE) registered in 1982, has the foremost objective to publish the research journal. Accordingly, the society was publishing the journal entitled Maharashtra Journal of Extension Education. Since the year 2004 this journal has been renamed as Asian Journal of Extension Education.

The journal includes research articles from the researchers and extension workers in the field of extension education from various faculties of various institutes in the country. Extension education plays an important role not only in transfer of innovative technologies but also in developing appropriate methodology in the field of extension more suited for field application. The innovative research methods can be very well communicated for its application and use in further research by the extension fraternity. This can be achieved by publishing research articles.

Asian Journal of Extension Education is a very humble attempt to provide platform towards this goal of networking with the all extension professionals who could kindle the minds of their peers and young scientists through their research articles.

I have immense pleasure to present this 42th issue of Asian Journal of Extension Education for the year 2024. The Journal has received an encouraging response from all corners of the country. We have made an effort to encompass the best articles for the issue. Thanks are due to all the authors who have contributed for this issue.

I extend sincere thanks to Capt. Dr. L. B. Kalantri, Hon'ble President, Dr. D. M. Mankar, Vice President and Respected Member of Executive Body Dr. N. R. Koshti, Dr. N. V. Kumbhare for their constant inspiration, valuable guidance and concrete suggestions to maintain the quality of the journal.

I appreciate the tireless contribution of my colleagues and Joint-Secretary Dr. M. K. Rathod and Dr. S. D. More for their endless efforts in publishing this issue. I am confident that this issue of the Journal will be appreciated by the extension scientists, researchers, students and readers for its usefulness and contents. I solicit their suggestions for further enhancement of quality of the Journal.

Akola
Date: Dec, 2024

P. K. Wakle
Chief Editor

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RESEARCH ARTICLE

Socio-economic status of indigenous chicken rearing rural farmers of Poonch of Union Territory of Jammu & Kashmir (India)

Simran Singh, D. Chakraborty*, Aakriti Sudan, Komal Deep Kour[3], Vidushi Sharma[4], Soshthi Talwar[4] and Mandeep Singh Azad[5]

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ABSTRACT

Poonch district of Union Territory Jammu and Kashmir (India) is bordered by Kashmir valley (Baramula, Budgam, Shopian and Kulgam Districts) in the north east, district Rajouri in the south and Pakistan Occupied Kashmir (POK) in the west having 33.77°N 74.1°E coordinates. Winters are cool and temperatures go below freezing at night. Summers are short and usually pleasant. The average temperature ranges from -6°C in January to 28°C in July-August. The intermittent shelling and cross firing is a regular happening affecting the quality of life of the people living in this area. Moreover, industrial background is totally missing and commercial activity exists on a very low level. Also, farmers are having small pieces of land for agriculture purpose. In such circumstances, poultry seems to be the most appropriate and practical intervention among all livestock species, to enhance the rural livelihoods. Poultry is a proven venture for livelihood of many landless and small farmers. It can be reared by the poorest people of the society for livelihood security. Indigenous poultry have the ability to scavenge mainly on agricultural and kitchen waste products, disease tolerance, meat quality and general hardiness have made indigenous chicken to acclimatize very well to the traditional small-scale production system of the rural community. They gratify the numerous economic, social and cultural requirements of rural households. Therefore, the present study was undertaken for socio-economic characterization of farmers aid in resource allocation to rural poultry improvement and conservation projects of Poonch districts of UT of Jammu and Kashmir.

METHODOLOGY

A structured questionnaire was used to collect data from 55 randomly selected rural farmers rearing indigenous chicken from four tehsils of Poonch district namely Haveli (Magnar village), Mandi (Sathra, Sekaloo and Loran villages), Surankote (Sanai and Lassana villages) and Mendhar (Ari and Goldh villages). Data of socio-economic status were collected for age (years), marital status, family type, number of family members, occupation, annual income, size of family holding (hectare), education, average Flock size and flock composition. The data were compiled, tabulated and subjected to suitable statistical analysis in order to get logical interpretation Snedecor and Cochran (1967). Descriptive statistics like mean, standard error and percentage were used to analyze the data.

FINDINGS

The results of various socio-economic aspects of the indigenous poultry farmers have been presented Table 1.

Table 1 Descriptive analysis of socio-economic traits

Characteristic	Category	Mean ± SE (n)	Percentage (n)
Age (years)		42.73 ± 1.78 (55)	NA
Material status		NA	100 %
Family Type	Nuclear	NA	52 % (31)
	Joint		48 % (24)
Number of family members		5.69 ± 0.43	NA
Occupation	Agriculture and animal husbandry	NA	76.45 % (45)
	Business and Service/Job		11.63 % (05)
	Labour and others		11.63 % (05)
Size of family holding (hectare)		0.22 ± 0.02	NA
	Below Matriculation	NA	37.03 % (30)
	Matriculation		48.15 % (10)
	Above Matriculation		14.82 % (5)
Average Flock size		7.22 + 0.68 (234)	NA
Flock Composition	Chicks (0-8 wks)		9.40 % (22)
	Cockrel (8-20 wks)	NA	1.71 % (04)
	Pullet (8-20 wks)		7.69 % (18)
	Cocks (>20 wks)		22.22 % (52)
	Hens (>20 wks)		58.97 % (138)

Age

In the present study, the average age of farmers was found to be 42.73±1.78 years. This was in accordance with the findings of Justus et al. (2013) in smallholder indigenous chicken production in Western Kenya. However, Bekele et al. (2016), Goraga et al. (2016) and Yadessa et al. (2017) in their studies reported lower age of the respondents in Ethopia. Age is used as a substitute for experience in most studies (Luong and Hèbert, 2009).

Marital status

100% respondents were married which was contrary to the findings of Goraga et al. (2016) in village production system of Ethopia, Balamurugan et al. (2017) in the backyard poultry farmers of Tamil Nadu (India) and Mishra et al. (2020) in tribal backyard poultry farmers of Koraput district (Odisha). This indicated that married respondents were considered to be accountable and rational in decisions making (Olaniyi et al., 2008).

Family type

In the present study, nuclear family type (52.00%) is dominant over joint family type (48.00%). Similar finding was observed by Bikash et al. (2010), Balamurugan et al. (2017) and Mishra et al. (2020) where majority of the family involved in poultry rearing belonged to nuclear family than joint family in Tamil Nadu, Assam and Odisha, respectively.

Number of family members / Family size

The average number of family members was observed to be 5.69±0.43. Similar result was reported by Bekele et al. (2016) and Yadessa et al. (2017) in small holder poultry production system of Ethopia. Mishra et al. (2020) also reported similar types of finding in Odisha. This was found to be lower than the findings of Ayieko et al. (2014) in Makueni County of Keneya, Aman et al. (2015), Bekele et al. (2015) and Goraga et al. (2016) in indigenous chicken village production system of Ethopia.

Occupation

Agriculture and animal husbandry (76.45%) is an important mean of livelihood for majority of the respondents. Similarly, Nayak et al. (2020) reported Agriculture as major occupation among

Khadia poultry farmers of Odisha (India).

Annual Income

Farmers rearing Poonchi chicken population are landless to marginal and small farmers. The annual income is very less ranging from Rs. 2000/- to Rs. 36,000/- with an average value of Rs. 14,475/-. Annual income of farmers mostly depends on subsistence agriculture, animal husbandry activities, poultry rearing and forest produce. Mishra et al. (2020) reported only 8.13% of the respondents had annual income below 50,000/.

Size of family holding (hectare)

Average size of land holding was observed to be 0.22±0.02 hectare which also indicated social status of farmers. The result showed poultry farmers are marginal farmers. Their livelihood security depends on poultry rearing. On contrast higher land holdings were reported by Ayieko et al. (2014) in Makueni County of Keneya, Bekele et al. (2015) and Goraga et al. (2016) in village production system of Ethopia.

Education

Very few respondents (14.82%) were above matriculation/ high school passed, whereas most of the farmers (48.15%) were under the category of only matriculation / high school passed. Education equips farmers with knowledge and skills that will ensure efficient utilization of resources for the improvement of productivity and income (Roseline et al., 2015). Low levels of education may explain the dependence on indigenous knowledge for management by poultry keepers.

Total flock size

The overall mean flock size was found to be 7.22±0.68. On contrast, higher flock size were reported by Gyeltshen et al. (2012) of indigenous chicken of Bhutan, Justus et al. (2013) in smallholder indigenous chicken production in Western Kenya, Bekele et al. (2016) and Yadessa et al. (2017) in smallholder poultry production systems Ethopia. The flock size variation of this study could be due to the difference in availability of feed, the presence of different diseases, predators and the socioeconomic status of the owners and household size. Also the flock size has a positive and significant effect on the profitability of indigenous chicken (Ayieko et al., 2014).

Flock composition

The proportion of the different sex and age groups in the flock is referred as flock composition. Hens (58.97%) were found to be in majority fallowed by cocks (22.22%), chicks (9.40%) pullets (7.69%) and cockerels (1.71%) which was contrary to the findings of Justus et al. (2013) in smallholder indigenous chicken production in Western Kenya. The highest number of hen observed in this study might be due to rearing of chickens mainly for egg production. Cockerels and cocks are maintained in a flock for breeding.

Constraints faced by farmers

Inadequate veterinary services followed by high mortality were reported to be the major and economically important constraints for the production system of the district. However, predators from the wild, unpredictable climatic conditions, natural calamities, cross border firing and high feed cost are also important constraints for indigenous backyard chicken production system in the Union territory of Jammu & Kashmir.

CONCLUSION

Most of the farmers rearing indigenous chicken population are having kachha house, lower annual income and less flock size in the present study. This indicates that the farmers are from poor socio-economic condition. In rural areas, indigenous chicken virtually plays a key socio-economic role and contributes to food security. Government agencies and NGOs are very much encouraged to make sure financial support, uptake skill development trainings and setting up marketing chains for the rural farmers for

specifically those who want to adopt poultry production on commercial aspect. Hence, all these holistic approaches aim to enhance the livelihoods of rural farmers rearing indigenous chicken.

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RESEARCH ARTICLE

Effects of farmers' socio economic characteristics on adoption of push pull technology in Western Kenya: insights from UPSCALE Project

Ng'ong'a, E.[1], Osewe, D. O.[2], Ombok, B[3], Odhiambo, G[4], Aila, F[5], Oliech, W.[6], Mulupi, D.[7], Kiprono, C. [8] and Kharde, P.B [9]

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ABSTRACT

Agricultural technologies are being developed and improved to help in curbing constraints associated with agricultural production and income. Push pull Technology(PPT) is an organic approach in pest management that uses cereal as the main crop and companion crops as Brachiaria.spp and desmodium.spp. UPSCALING the benefits of PPT and its adoption has the potential for intensification of farming systems, addresses food security, livelihoods and climate change resilience in Kenya and beyond while reducing the environmental impact of agricultural practices. The technology significantly reduces Fall Army Worm (FAW), Striga weed and stem borer infestation which is still major menace to cereal yield losses in Kenya. Maize worth USD 1.5b is lost annually due to stem bore in Sub Saharan Africa (SSA). Maize is a staple food in East Africa. PPT enhances quality of grains, retains soil moisture, improves soil fertility and protects the soil from erosion thus has the potential to increase cereal yields by 25%-30%. This study was done in Western Kenya with a focus of determining the effects of farmers' socio economic characteristics on adoption of PPT. Sample size of 304 maize household farmers from five counties with UPSCALE project were proportionately sampled. Questionnaires and key informant interviews (KII) were used for data collection. The findings revealed that Striga weeds, stem borer and fall army worms are still the major menaces. Farmers practiced PPT for various combined reasons which included; to control striga, to increase crop productivity and to control stem borer at 76.70%, 59.09% and 57.39% respectively. The outstanding observation is that only a few farmers (3.41%) practiced PPT as a response to climate change. This could be due to labour intensification of the technology.

Keywords: Farmer' Socio-Economic Characteristics, Adoption, Push Pull Technology, UPSCALE, Kenya

INTRODUCTION

Agricultural technologies are being developed and improved to help in curbing constraints associated with agricultural production and income. Adoption of agricultural technologies has the potential to contribute to sustainable farming systems and improves the global market. Kenya's International Centre of Insect Physiology

and Ecology (ICIPE) and Britain's Rothamsted Research collaborated with partners in Eastern Africa developed the Push-Pull technology (PPT). This is an organic approach in pest management that uses cereal the main crop and companion crops as Brachiaria.spp and desmodium.spp (Amudavi et al., 2009; Cook, Khan & Picket, 2007).

According to Mwangi (2015) East African countries often experience major constraints such as food insufficiency, increasing population pressure on resources, declining food production, high incidences of environmental unsustainability, as well as high food prices.

Maize is a staple food in western region of the Republic of Kenya. Striga weeds, stem borer and fall army worms are still the major menaces ().



Figure 2: Maize field infested with Striga and stalk borer (Source: Amudavi, et all, 2009)

PPT is an innovative knowledge-based technology that significantly reduces fall armyworm (FAW), Striga weed and stem borer infestation which is significant to cereal yield losses in western region of the republic of Kenya (Figure 1). PPT enhances quality of grains, retains soil moisture, improves soil fertility and protects the soil from erosion thus it has the potential to increase cereal yields by 25%-30% ().

The technique involves intercropping silver leaf desmodium, a fodder legume, with maize, Napier and Sudan grass (Figure 2) to provide both immediate and long-term benefits (Cheruiyot, et al., 2022).

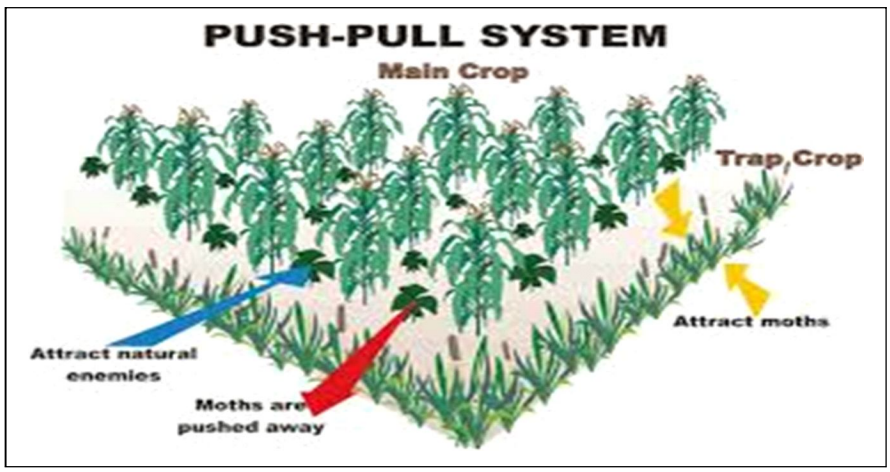


Figure 2: Push Pull Technology (Source: http:/www.push-pull.net/works.shtml)

PPT has a number of benefits that includes but not limited to stem borer and striga control; increased fodder production; nitrogen fixation and reduced soil erosion; increased forage seed production; increased crop yields; improved dairy production; improved Farm Yard Manure (FYM) production; and icreased household income as depicted in Figure 3.

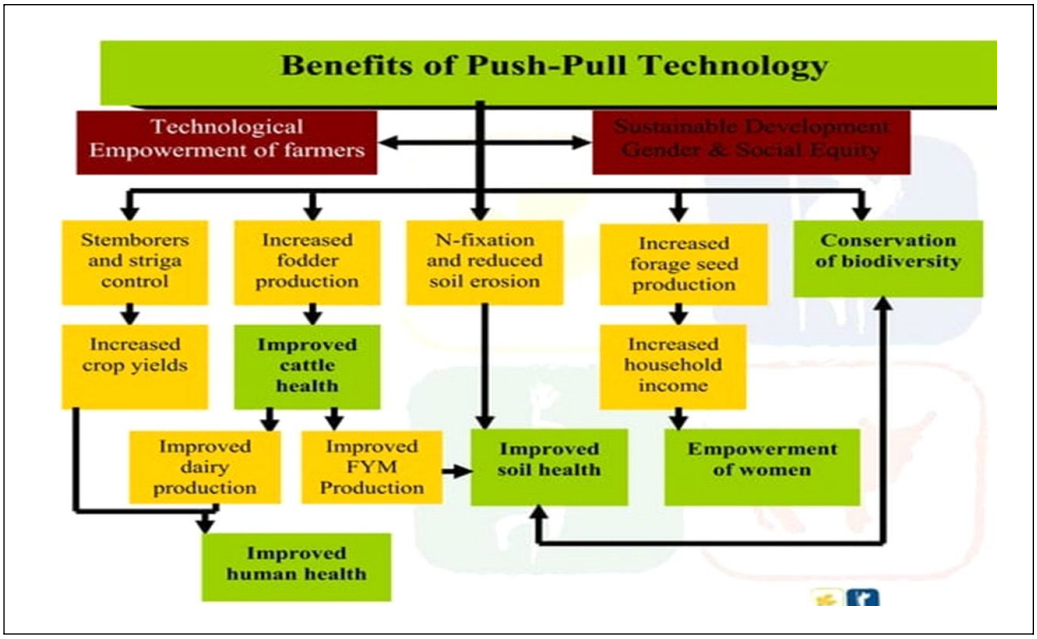


Figure 3: Benefits of Push Pull Technology (Source:

Upscale is a Horizon 2020 (H|2020) project focusing on increasing production efficiency of smallholder farmers in East Africa. The project applies transdisciplinary approaches to research and innovation through Multi-Actor Community (MAC) engagements which is likely to enable smallholder farmers cope with climatic changes while ensuring sustainability and resilience. It is an EU-funded project which aims at scaling up the understanding and applicability of push–pull technology from individual fields, farm, landscape and regional scales; and from cereal to other crops and cultivation systems.

METHODOLOGY

This study was done in Western Region of the Republic of Kenya. The focus of the study was to determine the effect of farmers' socio-economic characteristics on adoption of PPT. Sample size of 304 maize household farmers from counties with UPSCALE project were proportionately sampled namely Kisumu, Homa Bay, Vihiga and Siaya (Table 1). Questionnaires and key informant interviews (KII) were used for data collection (Kothari & Garg 2014; p.35).

Table 1: Sample Size Determination

Country	Frequency	Percentage (%)
Krisumu	47	15.46
Homa Bay	62	20.39
Vihiga	75	24.67
Siaya	120	39.47
Total	**304**	**100.00**

This study employed a descriptive and casual research design that allows data collection from individuals from the five counties. This helps to compare relationships between two or more variables among different maize farmers among the UPSCALE project. The research designs were appropriate since the study tends to explore aspects of PPT adoption among smallholder maize farmers as opined by Rodger (1995)

RESULTS AND DISCUSSION

Farmers' Socio-Economic Characteristics Under UPSCALE Project

The results in Table 2 shows socio-economic characteristics of the responded in the study area.

Table 2: Socio-Economic Characteristics of the Respondent

Gender of respondent	**Frequency**	**Percentage (%)**
Female	190	62.50
Male	114	37.50
Gender of Household head (HH)		
Female	83	27.30
Male	221	72.70
Marital status of HHH		
Single (never married)	1	0.33
Married	222	73.03
Separated	1	0.33
Divorced	3	0.99
Widowed	77	25.33
Main occupation of HHH		
Agriculture self-employed	239	78.62
Agriculture wage labour	3	0.99
Non-Agri self-employed	29	9.54
Non-Agri wage labour	6	1.97
Retired/on pension	2	0.66
Salaried worker	19	6.25
Remittances	1	0.33
Sickly/old/not able to work	1	0.33
Unemployed	4	1.32

	Mean	**Min**	**Max**	**S. Dev.**
Household head age (years)	55.82	23	90	12.8974
Academic Years	9.05	0	36	4.2095
Family size (number)	5.92	1	15	2.5486
No. of HH members earning income	1.42	0	9	1.0310
Agricultural Experience (years)	23.19	3	60	12.1106
Total land owned by the household (acres)	2.1625	0	20	2.4271
Total land Rented-in by the household (acres)	1.11	0.125	8	1.1580
Total land Rented-out by the household (acres)	0.97	0.25	2	0.6373

A total of 304 farmers were proportionately sampled and interviewed from Kisumu, Homabay, Vihiga and Siaya Counties at 15.46%, 20.39%, 24.67% and 39.47% repetitively. Individuals within the household who were more informed about the households' farming activities were chosen to be the respondents during the interviews. Out of the sampled respondents, majority (62.50%) were female. This result highlights the increased involvement and gender role of women in the farming sector.

A large proportion of the interviewed households were male headed (72.70), the household heads were mostly within the prime productive age brackets with an average household head being 55.82 years of age and 73.03% of them were married. The household heads were educated as most of them had acquired formal education with an average of 9.05 academic years. The statistics reflect high dependency since the results showed that an average household had 5.92 members of whom an average 1.42 members were in a position of earning income.

A combined 79.61% of the interviewed farmers relied on agriculture as their primary source of income, this was through being agriculturally self-employed or through agriculture related wage. The sampled farmers were experienced farmers and this is depicted by their average 23.19 years of farming activities. On average the households owned 2.1625 acres of land which is relatively small given the mixed farming nature of the farmers in the study area, to expand on their farm land some rented in land which was averagely an addition of 1.11 acres. Some households other than relying on agricultural production of their land, they earned income from it by renting it out, this was at an average of 0.97 acres of land rented out by a farmer.

Adoption of Push Pull Technology

Table 3 shows results on effects of farmers socio economic characteristics on adoption of push pull technology

Table 3: Effects of farmers socio economic characteristics on adoption of push pull technology

Variable	Frequency	Percentage (%)
Is your household aware of / heard about Push-pull t echnology (PPT)		
Yes	235	77.30
No	69	22.70
How did yo first learn about PPT?		
ICIPE staff	175	74.47
Research Centre (trials/demos/field days) KALRO,	39	16.60
ICIPE, ISD, ICRAF, GIZ		
Government extension	5	2.13
Farmer Coop/Union/Group	7	2.98
Farmer field school	5	2.13
NGO/CBO	7	2.98
Fellow farmer	44	18.72
Universities	1	0.43
Social media: YouTube/radio TV etc.	9	3.83
Did the HH use PPT in the pest?		
Yes	47	44.76
No	58	55.24

Is your household currently using PPT?		
Yes	130	44.68
No	105	55.32
Have you consistently used PPT?		
Yes	136	76.84
No	41	23.16
Will you continue using PPT in future?		
Yes	128	98.46
No	2	1.54
What are the reasons for using PPT		
Increase crop productivity only	104	59.09
Increase livestock productivity only	38	21.59
To increase livestock fodder	76	43.18
Adopt to changing climate	6	3.41
To improve soil fertility	84	47.73
To control striga	135	76.70
To control stem borer	101	57.39
To control fall armyworm incidences	78	44.32

	Mean	Min	Max
For how many years have you known PPT?	8.30	1	27
For how many years have you been using PPT?	8.32	1	25
How many farmers do you know who are using PPT in your village?	5.91	0	100

From the results in table 3, it's worth noting that the farmers' awareness of push-pull technologies in the study region is good, with 77.30% reporting that they were aware or had heard of push-pull technologies while 22.70% were not aware or had never heard of it. The average number of years that the farmers had known PPT and the years they had practiced it were very close as they were 8.30 years and 8.32 years respectively. The highest number of years reported that a farmer had practiced PPT was 25 years.

The farmers' awareness of the PPT was facilitated by a combination of different actors. ICIPE staff were the most influencers on PPT at 74.47%, followed by influence of fellow farmers and Research Centre (trials/demos/field days) at 18.72% and 16.60% respectively. It is worth noting that even though the Universities had an influence in PPT awareness it was the least impactful at 0.43%. From the results it can be noted that farmers were aware of other farmers PPT practices as the reported an average 5.91 neighboring farmers to be practicing it.

As at the time of conducting the study, 44.68% of the farmers were practicing PPT while 55.32% were not practicing PPT. 44.76 % of those who were not currently practicing PPT had previously in the past adopted it and later de-adapted it while, 55.24% of those who were not practicing currently had never adopted it even before. Of the farmers who were currently practicing PPT 76.84% had practiced it consistently over the past years. On the future prospect of PPT, 98.46% of those who were currently practicing PPT reported that they will continue practicing it.

Conclusion and Recommendations

The farmers practiced PPT for various combined reasons which included; to control striga, to increase crop productivity only and to control stem borer reported at 76.70%, 59.09% and 57.39% respectively. The outstanding observation is that only a few farmers (3.41%) practiced PPT as a response to climate change. This could have been due labour intensive nature of PPT.

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RESEARCH ARTICLE

Growth performance of commercially viable major bamboo species in Central India

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ABSTRACT

Present study was carried out to evaluate the growth performance of commercially viable bamboo species at eleven agro climatic zones of Madhya Pradesh. In total 11 bambusetums, 40 bamboo demo plots, and 264 bamboo plantations under 12 Forest Divisions have been surveyed between July 2021 and April 2022. Growth performances were measured by i) Growth in height of each bamboo species per annum, ii) Increase of Girth at breast height (GBH) per annum and iii) Number of culms appearance per clumps.

Study revealed that the maximum culm height growth was observed in *B. balcooa* in Bundelkhand region (6.63 m per annum), followed by *B. tulda* in Vindhya Plateau (4.08 m per annum), and *D. strictus* in Central Narmada Valley (3.72 m per annum). Maximum girth growth observedin *B. balcooa* in Malwa Plateau (14.62 cm per annum), followed by Jhabua hills (12.2 cm per annum) *and* Nimad plain (11.41 cm per annum). Maximum culm appearance per clump were observed in *B. bambos* in Bundelkhand region (36.67 culm appearance per annum), followed by *D. brandesii* in Vindhya Plateau (18 culm appearance per annum), and *B. vulgaris green* in Kymore Plateau and Satpura Hills (16 culm appearance per annum)

Overall performance of *B. balcooa* is more consistent and higher than the other bamboo species, followed by *D.strictus, Bambusa tulda B. tulda, B. bambos, D. longispathus, B. wamin, B. vulgaris green, D. palida, B. nutans, D. asper, D.hamiltonii, D. brandessii, D. giganteus and B. vulgaris yellow* at various agro climatic zones of Madhya Pradesh.

Keywords: Bambusetum, demo plot, bamboo plantation, Agro climatic zones

INTRODCUTION

Bamboo, a perennial giant herbaceous and woody grass, belongs to the subfamily Poaceae or Graminaceae (Liese and Köhl, 2015). The grass has a tremendous capacity to rapidly regenerate after disturbance and has been reported to grow well in degraded areas under condition of impoverished soil nutrients and water stress (Tripathi and Singh, 1994). It makes efficient use of available nutrients and builds up relatively fertile soil around its clumps (Singh & Singh, 1999). Bamboo also offers excellent resilience to climatic extremes especially recurring floods and droughts. It has about 90 genera with more than 1500 species that are native to the tropical, subtropical and temperate regions of all continents except Antarctica and Europe (Kaminski *et al.,* 2016; Yigardu *et al.,* 2016).

India is the second richest country in term of bamboo genetic diversity, with a total of 136 species under 20 genera. 12.8% of total forest cover in the country is bamboo, encompassing about 8.96 million hectare of forest area (Rai and Chouhan, 1998). *Bambusa, Dendrocalamus* and *Ochlandra* are the most widely distributed

bamboo genera in India, totaling about 45% of the total bamboo species found in the country.

Bamboo plays an important role in local economies and its commercial importance is growing at national and international levels (Bystriakova *et al.,* 2004). The ten major species identified by the National Bamboo Mission (NBM) for commercial purpose are *Bambusa bambos, B. balcooa, B. nutans B. tulda, Dendrocalamus strictus, D. hamiltonii, D. asper, D. giganteus, Melocanna baccifera, and Ochlandra travancorica.* Bamboos are the most important items of forest produce used by rural communities in Asia and the Pacific, with many edible species fetching high market values.

Madhya Pradesh (MP) contains the largest forest area of all of India's states, accounting for 20.3% of India's forest area. 30.72% of MP is recorded as forest area, equaling 94,689 sq. km. Reserve forests constitute 65.36%, protected forests, 32.84%, and unclassed forests, 1.8%. According to ISFR (2021), Madhya Pradesh has a maximum bamboo bearing area of 1.84 million ha. followed by Arunachal Pradesh (1.57 million ha.), Maharashtra (1.35 million ha.), and Odisha (1.12 million ha.).

Forestry plays a very important role in economy of the state. Bamboo, an important forest produce and has high significance in the socio-economic life of rural MP. It is often called poor man's timber and is put to multifarious uses for various livelihood options. Bamboo occurs naturally in almost all the Forest Circles of M.P. with Balaghat having the largest bamboo forest area and maximum annual production. The extent of bamboo- bearing area in the forest of the state is about 18394 km^2. Pure bamboo forest area is about 847 km^2, dense forest area is about 4046 km^2, 8327 km^2 has scattered bamboos, and 1928 km^2 hacked bamboo culms (ISFR 2021). Roughly half of MP's natural bamboo forest are degraded. In some areas, the degradation of the bamboo forests has led to the extinction of bamboo altogether (MP Bamboo Mission).

Dendrocalamus strictus, also known as male bamboo, is the most abundant bamboo species in MP. *Bambusa bambos,* locally known as Katang bans, is another important bamboo species found occurring along the banks of perennial rivers, streams, and other moist locations in the state. *Bambusa vulgaris* (Ornamental bamboo), *Bambusa balcooa, B. tulda, Dendrocalamus asper* (popularly known as 'edible bamboo') and *D. stocksii* have been planted in MP, but these plantations are not significant. Occurrence of *Cephalostachyum pergracile* and *B. polymorpha* in the Bori range of Hoshangabad district and *B. nutans* in Jhabua district has been reported previously. *Oxytenanthera nigrociliata* occurs in some patches in Chhattisgarh.

The present study was carried out to identify the best performing bamboo species in all the agro-climatic zones of MP based on the study of bambusetums, demo-plots, and other bamboo plantations in Madhya Pradesh. Through this study, best performing bamboo species have been identified based on the growth performance of different agroclimatic zones of Madhya Pradesh, though which farmers can earn more profit by producing suitable bamboo species. This study also should be helpful to make policy & plan by officials for bamboo cultivation in M.P.

Study Sites

M.P. literally means "Central Province", and is located in the geographic heart of India, between latitude 21°04'N-26.87°N and longitude 74°02′-82°49′ E. With an area of 308,000 sq.km. MP is the second largest state in India after Rajasthan. It is in the north central part of the peninsular plateau of India, whose boundary can be classified in the north by the plains of Ganga-Yamuna, in the west by the Aravali, in the east by the Chhattisgarh plain, and in the south by the Tapti valley and the plateau of Maharashtra. The state is bordered on the west by Gujarat, on the northwest by Rajasthan, on the

northeast by Uttar Pradesh, on the east by Chhattisgarh, and on the south by Maharashtra. The entire country has been delineated into 126 agro-climatic zones by the Indian Council of Agricultural Research (ICAR). Similarly, Madhya Pradesh was divided into 11 agro climatic zones. Brief of agro climatic zones of Madhya Pradesh are as following:

Chhattisgarh plains: This agro climatic zone comprised of Balaghat and Seoni districts of Madhya Pradesh. The average rainfall of this zone is 1200 to 1600 mm and the zone having Red & Yellow (Medium) type of soil.

Northern Hill Region of Chhattisgarh: This agro climatic zone comprised of Shahdol, Mandla, Dindori, Anuppur, Sidhi, Singrauli districts of Madhya Pradesh. The average rainfall of this zone is 1200 to 1600 mm and zone having Red & Yellow Medium black& skeletal (Medium/light) type of soil.

Kymore Plateau & Satpura Hills: This agro climatic zone comprised of Rewa, Satna, Panna,, Katni, Umaria districts of Madhya Pradesh. The average rainfall of this zone is 1000 to 1400 mm and zone having mixed red and black (Medium) type of soil.

Central Narmada Valley: This agro climatic zone comprised of Jabalpur, Narsinghpur, Narmadapuram, Harda, districts of Madhya Pradesh. The average rainfall of this zone is 1200 to 1600 mm and zone having Deep black (deep) type of soil.

Vindhya Plateau: This agro climatic zone comprised of Bhopal, Sagar, Damoh, Vidisha, Raisen, Sehore, Guna, Rajgarh, Ashoknagar districts and the average rainfall of this zone is 1200 to 1400 mm. The zone having Medium black & deep black (Medium/Heavy) type of soil.

Grid Region: This agro climatic zone comprised of Gwalior, Bhind, Morena, Shvpuri, Sheopur districts of Madhya Pradesh. The average rainfall of this zone is 800 to 1000 mm and zone having Alluvial (Light) type of soil.

Bundelkhand: This agro climatic zone comprised of Chhattarpur, Datia, Tikamgarh districts of Madhya Pradesh. The average rainfall of this zone was 800 to 1400 mm and zone having mixed red and black (Medium) type of soil.

Satpura Plateau: This agro climatic zone comprised of Betul and Chhindwara districts of Madhya Pradesh. The average rainfall of this zone is 1000 to 1200 mm and zone having Shallow black (Medium) type of soil.

Malwa Plateau: This agro climatic zone comprised of Mandsaur, Neemuch, Ratlam, Ujjain, Dewas, Indore, Shajapur, Dhar (Partly) districts of Madhya Pradesh. The average rainfall of this zone was 800 to 1200 mm and zone having Medium black (Medium) soil.

Nimar Plains: This agro climatic zone comprised of Khandwa, Burhanpur, Khargone districts of Madhya Pradesh. The average rainfall of this zone was 800 to 1000 mm and zone having Medium black (Medium) type of soil.

Jhabua Hills: This agro climatic zone comprised of Jhabua and Alirajpur districts of Madhya Pradesh. The average rainfall of this zone was 800 to 1000 mm and zone having Medium black skeletal (Light/Medium) type of soil.

MATERIAL AND METHODS

Survey of Bambusetum, demo plot and bamboo plantation in farmer's fields

This study was conducted to evaluate the growth performance of different bamboo species in different agro-climatic zones of Madhya Pradesh. Primary information of bambusetum, demo plots, and bamboo plantations was collected from relevant Forest Divisions and available lists from Madhya Pradesh Bamboo Mission. These lists included planting year, area, planting bamboo species,

number of planted plants, interval between bamboo plants, soil types, etc.

The bambusetums were established by Madhya Pradesh State Bamboo Mission at different Forest Divisions of this state for the collection of various bamboo species. The main aim to establish bambusetum is ex-situ preservation of bamboo germplasm and to spread awareness about various species of bamboo to farmers and people which have multiple uses that they are ignorant about.

Bamboo demo plots were also established by MP State Bamboo Mission through Madhya Pradesh Forest department in farmer's field in different urban and rural areas of Madhya Pradesh to create awareness on bamboo species, cultivation practices and economic growth for bamboo growers and farmers. The bamboo demonstration plot is also being taken up under the National Bamboo Mission to increase the area under bamboo cultivation.

After collecting primary information, counting was done for the bamboo clumps at different stages of growth: Karla (new bamboo clump), Mahila (2nd year bamboo clump which is formed from Karla), Pakiya (3rd stage bamboo clump which gets formed in 4th year from Mahila), Thoth, and Dry. Present study data of the Karla, Mahila, and Pakiya growth stages of bamboo were compiled for calculation of availed bamboo culm per clump followed by measurement of the height of bamboo by relascope and the culm girth at breast height by measuring tape. Data was collected through prescribed questionnaires from concerned forest departments between July 2021 and April 2022.For accurate measurement of culms, grasses and herbs were removed in the field. In total 11 bambusetums located in 11 districts, 40 bamboo demo plots located in 12 Forest Divisions, and 264 bamboo plantations of farmers located in 12 Forest Divisions of all agro climatic zones of M.P. were surveyed, during this period (Table 1 & Figure 1).

Culm diameter can be interpreted in different ways, depending on the end use of the product (Mullik, 2007). The diameter of successive generations of culms increase with the age of the clump (Banik, 2015) until it reaches maximum size. Increased culm size (diameter) is an indicator of the suitability of the species to the biophysical conditions of the growth sites (Anjulo *et al.,* 2022). Getachew *et al.,* 2021 also suggested that bamboo species yields thicker culms are better suited to the biophysical conditions of the land.

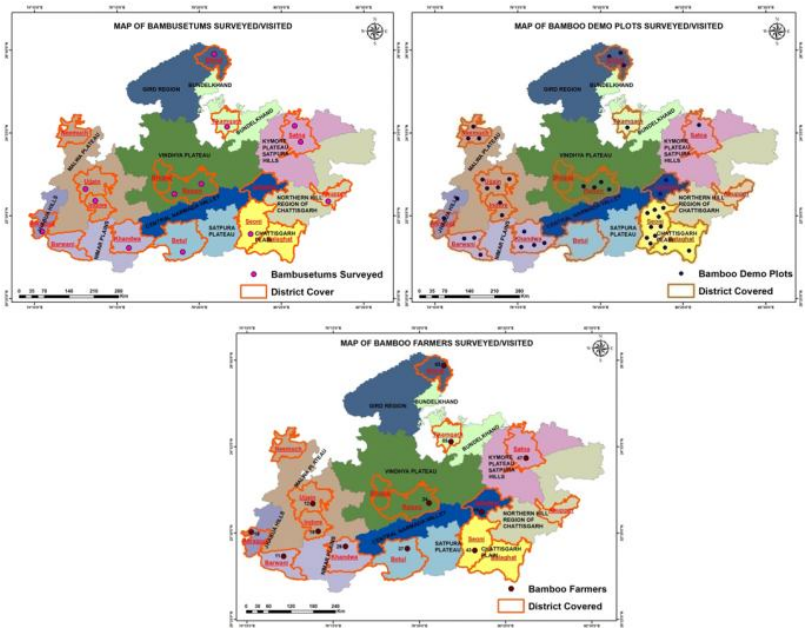


Figure 1: Surveyed bamboo setum, demo plots and farmer plantation of Madhya Pradesh

Biometric observations

The biometric observations for growth attributing characters were recorded on marked clumps for different bamboo species. In most samples, initial height was not properly measured; instead, the overall height data was used and divided with the total age to determine average growth per annum. This data gave an indication of average growth of different bamboo species at different agro-climatic zone. During the field survey of bambusetum, demo plots and bamboo plantations, primary information has been collected *viz* demo plot planting year, demo plot area, planting bamboo species, number of planted plants, interval between bamboo plants, soil type, manure applied etc. After collection of primary information counting was done for the bamboo clumps at different stages of growth, thereafter height of bamboo was measured through relascope and girth of each bamboo culm by measuring tape. Different biometric observations like number of culms per clumps, culm height and girth at breast height were assessed for measured growth attributing characters of different bamboo species.

Number of culms per clumps

The number of culms per clumps was determined species- wise by counting all culms of randomly selected and marked clumps (Kibwage *et al.,* 2008; Gaikwad *et al.,* 2021).

Culm height

The culm height of five representative culms was measured species-wise by using a relascope expressed in meters (Kibwage *et al.,* 2008; Gaikwad *et al.,* 2021) (Plate 1).

Girth at breast height (GBH)

Girth at the 5th internode from the base of the culm below the first internode was measured in centimeters using measuring tape (Kibwage *et al.,* 2008; Gaikwad *et al.,* 2021).

To compare growth performances of various bamboo species at different agro-climatic zones, following facts were also considered for data analysis-

i) Year of plantation in Bambusetums and demo plots and farmers' field are similar and they are mostly of the same provenance in surveyed field areas of each agro-climatic zone.
ii) All surveyed field areas are properly irrigated and protected.
iii) Proper manure application in all surveyed field areas of each agro-climatic zone
iv) Time to time tending operations like weed cleaning and thinning are provided in all surveyed field areas of each agro-climatic zone.

All the three growth performances criteria were compared with ten best commercially viable bamboo species surveyed out of all bamboo species at bambusetums, demo plots and farmers' field of different agro-climatic zones. For selection of best performing species, in addition to ground truithing data, list of commercially viable bamboo species of National Bamboo Mission (www.nbm.nic.in/Bamboo-Species) have also been considered.

RESULTS

Distribution of bamboo species in different agro climatic zones of M.P.

In Madhya Pradesh, out of 10 commercially viable species mentioned in National Bamboo Mission website, the following 8 species were found during our survey: *B. bambos, B. Balcooa, B. nutans, B. tulda, D. strictus, D. hamiltonii, D. asper, and D. giganteus.* Growth performance data was also collected from *D. longispathus, D. brandessii, B. wamin, B. vulgaris* green, *B. vulagaris* yellow and D. *palida.*

Data on surveyed bambusetum, demo plot and different bamboo plantation of farmers' field have been compiled to derive distribution patterns of different bamboo species. During the survey we observed 39 different bamboo species at all 11 agroclimatic zones of Madhya Pradesh.

The detail distribution of different bamboo species is given in Figure 2.

All three growth performance criteria were compared between the fourteen best commercially viable bamboo species surveyed out of at bambusetums, demo plots, and farmers' fields of different agro-climatic zones. These zones were Chhattisgarh plains, Northern Hills Region of Chhattisgarh, Kymore Plateau & Satpura Hills, Vindhya Plateau, Central Narmada Valley, Gird Region, Bundelkhand, Satpura Plateau, Malwa Plateau, Nimad Plain, and Jhabua Hills of Madhya Pradesh.

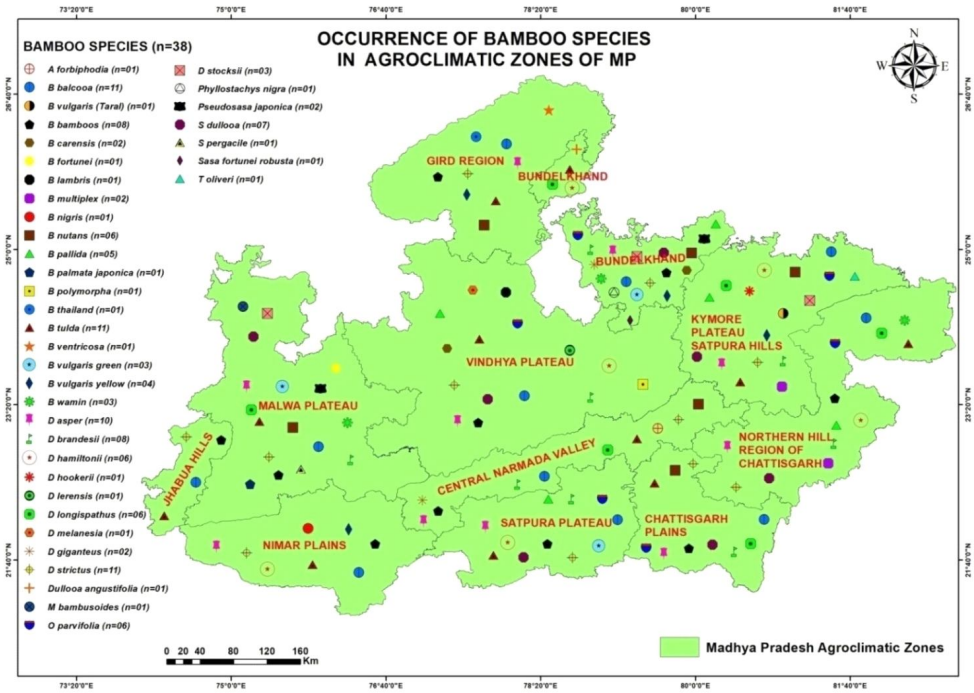


Figure 2: Distribution of bamboo species in different agro climatic zones of Madhya Pradesh

Chhattisgarh Plains

Maximum culm height growth was observed in B. balcooa (2.75 m per annum) in Bambusetum. This was followed by D. longispathus (2.5 m) in demo plot, and B. tulda (2.50 m) in Bambusetum. The lowest culm height growth was D. strictus (0.36 m) in demo plot. In culm girth growth, maximum growth was observed in B. balcooa (4.17cm per annum) in farmer plantation followed by D. longispathus (3.25 cm) in demo plot. Lowest culm girth growth was D. brandesii(0.25 cm) in demo plot. Maximum culm appearance per annum was observed in D. longispathus (12.5 culm) in demo plot followed by D. longispathus (5) in bambusetum. The lowest culm appearance per annum was in D. asper (0.75 culm) in demo plot (Table 2,3 &4).

Northern Hill Region of Chhattisgarh

Maximum culm height growth was observed in B. balcooa (1.67 m per annum) followed by B. wamin (1.50 m) in bambusetum. The lowest culm height growth was in B. bambos (0.5 m). In culm girth,maximum growth was observed in B. balcooa(4.5 cm) followed by D.hamiltonii (3.50 cm) bambusetum. The lowest culm girth growth was in D. palida (1.50 cm) bambusetum. Maximum culm appearance was observed in B. wamin (12.50 culm) followed by D. hamiltonii (9.75) bambusetum. The lowest in culm appearance was B. bambos (3.5 culm) in bambusetum (Table 2,3 &4).

Kymore Plateau and Satpura Hills

Maximum culm height growth was observed in D. hamiltonii(3.33 m per annum)

followed by B. tulda (3 m). Lowest culm height growth was in B. vulgaris green (0.4 m) in bambusetum. In culm girth, maximum growth was observed in B. tulda (4.67 cm per annum) followed by D. longispathus (3.67 cm). Lowest culm girth growth was in B. vulgaris green (0.40 cm) in bambusetum. Maximum culm appearance was observed in B. vulgaris green (16 culm) followed by D. brandessii (12.85) in bambusetum. Lowest culm appearance was in D. strictus (3 culm) in farmer plantation (Table 2, 3 &4).

Central Narmada Valley

Maximum culm height growth was observed in D. strictus (3.72 m per annum) in farmer plantation followed by D. asper (3.67 m) in demo plot. Lowest culm height growth was in B. nutans (0.4 m) in bambusetum. In culm girth maximum growth was observed in B. balcooa (5.82 cm per annum) followed by D. strictus (4.37) in farmer plantation. Lowest culm girth growth was in D. hamiltonii(0.53 cm) in demo plot. Maximum culm appearance was observed in D. giganteus (15 culm per annum) in demo plot followed by D. palida (9.67) in demo plot. Lowest culm appearance was in B. bambos (1.37 culm) in farmer plantation (Table 2,3 &4).

Vindhya Plateau

Maximum culm height growth was observed in B. tulda (4.08 m per annum) in farmer plantation followed by in B. balcooa (3.05 m) in demo plot. Lowest culm height growth was in B. bambos (0.34 m) in farmer plantation. In culm girth, maximum growth was observed in B. tulda (7 cm per annum) in bambusetum followed by B. balcooa (5.45 cm) in demo plot. Lowest culm girth growth was in B. bambos (1.0 cm) in farmer plantation. Maximum culm appearance was observed in D. brandesii (18 culm appearance per annum) in farmer plantation followed by B. balcooa (6.5) in bambusetum. Lowest culm appearance was in D. strictus (1.9 culm) in demo plot (Table 2,3 &4).

Bundelkhand region

Maximum culm height growth was observed in B. balcooa(6.63 m per annum) in farmers' plantation followed by B. vulgaris green and B. palida (4.0 m). Lowest culm height growth was in D. brandessii (0.83 m) in bambusetum. In culm girth, maximum growth was observed in B. wamin (6.67 cmper annum) in bambusetum followed by D. strictus (6.66 cm). Lowest culm girth growth was in D. giganteus(1.33 cm) in bambusetum. Maximum culm appearance was observed in B. bambos (36.67 culm appearance per annum) followed by D. longispathus (15.00) in bambusetum. Lowest culm appearance was in B. bambos (2.0) in demo plot and D. strictus (2 culm) in farmer plantation (Table 2, 3 &4).

Gird region

Maximum culm height growth was observed in B. balcooa (3.2 m per annum) followed by B. tulda (2.20 m) in bambusetum. Lowest culm height growth was in D. strictus (0.22 m) in farmer plantation. In culm girth, maximum growth was observed in D. strictus (5.0 cm per annum) followed by B. balcooa (4.40 m) in bambusetum. Lowest culm girth was in D. palida (1.29 cm) in demo plot. Maximum culm appearance was observed in B. vulgaris green (13.33 culm appearance per annum) in demo plot followed by B. nutans (9.4) in demo plot. Lowest culm appearance was in D. strictus (2 culm) in farmer plantation (Table 2, 3 &4).

Satpura plateau

Maximum culm height growth was observed in B. bambos (3.0 m per annum) in farmer plantation followed by B. balcooa (2.78 m) in demo plot. Lowest culm height was in B. balcooa (0.5 m) in farmer plantation. In culm girth, maximum growth was observed in B. bambos (5 cm per annum) followed by D. strictus (4.75 cm) in farmer plantation. Lowest culm girth was in B. vulgaris green (0.6 cm) in bambusetum. Maximum culm appearance was observed in B. balcooa (5.27 culm) in farmer plantation

followed by B. tulda (4.8) in bambusetum. Lowest culm appearance was in B. balcooa (1.75 culm) in bambusetum (Table 2,3 &4).

Malwa plateau

Maximum culm height growth was observed in B. balcooa (2.07 m per annum) followed by B. bambos (2 m) in farmer plantation. Lowest culm height was in D. asper (0.62 m). In culm girth, maximum growth was observed in B. balcooa (14.62 cm per annum) in demo plot followed by B. wamin (5.5 cm) in bambusetum. Lowest culm girth growth was in B. bambos (1.0 cm) in farmer plantation. Maximum culm appearance was observed in B. balcooa and B. wamin (5.5 culm) in bambusetum. Lowest culm appearance was in B. bambos (1 culm per annum) (Table 2,3 &4).

Nimad plains

Maximum culm height growth was observed in B. balcooa (3.33 m per annum) in farmer field followed by B. bamboos (2.33 m) in demo plot. Lowest culm height growth was in D. asper (0.67 m) in bambusetum. In culm girth, maximum growth was observed in B. balcooa (11.41 cm per annum) in farmer field followed by D. strictus (9.0 cm) in demo plot. Lowest culm girth growth was in D. apser and B. vulgaris yellow (2.0 cm) in bambusetum. Maximum culm appearance was observed in B. tulda (12.67 culm) in demo plot followed by B. bambos (9.78 culm) in demo plot. Lowest culm appearance was in B. tulda (1.67 culm) in bambusetum (Table 2,3 &4).

Jhabua hills

Maximum culm height growth was observed in *B. balcooa* in both demo (3.6 m/annum) & farmer plantation (2.5 m/annum) followed by *B. tulda* (1.37 m/annum) in demo plot. Lowest culm height growth was in *B. bambos* (0.53 m) in farmer plantation. Maximum culm girth growth was observed in *B. balcooa* in both demo (12.2 cm/annum) & farmer plantation (7.7 m/annum) followed by *B. tulda* (3.38 cm/annum) in farmer plantation. Lowest culm girth growth was in *B. bambos* (0.94 cm) in farmer plantation. Maximum culm appearance was observed in *B. tulda* (7.33 culm per annum) in demo plot followed by *B. tulda* (3.33) in farmer plantation. Lowest culm appearance was in *D. strictus* (0.73) in bambusetum (Table 2,3 &4).

Discussion

On the basis of different growth parameters, the following species performed best in each agro climatic zone. Chhattisgarh Plains: *B. balcooa and D. longispathus;* Northern Hill Region of Chhattisgarh: *B. balcooa* and *B. wamin;* Kymore Plateau and Satpura Hills: *D. hamiltonii, B. tulda,* and *B. vulgaris green;* Central Narmada Valley: *D. strictus, B. balcooa* and *D. giganteus;* Vindhya Plateau: *B. tulda* and *D. brandesii;* Bundelkhand region: *B. balcooa, B. wamin,* and *B. bambos;* Gird region: *B. balcooa, D. strictus,* and *B. vulgaris* green; Satpura plateau: *B. bambos* and *B. balcooa;* Malwa plateau: *B. balcooa and B. wamin;* Nimad plains: *B. balcooa* and *B. tulda;* lastly, in Jhabua hills: *B. balcooa* and *B. tulda* were comparatively found to be the best performing bamboo species.

The maximum culm height growth was observed in *B. balcooa* in Bundelkhand region (6.63 m per annum), followed by *B. tulda*in Vindhya Plateau (4.08 m per annum), and *D. strictus* in Central Narmada Valley (3.72 m per annum). In a study conducted at Singalkhanch, Ukai, Tapi, and Gujara in India, *B. vulgaris* had a greater culm height than *D. asper* (Amlani *et al.,* 2017). Our study suggests that *B. balcooa* has a better adaptation potential in the study area than *B. vulgaris*.

The maximum girth growth was observed in *B. balcooa* in Malwa Plateau (14.62 cm per annum), followed by Jhabua hills (12.2 cm per annum), and Nimad plain (11.41 cm per annum). Amlani *et al.,* (2017) on their study at Tapi, Gujarat reported culm diameter at breast height for bamboo species *viz., D. asper* (5.64 cm), *B. balcooa* (4.14 cm), *B. tulda (*3.97 cm), *B.*

vulgaris (Green) (7.54cm) and *B. vulgaris* (Yellow) (6.95 cm). Krishnakumar et *al.,* (2017) reported diameter of 3.37 cm, 3.19 cm, and 4.40 m for *B. balcooa, B. vulgaris*, and *B. bambos* respectively at the end of three years age in north eastern zone of India. Amani *et al.,* 2022, who also reported better performance of *B. vulgaris* and *B. balcooa* in the agro-climatic conditions of Kerala. Interestingly, the culm girth of *B. vulgaris* was considerably higher than *B. balcooa.* In our study, *B. balcooa* had greater culm height and culm thickness.

The maximum culm appearance per clump was observed in *B. bambos* in Bundelkhand region (36.67 culm appearance per annum), followed by *D. brandesii* in Vindhya Plateau (18 culm appearance per annum), and *B. vulgaris green* in Kymore Plateau and Satpura Hills (16 culm appearance per annum). Amlani *et al.,* 2017, who reported number of culms per clump of bamboos, noted a maximum in *Schizostachyum dullooa* of 105.00. This was at par with *Melocanna bambusoides,* 100.67. The lowest number of culms per clump was recorded in *Bambusa balcooa* (9.67). In our study, the maximum culm appearance observed in *B. bambos* followed by *D. brandesii.*

Our present study revealed that the overall performance of *B. balcooa* was consistent and higher than the other bamboo species followed by *D. strictus, Bambusa tulda, B. bambos, D. longispathus, B. wamin, B. vulgaris green, D. palida, B. nutans, D. asper, D.hamiltonii, D. brandessii, D. giganteus* and *B. vulgaris yellow*. Study also revealed that the occurrence of *B. balcooa* found in all eleven agroclimatic zones of Madhya Pradesh. *B. bambos*, *D. strictus* and *B. tulda* occurred in all eleven agro climatic zones of Madhya Pradesh. *D. asper* occurred in ten agro climatic zones. *D. hamiltonii, D. brandessii* occurred in seven agro climatic zones. *B. vulgaris* occurred in five agro climatic zones. *B. nutans* and *B. vulgaris* green occurred in six agro climatic zones. *D. longispathus*, and *D. brandesii* occurred in four agro climatic zones. *B, wamin* occurred in three agro climatic zones. Lastly, *D. giganteus* occurred in two agro climatic zones of Madhya Pradesh.

The present study showed that, at different agro climatic zones, different bamboo species found to be superior, but based on overall growth performance wise rank, *B.balcooa was* found to be the best performing. This was followed by *D. strictus, B. tulda, B. bambos, D. longispathus, B. wamin, B. vulgaris* green, *D. palida, B. nutans, D. asper, D.hamiltonii, D. brandessii, D. giganteus,* and *B. vulagaris* yellow (Figure 3).

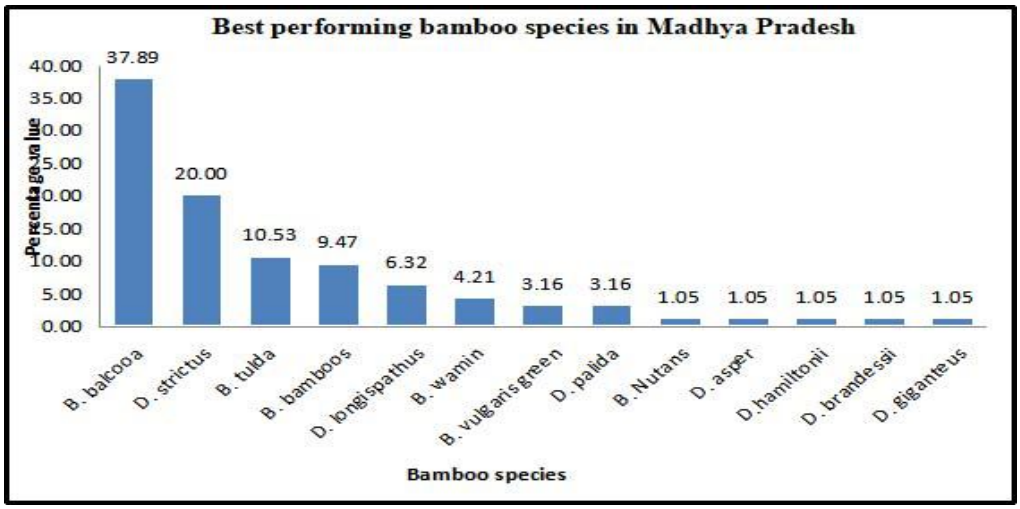


Figure 3. Growth performance wise best rank of bamboo species in overall agro-climatic zones of Madhya Pradesh

CONCLUSION

The present study attempted to explore the comparative growth performance of commercially viable bamboo species in different agro climatic zones of Madhya Pradesh. It revealed that on the basis of overall growth performance, the superior bamboo species are *B. balcooa* followed by *D. strictus* and *B. tulda*. However, management objectives and market value are the primary consideration in deciding the farmer's choice of bamboo species. Hence, depending on the management objective, any of these species can be suggested for farmer cultivation. For example, *D. asper* and *B. brandisii* are edible bamboos and fetch high price in the market while *B. balcooa*, *B. vulgaris, B. tulda* are structurally stronger bamboos which have unique market niches. Furthermore, the clump circumference of the bamboos under study showed compact spread as compared with *B. bambos*, the traditional bamboo of Madhya Pradesh, suggesting their possible suitability for integration with the multitier agro-forestry systems in Madhya Pradesh.

Though we observed multiple challenges are being faced by the bamboo depending communities, a wide variation of species was recorded in various demo plots and bambusetums which can serve as a "security deposit" and needs to be maintained with highest efforts and standards. Protection system need to be strengthened at different bambusetums and demo plots in certain areas to conserve the species. More advanced irrigation facilities are suggested in bambusetums and demo plots especially in areas where summer temperature is high (eg. Bundelkhand Agro-climactic zone).

A bamboo theme park can be developed in the state where representation of various species can be properly maintained. It can be used for educational purpose and also for the promotion of a bamboo based economy. Seed banks of various native bamboo species needs to be developed and maintained at Division/district level.

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Table 1: Details of surveyed bambusetum, demo plots and bamboo plantation of different agro-climatic zones of Madhya Pradesh

S.No.	Agro-climatic zones	Division	Bambusetum	Demo plots	Bamboo plantation
1	Chhattisgarh plains	South Seoni Division	01	9	43
		North Balaghat Division	*	2	
2	Northern Hill Region of Chhattisgarh	Anuppur Division	01		
3	Kymore Plateau & Satpura Hills	Satna Division	01	1	47
		Katni Division	*		
4	Vindhya Plateau	Raisen Division	01	4	24
		Bhopal Division	*		
5	Central Narmada Valley	Jabalpur Division	0	2	16
		Narmadapuram Division	*		
6	Gird Region	Bhind Division	01	3	2
7	Bundelkhand	Tikamgarh Division	01	1	5
8	Satpura Plateau	North Betul Division	01		37
9	Malwa Plateau	Ujjain Division	01	4	12
		Indore Division	01	2	19
		Neemuch Division	*	3	
10	Nimad Plains	Khandwa Division	01	4	29
		Badwani Division	*	3	11
11	Jhabua Hills	Alirajpur Division	01	2	19
		Total	**11**	**40**	**264**

Table 2: Growth performance of major commercial viable bamboo species in Bambusetum of Madhya Pradesh

Bamboo Species	Chattisgarh Plains			Northern hill of CG			Kymore Plateau			Cental Narmada Valley			Vindhya Plateau			Grid			Bundelkhand			Satpura Plains			Malwa Plateau			Nimad Plains			Jhaba HiLL		
	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C
B. balcooa	2.75	2.00	2.00	1.67	4.50	4.00	1.6	3.40	5.00				2	6.00	6.50	3.2	4.40	6.20	3.33	5.33	6.33	0.58	1.5	1.75	1.25	3.5	5.5						
B. bambas				0.5	2	3.5							1.00	2.26	4.60	1.6	3.60	6.00	2.33	5.00	36.67	1.4	0.9	2.7	1.13	3.38	2.63						
D. strictus				0.625	3.00	3.75	1.6	3.00	7				1.13	3.25	4.4	1.70	5.00	7.80	1.33	6.66	6.66				1	3	2.25	1.5	4.00	2.33	0.55	1.45	0.73
B. Nutans	1.50	2.00	2.50				1.63	1.87	6.73							1	2.6	9.4	3.33	5.33	5.33				1	2	2.75						
D. asper	0.5	1.50	0.75	0.75	2.00	6.33	7.17	2.67	4.33				1	1.50	3.5				1	3.33	10.00	0.875	1	4.575	0.62	1.63	2	0.67	2.00	2			
D. hamiltonii				0.87	3.50	9.75	3.33	2.67	10.33				1.75	3.00	2.50				1.66	5	20												
D. longispathus	1.88	2.5	5	1	2.25	4.75	2.67	3.67	8.67										1.67	4.00	15.00				0.75	2	4.25						
D. brandessii	1.50	2.00	3.8	1.25	2.38	5.5	1.1	2.4	12.85				1.50	3.00	2.5				0.83	2.67	6.33				1.5	3	2						
B. wamin				1.5	2.75	12.25													1.67	6.67	6.33				0.75	5.5	5.5						
D. giganteus																			2	1.33	7.33												
B. vulgaris Green							0.4	0.4	16				1.25	4	4.5							0.75	0.6	2.5									
B. vulgaris yellow							1.2	0.6	1.2							1.8	3.60	7.20	1.5	5	4							1	2	2			
D. palida				1.00	1.50	5.25	2.67	2.47	12.33				0.75	2.50	2.00				4.00	5.67	5.00	1.45	1.45	2.75									
B. tulda	2.5	2.50	3.75	0.88	2.50	6.25	3.00	4.67	5.33				1.75	7.00	6.00	2.20	4.00	6.60	2.33	3.00	2.67	0.75	1.45	4.8	1.19	2.75	3.75	1	2.67	1.67			

Table 3. Growth performance of major commercial viable bamboo species in Demo Plot of Madhya Pradesh

Bamboo Species	Chattisgarh Plains			Northern hill of CG			Kymore Plateau			Cental Narmada Valley			Vindhya Plateau			Grid			Bundelkhand			Satpura Plains			Malwa Plateau			Nimad Plains			Jhaba HiLL		
	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C
B. balcooa	2.13	2.11	1.62							1.84	4.33	3.25	3.05	5.45	4.5	1.72	3.35	7.15				2.78	2.44	2.99	1.95	14.62	3.47	1.44	4.65	6.22	3.6	12.2	3.2
B. bambas										2.67	4	3.17	1.85	2.65	1.9	1.24	2.7	5.14	1.8	4.5	2							2.33	5.78	9.83			
D. strictus	0.36	0.69	1.31				1.75	1.87	5.75																			2.25	9	7			
B. Nutans										0.4	0.67	3.67																					
D. asper										3.67	1.33	3.3				1.57	3.12	7.88										0.67	2.67	9.33			
D. hamiltonii										0.5	0.53	2.07				0.86	1.57	2.43										1	3.17	8.67			
D. longispathus	2.5	3.25	12.5							1.33	4.33	4.67																					
D. brandessii	1	0.25	2.5							1	3	3																					
D. giganteus										0.83	0.67	15																					
B. vulgaris Green										1.67	3.67	2.17				1	2.67	13.33															
B. vulgaris yellow										2	4.17	6.5																					
D. palida										1.5	3.33	9.67				0.71	1.29	3.86															
B. tulda	1.63	1.88	3.77							1.33	2.08	6.25				0.71	1.71	2.14															

Table 4.Growth performance of major commercial viable bamboo species in Farmers Plantation of Madhya Pradesh

Bamboo Species	Chattisgarh Plains			Northern hill of CG			Kymore Plateau			Cental Narmada Valley			Vindhya Plateau			Grid			Bundelkhand			Satpura Plains			Malwa Plateau			Nimad Plains			Jhaba HiLL		
	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C	H	G	C
B. balcooa	1.16	4.17	1.8				1.15	2.76	3	3.27	5.82	3.29	1.45	3.65	3.09	0.18	3	3	6.63	4.25	3	0.50	4.55	5.27	2.07	4.88	3.95	3.33	11.41	5.33	2.5	7.7	3.0
B. bambas	0.85	1.58	2.19				1.19	2.85	3.08	1	2.11	1.37	0.34	1	3.71							3	5	4	2	1	1	2.15	4.92	5.51	0.53	0.94	1.2
D. strictus	1.57	1.76	2.71				1.18	2.77	3	3.72	4.37	8.27	1.81	5.5	4.75	0.22	5	2	1.8	3	2	1.20	4.75	1.86	1.85	4.05	3.52	2.13	5.60	9.91	0.69	1.97	3.27
D. hamiltonii													1.25	5	18																		
B. tulda													4.08	3.94	5.22																2	3.38	3.33

H.=Average height growth per annum (meter), G.=Average girth growth per annum (cm), C=Average culm appearance per annum (Nos)

RESEARCH ARTICLE

Farmers' adaptation strategies to climate change in cereal cultivation on gender perspective

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ABSTRACT

Climate change poses significant challenges to agricultural sustainability, particularly in regions like India where farming is the primary livelihood. This study investigates the adaptation strategies employed by farmers in response to climate-induced challenges, identifies the constraints faced in adopting improved farming practices, and explores potential solutions for enhancing resilience. Conducted in the Kheda district of Gujarat, the research utilized an ex-post- facto design and surveyed 80 farmers using structured interviews. Data analysis employed frequency, percentage and mean score techniques using SPSS software. The findings revealed that a substantial proportion of farmers adopted medium to low levels of adaptation technologies related to soil and water conservation, irrigation management, pest control, crop production and improved practices. Major constraints included high input costs, inadequate access to climate- resilient technologies, lack of timely information and poor institutional support. Farmers suggested interventions such as timely supply of agricultural inputs, capacity-building training, subsidies for climate-resilient technologies and enhanced access to weather forecasting and storage facilities.

Keywords: Cereal crops, Climate change, Farmers, Adaptation, Gender

INTRODUCTION

Climate change is a pressing global issue with far-reaching consequences for agriculture, particularly in regions like India, where farming forms the backbone of the economy and livelihoods. Shifts in temperature, rainfall patterns, and the increased frequency of extreme weather events significantly affect agricultural systems, influencing crop yields, pest outbreaks, soil health, and water resources (IPCC, 2021; FAO, 2018). Rice, as a staple crop integral to food security in India, is particularly susceptible to these climatic variations, making it crucial to understand and enhance farmers' adaptation strategies.

Farmers adopt diverse strategies to mitigate the adverse impacts of climate change, including soil and water conservation, improved irrigation practices, pest management, and adopting better crop production technologies (World Bank, 2020). However, these efforts are often hindered by constraints such as high input costs, lack of technical knowledge, insufficient institutional support, and dependence on erratic monsoons (Kumar et al., 2019). Overcoming these barriers requires targeted interventions, including policy reforms, capacity-building initiatives, and the development of climate-resilient agricultural technologies.This study, conducted in the Kheda district of Gujarat, aims to examine the adaptation technologies employed by farmers, identify the constraints they face in adopting improved farming

practices, and gather their suggestions for overcoming these challenges. The findings will contribute to a better understanding of farmer resilience and inform strategies to promote sustainable agriculture in the face of climate change.

OBJECTIVES:

1) To study the profile of the respondents
2) To find out the adaptation technologies used by respondent on gender perspective
3) To find the constraints faced by the respondents in adoption of improved farming practices
4) To see the suggestions to overcome the constraints faced by the respondents in adoption of improved farming practices

METHODOLOGY

The present study was carried out in Kheda district of Gujarat state. In Kheda district, 2 talukas were selected after discussion with the experts on the basis of prevalence of production and area of rice crop. From each taluka, two villages were selected randomly. And from each village, ten men and ten women farmers were selected for the study, randomly. So total 80 farmers were selected for the study. *Ex-Post-Facto* research design was used in the present study (Kerlinger, 1976). The data were gathered, processed and analyzed to draw the meaningful conclusion. The statistical tools used for the analysis of the data were frequency, percentage and mean score rank and t-test. Data was analyzed in SPSS software. Five indicators were used to ascertain the adaptation technologies of farmers' *viz.,* adaptation strategies related to soil and water conservation, adaptation strategies related to irrigation/ water management, adaptation strategies related to irrigation/ water management, adaptation strategies related to crop production and adaptation strategies related to improved crop practices.

RESULT AND DISCUSSION:

Table 1: Profile of the respondents **(n=80)**

Name of Variable		Male		Female	
		f	%	*f*	%
Age	Young Age	01	02.50	02	05.00
	Middle age	22	55.00	30	75.00
	Old age	17	42.50	08	20.00
Education	Illiterate	3	07.50	3	07.50
	Primary education	05	12.50	03	07.50
	Secondary education	07	17.50	08	20.00
	Higher secondary education	12	30.00	13	32.50
	Graduation	11	27.50	12	30.00
	Post graduation	02	05.00	01	02.50
Farming experience	Up to 05 years	03	07.50	08	20.00
	6 to 10 Years	01	02.50	11	27.50
	11 to 15 years	05	12.50	05	12.50
	16 to 20 years	10	25.00	04	10.00
	Above 21 years	21	52.50	12	30.00
Land holding	Marginal farmer	15	37.50	10	25.00
	Small farmer	12	30.00	15	37.50
	Semi-medium farmer	08	20.00	08	20.00

Name of Variable		Male		Female	
		f	%	*f*	%
	Medium farmer	03	07.50	06	15.00
	Big farmer	02	05.00	01	02.50
Annualfamily income	Up to 50,000	01	02.50	02	05.00
	50,001 to 2,00,000	14	35.00	18	45.00
	2,00,001 to 4,00,000	10	25.00	14	35.00
	4,00,001 to 10,00,000	03	07.50	06	15.00
	Above 10,00,001	03	07.50	06	15.00
Irrigation source	Tube well	15	37.50	14	35.00
	Well	21	52.50	25	62.50
	Canal	22	55.00	25	62.50
	Pond	02	05.00	00	00.00
	Rainfed	00	00.00	00	00.00
Agricultural mass media	Very low	25	62.50	38	95.00
	Low	07	17.50	01	02.50
	Medium	04	10.00	02	05.00
	High	02	05.00	00	00.00
	Very High	02	05.00	00	00.00
Extension contact	Very low	19	47.50	20	50.00
	Low	10	25.00	11	27.50
	Medium	06	15.00	09	20.00
	High	02	05.00	00	00.00
	Very High	03	07.50	00	00.00
Social participation	No membership	07	17.50	00	00.00
	Membership in one organization	12	30.00	08	20.00
	Membership in two organizations	16	40.00	19	47.50
	Membership in more than two organizations	03	07.50	12	30.00
Credit orientation	Low	19	47.50	27	67.50
	Medium	19	47.50	12	30.00
	High	02	05.00	01	02.50
Change proneness	Very low	05	12.50	07	17.50
	Low	06	15.00	08	20.00
	Medium	14	35.00	15	37.50
	High	12	30.00	10	25.00
	Very High	03	07.50	00	00.00
Cosmopolitness	Very low	00	00.00	02	05.00
	Low	08	20.00	09	22.50
	Medium	20	50.00	16	40.00
	High	12	30.00	12	30.00
	Very High	00	00.00	01	02.50
Scientific orientation	Very low	02	05.00	04	10.00
	Low	12	30.00	24	60.00
	Medium	18	45.00	11	27.50
	High	08	20.00	01	02.50
	Very High	00	00.00	00	00.00

Name of Variable		Male		Female	
		f	%	*f*	%
Risk orientation	Very low	06	15.00	03	07.50
	Low	08	20.00	13	32.00
	Medium	15	37.50	17	42.50
	High	07	17.50	06	15.00
	Very High	04	10.00	01	02.50

According to table 1, more than half (52.50 %) of respondents had above 21 years of farming experience followed by 16 to 20 years (25.00 %), 11 to 15 years (12.50 %) and up to 5 years (7.5 %) of farming experience. Only 2.5 per cent of the respondents had 6 to 10 years of farming experience. While in case of the female respondents, 30.00 per cent of respondents had above 21 years of farming experience followed by 6 to 10 years (27.50 %) of farming experience, very low (20.00 %) of farming experience and 11 to 15 years (12.50 %) farming experience. Only 10.00 per cent of the respondents 16 to 20 years of farming experience.

According to table 1, 30.00 per cent of the male respondents had higher secondary level of education followed by graduation level (27.50 %), secondary level (17.50 %) of education, primary level (12.50 %) of education. 7.50 per cent of respondents were illiterate and only 5.0 per cent of the respondents had post-graduation level of education. Among the female farmers, 32.5 per cent of respondents' higher secondary level of education followed by graduation level (30.00 %), secondary level (20.00 %) of education, primary level (3.00 %) of education. 3.00 per cent of respondents were illiterate and only 2.50 per cent of the respondents had post-graduation level of education.

According to table 1, more than half (52.50 %) of respondents had above 21 years of farming experience followed by 16 to 20 years (25.00 %), 11 to 15 years (12.50 %) and up to 5 years (7.5 %) of farming experience. Only 2.5 per cent of the respondents had 6 to 10 years of farming experience. While in case of the female respondents, 30.00 per cent of respondents had above 21 years of farming experience followed by 6 to 10 years (27.50 %) of farming experience, very low (20.00 %) of farming experience and 11 to 15 years (12.50 %) farming experience. Only 10.00 per cent of the respondents 16 to 20 years of farming experience.

According to table 1, more than one third (37.50 %) of the male respondents were belonged to marginal farmer category followed by small (30.00 %) farmer category, followed by semi-medium (20.00) farmer category, medium (7.50 %) farmer category and only 5.0 per cent of the respondents belonged to big farmer category. While in case of the female respondents, more than one third (37.50 %) of respondents were belonged to small farmer category followed by marginal (25.00 %) farmer category, semi medium (20.00 %) farmer category, medium (15.00 %) farmer category and only 2.50 per cent the respondents were belonged to big farmer category.

According to table 1, more than one third (35.00 %) of the male respondents had annual family income ranging from Rs.

50,001 to Rs. 2,00,000 followed by 25.00 per cent each for Rs.2,00,001 to Rs. 4,00,000 annual family income range and Rs. 4,00,001 to Rs. 10,00,000 annual family income range. 12.5 per cent of respondents were belonged to Above Rs. 10,00,001 annual family income category and only 2.5 per cent of the respondents were belonged to Up to Rs. 50,000 annual family income categories. While in case of the female respondents,, less than half (45.00 %) of respondents had annual family income ranging from Rs. 50,001 to Rs. 2,00,000 followed by 35.00 per cent respondents belonged to Rs. 2,00,001 to Rs. 4,00,000 annual family income, 7.50 per cent respondents were belonged to Rs. 4,00,001 to Rs. 10,00,000 annual family income category and to Above Rs. 10,00,001 annual family income category each. Only 5.0 per cent of the respondents were belonged to Up to Rs. 50,000 annual family income categories.

According to table 1, 55.00 per cent of the male respondents were used canal as irrigation source followed by 52.00 per cent respondents used well, 37.50 per cent respondents used tube well and 5.0 per cent respondents used pond as irrigation source. While in case of the female respondents, 62.50 per cent of respondents were using canal as irrigation source and well as irrigation source each followed by 35.00 per cent respondents used tube well as irrigation source.

According to table 1, 62.50 per cent of the male respondents had very low level of agricultural mass media exposure followed by low (17.50 %) level of agricultural mass media exposure, medium (10.00 %) level of agricultural mass media exposure and high (5.00 %) level of agricultural mass media exposure. Only 2.5 per cent of the respondents had very high level of agricultural mass media exposure. Among the female farmers, almost all (95.00 %) of respondents had very low level of agricultural mass media exposure followed by low (2.50 %) level of agricultural mass media exposure and medium (2.50 %) level of agricultural mass media exposure. No respondents had high level of agricultural mass media exposure and very high level of agricultural mass media exposure.

According to table 1, half (50.00 %) of the male respondents had very low level of extension contact followed by low (25.50 %) level of extension contact, medium (15.00 %) level of extension contact, high (5.00 %) level of extension contact and very high (7.50 %) level of extension contact. While in case of the female respondents, half (50.00 %) of the respondents had very low level of extension contact followed by low (30.00 %) level of extension contact and medium (20.00 %) level of extension contact. No respondent of the female group had high level of extension contact and very high level of extension contact.

According to table 1, more than one third (40.00 %) of the male respondents had Membership in two organizations category followed by membership in one organization (30.00 %) category, no membership (17.50 %) category, membership in more than two organizations (7.50 %) category and membership along with position holding (5.00 %) category. Among the female farmers, less than half (45.50 %) of respondents had membership in two organizations category followed by membership in more than two organizations (30.00 %) category, membership in one

organization (7.50 %) category and membership along with position holding (2.50 %) category. No respondent had no membership category.

According to table 1, 47.50 per cent of the male respondents had medium level of credit orientation category. Same number of respondents (47.50 %) had low credit orientation and only 5.0 per cent of the respondents had high credit orientation. While in case of the female respondents, majority (67.50 %) of respondents had low level of credit orientation followed by medium (30.00 %) level of credit orientation and high (2.50 %) level of credit orientation.

According to table 1, more than one third (35.00 %) of the male respondents had medium level of change proneness followed by high (30.00 %) level of change proneness, low (15.00 %) level of change proneness and very low (12.50 %) level of change proneness. Only 7.50 per cent of the respondents had very high level of change proneness. While in case of the female respondents, more than one third (37.50 %) of respondents had medium level of change proneness followed by high (25.00 %) level of change proneness, low (20.00 %) level of change proneness and very low (17.50 %) level of change proneness. No respondent was belonged to very high level of change proneness.

According to table 1, half (50.00 %) of the male respondents had medium level of cosmopolitness followed by high (30.00 %) level of cosmopolitness and low (20.00 %) level of cosmopolitness. No respondent was belonged to very high level of cosmopolitness and very low level of cosmopolitness. While in case of the female respondents, more than one third of respondents had medium (40.00 %) level of cosmopolitness followed by high (30.00 %) level of cosmopolitness, low (22.50 %) level of cosmopolitness and very low (5.00 %) level of cosmopolitness. Only 2.50 per cent of the respondents had very high level of cosmopolitness.

According to table 1, more than one third (45.00 %) of the male respondents had medium level of scientific orientation followed by low (30.00 %) level of scientific orientation and high (20.00 %) level of scientific orientation. Only 5.00 per cent of the respondents had very low level of scientific orientation. While in case of the female respondents, majority (60.00 %) of respondents had low level of scientific orientation followed by medium (27.50 %) level of scientific orientation and very low (10.00 %) level of scientific orientation. Only 2.50 per cent of the respondents had high level of scientific orientation. No respondents from male and female group had very high level of scientific orientation.

According to table 1, more than one third (37.50 %) of the male respondents had medium level of risk orientation followed by low (20.00 %) level of risk orientation, high (17.50 %) level of risk orientation, very low (15.00 %) level of risk orientation and very high (10.00 %) level of risk orientation. While in case of the female respondents, more than one third (42.50 %) of respondents had medium level of risk orientation followed by low (32.00 %) level of risk orientation, high (15.00 %) level of risk orientation, very low (7.50 %) level of risk orientation and very high (2.50 %) level of risk orientation.

Table 2: Distribution of respondents according to adaptation strategies related to soil and water conservation (n=40)

Soil and water conservation	Male		Female	
	f	%	*f*	%
Very low	05	12.50	09	22.50
Low	16	40.00	27	67.50
Medium	12	30.00	02	02.50
High	05	12.50	02	02.50
Very high	02	05.00	0	0.00

According to table 4, more than half (55.00 %) of the male respondents were belonged to medium level of insect pest management adaptation technologies followed by low (32.50 %) level of insect pest management adaptation technologies, high (7.50 %) level of insect pest management adaptation technologies. Similar number of respondents (2.50 %) were belonged to both very low level of insect pest management adaptation technologies and very high level of insect pest management adaptation technologies. While in case of the female respondents, more than half (52.50 %) of respondents were belonged to medium level of insect pest management adaptation technologies followed by low (30.00 %) level of insect pest management adaptation technologies, very low (15.00 %) level of insect pest management adaptation technologies. Only 2.50 per cent of the respondents were belonged to high level of insect pest management adaptation technologies. No respondents in the female group belonged to very high level of irrigation management adaptation technologies.

Table 3: Distribution of respondents according to adaptation strategies related to irrigation/ water management (n=80)

Irrigation/ water management	Male		Female	
	f	%	*f*	%
Very low	08	20.00	07	17.50
Low	05	12.50	09	22.50
Medium	14	35.00	18	45.00
High	12	30.00	06	15.00
Very high	01	02.50	00	00.00

According to table 3, more than one third (35.00 %) of the male respondents were belonged to medium level of irrigation management adaptation technologies followed by high (30.00 %) level of irrigation management adaptation technologies, very low (12.50 %) level of irrigation management adaptation technologies. 12.50 per cent of respondents were belonged to low level of irrigation management adaptation technologies and only 2.50 per cent of the respondents were belonged to very high level of irrigation management adaptation technologies. While in case of the female respondents, 45.00 per cent of the respondents were belonged to medium level of irrigation management adaptation technologies followed by low (22.50 %) level of irrigation management adaptation technologies, very low (17.50 %) level of irrigation management adaptation technologies. 15.00 per cent of respondents were belonged to high level of irrigation management adaptation technologies. No respondents in the female group were belonged to very high level of irrigation management adaptation technologies.

Table 4: Distribution of respondents according to adaptation strategies related to insect- pest management (n=80)

Insect-pest management	Male		Female	
	f	%	*f*	%
Very low	01	02.50	06	15.00
Low	13	32.50	12	30.00
Medium	22	55.00	21	52.50
High	03	07.50	01	02.50
Very high	01	02.500	0	00.00

According to table 4, more than half (55.00 %) of the male respondents were belonged to medium level of insect pest management adaptation technologies followed by low (32.50 %) level of insect pest management adaptation technologies, high (7.50 %) level of insect pest management adaptation technologies. Similar number of respondents (2.50 %) were belonged to both very low level of insect pest management adaptation technologies and very high level of

insect pest management adaptation technologies. While in case of the female respondents, more than half (52.50 %) of respondents were belonged to medium level of insect pest management adaptation technologies followed by low (30.00 %) level of insect pest management adaptation technologies, very low (15.00 %) level of insect pest management adaptation technologies. Only 2.50 per cent of the respondents were belonged to high level of insect pest management adaptation technologies. No respondents in the female group belonged to very high level of irrigation management adaptation technologies.

Table 5: Distribution of respondents according to adaptation strategies related to crop production (n=40)

Crop Production	Male		Female	
	f	%	*f*	%
Very low	04	10.00	08	20.00
Low	13	32.50	13	32.50
Medium	16	40.00	17	42.50
High	07	17.50	02	05.00
Very high	00	00.00	00	00.00

According to table 5, more than one third (40.00 %) of the male respondents were belonged to medium level of crop production adaptation technologies followed by low (32.50 %) level of crop production adaptation technologies and high (17.50 %) level of crop production adaptation technologies. 10.00 per cent respondents were belonged to very low level of crop production adaptation technologies. While in case of the female respondents, 42.50 per cent of the respondents were belonged to medium level of crop production adaptation technologies followed by low (32.50 %) level of crop production adaptation technologies and very low (20.00 %) level of crop production adaptation technologies. Only 2.50 per cent of the respondents were belonged to high level of crop production adaptation technologies. No respondents in male and female group belonged to very high level of crop production adaptation technologies.

Table 6: Distribution of respondents according to adaptation strategies related to improved crop practices (n=80)

Improved crop	Male		Female	
	f	%	*f*	%
Very low	06	15.00	03	07.50
Low	10	25.00	11	27.50
Medium	15	37.50	22	55.00
High	07	17.50	04	10.00
Very high	02	05.00	00	00.00

According to table 6 more than one third (37.50 %) of the male respondents were belonged to medium level of improved crop practices category followed by low (25.00 %) level of improved crop practices and high (17.50 %) level of improved crop practices. 15.00 per cent of respondents were belonged to very low level of improved crop practices category and 5.00 per cent per cent of respondents were belonged to high level of improved crop practices category. While in case of the female respondents, more than half (55.00 %) of respondents were belonged to medium level of improved crop practices category followed by low (27.50 %) level of improved crop practices and high (10.00 %) level of improved crop practices. 7.50 per cent of respondents were belonged to low level of improved crop practices. No respondents in the female group belonged to very high level of improved crop practices.

Comparison between male and female respondents about their adaptation strategies

To see the variation or similarity in adaptation strategies of respondents, 't' test was used.

Table 7: Comparison between male and female respondents about their sensitivity and adaptation strategies (n=40)

Sr. No.	Indicators	Categoryof sample	Mean	S.D.	't' value
1.	Soil and water conservation	Male	11.22	4.49	4.626
		Female	7.4	2.69	
2.	Irrigation/ water management	Male	7.4	2.68	3.93
		Female	5.2	2.31	
3.	Insect-pest management	Male	9.42	3.41	1.54
		Female	8.3	3.13	
4.	Crop production	Male	7.65	3.00	1.362
		Female	6.77	2.74	
5.	Improved crop practices	Male	13.78	5.79	-0.104
		Female	13.90	4.88	

From the above results, it can be concluded that there was a significant difference between male and female respondents. According to results, soil and water conservation adaptation strategies (4.626) and irrigation/water management adaptation strategies (3.93) shown significant difference at 0.01 per cent level. While, insect pest management (1.54) and crop production (1.362) shown significant difference at 0.05 per cent level. Improved crop practices (-0.104) shown no significance difference between male and female farmers.

Table 8 : Constraints faced by respondents (n=80)

Sr. No.	Constraints	Frequency	Percent
1.	Non availability of climate suitable varieties at sowing time	61	76.67
2.	Failure of tube well/reduction of water level in well and tube well	71	89.17
3.	Lack of knowledge of technical knowledge on climate change and on its consequence	60	75.42
4.	More dependence on monsoon	54	67.92
5.	High cost of irrigation facilities	64	80.42
6.	Low literacy level	49	60.83
7.	High cost of inputs	72	90.42
8.	Small land holding	48	59.58
9.	Lack of storage facility	51	63.75
10.	Lack of timely supply of needed information	70	87.08
11.	Poor access to information providing institutions	58	72.50
12.	Lack of institutional credit for climate related technologies	63	78.75
13.	Lack of training about climate change impacts on agriculture	57	71.25
14.	Lack access to weather forecasting	53	65.83
15.	Lack of need based technologies	46	57.92

As seen in table 8, major constraints faced by respondents according to their frequency and per cent. Major constraints faced by respondents were High cost of inputs (90.42 %) followed by Failure of tube well/ reduction of water level in well and tube well (89.17 %), Lack of timely supply of needed information (87.08 %), High cost of irrigation facilities (80.42 %), Lack of institutional credit for climate related technologies (78.75 %), Non availability of climate suitable varieties at sowing time (76.67 %), Lack of knowledge of technical knowledge on climate change and on its consequence (75.42 %), Poor access to information providing institutions (72.50 %), Lack of training about climate change impacts on agriculture (71.25 %), More dependence on monsoon (67.92 %), Lack access to weather forecasting (65.83 %), Lack of storage facility (63.75 %), Low literacy level (60.83 %), Small land holding (59.58 %) and Lack of need based technologies (57.92 %).

Table 9: Suggestions to overcome constraints **(n=80)**

Sr. No.	Suggestions	Frequency	Percent
1.	Need of training in areas of crop production, protection and enrichment of soil nutrients and climate change impact on agriculture	48	60.42
2.	Arrange capacity building training programmes for farmer arras	56	70.00
3.	Create awareness about sustainable and organic farming	57	71.25
4.	Provide storage facilities at village	47	58.33
5.	Timely supply of inputs like seeds, fertilizers, etc. by development departments	69	86.67
6.	Provide early warming in case of weather unpredictability	53	66.25
7.	Provide subsidy to climate proof technologies and inputs	66	82.08
8.	Provide training on soil and water management technology	62	77.50
9.	Extension service should be provided regular and timely	53	66.25
10.	Encourage group based farming activities through ATMA, FPO etc.	59	74.17

As indicate in Table 9, various suggestions were given by respondents to make wider adaptation to cope with effects of climate change. According to Table 32 suggestions given by farmers are Timely supply of inputs like seeds, fertilizers, *etc.* By development departments (86.87 %) followed by Provide subsidy to climate proof technologies and inputs (82.08 %), Provide training on soil and water management technology (77.50 %), Encourage group based farming activities through ATMA, FPO *etc.* (74.17 %), Create awareness about sustainable and organic farming (71.25 %), Arrange capacity building training programmes for farmers (70.00 %), Provide early warming in case of weather unpredictability (67.00 %), Extension service should be provided regular and timely (66.25 %), Need of training in areas of crop production, protection and enrichment of soil nutrients and climate change impact on agriculture (60.42 %) and Provide storage facilities at village (58.33 %).

CONCLUSION

Majority of respondents were belonged to middle age group with higher secondary

education and above 21 years of farming experience. About one third of respondents are marginal farmers having annual income between 50,001 to 2,00,000 and using well as an irrigation source. More than half of the respondents had very low level of agril. Mass media exposure and extension contact. Less than half of the respondents had membership in two organizations and low credit orientation. More than one third of respondents had medium change proneness scientific orientation and risk orientation. About half of the respondents had medium cosmopolitness.

More than one third of the respondents were belonged to low level of soil and water conservation adaptation technologies. Less than one third of the respondents were belonged to low level of irrigation management adaptation technologies. More than one third of the respondents were belonged to medium level of insect-pest management adaptation technologies. More than one third of respondents were belonged to medium level of crop production adaptation technologies. More than one third of respondents were belonged to medium level of improved crop practices.

There was a significant difference between male and female respondents. According to results, soil and water conservation adaptation strategies and irrigation/water management adaptation strategies shown significant difference at 0.01 per cent level. While, insect pest management and crop production shown significant difference at 0.05 per cent level. Improved crop practices shown no significance difference between male and female farmers.

Major constraints faced by respondents were high cost of inputs, failure of tube well/ reduction of water level in well and tube well, lack of timely supply of needed information high cost of irrigation facilities and lack of institutional credit for climate related technologies.

Suggestions to make wider adaptation are timely supply of inputs like seeds, fertilizers, etc. by development departments, provide subsidy to climate proof technologies and inputs, provide training on soil and water management technology, encourage group-based farming activities through ATMA, FPO etc. and create awareness about sustainable and organic farming.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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RESEARCH ARTICLE

Harnessing AI for financial inclusion, microfinance and SHGs: insights from a bibliometric analysis

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ABSTRACT

The integration of emerging technologies, such as Artificial Intelligence (AI), Machine Learning (ML), and Deep Learning (DL), with financial inclusion strategies has revolutionized the landscape of microfinance institutions (MFIs) and Self-help Groups (SHGs). This study presents a bibliometric analysis of the intersection between AI and microfinance using co-occurrence of terms. Utilizing data from Dimensions.ai database (1996–2024), of the 19144 publications, the refined set of 2,551 publications were analysed to generate network, overlay, and density visualizations in VOSviewer software. Network analysis revealed four different clusters related to development, methodological, strategic and technical focuses. Overlay analysis highlighted the evolution of research trends with the passing year, it concludes the application of foundational works of AI, algorithms and predictive modelling into real-time financing strategies, particularly for SHGs and microfinance, to enhance decision-making, efficiency, and resilience. Density visualization indicated research gaps in the vast available research landscapes to direct the future research studies of AI applications in financial inclusion. Although SHGs appears in a less dense area, its presence signifies a growing recognition of SHGs as critical players in financial inclusion. Promising research direction includes, deeper integration of AI into SHG frameworks and the exploration of novel fintech applications to enhance the operational efficiency of microfinance institutions. By examining key terms, their interconnections, and evolving trends, this study identifies research gaps, highlights the thematic landscape, and proposes future research directions.

Keywords: Artificial Intelligence, Microfinance, Self-help Groups, Financial inclusion, Bibliometric analysis.

INTRODUCTION

Artificial intelligence (AI) can be understood as a technical and scientific field devoted to the engineered system to generate outputs like content, forecasts, recommendations or decisions to achieve human-defined objectives (ISO, 2024). AI aims to create machines capable of performing tasks those include learning from experience (machine learning), understanding natural language, pattern recognizing, problem solving, and decision making. As the branch of AI advances quickly, governments and organizations are working together to establish the structured frameworks, regulations, and guidelines to secure AI technologies are developed and deployed responsibly. In 2023, due to the active collaboration of banks, the microfinance industry, and NGOs, today it serves more than 6.6 crore Indian households with an outstanding loan amount of 4,50,000 crores (UIC, 2024).

Microfinance is the financial services

that are offered to persons of lower socioeconomic backgrounds and also to those who lack access to traditional financial services through microfinance institutions (MFIs), non-governmental organizations (NGOs) or self-help groups (SHGs). Microfinancing includes a number of services, such as opening accounts, transferring funds, providing microinsurance, and microcredit (Corporate finance institute, 2024).

According to World Bank Group, the first step to achieve financial inclusion is being able to have access to a transaction account, since it allows people to store money, send and receive payments. As of 2021, 76% of the world's adult population had an account. The G20 devoted to advance financial inclusion and reaffirmed its commitment worldwide to implement the G20 High-level principles for digital financial inclusion. The World Bank Group considers financial inclusion a facilitator to lessen poverty and improve shared prosperity.

AI can bridge the gap with MFIs to detect fraudulent activities, reducing lending risks to diverse and vulnerable clients. It can also analyse into various variables of borrower's profile like social interactions, transactional history, financial profile and market trends to find the most vulnerable one who actually needs credit. With the help of fairness-aware machine learning and Explainable AI (XAI), institutions can mitigate the credit scoring bias and provide clear awareness into credit decisions (Muhammad, 2021). Tasks such as documentation verification, loan processing and customer support can be simplified, allowing MFIs to serve a larger client base with in their operational efficiency limit. Successful business models can be replicated across various geographical and cultural contexts, expanding financial inclusion (Chaitanya, 2023).

In India, the combination of microfinance and AI can be a powerful tool in the fight against financial exclusion. MFIs can benefit from the use of AI in making decisions, detecting fraudulent activities, and tailoring need-based customer service. The intersection of AI and microfinance is an emerging field with the potential to address financial inclusion more effectively through operational optimization, innovative models, and predictive credit scoring. This study uses bibliometric analysis to explore this interdisciplinary domain, focusing on key themes and trends using term co-occurrence analysis. Trends of publications was searched for over the years in the areas like AI and microfinance which is given in the appendix.

Literature review

The results of the study conducted by Bhanot and Bapat (2020) and Elayaraja (2020), finds that the contribution of self-help group-bank linkage programme (SHG-BLP) is relevant to goals 1, 2, 3, 4, 5, 8, 9, 10 and 17 (SDGs).

Walia (2023) study concludes that social capital has been a prominent catalyst in India in achieving SDG-1 through community-driven initiatives like SHGs and microfinance networks by assisting financially along with providing training in skills, and entrepreneurship opportunities to marginalised populations.

A study by Arunachalam (2024) discusses the application of modern machine learning (ML) techniques like credit scoring, clustering, and cash flow analysis to get applicable insights and develop tailored AI credit models, such models delivered through phones using interactive interfaces can drive towards complete financial inclusion, fulfilling one of the SDGs (UNSDG-1.4.). It also presents that AI lending models for SHGs can sustainably increase incomes and reduce poverty in vulnerable sections of India's poorest. This study also realised that the collaboration of banks, microfinance institutions, government, and tech startups combined with consent-based data sharing by women borrowers themselves is critical step to make it reality.

The study by Anand et al., (2023) discuss the potential societal advantages of AI chatbots and conversational user interfaces which can be applicable to SHGs to carry out their work smoothly. It also stated that chatbots can increase the 3A's (viz., availability, affordability, and accessibility) of necessary services for this community.

The study by Singh (2021) assures that the digitization has helped the SHG members to afford transparent services through the government without loss of time, assisting the government to reach grassroots level.

Pritiprada et al., (2023) study concludes that human-centric IoT solution-based model needs to be developed and implemented in SHGs to bring out effectiveness among the group members.

Dasgupta and Gupta (2021) employed four ML models [viz., XGBoost, Ridge, Lasso and Elastic Net] and logit regression in their study to predict the choice of an enterprise between SHG and in-formal lenders as the major source of finance. Their model showed that self-financed firms are not likely to take loans from SHGs.

The focus on realistic deployment, timeframes, and measuring the accuracy in effectiveness and ROI of AI is strategic in keeping the current momentum to grow forward, a study reflects while talking about AI in financial services, conducted by Mardanghom and Sandal (2021).

In a study by Chaitanya (2023) pointed out various challenges in AI implementation, those being data privacy concerns, assuring equal access to technology, and promoting fair treatment for all individuals. It further adds that this can be tackled with collaboration between government, financial institutions, and tech experts; it's easy to create financial ecosystem that is inclusive and accessible to all, despite their differences in geographic location or financial status.

Objectives

The objectives of the study are followed,

1. To map the key themes and trends at the intersection of AI and microfinance.
2. To identify emerging research areas and gaps in the literature.
3. To provide insights into the evolving role of AI in promoting financial inclusion through microfinance.

METHODOLOGY

The bibliometric network analysis was conducted using the Dimensions.ai database and VOSviewer software.

Data Collection

Datasets were extracted from Dimensions.ai databases, the search words being "artificial intelligence" and "microfinance". Initial results showed 19144 publications spanning from 1996-2024.

Data Refinement

The initial datasets were exported into Excel and filtered, yielding 2,551 relevant publications which were containing both search terms. This automatic reduction was also due to the removal of irrelevant or duplicate records while exporting the initial dataset.

Co-occurrence Analysis

After exporting the dataset into .csv file in Excel, the visualizations were created in VOSviewer by applying certain criteria and filters. The criteria applied was co-occurrence of terms, with binary counting method. Threshold for the terms was set to 10 occurrences (only the terms appearing in at least 10 documents were included). Of the 39294 terms, 1181 terms met threshold limit. Based on the calculation of default 60 percent of relevance score among 1181 terms, 709 terms were identified and finalized (top 60 percent) as the most relevant terms for creating visualization maps.

RESULTS AND DISCUSSION

The results of the network, overlay and density visualization analysis are presented and

discussed below in following subheadings.

Detailed analysis of the network visualization for bibliometric analysis

The network visualization presents a bibliometric mapping of co-occurring terms in the research domains of AI, microfinance, and SHGs. Based on the clustering algorithm in VOSviewer, the terms are grouped into distinct thematic clusters differentiated by grey scale. Each cluster (in figure 1) represents a coherent research theme, providing insight into the current state of knowledge and emerging trends.

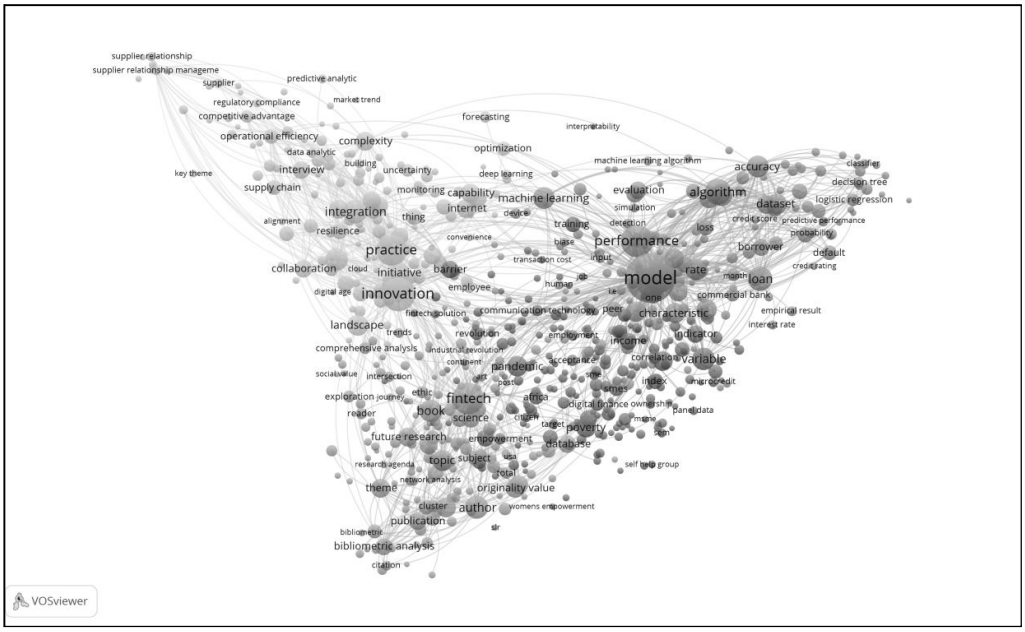


Figure 1. Network visualization of keyword co-occurrence terms, illustrating the formation of four distinct thematic clusters.

Discussion of clusters in the network visualization

Darkest grey cluster: Technical focus

Key terms in this cluster are AI model, algorithm, machine learning, accuracy, logistic regression, decision tree and credit score. On observing terms such as model, algorithm, and performance indicate a strong emphasis on developing predictive models for credit scoring, loan default prediction, and borrower risk assessment.

Recent literatures indicated that the focus is on applying advanced machine learning techniques (e.g., logistic regression, decision trees) to improve financial decision-making accuracy. These models are pivotal for predicting loan defaults, enhancing microcredit performance, and reducing financial risks.

Somewhat dark grey cluster: Development focus

This cluster focuses on key terms like variable, poverty, microcredit, indicator, income, correlation and digital finance. Thus, it highlights research focused on the socioeconomic dimensions of microfinance. Terms like poverty and income underscore the primary goal of financial inclusion—empowering marginalized groups, including SHGs, to achieve economic stability.

The presence of SHG, microcredit, and income indicates ongoing efforts to assess the impact of microfinance on poverty alleviation and livelihood enhancement. Digital finance solutions are also a prominent theme, suggesting that financial technology is increasingly critical in fostering inclusion.

Somewhat light grey cluster: Methodological focus

Key terms are being bibliometric analysis, fintech, future research, publication, author and originality value. It captures methodological and bibliometric aspects, with a focus on mapping scholarly contributions to AI and microfinance. Terms such as bibliometric analysis and publication emphasize the bibliometric nature of this research.

The cluster suggests an expanding interest in mapping the evolution of fintech and its intersection with AI, microfinance, and SHGs. It also highlights the importance of bibliometric tools for understanding knowledge flows and research collaborations.

Light grey cluster: Strategic focus

Profound key terms are innovation, collaboration, integration, operational efficiency, supply chain and practice. This cluster highlights the strategic and operational implications of AI integration in microfinance. Terms such as innovation and collaboration point to ongoing efforts to enhance financial service delivery and operational efficiency.

This implies that AI is being leveraged to optimize microfinance processes, improve supply chain management, and foster collaborative innovations. SHGs may benefit from such innovations by enhancing operational efficiency and resilience.

Detailed analysis of the overlay visualization for bibliometric analysis

The overlay visualization map generated using VOSviewer offers a dynamic view of the bibliometric network by incorporating a time dimension. It shows how terms associated with AI, microfinance, and SHGs have evolved over time. The colour (greyscale) gradient at the bottom right indicates the timeline, with terms in light grey emerging more recently (2023), while those in dark grey represent older trends (2021 and earlier). This temporal dimension provides valuable insights into the trajectory of research focus and highlights emerging areas of interest. Figure 2 represents the overlay visualization

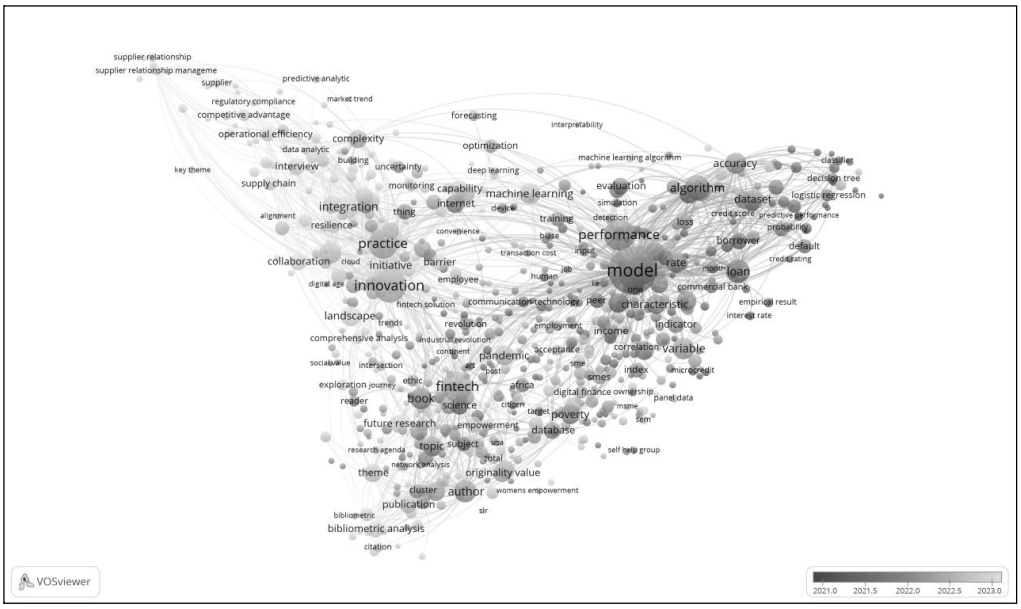


Figure 2. Overlay visualization, with nodes coloured by the average publication year, indicating the recent emergence of AI-related topics in microfinance research.

Key observations by cluster

Dark grey cluster (Older trends: 2021–2022)

Dominant terms in this cluster are model, algorithm, performance, dataset, logistic regression, default, credit scoring. This reflects the early foundational work in the application of AI to microfinance. Key terms such as algorithm and performance suggest an initial focus on developing and refining predictive models for loan default prediction and credit risk assessment.

It is implied that research in this phase was heavily focused on applying machine learning algorithms to improve credit decision-making processes in MFIs. The use of terms like logistic regression and classifier indicates an emphasis on traditional statistical methods during the early years.

Medium grey cluster (Transition phase: 2022)

Dominant terms are being innovation, fintech, bibliometric analysis, collaboration, integration. This cluster highlights a transitional phase where the focus began shifting toward the integration of AI with fintech solutions. Terms like innovation and fintech indicate the rise of novel technologies and partnerships aimed at enhancing microfinance ecosystems.

Additionally in 2022, bibliometric analysis and collaborative studies gained prominence, suggesting a growing interest in understanding the broader research landscape and exploring interdisciplinary approaches. Researchers also began focusing more on how technological integration could drive operational efficiency in microfinance and SHGs.

Light grey cluster (Emerging trends: 2023)

Dominating terms in this cluster are practice, complexity, resilience, predictive analytics, supply chain, SHGs. These terms represent the most recent developments in the field. A notable emergence of SHGs indicates a growing focus on applying AI and fintech solutions to SHGs. Terms like resilience and complexity suggest an increasing interest in addressing challenges faced by SHGs and microfinance institutions in dynamic and uncertain environments.

Emerging research in 2023 appears to be moving toward real-world applications, including leveraging predictive analytics to enhance SHG decision-making and resilience. The focus on supply chain and operational efficiency implies expanding the scope beyond traditional financial services to encompass broader logistical and operational innovations for financial inclusion.

Detailed analysis of the density visualization for bibliometric analysis

The density visualization map created using VOSviewer provides a heat map representation of keyword concentration and prominence in the bibliometric analysis of research on AI, microfinance, and SHGs. The heat map's colour (greyscale) intensity indicates the density of terms, with light grey regions signifying high-density, frequently occurring keywords, while medium grey and dark grey areas represent medium to low densities, respectively. Results of clusters are presented in figure 3 and discussed in the following headings.



Figure 3. Density visualization, showing high research intensity with noticeable gaps in the integration of AI with microfinance.

High-density areas (Light grey regions)

It is obvious in this area that model, performance, algorithm, and fintech are prominent keywords. The term model is the most prominent, indicating that a substantial body of research focuses on developing, evaluating, and refining predictive models. While keywords like performance and algorithm suggest a strong emphasis on the effectiveness and accuracy of machine learning algorithms in predicting financial outcomes such as credit risk or default likelihood. Also, the keyword fintech shows that integrating financial technology into microfinance and SHGs is a key focus area, reflecting the evolving role of technology in financial inclusion.

Medium-density areas (Grey regions)

Notable keywords in this area are innovation, practice, integration, and resilience. Keyword innovation highlights the exploration of new methods, technologies, and processes in AI applications for microfinance. Key terms like, practice and integration suggest research on how AI can be effectively incorporated into existing financial systems, particularly for SHGs. While resilience points to studies focusing on how AI and fintech enhance the ability of SHGs and microfinance institutions to withstand financial uncertainties.

Low-density areas (Dark grey regions)

Highlighted keywords in this area are SHGs, bibliometric analysis, collaboration, supply chain. The presence of SHGs indicates that while the term is emerging, it is still a relatively niche area compared to broader AI and fintech research. Bibliometric analysis and collaboration suggest ongoing efforts to map and understand the research landscape and foster interdisciplinary cooperation. Supply chain reflects an expanding scope of financial inclusion research beyond traditional microfinance, potentially exploring logistics and operational efficiencies within SHGs.

CONCLUSION

The clusters in network visualization reveal a multi-dimensional research landscape, with distinct yet interconnected themes. Despite the focus on technical advancements, few studies explore the application of these models specifically for SHGs. Future research could delve into how AI can tailor models for SHG-driven financial systems to improve credit access and inclusion. While the socio-economic benefits of microfinance for SHGs are well-documented, there is limited exploration of how AI-driven tools can further enhance these outcomes. Future research could explore how integrating AI with SHGs can foster data-driven decision-making for

enhanced financial inclusion. Although bibliometric studies provide valuable insights into research trends, more focused studies on the interdisciplinary application of AI in microfinance and SHGs are needed. This can enrich understanding of evolving knowledge ecosystems. There is an opportunity to investigate how SHGs can play a more active role in collaborative fintech innovations. Future research can be focused on how AI-driven strategies can enhance SHG resilience and efficiency in dynamic economic contexts.

The overlay visualization illustrates the evolution of research priorities. The temporal trends showed the critical shift from algorithm development of robust AI models towards practical applications particularly for SHGs and microfinance, to enhance decision-making, efficiency, and resilience. Focus on innovation, resilience, and complexity in recent research suggests a holistic approach to enhancing the sustainability and scalability of SHG-driven microfinance. The growing focus on bibliometric studies and collaboration highlights an effort to map the knowledge landscape and foster interdisciplinary research across AI, microfinance, and SHGs. These findings suggest promising research directions, including the deeper integration of AI into SHG frameworks and the exploration of novel fintech applications to enhance the operational efficiency of microfinance institutions.

The density visualization offers a comprehensive overview of research trends, emphasizing the prominence of AI-driven modelling and performance evaluation. The dominance of terms like model, algorithm, and performance underscores the centrality of AI and machine learning in this field. Researchers were heavily invested in optimizing predictive models to improve financial inclusion outcomes. Although SHGs appears in a less dense area, its presence signifies a growing recognition of SHGs as critical players in financial inclusion. This suggests that future research may further explore how AI and fintech can empower SHGs. It is also obvious that microfinance institutions and SHGs faces challenges particularly in dynamic and uncertain environments. Thus, future researchers should direct research interests in how AI can enhance adaptive capacity at grassroots level.

The study analysis revealed several gaps in the current literature as follows, lack of Integration of AI in grassroots microfinance models like SHGs, limited focus on ethical implications of using AI in microfinance, particularly in terms of data privacy and bias, underexplored impact of AI on financial resilience post-pandemic. Future research should focus on addressing the identified gaps, particularly in integrating AI with grassroots microfinance initiatives and exploring the ethical dimensions of AI applications in grassroot levels of microfinance.

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Figure 4. Trends of publications over the years in the areas like AI and microfinance (Source: Dimensions.ai databases)

RESEARCH ARTICLE

Exploring entrepreneurial constraints faced by rural women in Muzaffarpur district of Bihar

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ABSTRACT

Women entrepreneurship serves as the cornerstone of economic growth, particularly in developing nations, where it plays a pivotal role in fostering rural community development. In India, economic liberalization and globalization have significantly influenced the landscape of women entrepreneurship, providing rural women with opportunities to overcome poverty and engage in economic activities. This study aims to identify the entrepreneurial constraints faced by rural women in the Muzaffarpur district of Bihar. The research was conducted purposively in this district due to the diverse range of entrepreneurial activities undertaken by rural women. Two blocks, Saraiya and Marwan, were randomly selected, from which five villages per block were further chosen. A total of 120 rural women entrepreneurs were selected through random sampling, with 12 respondents from each village. The constraints encountered by these women were categorized into four groups: financial constraints, marketing constraints, production and labour constraints, and personal constraints. The mean score for each constraint was calculated, and rankings were assigned accordingly. The findings indicate that marketing constraints emerged as the most significant challenge faced by rural women entrepreneurs. Addressing these challenges can empower rural women entrepreneurs, enabling them to contribute more effectively to economic development and social progress.

Key words: Entrepreneur, Constraints, Marketing constraints, Rural women, Personal constraints

INTRODUCTION

The perception of entrepreneurship as a predominantly male-dominated field is undergoing a transformation. In contemporary society, women are emerging as successful and influential entrepreneurs, serving as sources of inspiration for others (Chunera, 2020). Rural women's entrepreneurship is a powerful driver for economic development and self-reliance in rural areas (SwitchON, 2024). Rural entrepreneurship can be defined as the entrepreneurship emerging in rural areas or establishing industries in rural areas (Lavanya et al., 2014). According to J.A. Schumpeter, "Any woman who builds, adopts, or reproduces a business industry is a woman entrepreneur." This definition underscores the significant role women play in shaping rural economies. It reduces the migration rate to metropolitan areas and promotes the development of rural regions by generating employment and other economic opportunities. (Lalrokhawma and Lalromawia, 2021). Women entrepreneurs are those who have initiated a business, actively involved in managing it, and owns at least 50% of the firm which have been in operation at least one year or longer (Ahmad et al., 2011). The Government of India has defined women entrepreneurs as individuals who owns and control an enterprise with women having a minimum financial stake of

51% of the capital and giving at least 51% of the employment to women (Imam, 2012).

According to word Bank (2024) More than 85% of women-owned, rural, non-farm enterprises are concentrated in five key subsectors: retail trade, apparel manufacturing, food product manufacturing, food and beverage services, and the handloom sector. The Sixth Economic Census, published by the Ministry of Statistics and Programme Implementation, presents a concerning overview of women's participation in entrepreneurship in India. According to the report, women constitute only 13.76% of the total entrepreneurial population, representing 8.05 million out of 58.5 million entrepreneurs. Women-led enterprises collectively employ approximately 13.45 million individuals, with 34.3% (2.76 million) engaged in agricultural activities and 65.7% (5.29 million) working in non-agricultural sectors. Among the states, Tamil Nadu has the highest share of women-owned businesses at 13.51%, followed by Kerala (11.35%), Andhra Pradesh (10.56%), West Bengal (10.33%), and Maharashtra (8.25%) (SwitchON, 2024). Therefore, this study attempt has been made to identify Constraints Faced by Rural Women entrepreneur's.

METHODOLOGY

The study was conducted in Muzaffarpur district of Bihar during the year 2020-2021. Primary data was collected through structured interview schedule. A descriptive research design was used for the present study. For the study Muzaffarpur district of Bihar was selected purposively. The variety of entrepreneurial activities carried out in the Muzaffarpur district was a factor while choosing the district for study. Out of the sixteen blocks in Muzaffarpur district, two blocks namely Saraiya and Marwan were selected purposively. Five villages were selected by using the simple random sampling method with the total number of respondents 120. An effort was made to know the constraints faced by rural women and Suggestions obtained by the women entrepreneurs. At the time of the interview, they were asked to enumerate the constraints faced by them for better entrepreneurship. Constraints faced by rural women were classified into four categories financial constraints, marketing constraints, production and labor constraints, and personal constraints. The mean score for each constraint was calculated and ranks were assigned based on the mean score value.

RESULT AND DISCUSSION

Rural women engage in diverse economic activities. The selection of these activities is based on availability of local resources, traditional habit, market availability etc. Table 1 presents an overview of the various economic activities undertaken by women entrepreneurs in rural areas.

Table 1 Distribution of the respondents based on economic activities (n=120)

Sl. No.	Economic activities	Frequency	Percentage (%)
1.	Agriculture	38	32.5
2.	Goatery	18	15
3.	Poultry	10	8.3
4.	Fishery	5	4.1
5.	Tailoring	22	18.3
6.	Handicraft	27	22.5

The data presented in Table 1 indicates that among the total respondents, the highest proportion of rural women entrepreneurs (38) individuals, accounting for 32.5% are engaged in agricultural activities. This dominance of agriculture as an economic activity can be attributed to the fact that most rural women reside in agricultural areas where farming remains the primary occupation. Additionally, a significant proportion of respondents (22.5%) are involved in handicraft-related activities, including lac bangle making, Madhubani painting, and Sikki grass craft. These findings align with the study conducted by Dutta (2016), which reported that 42.5% of rural women were engaged in handloom and handicrafts as their primary economic activity. Tailoring is another prevalent occupation among rural women, with 18.3% of the respondents involved in this activity. These results are supported by the study of Timmapur and Hasalkar (2018), which also highlighted tailoring as a significant source of income for rural women. Other economic activities undertaken by rural women include goat rearing (15%), poultry farming (8.3%), and fisheries, with only 4.1 % of respondents engaged in this sector. These findings emphasize the diverse range of income-generating activities adopted by rural women, reflecting both resource availability and market demand.

Although women are increasingly interested in entrepreneurial activities such as mushroom farming, goat farming, poultry farming, dairy farming, and handicrafts, the growth rate of women entrepreneurship remains unsatisfactory (Dutta, 2016). This is primarily due to various constraints faced by entrepreneurs in entrepreneurial development, including financial constraints, marketing difficulties, and production-related issues. Moreover, women entrepreneurs face greater obstacles than their male counterparts due to societal restrictions and taboos, further hindering their business ventures.

Table 2 : Financial Constraints identified by rural women entrepreneurs (n=120)

Sl. No.	Particulars	Mean sore	Ranks
1.	Difficulties in sanction of loan	2.57	**I**
2.	Securing working capital	2.45	**II**
3.	Insufficient financial assistance by financial institution	2.13	**IV**
4.	Entire loan is not given at a time	2.34	**III**

Financial Constraints identified by rural women entrepreneurs in presented in table 2. The rural women getting difficulties in sanction of loan which ranked first under (mean score = 2.57) financial constraints. The other financial problem ranked second was securing working capital (score 2.45). The other financial problem ranked III, IV respectively where entire loan is not given at a time (2.34), Insufficient financial assistance by financial institution (2.13) and similar finding also reported by (Mupparapu, 2024) and (Mahanta, 2016). Financial constraints also reported as major constraints by (Dutta, 2016).

Table 3 Marketing Constraints identified by rural women entrepreneurs (n=120)

Sl. No.	Particulars	Mean sore	Ranks
1.	Lack of transport facilities	2.48	**II**
2.	Long distance of market.	2.26	**IV**
3.	Lack of market information	2.42	**III**
4.	Low price for produce	3	**I**

Marketing Constraints faced by rural women entrepreneurs in depicted in table 2. Among the marketing constraints, rural women entrepreneurs getting low price for produce was ranked first (mean score=3) whereas, lack of transport facilities (2.48), lack of market information (2.42) and long distance of market (2.26) ranked II, III, IV respectively. The results of the study supported by the results of (Kokate et al., 2016) and (Dewangan et al., 2019). According to Switch ON foundation (2024) rural women entrepreneurs face challenges in accessing larger markets due to limited demand and lower prices in local markets. Poor infrastructure, including inadequate transportation and lack of digital access, further restricts their ability to reach more competitive and profitable urban or national markets

Table 4 : Production and Labour constraints identified by rural women entrepreneurs (n=120)

Sl. No.	Particulars	Mean sore	Ranks
1.	High labour cost	2.55	**III**
2.	Non-availability of quality input materials	2.60	**I**
3.	High cost of inputs	2.59	**II**
4.	Non-availability of skilled workers	2.20	**IV**

Production and labour constraints data is summarised in Table 4. In production and labour, most serious constraints faced by women entrepreneurs were non-availability of quality input materials (mean score=2.60) followed by high cost of inputs (2.59), high labour cost (2.55), non-availability of skilled workers (2.20). The finding is in line with the findings of (Suganthi and Asokhan; 2020 and Dewangan, 2019). The reason may be due to less exposure and unawareness and lack of entrepreneurial skills about the management techniques as women are new to the field

Table 5 : Personal and Social constraints identified by rural women entrepreneurs (n=120)

Sl. No.	Particulars	Mean sore	Ranks
1.	Social customs and beliefs	2.29	IV
2.	Dual duties	2.61	II
3.	Health problem	1.41	VI
4.	Low level of education	3.20	I
5.	Non cooperation of family members	2.50	III

The data presented in Table 5 highlights the personal and social constraints faced by women entrepreneurs. Among these constraints, low level of education was ranked as the most significant challenge, followed by dual responsibilities in the second position. Lack of cooperation from family members was identified as the third major constraint, while social customs and beliefs and health issues were ranked fourth and fifth, respectively. The finding of the study is line with finding of (Rao et al., 2022), (Lad, 2017), (Kumar et al., 2018) and (Sathyadevi, 2016) their finding also highlighted constraints such as dual role responsibility of home as well as job, low level of education and social barrier.

Low level of education may be due to societal beliefs always prioritize male education over female education, limiting educational opportunities for women. Notably, dual responsibilities emerged as a particularly serious challenge for women entrepreneurs. This can be attributed to their need to balance domestic duties and agricultural activities alongside their entrepreneurial ventures, often resulting in excessive stress. Additionally, the pressure to excel in their chosen economic activities further exacerbates these challenges, making it difficult for them to sustain and expand their businesses. (Dewangan et al., 2019).

CONCLUSION

The findings of this study highlight the diverse economic activities undertaken by rural women entrepreneurs, with agriculture, handicrafts, and tailoring being the most common. While there is a growing interest among rural women in entrepreneurship, their participation and growth remain constrained by multiple challenges. Financial barriers, including difficulties in securing loans and inadequate financial support from institutions, significantly hinder their entrepreneurial development. Moreover, marketing constraints, such as low prices for produce, lack of transportation, and limited market information, further restrict their access to profitable markets. Production-related challenges, including the non-availability of quality input materials, high input costs, and a shortage of skilled labor, also emerge as major obstacles. Additionally, personal and social constraints, particularly low levels of education, dual responsibilities, and lack of family support, place additional burdens on women entrepreneurs, limiting their ability to expand their businesses. These findings align with previous research, reaffirming the need for targeted interventions to address financial, infrastructural, and social barriers. To enhance the growth of women entrepreneurship in rural areas, it is essential to improve access to education, provide financial assistance, strengthen market linkages, and offer skill development programs. Addressing these challenges can empower rural women entrepreneurs, enabling them to contribute more effectively to economic development and social progress.

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RESEARCH ARTICLE

Utilization of climate smart practices by citrus producers in Oyo state, Nigeria

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ABSTRACT

Climate change has become a trending issue affecting agriculture in recent years, and a major global concern for which world leaders are seeking a common platform to tackle it. This paper assessed the usage of various climate smart practices by citrus producers in Oyo State. Oluyole and Afijio Local Government Areas (LGAs) within the state were purposively sampled for the study due to their comparative advantage in fruit production. Seventy-two respondents were randomly selected from lists presented in both the adopted village of Cocoa Research Institute of Nigeria in Oluyole LGA and All Farmers Association of Nigeria (AFAN), Afijio Chapter. Data collected using interview guide were analyzed with frequencies and percentages,chi-square and regression. The results revealed that majority (81.9%, 91.3% and 95.8%) of the respondents were males, married and farmers. The level of awareness of climate smart practices (CSA) by farmers (40.3%) and access to climate practices (37.5%) was low. Similarly, extent of use of CSA was also very low (38.3%). However, positive significant relationship exists between access to credit and extension and the utilization of climate smart practices. Specific programs need to be evolved for enlightenment of farmers to the current reality of climate change effects and encouragement for utilization in order that the citrus industry will be protected.

Key words : Fruit farmers, climate change, CSA, fruit production

INTRODUCTION

Horticulture has potential to make more significant contributions to efforts at attaining food security and self- sufficiency (Ogunwolu and Ekoja,2011). It has been described as a growing economic power house (ISHS, 2012) with diverse crops notable for providing nutrition, health, income generation and livelihood. An array of crops such as fruits, vegetables, spices and nuts form part of the horticultural chain. The global output of these crops forms a basis for the development of various economies of the world whether developing or developed countries. Fruits and vegetables are the most important sources of micronutrients, fiber, vitamins and minerals essential for a balanced and healthy diet. They are referred to as protective foods which play a significant role in nutritional security of humans (Kaur and Singh, 2021, Ganry et al,2011). Horticultural crops such as citrus are fruit tree crops which are permanent and provide regular income to farmers once they attain fruit bearing stage.

Climate plays a significant role in plant growth and productivity. Horticultural crops are largely dependent on climate, and its productivity may be influenced by changes within the climate which can invariably reduce crop productivity and in some cases, total loss can occur. Climate change is the long-term alteration in global weather patterns, measurable increases in the average temperature of earth's atmosphere, oceans and land masses, brought on by rising

levels of heat trapping atmospheric gases known as greenhouse gases, which over time affects the quality, quantity, volume and stability of crop production (Nwoko et al,2018 and Olasantan,2010). Nkumulwa and Pauline,2021 reported a resulting decline of agricultural productivity and increased deforestation in Tanzania due to climate change. In Nigeria, climate change has been reported to lead to consistently higher temperatures, heavier floods and drought which has impacted negatively on crops (Godson-Ibeji et al,2018). Furthermore, Adigun and Adelasoye, 2021 affirmed a change in rainfall pattern in Nigeria with resultant effect on commencement of planting season and poor harvest yield. In 2021 there was flood in different parts of Nigeria which ravaged farms and brought untold losses to farmers. Such floods have been traced to changes in weather patterns with resultant effect on change in rainfall output.

All horticultural crops are sensitive to temperature, and most have specific requirements for optimum yield and quality. Temperature increase affects photosynthesis directly, causing alterations in sugars, organic acids, flavonoids content, firmness and antioxidant activity (Kaur and Singh,2021). However, some adaptation measures can be put in place to cushion the negative effect of climate change on crop productivity. In a study by Remigius et al, 2018, cucumber growers employed crop diversification, planting of early maturing varieties, adoption of irrigation techniques and crop rotation as measures for climate change adaptation. Similarly in Yobe State, Nigeria, climate smart agricultural practices such as improved seed varieties, intercropping and integrated soil fertility management which was used gave resultant benefits of food, income diversification and improved resilience (FAO,2023). Although there is presently no policy to mainstream climate agriculture in different spheres of Nigeria, it is imperative to tackle climate change affecting farmers' productivity with climate smart agriculture for sustainability of the food system (Maigari,2022). Thus, the main objective of the study is to assess climate smart practices being used by citrus producers to reduce effect of climate change on fruit production. Specific objectives are to:

- identify social and personal characteristics of fruit producers
- ascertain the utilization of climate smart practices by fruit producers in the study area
- identify sources of information on climate smart agricultural practices
- identify factors influencing choice of climate smart agricultural practices
- identify constraints involved in use of climate smart practices

Test of Hypotheses

1. There is no significant relationship between utilization of climate smart agricultural practices and socio-personal characteristics of citrus farmers
2. There is no significant relationship between utilization of climate smart agricultural practices and factors affecting choice.

METHODOLOGY

The study area

The study was conducted in Oyo State. It is an inland state in southwestern Nigeria, bordered to the north by Kwara State, to the east by Osun State, and to the southwest by Ogun State and the Republic of Benin. Agriculture is currently the main contributor to Oyo State's economy comprising 38% of gross state product (GSP), and directly or indirectly employing as much as 70% of the workforce. Oyo State has an estimated landmass of 28,454km^2 and a favourable climate for equatorial crop production. The dry season lasts from November to March while the wet season starts from April-October. Average daily temperature ranges between 25^{0}C and 35^{0}C (Wikipedia 2023,

OBG,2023). The climate favours cultivation of crops like maize, yam, cassava, millet, rice, cocoa, plantain, cashew and palm produce. There is an equally strong horticultural output of fruit crops such as oranges (321,490tonnes), banana (61,770tonnes) and tomatoes (6210tonnes). The state is located within coordinates 8^0 00'N 4^0 00'E. In 2016, the projected population was 7,840,864 to make it the fifth most populous state in Nigeria.



Plate 1: Map of Oyo State showing the local government areas

Sampling procedure

The state has 33 Local Government Areas with four agricultural zones namely: Shaki, Ogbomoso, Oyo and Ibadan/Ibarapa. Population for this study comprised of the fruit producers in Oluyole and Afijio Local Government Areas of Oyo State. A three stage sampling method was used for the study. In the first and second stages,Oyo agricultural zone and Oluyole and Afijio Local Government Areas of Oyo State were purposively sampled due to their comparative advantage in fruit production. In the third stage, the survey sample was drawn from list of the All Farmers Association of Nigeria, Afijio Chapter, and that of adopted farmers of Cocoa Research Institute of Nigeria (CRIN) to give a total of 72 respondents.

Data collection and analysis

Data was collected with the aid of an interview schedule and analyzed with frequencies, percentages, chi-square and regression.

RESULTS AND DISCUSSION

Socio-personal Characteristics of Citrus Farmers

The result in Table 1 showed that majority (76.4%) falls between the ages of 40-69 which is an indication that most of the farmers interviewed were in their middle age and are getting old. Attah *et al* (2018) also found that citrus farmers in Benue State were middle aged and mostly between the ages of 51-60 years (46.67%), a scenario which does not favour the horticulture industry. Also, majority (81.9%) were males with the females being in the minority (18.1%). This could be attributed to socio-cultural factors which prevent women from possessing economic trees which are permanent in nature. (Koyenikan and

Anozie,2017). Furthermore, most (55.6%) of the respondents are Christians with 43.1% being Moslems respectively, an indication of the freedom to embrace modern religion. Majority (95.8%) of the respondents are farmers, and have farm experience between 30 and 60 years. This is in consonance with the findings of Attah *et al*, (2018) who reported involvement of 53% of the respondents in citrus production for more than 25 years in Benue State. Farming experience is very important in farming activities as it helps the farmer in the area of proper farm management to maximise profit. (Adebisi,2022) A sizeable proportion of the respondents (95.8%) have farming as their main source of income, which suggests the agrarian nature of the rural areas. Majority (84.8%) has one form of education or the other ranging from primary education, secondary, tertiary respectively. Anzaku *et al*, (2016) and Attah *et al* (2018) in studies carried out. found that most of the citrus farmers in Benue State were educated. It further showed that total farm size for 40.3% of the citrus farmers was between 1-4 hectares. This is similar to the findings of Attah *et al* (2018) who affirmed that 74.17% of the citrus farmers in Benue State had farm size of 1-3 hectares.

Table 1 : Socio-personal Characteristics of Citrus Farmers

S/N	Variable	Frequency	Percentage
1.	**Age**		
	30-39	6	8.3
	40-49	15	20.8
	50-59	21	29.2
	60-69	19	26.4
	70 and above	11	15.3
2.	**Sex**		
	Male	59	81.9
	Female	13	18.1
3.	**Religion**		
	Christianity	40	55.6
	Islam	31	43.1
	Traditional	1	1.4
4.	**Occupation**		
	Farming	69	95.8
	Artisan	1	1.4
	Trader	1	1.4
	Others	1	1.4
5.	**Experience in farming categorised**		
	<20	6	8.3
	20-29	26	36.1
	30-39	15	20.8
	40-49	8	11.1
	50-59	11	15.3
	60 and above	6	8.3
6.	**Education**		
	No formal education	11	15.2
	Primary education	27	37.5
	Secondary education	22	30.6
	Tertiary	12	16.7
7.	**Total farm size categorized**		
	<1 hectare	10	13.9
	1-4 hectares	29	40.3
	5-8 hectares	9	12.5
	9-12 hectares	9	12.5
	>12	15	20.8

Extent of Utilization of Climate Smart Agricultural Practices

The result in Table 2 revealed that majority (91.7%) never engage themselves in the utilization of harvesting rain water as a form of climate smart practices followed by 63.9%, 62.5% and 59.8% who never utilized control of soil erosion and run-offs, use of cover crops (diversification practices), use of improved seed variety, integrated pest management and crop rotation. However, Opeyemi *et al* (2021) found that, mixed crop and mixed farming were the most popular climate smart agricultural practices utilized among farmers in Ika North East Local Government Area of Delta State. Others include cover crop, mulching, intercropping, organic manure, use of compost, crop rotation and agro forestry. Oluwatayo and Ojo (2016) found that adaptation strategies used by farmers to improve yam production in spite of climate change include mixed cropping, irrigation,

diversification and change in planting dates. Orowole et al (2015) found that multiple cropping (97.26%) and adjusting time/date of planting (91.78%) were used as most climate smart adaptation strategies among crop farmers in Lagos State.

Table 2: Extent of Utilization of Climate Smart Agricultural Practices

S/N	CSA Practices	Very often	Often	Rarely	Never
1.	Minimum or zero tillage practice	9(12.5)	6(8.3)	24(33.3)	33(41.7)
2.	Use of organic fertilizer	6(8.3)	12(16.7)	12(16.7)	42(58.4)
3.	Shifting cultivation	8(11.1)	11(15.3)	19(26.4)	33(45.9)
4.	Use of improved seed variety	4(5.6)	8(11.1)	15(20.8)	45(62.5)
5.	Integrated pest management	5(6.9)	9(12.5)	15(20.8)	43(59.8)
6.	Crop rotation	9(12.5)	7(9.7)	13(18.1)	43(59.8)
8.	Control of soil erosion and run-offs	7(9.7)	8(11.1)	11(15.3)	46(63.9)
9.	Different methods of crop establishment				
10.	Use of cover crops (diversification practices)	5(6.9)	8(11.1)	14(19.4)	45(62.5)
12.	Agroforestry				
13.	Harvesting of rain water	1(1.4)	3(4.2)	2(2.8)	66(91.7)

Sources of information on climate-smart agricultural practices (CSA)

The result in Table 3 revealed that 37.5%, 33.3%, 26.4%, 23.6% and 22.2% of respondents often listen to radio, have contacts with extension agents, farmers organisation, view television, utilise fellow farmer as their sources of information on climate smart practices, while 80.6%, 75.0%, 73.6%, 69.4%, and 68.0% never obtain information on climate smart practices from University, Non-Governmental Organisations, social media, relatives, bulletin and research institutes. Nzeadibe *et al* (2011) affirmed that the mass media (radio/TV and newspaper) was the main source of information on the climate change phenomenon in Niger Delta Region of Nigeria. Also Adebisi-Adelani and Oyesola (2014) equally established that the information sources available on climate change to the majority (91.9%) of the respondents in Benue State, Nigeria are radio (87.0%), friends (82.1%) and GSM (69.9%).

Table 3: Respondents' sources of information on climate-smart agricultural practices (CSA)

S/N	CSA Practices	Often	Rarely	Never
1	Fellow farmer	16(22.2)	19(26.4)	37(51.3)
2	Friends	11(15.3)	11(15.3)	50(69.4)
3	Relatives	13(18.1)	6(8.3)	53(73.6)
3	Radio	27(37.5)	30(41.7)	15(20.9)
4	Farmers Organization	19(26.4)	12(16.7)	41(56.9)
5	Extension agents	24(33.3)	19(26.4)	29(40.3)
6	Television	17(23.6)	14(19.4)	41(56.9)
7	Bulletin	7(9.7)	15(20.9)	50(69.4)
8	NGOs	8(11.1)	10(13.9)	54(75.0)
9	Social media	7(9.7)	11(15.3)	54(75.0)
10	Research Institute	6(8.3)	17(23.6)	49(68.0)
11	University	2(2.8)	12(16.7)	58(80.6)

Factors affecting the choice of climate smart adaptation practices

The result on Table 4 revealed that farm experience, soil fertility, access to improved seedlings (43.1%) ranked first as factors affecting the choice of climate smart adaptation practices, followed by finance (41.7%), access to water (40.3%), access to credit (37.5%) and fertilizer (36.1%). Adebisi- Adelani (2018) in a related study found out that farming experience ranked first (95.2 %) as a major factor that influenced adaptation strategies used by horticultural farmers followed by tenure right (64.9 %), household size (64.4 %), soil fertility (63.7 %) access to water (57.1 %), off farm activities (53.5 %) and access to improved seedlings (52.8 %). Similarly, Apata (2011) opined that education of the head of household, livestock ownership and extension for crop and livestock production, availability of credit and temperature are factors influencing choice of adaptation strategies to climate smart adaptation strategies in Nigeria. Chete (2019) affirmed that factors influencing farmers' choice of adaptation methods included household size, access to credit and contact with extension agents, monthly farm income and access to climate change information. Adeagbo et al (2021) found that household size, depreciation ratio, frequency of extension visits, access to extension, and non-farm income were factors influencing the adoption of climate change adaptation strategies among maize farmers in southwest Nigeria.

Table 4: Factors affecting the choice of climate smart adaptation practices

Factors	Yes	No
Farm experience	31(43.1)	41(57.0)
Finance	30(41.7)	42(58.4)
Access to credit	27(37.5)	45(62.5)
Access to water	29(40.3)	43(59.8)
Tenure	21(29.2)	51(70.8)
Household tenure	11(19.4)	61(84,7)
Access to Extension	23(31.9)	49(68.0)
Soil fertility	31(43.1)	41(56.9)
Access to improved seedlings	31(43.1)	41(56.9)
Access to fertilizer	26(36.1)	46(63.9)

Challenges faced by the respondents in using climate-smart agricultural practices

The findings on Table 5 revealed that majority (62.5%) of respondents stated that lack of government support is a very severe problem facing respondents in the use of climate -smart agricultural practices. Half (50.0%) of the respondents adduced that lack of knowledge on CSA practices, lack of technical knowhow (45.8%) and unavailability of improved planting materials (44.4%) posed a very severe problem to the use of CSA. Furthermore, high cost of CSA practices (37.5%) lack of finance, division of labour, difficulty in application of CSA practices (36.1%) were also part of the challenges affecting the use of CSA practices. Opeyemi et al (2021) reported that high cost of production and inadequate financial resources were very serious constraints to adaptation of CSA practices in Ika Local Government Area of Delta State. Orowole et al (2015) also affirmed that the main constraints to climate change adaptation among crop farmers in Lagos State were inadequate financial resources (94.5%) and poor access to the technologies necessary for adaptation (76.7%). Ifeanyi-Obi et al (2022) opined that insufficient funding and support by government in programme planning and implementation, policy inconsistencies and poor farmers' attitude and resistance to change were the challenges to the uptake of climate smart agricultural practices in Nigeria.

Table 5: Challenges faced in use of climate-smart agricultural practices

Challenges	Very Severe	Severe	Not severe	Not a challenge
No government support	45(62.5)	12(16.7)	3(4.2)	11(15.3)
High cost of CSA practices	27(37.5)	17(23.6)	2(2.8)	25(34.8)
Lack of finance	26(36.1)	20(27.8)	11.42	5(34.8)
Unavailability of improved planting materials	32(44.4)	25(34.7)	22.8	12(16.6)
Division of labour	26(36.1)	14(19.4)	1926.4	12(16.6)
Lack of knowledge on CSA practices	36(50.0)	28(38.9)	1(1.4)	6(8.4)
Lack of technical knowhow	33(45.8)	28(38.9)	4(5.6)	6(8.4)
Difficulty in application of CSA practices	26(36.1)	25(34.7)	4(5.6)	15(20.8)

Test of relationship between utilization of climate smart agricultural practices and socioeconomic characteristics of citrus farmers

Table 6 revealed that respondents' Local Government Area ($P \leq 0.000$) and Community ($P \leq 0.003$) were significantly related to utilization of CSA practices. This implies that community where each of the farmers belong determines their level of utilizing CSA practices. It also suggests that since the areas of study were notable for citrus production as a major industry for income generation, farmers will want to seek every means to protect the citrus trees from being negatively affected by the vagaries of weather so that the communities will still remain a frontline community in the citrus industry.

Table 6: Test of relationship between utilization of climate smart agricultural practices and socio-personal characteristics of citrus farmers

Socio-personal characteristics	P-Value	Chi-square value	Contingency coefficient	Decision
LGA	15.164	.000	.420	S
Community	25.058	.003	.511	S
Age	40.378	.010	.602	NS
Sex	1.509	.219	.144	NS
Marital status	4.522	.210	.245	NS
Religion	4.470	.107	.243	NS
Occupation	1.922	.589	.162	NS
Experience	20.609	.244	.474	NS
Difficulty in application of CSA	26(36.1)	25(34.7)	4(5.6)	15(20.8)
Education	6.994	.072	.299	NS
Household size	12.278	.424	.384	NS

Regression analysis showing factors affecting utilization of CSA practices by citrus farmers

The results on Table 7 reveal that the access to credit coefficient was significant which implies that a farmer's access to credit will influence his/her utilization of climate smart practices. Olutumise (2023) affirms the crucial role of credit in adopting and utilizing of climate adaptation practices among farmers in rural areas. Access to water was also a significant

coefficient affecting utilization of CSA practices. Citrus production is critically dependent on water since it is rainfed, lack of which has adverse effect on its productivity. Negative and significant relationship exists between access to water and utilization of CSA practices, and similarly between access to improved seedlings and utilization of CSA practices. Improved citrus seedlings which are drought tolerant if not readily available to farmers may make it impossible to be used as a means to combat effect of climate change. Off farm activity is significant and has positive coefficient which suggest that proceeds from different off farm activities may assist the citrus farmers to utilize climate smart practices. Access to extension was a positive significant coefficient, and this implies that the more a farmer is in contact with extension agents who are trained in the delivery of CSA practices, the more the farmer will be able to utilize CSA practices for higher level of productivity.

Table 7: Regression analysis showing factors affecting utilization of CSA practices by citrus farmers

Factors	Coefficients	t	Sig.	Decision
Finance	.497	1.022	.311	NS
Access to credit	1.010	3.057	.003	S
Access to water	-1.041	-3.198	.002	S
Land tenure	.289	1.220	.227	NS
Household size	.103	.538	.593	NS
Off Farm activity	.491	2.850	.006	S
Access to Extension	.510	2.796	.007	S
Access to soil fertility	-.409	-1.538	.129	NS
Access to improved seedlings	-1.482	-3.644	.001	S
Access to. fertilizer	.284	1.115	.269	NS

CONCLUSIONS

The study established that the citrus industry is male dominated with small holdings. Electronic media (radio and television), contact with extension agents, farmer organisations and fellow farmers were major sources of information on climate smart practices explored by the citrus farmers. Lack of government support, lack of knowledge and technical knowhow on CSA practices, and unavailability of improved planting materials were some of the challenges faced by the citrus farmers.

The level of awareness of climate smart practices (CSA) by farmers and access to climate practices was low. Similarly, extent of use of CSA was also very low. However, positive significant relationship exists between access to credit and extension and the utilization of climate smart practices. The study hereby recommends that:

I) Sponsored agricultural programs on radio and television stations should include advocacy and enlightenment for farmers to create awareness and proffer solutions to address climate change issues.

ii) Government policies should focus on addressing climate change concerns and adequate budget allocated to assist farmers in utilization of climate smart practices

iii) Breeding of drought tolerant and improved planting materials by relevant Research Institutes for uptake by the citrus farmers.

iv) Training of extension agents with relevant technical knowhow on climate change so the information can cascade down to farmers.

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RESEARCH ARTICLE

Varietal preference of sorghum growers

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ABSTRACT

The present study was conducted in Mangalwedha and Mohol .tahasils of Solapur district of Maharashtra state since it had highest areas and production of sorghum crop. The findings of the study revealed that a cent percent of respondents given preference to production per hectare followed by fodder production of sorghum crop. It was also observed that sorghum variety M-35-1 stands first in the varietal preference even though there were better varieties released and recommended by the Agricultural Universities. So, the research institutions should consider characteristics of M-35-1 while developing newer varieties in future varietal development programmes. The variables - age and varietal preference found to be negative and non-significant relationship. The land holding, area under sorghum crop and annual income were exhibited positive and significant relationship between their varietal preferences. The other characteristics viz., education, source of information, risk orientation and source of seed had depicted positive non-significant relationship with their varietal preference. It is, therefore suggested that those variables had shown positive and significant relationship with varietal preference may taken into consideration while planning the varietal development programmes in future.

Key words: Perceived Attributes, Varietal Preference, Response Priority Index, Correlation etc.

INTRODUCTION

Sorghum is the fourth most important cereal crop in the world following wheat, rice and maize. Besides, being a major source of staple food for human beings, it also serves as an important source of fodder, animal feed and industrial raw material. It is used in various forms, similar to rice. It is used as cooked food, malted, flour for dosa and making chapatti or roti, popped, semolina etc. It is a very good dry and green fodder and a good concentrate feed for cattle and poultry. Raw material is used in starch industries. It is used in production of alcohol, similar to corn, and used for preparation of sorghum syrup (20-25% sugar) from sweet sorghum varieties. It is also used for production of Jaggary. It contains high amount of aconitic acid, which prevents the crystallization of sugar. It contains 72.6% carbohydrate, 10-12% protein, 3% fat, 1.6% mineral and contains more quantity of fibbers.

Sorghum is used in different ways as a

human food, fodder, poultry feed and industrial raw materials. It has medicinal value in human diet and associated with lower risk and several diseases, including coronary heart diseases, blood pressure, stroke, cancer and type 2 diabetes. The main uses of sorghum are for preparing *bhakari* , *papad*, cookies and other preparations. The feeds, concentrates and roughages from sorghum are required for maintenance of livestock and also to harness possible increase in animal milk. Different varieties of sorghum are used for these purposes such as CSV-05, CSH-15R, CSH-19R, *Mauli, Phule Anuradha, Phule Vasudha*, M-35, *Phule Revati, Phule Suchitra, Phule Rohini, Phule Panchami, PKV Kranti*, etc.

The sorghum crop is facing the problem of climate change. Besides this climate change there are many reasons as stated above for low productivity of sorghum. Amongst these, use of non-recommended and traditional variety is one of the major reasons for low productivity. Therefore, to know the use and preference of given by sorghum growers to the different sorghum varieties.

With this backdrop, the present study was undertaken with the specific objectives-

1. To know the perceived attributes of sorghum crop
2. To study the varietal preferences of sorghum growers.
3. To ascertain the relationship between personal and socio-economic characteristics of sorghum growers with varietal Preferences

METHODOLOGY

The study was conducted purposively selected Solapur district as it has highest production sorghum in Maharashtra state. Solapur district comprises of 11 tahsils. The study was conducted in two tahsils i.e. Mangalwedha and Mohol as it has highest area under Sorghum cultivation. The list of villages having highest area under Sorghum was obtained from Taluka Agriculture Officer, and 10 villages were selected from both tahsils depending upon highest area under Sorghum crop. With the help of Taluka Agriculture Officers, Circle Agriculture Officer and Agricultural Assistant list of Sorghum growers was prepared for these 10 villages. According, Sorghum growers were selected by proportionate random sampling method from Mangalwedha and Mohol tahsil of Solapur district. Thus, total 130 respondents were selected for the study purpose. Response Priority Index was of sorghum growers were calculated by using following formula

Response Priority Index

$$RPI_i = \frac{\sum_{j=1}^{k} fij \; X_{[(k+1)-j]}}{\sum_{j=1}^{k} \sum_{j=1}^{k} f_{ij}}$$

Where,

RPI_i = Response Priority Index for ith constraint,

f_{ij} = Number of responses for the j^{th} priority of the i^{th} constraint

(i=1, 2……, l; j= 1,2,3 …..k),

$\sum_{j=1}^{k} fij$ = Total number of responses for the i^{th} constraint,

k = Number of priorities

$X_{[(k+1)-j]}$ = Scores for the j^{th} priority

$\sum_{j=1}^{k} \sum_{j=1}^{k} f_{ij}$ = Total number of responses to all constraints.

RESULTS AND DISCUSSION

1. Perceived attributes

Table-1 Distribution of the sorghum growers according to their preference in given to the attributes of Sorghum crop

Sr. No	Attributes of sorghum variety	Respondents (N=130)		
		Frequency	Percentage	Rank
1.	Production per hectare	130	100.00	I
2.	Fodder production	116	89.23	II
3.	Pest and disease resistance	86	66.15	III
4.	Size of grains	97	74.61	IV
5.	Color of grains	72	55.38	V
6.	Quality of *bhakari* (Softness)	95	73.07	VI
7.	Maturity duration	80	61.53	VII
8.	Quality of *hurada*	73	56.15	VIII
9.	Time of Flowering	79	60.76	IX
10.	Resistant to lodging	56	43.0	7X

Results in Table-1 Indicated that a cent percent of respondents given preference to Production per hectare. This was followed by the respondents had gave variety preferred on the basis of attributes viz., fodder production (89.23 per cent) followed by size of grains (74.61 per cent), quality of Bhakari (73. 07 per cent), pest and disease resistance (66.15 percent) and maturity duration (61.53 per cent)

This finding is consistent with the finding of Borthakur*et al.* (2014) and Dhawale (2017).

2. Varietal Preference

Table -2: Distribution of Sorghum growers according to their Varietal preference.

Sr.	Name of variety	Preferences given (frequency and percent)						
		1	2	3	4	5	6	Rank
1.	M-35-1	130 (100)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	I
2.	Phule Revati	0 (0.00)	63 (48.46)	61 (46.92)	5 (3.84)	1 (0.76)	0 (0.00)	II
3.	Dagadi/Dadar	0 (0.00)	61 (48.92)	7 (5.38)	58 (44.61)	4 (3.07)	0 (0.00)	III
4.	Phule Vasudha	0 (0.00)	5 (3.84)	46 (35.38)	34 (26.15)	36 (27.69)	9 (6.92)	IV
5.	PhuleMauli	0 (0.00)	1 (0.76)	10 (7.69)	24 (18.46)	57 (43.84)	37 (28.46)	V
6.	Yashidhara	0 (0.00)	0 (0.00)	8 (6.15)	8 (6.15)	31 (23.84)	83 (63.84)	VI

The data in Table-2 depicted that the respondents had gave first preferred to M-35-1 (100.00 per cent) sorghum variety for cultivation followed by *Phule Revati* (48.46 per cent) , *Dagadi / Dadar* (46.50 per cent) a local variety. *Phule Vasudha* (35.38 per cent) was preferred at forth position.*PhuleMauli* (43.84 pe rcent) and *Yashodhara* (63.84) were preferred by the respondents at fifth and sixth positions respectively.

3. Response Priority Index

The response priority index for the different sorghum varieties was s measured by considering the preferences given by the respondents.

Table-3:Response priority index of sorghum growers according to their varietal preference given

Sr. No.	Variety	Response Priority Index (RPI	Percent frequency	Average response	Rank
1.	M-35	1.00	29	223	I
2.	*Phule Revati*	0.76	22	169	II
3.	*Dagadi*	0.64	18	142	III
4.	*Phule Vasudha*	0.54	15	121	IV
5.	*Phule Mauli*	0.33	9	74	V
6.	*Yashodhara*	0.23	7	51	VI
	Sum	4.00	100	780	

From the Table -3 It is observed that RPI of the M-35-1 variety was 1.00 followed by *Phule Revati* with 0.76.The RPI of the *Dagadi* variety was 0.64 followed by*Phule Vasudha* with 0.54.The RPI of the varieties *Phule Mauli* and *Yashodhara* was 0.33 and 0.23 respectively.

4. Relationship between personal and socioeconomic characteristics of sorghum growers with their varietal preference:

Sr. No.	Independent variables	Correlation coefficient ®
1.	Age	-0.031^{NS}
2.	Education	0.058^{NS}
3.	Family Size	0.179^{NS}
4.	Land Holding	0.116**
5.	Area under sorghum crop	0.041**
6.	Source of information	0.107^{NS}
7.	Annual Income	0.180**
8.	Risk Orientation	0.004^{NS}
9.	Source of Seed	0.151^{NS}

** = Significant at 1 per cent level of probability
* = Significant at 5 per cent level of probability
NS = Non – Significant

1. Age and Varietal preference

The Table-4 indicates that the relationship between age and varietal preference of sorghum growers was negative and non-significant (r = -0.031) at 0.01 per cent level.

2. Education and Varietal preference

It was observed from Table-4 that the education and varietal preference of respondents had positively non- significant (r =0.058) at 0.01 per cent level.

3. Family size and Varietal preference

The relationship between family size of respondents and varietal preference of sorghum growers was found positive and non-significant (r=0.179) at 0.01 per cent level.

4. Land holding and varietal preference

The data in the Table-4 revealed that there was a positive and highly significant correlation (r=0.116**) between land holding and varietal preference.

5.Area under sorghum crop and Varietal preference

The correlation coefficient (r=0.041**) indicated that the relationship between area under sorghum crop and varietal preference of the respondents was positive and highly significant.

6.Source of information and Varietal preference

The relationship between respondent's source of information and varietal preference of sorghum growers was found to be positive and non-significant (r=0.107) at 0.01 per cent level.

7.Annual income and Varietal preference

The relationship between annual income and varietal preference of sorghum growers was found to be positive and significant (r=0.180) at 0.01 per cent level.

8. Risk orientation and Varietal preference

The variable risk orientation of the respondents exhibited positive and non-significant (r = 0.004) relationship with their varietal preference.

9. Source of seed and Varietal preference

The relationship between respondent's source of seed and varietal preference of sorghum growers was found to be positive and non-significant (r=0.151) at 0.01 per cent level.

CONCLUSION

The finding of present investigation revealed that a cent percent of respondents given preference to production per hectare followed by fodder production of sorghum crop. It was also observed that sorghum variety M-35-1 stands first in the varietal preference even though there are better varieties released and recommended by the Agricultural Universities. So, the research institutions should consider characteristics of M-35-1 while developing newer varieties in future varietal development programmes. The variable age and varietal preference found to be negative and non-significant relationship. The land holding, area under sorghum crop and annual income were exhibited positive and significant relationship between their varietal preference. The selected other characteristics viz., education, source of information, risk orientation and source of seed had exhibited positive non-significant relationship with their varietal preference. It is , therefore suggested that those variable had shown positive and significant relationship with varietal preference may taken into consideration while planning the varietal development programme in the study areas.

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RESEARCH ARTICLE

Partnerships in rice sector: Understanding stakeholder preferences and intended outcomes

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ABSTRACT

Partnerships in agricultural research and development have gained increasing attention as effective mechanisms for addressing complex challenges in both developed and developing economies. Especially, public-private partnerships, play a pivotal role in advancing research, innovation, and commercialization. This study is an attempt to explore the perceptions and expectations of rice researchers regarding partnerships in the rice sector. It focuses on understanding the willingness to collaborate, preferred types of partnerships, and the intended outcomes of such collaborations. The results indicate that most respondents are highly willing to participate in technology development, showing a strong preference for partnerships focused on resourcing and commercialization. The research highlights the importance of funding, infrastructure, and research material exchange as primary purposes of collaboration, with an emphasis on increasing crop yields and resilience to environmental stresses as the intended outcomes. The study concludes that successful partnerships are driven by the perceived tangible benefits they offer, including resource sharing and the potential for advancing sustainable rice production. The findings underscore the importance of strategic collaborations, particularly with institutions like ICAR and CGIAR, which possess the capacity to drive meaningful innovations in the rice sector.

Keywords: Partnerships, Rice research, Public-private partnership, commercialization, resource sharing.

INTRODUCTION

Partnership in agricultural research and development, akin to other sectors like health and construction, have received heightened attention in both developed and less developed economies. The need for this approach stems from the innovation system powered by ever evolving science and technology that demands to solve increasing complex problems. The approaches like public–private partnerships in agricultural research innovation are viewed as an effective means to achieve the advanced research and commercialisation goals. This has proved to benefit various actors involved in the partnership cycle. Right partnership makes it possible for any agricultural value chain to achieve improved performance in terms of efficiency, effectiveness, competitiveness, access to technologies, inputs, markets, coordination, information and credit to address complex economic,

environmental, social and technological problems (ADB, 2012; Horton, et al, 2009). There is considerable evidence of usually neglected marginalized groups like resource poor and small scale farmers being benefited from such innovative partnership approaches. Partnerships among various stakeholders of rice research and development or rice value chain have a significant impact on the growth of the rice sector. This has created interest on how partnership is understood especially by the public sector researchers. The objective of the study is to explore and document researchers' expectations for building partnerships to enhance rice research and extension activities.

METHODOLOGY

The partnership in the rice sector theoretically has some assumptions like there is a need for partnership in the rice sector that has many actors who are willing to forge partnerships and there are many factors that are associated and influence the partnership building and sustainable partnership. Partnership for the present study was operationalised as a kind of agreement between two or more researchers (from Public or private sector) to achieve a common objective by sharing some kind of resources. The data on willingness to forge partnership, the type of partnership, choice of organisation and expected outcome was collected. The data was collected using a questionnaire from eighty rice researchers from NARES to know about expectations about the partnerships.

RESULTS AND DISCUSSION

3.1 Willingness to forge partnership and the type of partnerships

Willingness to collaborate in any activity is related to the stakeholder's intentions towards partnership situations. It may be dependent on a variety of aspects, which are basically related to the expected outcomes of the partnership or collaboration opportunity. If the partnership is perceived as a beneficial one for the individual or organisation, the intention to forge partnership increases and it is reflected in the willingness.

Table 1. Willingness to forge partnership

Partnership Activity	Number of Respondents	Percentage of respondents
Technology development	53	66.25
Technology dissemination	19	23.75
Technology utilisation	8	10

The analysis of the results reveals that the majority of the respondents (66.25%) are willing to forge partnerships especially in the technology development activities. Respondents showed less preference for forming partnerships in technology dissemination, with only 23.75% expressing interest, focusing primarily on technology development processes instead. When further probed about the type of partnerships, the following results were observed. The partnership was classified into five functional categories and the factors considered were definite roles, risk allocation and potential impact.

Table 2. Type of partnership

Types of partnership	Number of Respondents	Percentage of respondents
Resourcing partnership	57	71.25
Contracting partnership	36	45
Commercialisation partnership	41	51.25
Frontier research partnership	19	23.75
Sector and value-chain development partnership	22	27.5

The results revealed that the resourcing partnership is the most preferred (71.25%), indicating a strong interest in collaborations that focus on pooling resources such as funding, technology, or expertise. Resourcing partnerships is the one where mostly the public sector receives funding or the expertise from the funding agency like philanthropic foundations or private sector. Respondents may consider this as a practical way to achieve mutual goals with shared contributions. The second-highest preference suggests that many respondents value commercialization partnership (51.25%) that support bringing innovations or products to market, emphasizing the importance of business-oriented collaborations. In order to accelerate the transfer of technology or transferring the research findings or materials to be used by the end user or other partner in their programmes, commercializing partnerships are undertaken. This is mostly done for the commercialization, marketing, and distribution purpose by the public sector using the vast infrastructural and marketing resources of the other partner mostly from the private sector.

In case of contracting partnerships, one of the partners contracts their facilities or expertise to the other in partnership to execute the research project. Mostly, the public sector facilities used by the private sector falls in the category. The results revealed that about 45% preferred this type of partnership that might involve outsourcing specific tasks, which may not align with respondents' priorities. When public research organisations jointly work with the stakeholders like other networks of public, private, and civil society partners to develop a commodity sub sector or its associated value chain the sector/value chain development partnerships are forged. About 27.5% preferred this type where as 23.75% preferred the frontier research partnerships that are jointly undertaken by the public and private sector where the project outcomes are universal and the success of the project has some uncertainty.

Respondents prioritize and choose the partnerships that provide tangible and immediate benefits, such as resource sharing and commercialization opportunities, while being less inclined toward collaborations requiring long-term, systemic, or high-risk investments (Spielman et al., 2007).

3.2 Choice of organisations to forge partnerships

Organizations play a critical role in forging agricultural research partnerships and only right choice of organisations help leverage resources and knowledge, leading to innovative solutions for agricultural challenges. Through partnerships, organizations can influence agricultural policies and support the development of evidence-based strategies that promote sustainable agricultural practices at both local and global levels (Pretty et al., 2018).

Table 3. Choice of partnering organisations

Partnering Organisations	Number of Respondents	Percentage of respondents
ICAR institutes	74	92.5
CGIAR institutes	66	82.5
Other Indian Public sector research organisations	48	60
Private sector organisation	36	45
State Agricultural Universities (SAUs)	16	20

In case of choice of organizations, the respondents preferred the partners from ICAR institutes (92.5%) followed by CGIAR institutes (82.5%). The organisations that possess substantial expertise and research capacity in various areas of agricultural science are mostly preferred for the partnership. Both, ICAR and CGIAR have network of organisation and focus on key global agricultural issues like food security, climate resilience, and sustainable farming practices. ICAR and CGIAR institutes such as International Rice Research Institute (IRRI) have worked together with many partners at national, state and with the NGO sector to improve rice production in India. Through various joint research initiatives, they have developed high-yielding, disease-resistant, and climate-resilient varieties. The "Rice-Wheat Consortium for the Indo-Gangetic Plains," a partnership involving ICAR, CGIAR, and national agricultural research systems, was particularly successful in improving the productivity and sustainability of rice-wheat cropping systems in the region.

3.3 Purpose and intended outcome of the partnership

The reported purposes for forging partnerships include achieving the vision, exchanging research materials, scaling up efforts, reaching a larger number of potential users, and making effective use of genetic resources.

Table 4. Purpose of partnership

Purpose of partnership	Number of Respondents	Percentage of respondents
Funding assistance	60	75
Use of infrastructural facility	58	72.5
Research material exchange	52	65
Vision of organisation	50	62.5
Project scope	44	55
Use of genetic resources	28	35
Career advancement	10	12.5

The majority of respondents (75%) identified funding assistance as the primary reason for entering into partnerships, indicating that securing financial resources is a top priority for them. About 72.5% of respondents highlighted the use of infrastructural facilities as a key purpose and it may be for the benefit of having access to research labs, equipment, or other project resources. As the respondents are from rice sector, about 65% of respondents see the exchange of research materials such as samples, data or technologies as a significant benefit of partnerships. About

62.5% of the respondents cited alignment with the organization's vision as an important factor in choosing partnerships. This indicates that shared goals and values are essential to successful collaborations. In case of scope of the project as purpose, 55% of respondents indicated scale, reach, and objectives as a key factor. Use of Genetic Resources (35%) and Career Advancement (12.5%) are the other purposes cited in the study. Partnerships are mainly driven by practical and strategic needs related to resources and research rather than personal or career growth.

Table 5. Intended outcome from partnership

Intended outcome from partnership	Number of Respondents	Percentage of respondents
Advanced research for increased yield, resistance to biotic and abiotic stresses	64	80
Participatory Technology Development	18	22.5
Improved Hybrid rice technology	10	12.5
Managing risk and enhancing food security	10	12.5
Increase in total system productivity	23	28.75
Enhanced environmental benefits	16	20

The majority of respondents (80%) intend that partnerships will lead to advanced research that improves crop yields and enhances resistance to various biotic (e.g., pests, diseases) and abiotic (e.g., drought, salinity) stresses. This indicates that increasing resilience and productivity in crops is a top priority for most respondents to forge the partnership. Strengthening the capacity of institutions and individuals ensures that agricultural innovations can be effectively implemented and sustained over time. About 60% of respondents expect partnerships to help develop capacity, particularly in terms of human resources and infrastructure. Other expected outcomes, such as Increase in Total System Productivity (28.75%), Participatory Technology Development (22.5%), Enhanced Environmental Benefits (20%), improved hybrid rice technology (12.5%) and managing risk and enhancing food security (12.5%), suggest a more targeted focus on specific crop innovations and addressing broader systemic agricultural challenges.

In the rice sector, the purpose is to foster collaboration among research institutions, universities, government agencies, and private sectors to enhance the productivity, sustainability, and resilience of rice farming. By combining resources and expertise, these partnerships aim to develop sustainable rice production systems, ensure food security, and improve livelihoods, particularly in rice-dependent communities. The ultimate goal is to advance rice production techniques, strengthen crop resilience, and support policy development to improve global food systems.

CONCLUSION

The willingness to engage in rice research partnerships is strongly influenced by stakeholders' perceptions of the potential benefits these collaborations can deliver. Respondents demonstrated a clear preference for partnerships that offer tangible, immediate outcomes, such as technology development, resource sharing, and commercialization opportunities, while showing less interest in high-risk or long-term investments. The findings also reveal a strong inclination toward partnerships focused on advanced research, particularly in enhancing yields and resilience to biotic and abiotic stresses, with resourcing partnerships being the most favoured

type. The selection of partnering organizations further highlights a preference for established entities like ICAR and CGIAR, renowned for their robust research capacities and focus on critical global agricultural challenges. This study suggests that stakeholders are driven by both short-term, practical benefits and long-term, strategic objectives, favouring collaborations that provide concrete support, resource sharing, and commercialization potential.

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RESEARCH ARTICLE

Student Advisory System of PJTSAU: Constraints faced by students, teachers and formulation of a strategy to improve student advisory system

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ABSTRACT

As universities adopt flexible curriculum models and offer a broader range of courses, students must optimize available resources to navigate their academic paths effectively. A robust advisory system is essential in this endeavour. Within this framework, every faculty member plays a role in guiding and supporting each student through ongoing advice and access to tools and expertise, advisors significantly contribute to students' academic success. This paper focused on the constraints faced by students and teachers under student advisory system. Ex-post facto research design was adopted for the study with a sample of 120 students covering three agricultural colleges under the PJTSAU. From the analysis, it was found that 84.16 per cent of students felt that there were no regular advisory classes for students, followed by 83.33 per cent students felt there were no suggestions and solutions given by their concerned advisors. Majority of the students 87.50 per cent suggested that there should be regular scheduled advisory meetings, followed by 83.33 per cent students suggested that advisors should be given much time for counselling students. Majority of teachers 80.00 per cent said that students are not treating the advisory class as a part of curriculum, followed by 70.00 per cent teachers said students never follow the instructions which are given by the advisors. Majority of teachers 73.33 per cent suggested that students should be given punishment for not attending the advisory classes, followed by 66.66 per cent suggested that student response to their advisory should be changed.

Keywords: Advisors, Administration, Curriculum, Teachers, Open ended,

INTRODUCTION

The student advisory system traces its origins back to Harvard College in 1636. Over the following century, college presidents and later instructors provided guidance to students on extracurricular activities, moral conduct, and intellectual pursuits. The enactment of the Morrill Acts of 1863 and 1869, which established Black colleges, land grant colleges, and universities, broadened access to higher education and introduced practical disciplines to curricula. This expansion led to a growing demand for specialized student services to support the diverse student body, programs, and institutions. During the 1940s and 1950s, faculty members primarily served as mentors for students. The surge in student enrollment during the 1960s and 1970s highlighted the need for further enhancements in student support services.

Outside of class, it's important for a

student to maintain a strong relationship with their faculty advisor. Working closely with an advisor helps students clarify their academic and career objectives, leading to greater academic success and progression. Pizzolato (2008) highlights the benefit of ongoing one-on-one interactions over multiple years in academic advising. According to Baker and Griffin (2010), advisors play a crucial role in guiding students through major and degree requirements, assisting with course scheduling, and ensuring timely progress towards graduation.

In PJTSAU, upon enrolment in the college, students are promptly assigned to their advisory committee in anticipation of graduation. This early involvement aids students in acclimating to the campus environment, familiarizing themselves with college policies and procedures, and gaining a comprehensive understanding of the curriculum.

METHODOLOGY

Professor Jayashankar Telangana State Agricultural University (PJTSAU), Rajendranagar, Hyderabad was purposively selected for the study. Three agricultural colleges were purposively selected based on the chronological order of establishment i.e. Rajendranagar, Aswaraopet and Jagityal. A sample of 40 students from each campus i.e. B.Sc. (Ag) third year (20) and final year (20) students were randomly selected. Thus, in total 120 students from three campuses. A sample of 10 teaching faculty members were randomly selected from each campus. Thus, a total of 30 teaching faculty members were selected for the study.

The data from the students and teachers on constraints and suggestions was collected with the help of open-ended questionnaire. Data collected was analysed and interpretations were drawn based on results. The statistical techniques i.e., frequency, percentage and ranking were followed for analysing the data, and accordingly.

RESULTS AND DISCUSSION

The data was collected from the students and teachers on constraints and suggestion were analysed, interpreted, and accordingly the following results and conclusion were drawn.

Table 1. Constraints elicited by students under advisory system in PJTSAU (n=120)

S.No	Constraints	f	%	Rank
1.	There are no regular advisory classes	101	84.16	**I**
2.	Advisors are not interested to listen to student concerned problems and issues in academics	85	70.83	**VIII**
3.	Attitude of the advisors make students not approach them	50	41.6	**X**
4.	Time assigned for advisory class are not enough for discussing their academic issues.	90	75.00	**V**
5.	There were no suggestions and solutions after student problems are told to advisors	100	83.33	**II**
6.	Number of students assigned to the advisors are more	86	71.67	**VII**
7.	Advisor are not competent to deal with problems of students and provide suitable solutions.	91	75.83	**IV**
8.	Advisor were showing favoritism towards some students discouraging the other students to come up with their issues	89	74.17	**VI**
9.	Advisors are not available in the scheduled time period	99	82.5	**III**
10.	My advisory does not provide any valuable information regarding job opportunities and post-graduation.	70	58.33	IX

Table 2. Suggestions elicited by students under advisory system in PJTSAU (n=120)

S.No	Suggestions	f	%	Rank
1.	There should be regular scheduled advisory meetings	105	87050	I
2.	The way advisors treating their students should be changed and students should be felt concerned rather being ignored	82	68.33	VIII
3.	The attitude of the advisor should be changed so that students approach them	50	41.6	X
4.	Each student should be given time slots for advisory meetings	92	76.66	V
5.	The advisor should timely provide suggestions and solutions for the student problems	99	82.5	III
6.	As number of students per advisory cannot be changed, the duration of the advisory meeting should be increased.	87	72.50	VII
7.	Advisor should undergo training to be competent enough to solve student Problems	93	77.50	IV
8.	Advisor should equally treat their concerned students rather than showing bias	89	74.17	VI
9.	Advisor should be given much time for counseling students	100	83.33	II
10.	The advisors should provide latest information of post-graduation and job formats	70	57.5	IX

Table 3. Constraints elicited by teachers under advisory system in PJTSAU (n=120)

S.No	Constraints	f	%	Rank
1.	Students never follow the instructions which are given by the advisors	42	70.00	**II**
2.	Students are not regular to advisory classes and never inform to advisors when they are going home.	41	68.33	**III**
3.	Sometimes advisory students did not follow the rules and regulations which	39	65.00	**V**
	are taught in the class			
4.	They are not treating advisory class as a part of curriculum	48	80.00	**I**
5.	Instead of approaching to the advisory in the times of problematic situation	20	33.33	**VIII**
	they are taking directly to higher authority			
6.	Response of the students to their concerned advisor are unsatisfactory	28	46.66	**VI**
7.	We cannot keep an eye on each and every student's personal behaviour with available time because of too many students are assigned to each advisor	24	40.00	**VII**
8.	In spite of the given solutions and advices, students make mistakes again and again	40	66.66	**IV**
9.	Students are very negligent in filling the performance register	28	46.66	**VI**
10.	Lack of disclosing problems faced by the students and blaming the advisory committee	40	66.66	**IV**

Table 4. Suggestions elicited by teachers under advisory system in PJTSAU (n=120)

S.No	Suggestions	f	%	Rank
1.	Students should be imposed with punishments who aren't following instructions given by the advisors	12	40.00	**VI**
2.	The administration should make advisory classes with attendance mandatory	10	33.33	**VIII**
3.	The advisors should inform the concerned parents if the students are not following the rules and regulations taught in the class meetings	11	36.66	**VII**

S.No	Suggestions	f	%	Rank
4.	Students should be given punishment for not attending the advisory classes	22	73.33	**I**
5.	The students should first meet their advisory regarding their problematic situations rather meeting the higher authority	18	60.00	**III**
6.	The student response to their advisory should be changed	20	66.66	**II**
7.	The amount of time allotted for advisory meeting should be gradually increased	14	46.67	**V**
8.	The students should be monitored and their behaviour of committing mistakes repeatedly should be controlled	11	36.66	**VII**
9.	Students should be regularly filling their performance register after the completion of the semester	17	56.66	**IV**
10.	Students should freely discuss their problems rather blaming the committee for not solving their problems	12	40.00	**VI**

Strategy to Improve the effectiveness of Advisory System

Based on the findings of the study the suitable strategies were suggested to the administration to improve effectiveness of advisory system of PJTSAU.

1. The administration should impose strict rules and regulations on student advisory system including regular advisory classes, monitoring of professors who are stakeholders of advisory system regarding the fulfilment of their duties and responsibilities, time allotted for advisory meetings should be increased,
2. The students should be allotted scheduled time slots with their advisors to discuss their concerns and problems.
3. Students should be strictly warned to fill their performance register soon after the completion of the semesters.
4. Professors should be given much time to interact with the students freely and mingle with them to better know the student problems.
5. Advisors should equally treat every student so that he is able to discuss his concerns regarding academics and personal life.
6. Strict punishment should be given to the students who are not attending the advisory classes and not taking the advisory system as a part of curriculum.
7. The concerned advisors should be available to students in their scheduled time.
8. There should be separate classroom mode advisory system which could be widen the approachability to the students and advisor.
9. Should maintain a year wise WhatsApp group with their students to help and support even after college hours.
10. Concerned advisors should provide detailed information to students about the post-graduation courses and jobs in public, private, MNCs, NGOs and many other job formats.
11. Specialised trainings, seminars and workshops should be conducted for the advisory committee to better understand different student mentalities and psychology so as to treat the students orderly.

CONCLUSION

The effectiveness of advisory system can be improved by decreasing the number of students assigned to each professor but, in the present scenario it is not possible for doing such. So, students should be given time slots so to improve the effectiveness. As given so, each student will be given considerable amount of

time to discuss with their advisory and the advisor can also get to know the student problems and provide a valuable alternative suggestion.

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RESEARCH ARTICLE

Assessing construction challenges during the house construction Stage

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ABSTRACT

This research study investigates the construction challenges encountered during the house construction stage in the Karnal and Hisar regions of India. Using a quantitative methodology, data were collected from 60 participants—30 from each region—through a structured questionnaire. Respondents rated their agreement on various construction challenges using a Likert scale, with responses analyzed through frequency percentages and Weighted Mean Scores (WMS). Key findings reveal significant challenges related to the availability and affordability of building materials, adherence to construction timelines, and lack of flexibility in material selection. Other notable issues include sanitation, waste disposal, workforce shortages, and security concerns. The results indicate a more pronounced difficulty in the Hisar region compared to Karnal, highlighting the need for targeted interventions. This study provides essential insights into the complex challenges faced during residential construction, laying the groundwork for further research and informing decision-making processes to enhance construction project outcomes in these regions.

Keywords: building, challenges, construction, house, process

INTRODUCTION

The construction industry plays a vital role in the development and growth of urban areas, providing essential infrastructure and housing for communities. However, the process of house building is often accompanied by numerous challenges that can impact the timely completion and overall success of construction projects. Understanding these challenges is crucial for industry professionals, policymakers, and researchers to develop effective strategies and solutions. Over the past five decades, the construction industry in India has undergone significant transformations in terms of project scale and complexity. The primary objectives of construction projects have remained consistent, focusing on timely project completion, adherence to quality standards, and staying within the allocated budget (Alaloul *et al.*, 2016). The construction projects play a crucial role in the economic development of a country, contributing to its commercial, infrastructure, and industrial growth. However, delays in construction projects are common, and their impact varies depending on factors such as the project's nature, design, and significance. When a project experiences delays, there are two main approaches: extending the delivery time or intensifying the project's progress to ensure timely completion (Choudhry *et al.*, 2021). (Ng *et al.*, 2004) studied in any construction project, challenges are unavoidable and have a significant impact on its performance. These challenges can arise from various factors, including ineffective communication among staff members, poor workmanship leading to low-quality output, and inadequate availability of materials. Moreover, organizational shortcomings and an inability to effectively handle critical situations further contribute to these challenges (Yadollahi *et al.*,

2014). One of the primary factors contributing to the low success rate of building projects is often attributed to construction delays (Doloi *et al.*, 2012). These delays stem from a range of project management-related issues involving clients, contractors, design, and consultants (Aiyetan and Das, 2016). Construction challenges encompass a wide range of factors that can hinder the progress and performance of a project. These challenges may arise from various sources, such as technical limitations, resource constraints, regulatory compliance, environmental considerations, and organizational issues. (Mokhtariani *et al.*, 2017) stated that the key attributes of a construction project, namely time, cost, and quality, cannot be precisely determined or assessed until the project is contracted and completed. According to (Frimpong *et al.*, 2003), project success is achieved when the project objectives and goals are met as intended. This entails achieving successful technical performance while staying within the allocated budget and adhering to the scheduled timeline. This research paper aims to explore and analyze the construction challenges faced during the construction stage of projects.

METHODOLOGY

The research conducted to analyze the construction challenges faced during the construction stage of houses involved a quantitative approach. The methodology aimed to gather data from respondents in the Karnal and Hisar regions of India. The sample size consisted of 60 participants, with 30 respondents from each location. A structured questionnaire was developed to collect data on the construction challenges faced by the respondents. For each challenge, the respondents were asked to indicate their agreement level on a Likert scale, with options of "Agree," "Neutral," and "Disagree." The frequency of responses for each challenge was recorded as a percentage to determine the prevalence of the challenges among the respondents. The data collected from both locations were analyzed separately, as well as collectively to derive overall insights into the construction challenges. To further analyze the data, Weighted Mean Scores (WMS) were calculated for each construction challenge. The WMS provided a quantitative measure of the respondents' agreement level, ranging from a minimum of 1 to a maximum of 3. Higher WMS indicated a higher level of agreement with the respective challenge.

The study did not delve into the underlying causes or potential solutions for these challenges. However, the research outcomes can serve as a basis for further investigation and inform decision-making processes in the construction industry.

RESULTS AND DISCUSSION

The research study focused on examining the challenges encountered during the construction stage of residential houses in the Karnal and Hisar regions. The results, presented in Table 1, provide a comprehensive overview of the frequencies and percentages of agreement among the participants regarding various construction challenges.

Table 1: Construction challenges faced by respondents at construction stage

Sr. No.	Construction challenges	Karnal (n=30) Frequency(%)	Hisar (n=30) Frequency(%)	Total (N=60) Frequency(%)	WMS (Karnal)	WMS (Hisar)
1.	**Availability of building material**					
	Agree	10(33.33)	20(66.66)	30(50.00)	1.83	2.50
	Neutral	5(16.66)	5(16.66)	10(16.66)		
	Disagree	15(50.00)	5(16.66)	20(33.33)		

Sr. No.	Construction challenges	Karnal (n=30) Frequency(%)	Hisar (n=30) Frequency(%)	Total (N=60) Frequency(%)	WMS (Karnal)	WMS (Hisar)
2.	**Affordability of building material**					
	Agree	11(36.66)	19(63.33)	30(50.00)	2.03	2.50
	Neutra	l9(30.00)	7(23.33)	16(26.66)		
	Disagree	10(33.33)	4(13.33)	14(23.33)		
3.	**Lack of flexibility in selection of building material**					
	Agree	21(70.00)	15(50.00)	36(60.00)	2.53	2.33
	Neutra	l4(13.33)	10(33.33)	14(23.33)		
	Disagree	5(16.66)	5(16.66)	10(16.66)		
4.	**Setting and sticking to construction timeline**					
	Agree	16(53.33)	15(50.00)	31(51.66)	2.36	2.33
	Neutral	9(30.00)	10(33.33)	19(31.66)		
	Disagree	5(16.66)	5(16.66)	10(16.66)		
5.	**Adequate sanitation, drainage, sewage, waste disposal and environment**					
	Agree	17(56.66)	14(46.66)	31(51.66)	2.46	2.23
	Neutral	10(33.33)	9(30.00)	19(31.66)		
	Disagree	3(10.00)	7(23.33)	10(16.66)		
6.	**Lack of skilled workforce**					
	Agree	11(36.66)	8(26.66)	19(31.66)	2.23	1.96
	Neutral	15(50.00)	13(43.33)	28(46.66)		
	Disagree	4(13.33)	9(30.00)	13(21.66)		
7.	**Curing process for strengthing of building taken care of properly**					
	Agree	6(20.00)	15(50.00)	21(35.00)	1.83	2.33
	Neutral	13(43.33)	10(33.33)	23(38.33)		
	Disagree	11(36.66)	5(16.66)	16(26.66)		
8.	**Changes in design**					
	Agree	15(50.00)	13(43.33)	28(46.66)	2.33	2.23
	Neutral	10(33.33)	11(36.66)	21(35.00)		
	Disagree	5(16.66)	6(20.00)	11(18.33)		
9.	**Access to basic housing facilities**					
	Agree	19(63.33)	13(43.33)	32(53.33)	2.40	2.30
	Neutral	4(13.33)	13(43.33)	17(28.33)		
	Disagree	7(23.33)	4(13.33)	11(18.33)		
10.	**Security issues**					
	Agree	14(46.66)	10(33.33)	24(40.00)	2.26	2.13
	Neutral	10(33.33)	14(46.66)	24(40.00)		
	Disagree	6(20.00)	6(20.00)	12(20.00)		
11.	**Construction schedule delay**					
	Agree	20(66.66)	17(56.66)	37(61.66)	2.66	2.40
	Neutral	10(33.33)	8(26.66)	18(30.00)		
	Disagree	0	5(16.66)	5(8.33)		

Figures in parenthesis represent percentage

The research study focused on examining the challenges encountered during the construction stage of residential houses in the Karnal and Hisar regions. The results, presented in Table 4.7, provide a comprehensive overview of the frequencies and percentages of agreement among the participants regarding various

construction challenges.

The study's findings reveal several significant challenges related to the availability and affordability of building materials in the regions of Hisar and Karnal. Firstly, the availability of building materials emerged as a substantial obstacle, with a notably higher percentage of respondents (66.66%) in Hisar acknowledging this challenge compared to Karnal (33.33%). This discrepancy suggests that sourcing necessary construction materials posed a more pronounced difficulty in the Hisar region, potentially due to factors such as supply chain disruptions, logistical issues, or local resource constraints.

Furthermore, the affordability of building materials also surfaced as a noteworthy concern. In this regard, a greater percentage of participants in Hisar (63.33%) expressed agreement with this challenge, as opposed to Karnal (36.66%). This disparity implies that while the cost of materials was a shared concern, it was more acute in Hisar. Economic factors, inflation, and market dynamics might contribute to the increased affordability issue faced by participants in this region, potentially impacting the feasibility of construction projects.

Another prominent challenge identified in the study relates to the lack of flexibility in selecting building materials. This obstacle garnered agreement from a majority of respondents in both Hisar and Karnal. This implies that participants encountered limitations in terms of available choices for suitable construction materials, which could potentially compromise the construction process and overall project quality. This limitation could be attributed to factors such as regional availability, regulatory constraints, or a lack of awareness regarding alternative materials.

The study also highlighted the challenge of ensuring adherence to construction timelines, with a majority of respondents from both regions acknowledging this issue. This suggests that delays in project completion were a common occurrence, which could have significant implications for project success, budget management, and stakeholder satisfaction. Reasons for these delays might encompass factors such as weather disruptions, inadequate project planning, or unforeseen technical difficulties.

In addition to the core challenges mentioned, the study also brought to light several other issues impacting the construction stage. These encompassed concerns related to sanitation, waste disposal, environmental considerations, shortage of skilled workforce, managing design changes, providing basic housing facilities, and addressing security issues. These findings underscore the intricate and multifaceted nature of challenges faced during the construction phase, encompassing both technical and socio-economic dimensions. Addressing these challenges necessitates a comprehensive and adaptive approach that takes into account the diverse range of factors influencing construction projects in these regions.

Overall, the research provides valuable insights into the specific challenges experienced during residential construction projects in the Karnal and Hisar cities. By understanding and addressing these challenges, stakeholders in the construction industry can develop targeted strategies and interventions to improve project outcomes and ensure successful completion of construction projects. This research serves as a foundation for further exploration and implementation of effective measures to mitigate these challenges and enhance the overall efficiency and quality of construction projects in these cities.

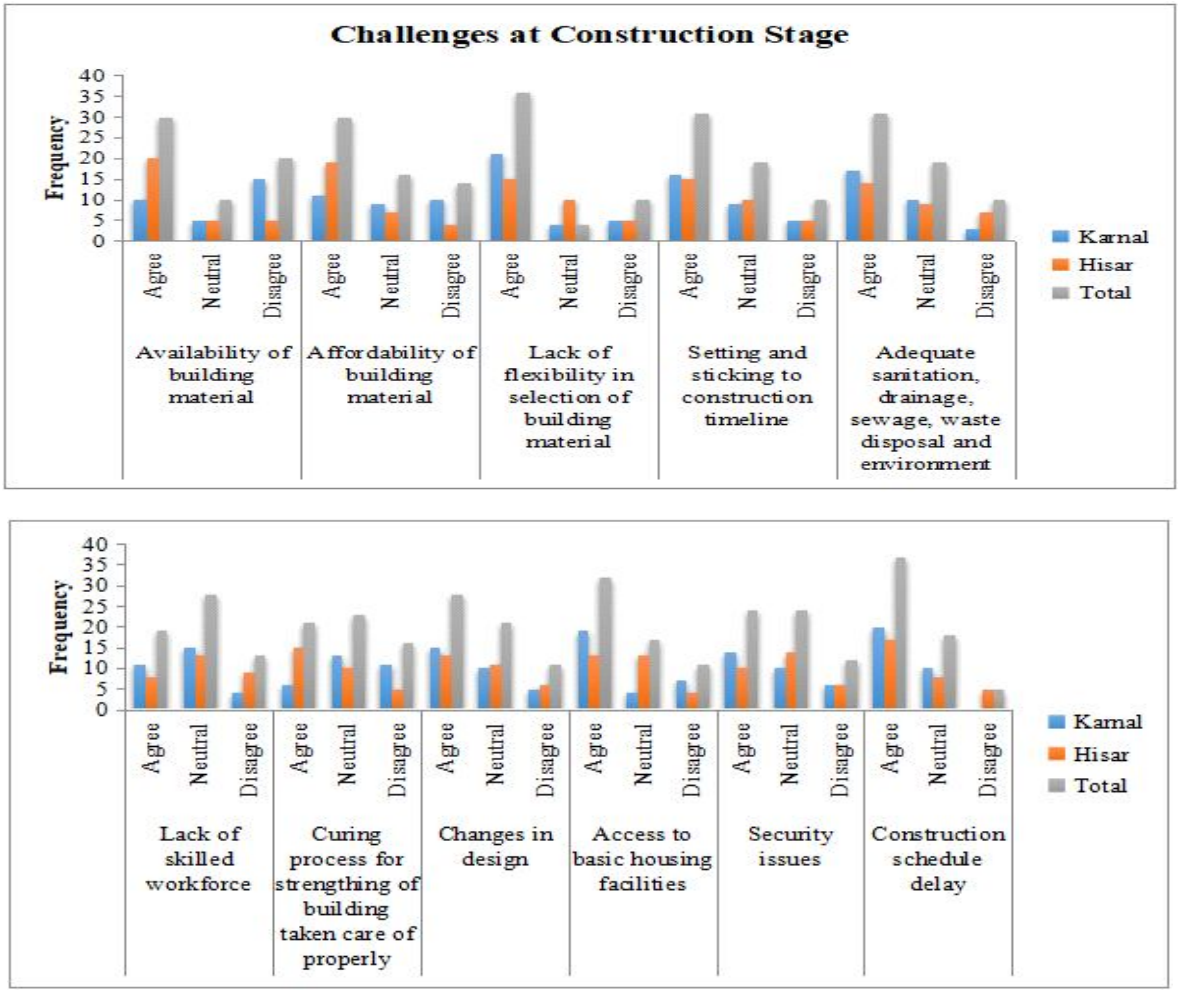


Fig. 1: Construction challenges faced by respondents during house construction

CONCLUSION

This study provides a comprehensive analysis of the significant challenges encountered during the residential construction stage in Karnal and Hisar, India. The findings highlight critical issues related to the availability and affordability of building materials, which were notably more severe in Hisar, suggesting regional disparities likely influenced by supply chain disruptions and economic factors. The lack of flexibility in selecting building materials further complicates the construction process, potentially compromising project quality and efficiency. Moreover, adherence to construction timelines emerged as a widespread concern, with delays frequently impacting project success and budget management. Issues such as inadequate sanitation, waste disposal, environmental considerations, and shortages of skilled labor also posed substantial obstacles, emphasizing the intricate and multifaceted nature of construction challenges. Security concerns and the difficulty in managing design changes further underscore the complexity of the construction environment in these regions.

To address these challenges effectively, stakeholders must adopt a comprehensive and adaptive approach that considers both technical and socio-economic dimensions. This involves improving supply chain management, enhancing workforce training programs, and implementing robust project planning and management strategies. Additionally, fostering greater flexibility in material selection and ensuring adherence to environmental and safety standards are crucial steps toward mitigating these challenges.

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RESEARCH ARTICLE

Constraints faced by CFLDs beneficiary farmers in adoption of improved chickpea production technology in malwa pleatue agro-climatic zone of Madhya Pradesh

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ABSTRACT

The present study will be under taken in the Malwa Plateau Agro-climatic zones of Madhya Pradesh. The KVKs conducted a many numbers of Cluster Frontline demonstration on chickpea crop. Chickpea crop will be selected as under all pulse's crops chickpea covers highest area and it is one of the most important pulse crops grown of Malwa Plateau Agro-Climatic Zone of Madhya Pradesh. The hill region constitutes about 14% in the Malwa plateau. The design of research is the most important and crucial aspect of the research methodology. It is the entire process of planning and carrying out the research. To seek the answers for the research question, an ex-post facto research design was used to explore or search through a problem or situation to provide insights and understanding in the investigation.

Kew words: Adoption, Improved Practices, Production Technology, Constraints.

INTRODUCTION

Pulse crops play an important role in Indian agriculture. Besides being rich in protein, pulses are the main sources of essential amino acids for predominantly vegetarian population of India. They contain 22-24 per cent of protein, which is almost twice the protein in wheat and thrice as that of rice. In India, owing to its diverse agro-climatic conditions, pulses are grown throughout the year and plays an important role in crop rotation, mixed and inter-cropping, maintaining soil fertility through nitrogen fixation, release of soil-bound phosphorus and thus contribute significantly to sustainability of the farming systems. In the production process, pulses require less water than cereals. Cluster Front Line demonstrations (CFLDs) is a unique approach by the Indian Council of Agricultural Research on Oilseed and Pulse crops to provide an direct interface between researcher and farmers as the scientists are directly involved in planning, execution and monitoring of the demonstrations. With this background the study was conducted to know the constraints faced by chickpea producer during the production technology in malwa plateau agro-climatic zone of Madhya Pradesh in the year 2023-24 and this study also involves suggestions to overcome these constraints.

MATERIALAND METHODS

The present study will be under taken in the Malwa Plateau Agro-climatic zones of Madhya Pradesh. The design of research is the

most important and crucial aspect of the research methodology. It is the entire process of planning and carrying out the research. To seek the answers for the research question, an ex-post facto research design was used to explore or search through a problem or situation to provide insights and understanding in the investigation. Among all 8 KVK in Malwa Plateau Agro-Climatic Zone i.e., Indore, Dewas, Ujjain, Shajapur, Rajgarh, Ratlam, Mandsaur and Neemuch; four (50 %) KVKs were selected randomly. List of villages where CFLD pulses programme is being implemented from last five year was taken from the respective KVKs. One village at nearest vicinity and one village at remote vicinity from each KVK was selected for the present study. Two villages from each KVK were selected. Thus, total eight villages were selected for the study. List of CFLD beneficiary farmers was taken from respective KVKs. 15 beneficiary's farmer and 15 non beneficiary's farmers were selected randomly from each village. Thus total 120 beneficiary and 120 non-beneficiary farmers were selected from 4 KVKs, for the study. Thus, the total sample drawn for study was 240 farmers.

RESULTS AND DISCUSSION

The constraints analysis is reported based on the opinion survey of the sample Chickpea growers. Thus, the generalizations of results are the feedback through Chickpea growers engaged in chickpea farming in the region.

Several constraints barring the sustainable production of the traditional or local practices of chickpea crop in the area. These are related to resources management faults and stresses of a biotic and biotic nature. The farmer's opinion obtained regarding the factors affecting adversely production as well as non adoption of various improved chickpea production technology and practices are presented in table 1.

Table. 1. Constraints faced by chickpea growers:

S.No.	Constraints	No. of chickpea grower's	Percentage	Rank
A	**Production constraints**			
1.	Lack of good quality of seeds	54	45.00	**IX**
2.	Not availability of seed at time	63	52.50	**VI**
3.	Not availability of loan at proper time	67	55.83	**V**
4.	Lack of proper resource and money	61	50.83	**VII**
5.	High cost of agricultural inputs	56	46.67	**VIII**
6.	High infestation of insect,disease.	110	91.66	**I**
7.	Non availability of fertilizers at proper time	102	85.00	**II**
8.	Incidence of weeds menace.	95	79.16	**IV**
9.	Unfavourable weather condition	98	81.66	**III**
B.	**technical constraints**			
10.	Lack of knowledge about improved technology	58	48.33	**II**
11.	Lack of trainings / demonstration for improved	55	45.83	**III**
	agriculture			
12.	Lack of knowledge on location specific improved varieties of chickpea	80	66.66	**I**
13.	Lack of irrigation facilities	48	40.00	**V**
14.	Lack of cooperation and demotivation of agriculture extension officer and workers for field survey.	51	42.50**I**	**V**

S.No.	Constraints	No. of chickpea grower's	Percentage	Rank
15.	Lack of information	38	31.67	VI
C	**marketing constraints**			
16.	Lack of market facilities	90	75.00	IV
17.	Low market price of product	85	70.83	V
18.	Less transportation facilities	80	66.67	VII
19.	In sufficient storage facilities.	95	79.16	II
20.	Lack of knowledge about proper place of marketing.	110	91.67	I
21.	Lack of cooperative marketing organization.	92	76.67	III
22.	Loading charges has to be bear by the growers.	83	69.17	VI

The above table reveals the production, technical and marketing constraints as reported by the chickpea grower's and it was found that in case of production constraints majority of the chickpea grower's reported that High infestation of insect,disease (91.66%)with rank-I, followed by Non availability of fertilizers at proper time 85% with II rank ,unfavourable weather condition 81.66% with III rank, incidence of weeds menace 79.16% with IV rank, not availability of loan at proper time 55.83% with V rank, not available of seed at time 52.50% with VI rank, lack of proper resource and money 50.83%with rank-VII, high cost of agricultural inputs 46.67%with the rank-VIII, lack of good quality of seeds with the rank-IX.

In case of technical constraints most of them had lack of knowledge on location specific improved varieties of chickpea 66.66% with the rank -I followed by 48.33% farmers had lack of knowledge about improved technology with the rack-II, lack of training/ demonstration for improve the agriculture 45.83% with the rank -III, lake of cooperation and de-motivation of agriculture extension officer and workers for field survey 42.50% with the rank-IV lake of irrigation facilities 40% with the rank-V, lake of information 31.67% with the rank -VI respectively.

Similarly in case of marketing constraints majority of farmers belong to lack of knowledge about proper place of marketing 91.67% with the rank-I, followed by insufficient storage facilities 79.16% with the rank -II, lack of cooperative marketing organization 76.67% rank -III, lack of market facilities 75% rank-IV ,low market price of product 70.83% with the rank -V, loading charges has to be bear by the growers 69.17% with the rank -VI and less transportation facilities 66.67% rank-VII respectively.

Suggestion to overcome the constraints:

For removing of these constraints expressed by the Chickpea growers following suggestion were made. Table 2 shows the suggestions expressed by the Chickpea growers to remove the constraints their off.

Table.2. Suggestions confronted by the chickpea grower's for solving the constraints

S.No.	Items	No. of chickpea grower's	Percentage	Rank
1.	Providing the improved variety seed at time	63	52.50	IV
2.	Easley providing the loan at low interest level	67	55.83	III
3.	Availability of fertilizer and other agricultural input at time	61	50.83V	
4.	Technical information should be provided at right time	38	31.67	IX
5.	Information of plant protection at time	93	77.50	I

S.No.	Items	No. of chickpea grower's	Percentage	Rank
6.	Co-operation and motivation of agriculture extension officer and workers for field survey	55	45.83	VI
7.	Irrigation facilities providing at proper time	48	40.00	VIII
8.	Availability of input at low cost for poor and small farmers	51	42.50	VII
9.	Fair marketing facilities in area	36	30.00	X
10.	Transportation facilities at low cost should be available to the farmers	85	70.83	II

In the present study chickpea growers were asked for minimizing the technological gap regarding chickpea production. The following suggestions were confronted by the chickpea grower's to overcome the constraints, Majority belonged to Information of plant protection at time 77.50 %followed by transportation facilities at low cost should be available to the farmers 70.83% easily providing the loan at low interest level 55.83% ,providing the improved variety seed time 52.50%, availability of fertilizer and other agriculture input at time 50.83%, corporation and motivation of agriculture and workers for field survey 45.83%, availability of input at low cost for poor and small farmers 42.50%, irrigation facilities providing at proper time 40.00%,technical information should be provided at right time 31.67%,share marketing facilities in area 30% respectively .were the main suggestions as given by the chickpea grower's for solving the constraints.

CONCLUSION

Based on the results of the study it can be concluded that during the chickpea production technology farmers faced several constraints, such as- production, technical, and marketing constraints. It was found that, majority of the problems faced by chickpea growing farmers were related to production constraints. Further, it was also revealed that, majority of the innovative farmers faced issues like more demotivation from others, lack of awareness about financial support, lack of technical guidance, lack of timely guidance and unavailability of proper storage facility for produce. Hence, the findings indicated that farmers are keen to innovate more but due to various constraints improved chickpea production technologies. Therefore, concerned organizations should lend their support to those farmers.

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RESEARCH ARTICLE

Technical and allocative efficiency of rabi maize in Buldhana district

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INTRODUCTION

India has been predominantly an agrarian economy since time immemorial. Agriculture occupies the central place in rural life. However, agriculture continues to be mainstay of our economy even today India ranks second worldwide in farm output. It is the largest sector contributing to the overall socio-economic development of India. Therefore, it is rightly said that agriculture is the backbone of the Indian economy. Last year good monsoon rain helped, output of both food grain and horticulture production in India. It hit a second high in the July 2022 to June 2023 crop year, with a production of 529.68 million tons and 352 million tons respectively. Production of maize in the country during 2022-23 was 346.13 lakh tonnes. Which is higher by 8.83 lakh tonnes than the previous year production of 337.30 lakh tonnes. Thus, maize is the third most important crop after rice and wheat in India in terms of its area coverage and contribution to total food grains production.

Apart from rice and wheat, other major cereals like maize, millets, and sorghum also contribute significantly to agriculture production in India. These cereals are vital for diverse dietary preferences and have adapted well to various agro-climatic conditions in different parts of the country and grown in many parts of the country throughout the year. Considering the area under cultivation of maize, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bangal, Rajasthan, Bihar, Andhra Pradesh, Uttar Pradesh And Telangana are the leading states in the country, during the year 2020-21.

In Maharashtra Jalgaon district (80322ha) is leading in production of Rabi maize in terms of area followed by Solapur(56248ha), Ahmednagar(45433ha), Aurangabad(42345ha) and Sangli (19903ha). In terms of productivity Jalna(6156.80kg/ha) is the leading district followed by Jalgaon(4767.20kg/ha), Nandurbar(4767.20kg/ha), Nanded(4698.50kg/ha) and Dhule(4517kg/ha). In Vidarbha region Buldhana district is leading in production of Rabi maize with Area of 13596 ha and productivity of 2176.50 kg/ha.

METHODOLOGY

The present study was undertaken in Buldhana district of Vidarbha region. to analyze the objectives of the study, multistage simple random sampling technique was adopted in the selection of tehsils, villages and farmers. according to area under rabi maize crop Malkapur, Motala and Buldhana tehsil were selected for present investigation. three villages were selected purposively from each tahsil total 9 villages were selected and from each village 10 farmers selected randomly. Overall, 90 Rabi maize cultivators were selected for the present study

Collection of data

A schedule was designed for data collection by keeping the objectives of the study in view. The data were collected for the year

2021-22 through personal interview method from selected cultivators, village traders, wholesalers, commission agents, retailers and Agriculture produce market committee.

Analytical tools and techniques

The collected data were tabulated, and simple tabular analyses were carried out using the standard cost concept.

A. Standard cost concept

The standard cost concept was used to workout per hectare cost of cultivation of rabi maize. This method is accepted by The Commission for Agricultural Costs and Prices.

Cost 'A_1', Cost 'A_2', Cost 'B_1', Cost 'B_2', Cost 'C_1', Cost 'C_2', Cost 'C_3'.

B. Technical and Allocative Efficiency

In the present study stochastic production frontier function and stochastic frontier profit functions were used to determine the farm-specific technical and economic efficiencies respectively.

1. Stochastic production frontier function

In the present study, the stochastic production frontier function was used to measure the technical efficiencies of Maize cultivating farms.

Specification of the model

$$\ln Yi = \beta 0 + \beta 1 \ln X_1 + \beta 2 \ln X_2 + \beta 3 \ln X_3 + \beta 4 \ln X_4 + \beta 5 \ln X_5 + \beta 6 \ln X_6 + (Vi - Ui)$$

Where,

Yi = Output of specific crops (Maize) (Quintals/ha)

X_1 = Human labour (hrs/ha)

X_2 = Bullock labours (hrs/ha)

X_3 = Machine hours (hrs/ha)

X_4 = Quantity of seeds (kg/ha)

X_5 = Quantity of fertilizers (kg/ha)

X_6 = Quantity of pesticides (lit/ha)

Vi = Random variable

Ui = Farm specific technical efficiency related variable

$\beta 0$ = Intercept/Constant

2. Stochastic profit frontier function

Stochastic frontier profit function was used to estimate economic efficiency of sample maize. The stochastic profit frontier function was estimated as-

$$\Pi i = f(Xi, Pi) + (i - ui)$$

where,

Πi = Normalized profit at cost-A of the i^{th} farmer.

Xi = The vector of variable input prices divided by output price faced by the i^{th} farm. Pi = The vector of fixed factor of the i^{th} farm.

Vi = random error due to factors outside the control of the farmers.

Ui = A non- negative random variable associated with economic inefficiency component

The economic efficiency in relation to the stochastic profit frontier is given by,

$$EEi = \exp(ui)$$

Specification of the model

$$\text{Ln } i = \beta 0 + \beta 1 \ln X_1 + \beta 2 \ln X_2 + \beta 3 \ln X_3 + \beta 4 \ln X_4 + \beta 5 \ln X_5 + \beta 6 \ln X_6 + (Vi - Ui)$$

Where,

i = Normalized profit at cost-A of the i^{th} farmer.

X_1 = Human labour wage rate per hr normalized by output price of i^{th} farm.

X_2 =Bullock labour wage rate per hr normalized by output price of i^{th} farm.

X_3 = Machine wage rate per hour normalized by output price of i^{th} farm.

X_4 = Price of seed per kg normalized by the output price of i^{th} farm.

X_5 = Price of fertilizer per kg normalized by the output price of i^{th} farm.

X_6 = Price of pesticides per liter normalized by the output price of i^{th} farm.

Vi = Random variable

Ui = Farm-specific economic efficiency related variable

$\beta 0$ = Intercept

Factor price is obtained by dividing the price of input with the output price.

3. Allocative efficiency

Allocative efficiency was estimated by

dividing economic efficiency with technical efficiency for each farm.

$$AEi = EEi/Te$$

RESULTS AND DISCUSSION

It is revealed that from the above table 1. that 5.00 per cent, 2.00 per cent, 1.00 per cent of farmers are illiterate from small, medium and large groups respectively and rest of them have completed their primary school, middle school, high school, higher secondary, graduate and above level of education.

On the basis of average size of holding 90 Rabi maize cultivators categorized into small, medium and large size of holding contributed 1.52 hectare, 2.96 hectare and 5.80 hectare, respectively. While average size of holding is 2.74 hectare for overall 90 farmers.

The majority of selected farmers (44.44 per cent) had their income between 1 lakh to 2.5 lakhs, 20.00 per cent farmers had their income between 2.5 lakh to 5 lakhs, 14.44 per cent farmers had their income up to 1 lakh, 13.34 per cent farmers had their income between 5 lakhs to 7.5 lakhs, 7.78 per cent farmers had their income above 7.5 lakhs.

Table: 1 Socio-Economic characteristics of selected farmers

No.	Particulars	Type of farmer		
A	**Educational status**	**Small**	**Medium**	**Large**
1.	Illiterate	5.00 (11.63)	2.00 (6.25)	1.00 (6.67)
2.	Primary	7.00 (16.28)	3.00 (9.38)	1.00 (6.67)
3.	Up to middle school	7.00 (16.28)	8.00 (25.00)	4.00 (26.67)
4.	High school	11.00 (25.59)	9.00 (28.13)	3.00 (20.00)
5.	High secondary	10.00 (23.26)	5.00 (15.53)	1.00 (6.67)
6.	Graduation and above	3.00 (6.96)	5.00 (15.53)	5.00 (33.32)
	Total	**43.00 (100.00)**	**32.00 (100.00)**	**15.00 (100.00)**
B.	**Distribution of farmers according to size of holding**			
	Average size of holding (ha)	1.52	2.96	5.8
C.	**Annual income of selected farmers**			
1.	Up to 1 lakh	13 (30.23)	00 (00.00)	00 (00.00)
2.	1.1 lakh to 2.5 lakh	27 (62.79)	13 (40.62)	00 (00.00)
3.	2.51 to 5 lakh	03 (6.97)	12 (37.50)	03 (20.00)
4.	5.1 lakh to 7.5 lakh	00 (00.00)	07 (21.87)	05 (33.33)
5.	7.51 lakh and above	00 (00.00)	00 (00.00)	07 (46.67)
	Total	**43.00 (100.00)**	**32.00 (100.00)**	**15.00 (100.00)**
D.	**Size of family of selected rabi maize growers**			
1.	Nuclear family	06 (13.96)	05 (15.63)	03 (20.00)
2.	Joint family	37 (86.04)	27 (84.37)	12 (80.00)
	Total	**43.00 (100.00)**	**32.00 (100.00)**	**15.00 (100.00)**

It is revealed that from the above table 2. that the selected farmers adopted diversified cropping pattern and had grown their crops all-round the year in kharif, rabi and summer seasons. The contribution of kharif was highest i.e. 1.47, 2.90 and 5.73 ha for small, medium and large farmers followed by rabi season as 0.87, 1.57, 2.68 ha and overall contribution of the two seasons were 2.69 and 1.42 ha respectively.

Table: 2 Cropping pattern of selected cultivators **(Area in ha.)**

No.	Particulars	Small	Medium	Large
A.	**Kharif**			
1.	Soybean	0.74 (31.22)	1.71 (36.16)	2.72 (29.56)
2.	Cotton	0.47 (19.84)	0.69 (14.58)	1.05 (11.42)
3.	Tur	0.17 (7.17)	0.31 (6.55)	1.52 (16.52)
4.	Vegetable and other	0.09 (3.80)	0.20 (4.22)	0.44 (4.78)
	Total of kharif crops	**1.47 (62.04)**	**2.90 (61.32)**	**5.73 (62.29)**
B.	**Rabi**			
1.	Maize	0.48 (20.25)	0.78 (16.49)	1.24 (13.47)
2.	Gram	0.24 (10.12)	0.43 (9.09)	0.73 (7.93)
3.	Wheat	0.15 (6.32)	0.27 (5.70)	0.30 (3.26)
4.	Vegetable and other	0.00 (00.00)	0.08 (1.69)	0.41 (4.45)
	Total of Rabi	**0.87 (36.70)**	**1.57 (33.19)**	**2.68 (29.13)**
C.	**Summer Crop**			
1.	Maize	0.02 (0.84)	0.11 (2.32)	0.21 (2.28)
2.	Vegetable and other	0.01 (0.42)	0.00 (0.00)	0.07 (0.76)
	Total of Summer	**0.03 (1.26)**	**0.11 (2.32)**	**0.28 (3.04)**
D.	**Perennial**			
1.	Sweet orange	0.00 (0.00)	0.15 (3.17)	0.51 (5.54)
2.	Other	0.00 (0.00)	0.00 (0.00)	0.11 (1.19)
	Total of Perennial	0.00 (0.00)	0.15 (3.17)	0.51 (5.54)
	Gross cropped area	2.37	4.73	9.20

(figures in parenthese indicate the percentages to gross cropped)

Table: 3 Per hectare input utilization pattern of selected farmers

No.	Particulars	Unit	Small	Medium	Large
1.	Hired human labour				
a)	Male	Days	14.21	16.48	21.69
b)	Female	Days	14.83	18.29	20.65
2.	Bullock Labour	Pair days	11.63	10.05	7.43
3.	Machinery	Hrs.	8.37	9.14	9.65
4.	Irrigation	No.	8.07	8.25	9.00
5.	Fertilizers				
	N	Kg	73.39	75.53	85.64
	P	Kg	74.41	76.76	92.04
	K	Kg	45.73	49.03	53.60
6.	Seed	Kg	18.61	19.23	20.61
8.	Family human labour				
a)	Male	Days	16.70	12.77	12.31
b)	Female	Days	11.20	13.06	11.73

It is revealed that from the above table 3. that the hired male and female labour utilization on small, medium and large size group was 14.21, 16.48, 21.69 days and 14.83, 18.29, 20.65 respectively. From the above it is seen that, the utilization of hired male and female labour increases with increase in the size of holding.

The utilization of bullock labour per hectare for maize on selected farmers were 11.63, 10.05 and 7.43 pair days for small, medium and

large size group respectively. From this, it was revealed that, in case of large farmers, bullock labour was used comparatively less than small and medium farmers and bullock labour utilization replaced by machinery power on the farm.

The utilization of machinery (Hrs.) per hectare was 8.37, 9.14 and 9.65 hrs for small, medium and large size group respectively. From this it was revealed that, in case of small farmer's use of machinery was comparatively less than medium and large farmers.

In case of irrigation showed increasing trend for small, medium and large farmers respectively. Number of average irrigations given by small, medium and large size farmers were 8.07, 8.28 and 9.04 respectively. The application of fertilizers per hectare in terms of N.P.K in case of small size group was 73.39 kg, 74.41 kg and 45.43 kg, respectively. In case of medium and large size group, N.P.K utilization levels were 75.53 kg, 76.76 kg, 49.03 kg and 85.64 kg, 92.04 kg, 53.60 kg, respectively. It is noticed from the levels of N.P.K utilization that, the size of holding and levels of application of N.P.K are directly related to each other. From the above it is seen that, the application of N.P.K increases with the increase in the size of holding.

The quantity of seed used increased with the increased size of holding. It was highest in large size group i.e., 20.61 kg followed by small and medium group i.e. 18.61 kg and 19.23 kg respectively.

The family male and female labour utilization on small, medium and large size group were 16.70, 12.77, 12.31 and 11.20, 13.06, 11.73 days respectively.

Table: 4 Per hectare cost of cultivation of overall farmers

No.	Particulars	Unit		Input/ha.	Cost/Unit	Total Cost	% to
					of input	per ha.	Cost 'C$_3$'
1.	Hired human labour	Male	Days	17.27	282.85	4884.77	6.63
		Female		17.87	226.19	4041.41	5.49
2.	Bullock Labour		Pair days	9.79	481.65	4717.05	6.41
3.	Machine charges		Hours	8.86	579.73	5082.00	6.90
4.	Seed		Kgs	19.29	247.91	4782.89	6.49
5.	Fertilizers	N	Kg	77.79	29.94	2328.88	3.16
		P	Kg	80.45	29.94	2360.68	3.21
		K	Kg	49.30	29.61	1459.72	1.98
6.	Irrigation charges	(Rs.)				1343.25	1.82
7.	Insecticide	(Rs.)				4316.80	5.86
8.	Incidental charges	(Rs.)				183.00	0.25
9.	Repairing charges	(Rs.)				925.64	1.26
10.	Insurance Premium	(Rs.)				0.00	0.00
11.	Growth Regulator	(Rs.)				0.00	0.00
12.	Working Cap. (1 to 11)	(Rs.)				36426.10	49.46
13.	Interest on working Cap.					655.67	0.89
14.	Depreciation	(Rs.)				1793.11	2.43
15.	Land Revenue	(Rs.)				112.00	0.15
16.	COST A$_1$ (Items 13 to16)	(Rs.)				38986.87	52.94
17.	Retal Value Leased in land					0.00	0.00
18.	COST A$_2$ (Items 17 to18)					38986.87	52.94
19.	Int. on Fix. Cap. @ 10%					1306.46	1.77
20.	COST B$_1$ (Items 17 + 20)					40293.34	54.71
21.	Retal Value of land	(Rs.)				19869.28	26.98

Table: 4 Per hectare cost of cultivation of overall farmers

No.	Particulars	Unit		Input/ha.	Cost/Unit of input	Total Cost per ha.	% to Cost 'C_3'
22.	COST B_2 (Items 21 + 22)					60162.61	81.70
23.	Family Human Labour	Male	Days	13.90	258.09	3587.12	4.87
24.	Cost C_1 (Items 21 + 24)	Female	Days	13.74	232.78	3198.05	4.34
25.	Cost 'C1' (Items 21 + 24)	(Rs.)				47078.50	63.93
	Cost 'C2' (Items 23 + 24)	(Rs.)				66947.78	90.91
	Cost C_2 (Items 23 + 24)						
26.	10% Cost C_2					6694.78	9.09
27.	Cost C_3 (Items 26 + 27)					73642.56	100.00
28.	Yield per hectare	(qt)		59.93	1903.26	114070.43	
29.	Value of By-produce/ha.	(qt)		64.85	88.78	5757.17	
30.	Main produce + By produce					119827.60	
31.	Per quintal cost of production	(Rs.)				1020.96	
32.	Benefit-cost ratio at cost 'A_1'					3.06	
33.	Benefit-cost ratio at cost 'B_1'					2.96	
34.	Benefit-cost ratio at cost 'B_2'					1.94	
35.	Benefit-cost ratio at cost 'C_1'					2.72	
36.	Benefit-cost ratio at cost 'C_2'					1.83	
37.	Benefit-cost ratio at cost 'C_3'					1.67	

It is revealed that from the above table 4 that the per hectare cost of production by the overall group farmers at cost 'A1', cost 'A2', cost 'B1', cost 'B2', cost 'C1', cost 'C2'. cost 'C3' were Rs. 38986.87, Rs. 38986.87, Rs. 40293.34 Rs. 60162.61, Rs. 47078.50, Rs. 66947.78 and Rs. 73642.56 respectively. The major share of cost of cultivation goes towards In cost 'A1' (52.94 per cent) In cost A1 share of hired labour was 12.12 per cent, fertilizer 8.35 per cent, machine charges 6.90 per cent, seed 6.49 per cent, bullock labour 6.41 per cent, insecticides 5.86 per cent indicating that, all the above inputs are cash inputs for which farmers required to pay immediately from his pocket. The per hectare yield obtained by overall farmers was 59.93 quintals with gross return of Rs. 119827.60. The per hectare cost obtained by overall farmers was Rs. 1020.96 per quintals.

The input output ratio which is an indicator of economic efficiency in crop production for the crop and other discussion indicated that rabi maize registered a good input output ratio 2.72 means Growing the Rabi maize is profitable.

Table: 5 Distribution of sample farmers under different levels of technical efficiency

TE %	No. of Farm	Per centage to total	Average	Per centage to increase production to achieve maximum efficiency
50.01-60	3.00	3.33	57.15	42.79
60.01-70	9.00	10.00	69.76	30.16
70.01-80	19.00	21.11	76.90	23.02
80.01-90	30.00	33.33	89.46	10.44
>90	29.00	32.22	97.54	2.35
Mean TE (%)	86.81			
Min TE (%)	56.50			
Max TE (%)	99.89			

It is revealed that from the above table 5. That for the average efficient farmers in the study, to achieve the technical efficiency level of the most efficient farmers could only bring about (99.89-86.81/99.89) 13.09 per cent increase in production. The least efficient farmers can increase the production of (99.89-56.50/99.89) 43.43 per cent to achieve the required technical efficiency of the most efficient farmers. Study revealed that number of 3 farmers lied between the efficiency range of 50-60 % could increase in production about 42.79% to achieve technical efficiency level of most efficient farmer respectively. 9 farmers lied in 60 to 70 % level of efficiency which have to increase about 30.16 % of efficiency to achieve the level of most efficient farmer. 19 farmers lied in 70 to 80 % level of efficiency which have to increase about 23.02 % of efficiency to achieve the level of most efficient farmer. 29 farmers lied in the efficiency range of above 90 %, to achieve technical efficiency of most efficient farmers which could bring about 2.35 % increase in production.

Table: 6 Distribution of sample farmers under different levels of economic efficiency

EE %	No. of Farm	Per centage to total	Average	Per centage to increase production to achieve maximum EE
60.01-70	5.00	5.56	68.89	31.03
70.01-80	14.00	15.56	75.60	24.32
80.01-90	15.00	16.67	89.05	10.85
>90	40.00	44.44	96.55	3.34
Mean EE (%)	90.50			
Min EE (%)	66.80			
Max EE (%)	99.81			

It is revealed that from the above table 6. that in the area the economic efficiency ranges from 66.80 to 99.81 with a mean efficiency of 90.50 per cent. For the average efficient farmers in the area, to achieve the economic efficiency level of the most efficient farmers could only bring about (99.81-90.50/99.81) 9.32 per cent increase in profit. The least efficient farmers can increase the profit of (99.81-66.80/99.81) 33.07 per cent to achieve the required economic efficiency of the most efficient farmers. from above table it was observed that, economic efficiency range of 60 to 70 consisting 5 farms which could bring about 37.03 % increase in profit to achieve level of most economic efficient farmer. 14 farmers lied between 70 to 80 % of economic efficiency, to achieve most efficient farmer level bring about 24.32 % increase in production. 15 farmers lied between 80 to 90 % of economic efficiency, to achieve most efficient farmer level bring about 10.85 % increase in production. 40 farmers lied in the efficiency range above 90% and to achieve most efficient farmer level bring about 3.34 % increase in production.

Table: 7 Distribution of sample farmers under different levels of allocative efficiency

AE %	No. of Farm	Per centage to total	Average	Per centage to increase production to achieve maximum EE
50.01-60	2.00	2.22	57.63	42.31
60.01-70	2.00	2.21	62.19	37.74
70.01-80	8.00	8.89	78.68	21.23
80.01-90	11.00	12.22	85.90	14.01
>90	67.00	74.44	102.33	-2.44

AE %	No. of Farm	Per centage to total	Average	Per centage to increase production to achieve maximum EE
Mean AE (%)	77.31			
Min AE (%)	57.00			
Max AE (%)	147.64			

It is revealed that from the above table 7. that the mean allocative efficiency of the sample farms was 77.31 per cent which means, the potential to further improve the allocative efficiency by 22.69 per cent. In the area the allocative efficiency ranges from 57.00 to 147.64 per cent with a mean efficiency of 77.31 per cent. For the average efficient farmers in the area, to achieve the allocative efficiency level of the most efficient farmers could only bring about (147.64-77.31/147.64) 47.63 per cent increase in production. The least efficient farmers can increase the production of (147.64-57.00/147.64) 61.40 per cent to achieve the required allocative efficiency of the most efficient farmers.

Table: 8 Marketing cost and Market margin of rabi maize

Sr. No.	Particulars	Total Price		
		Channel I	Channel II	Channel III
A.	**Marketing cost incurred by producer**			
1.	Cost of gunny bags	8.95	16.42	17.21
2.	Cost of packing	0.88	1.50	1.50
3.	Cost of Loading	30.26	29.74	29.47
4.	Transportation	17.05	19.09	20.63
5.	Weighing Charges	3.05	3.00	3.00
6.	Hamali	7.47	6.00	6.00
7.	Unloading	31.58	9.91	8.61
8.	Marketing cost	99.25	85.66	86.42
9.	Selling price of producer	1814.84	1909.37	1882.53
B.	**Marketing cost incurred by Wholesaler**			
1.	Sorting	0.00	0.00	4.30
2.	Transportation	0.00	0.00	7.20
3.	Cost of gunny bags	0.00	0.00	12.96
4.	Weighing charges	0.00	0.00	2.25
5.	Market Cess fund	0.00	0.00	24.82
6.	Hamali	0.00	0.00	4.16
7.	Labour charges	0.00	0.00	4.14
8.	Marketing cost	0.00	0.00	59.84
9.	Marketing margin	0.00	0.00	151.95
10.	Selling price of Wholesaler	0.00	0.00	2094.311
C.	**Marketing cost incurred by Retailer**			
1.	Transportation	0.00	12.00	6.97
2.	Hamali	0.00	4.5	4.08
3.	Weighing Charges	0.00	2.25	2.26
4.	Shop rent	0.00	8.21	4.53
5.	Labour Charges	0.00	8.21	9.41
6.	Marketing Cost	0.00	41.28	27.27

Sr. No.	Particulars	Total Price		
		Channel I	Channel II	Channel III
7.	Marketing margin	0.00	344.46	307.81
8.	Selling price of retailer	0.00	2253.83	2429.40
9.	**Total marketing cost**	**99.25**	**126.95**	**173.53**
10.	**Total margin**	**0.00**	**344.46**	**459.75**

It is revealed that from the above table 8. that out of three marketing channels, in channel I producer incurred marketing cost of Rs. 99.25. The selling price of producer was Rs. 1814.14. In channel II the marketing cost incurred by producer was Rs. 85.66. Among the different items of expenditure, the highest charges were paid for loading i.e., Rs. 29.74 followed by cost of marketing and transportation to the market. The retailers incurred marketing cost of Rs. 41.28 in channel II and the margin of retailer was Rs. 344.46.

In channel III the marketing cost incurred by producer was Rs. 86.42. Wholesaler incurred marketing cost of Rs. 59.84 in channel III and and received the margin of Rs. 151.95 in channel III. The retailer incurred the marketing cost Rs. 27.27 and received margin of Rs. 307.81. The total marketing cost of channel III was Rs. 173.53 and total margin received by different intermediaries was Rs. 459.7. From above discussion it is concluded that, highest marketing cost was observed in channel III i.e., Rs. 173.53 and highest total margin was of Rs. 459.75.

Table: 9 Constraints in production and marketing of maize

Sr. No.	Particulars	Mean Score	Rank
	Constraints in production		
1.	Irregular electricity supply	60.11	2
2.	Damage by wild animals	44.38	7
3.	High cost and shortage of labour	58.27	3
4.	High cost of plant protection	46.29	4
5.	High cost of seed	44.49	6
6.	Reduction of soil fertility for next season	41.56	8
7.	Uncertain rainfall	60.22	1
8.	High cost of fertilizer	44.69	5
	Constraints in Marketing		
1.	Distress sale of produce	58.789	2
2.	Lack of market information	44.378	5
3.	lack of storage	59.622	1
4.	Monopolistic position of intermediates	44.356	6
5.	Lack of information about foreign market	43.956	7
6.	Malpractices during moisture measurement	43.711	8
7.	Govt. procurement system is not much effective	58.267	3
8.	Distance of market from farm	46.922	4

It is revealed that from the above table 9. that the problem of Uncertain rainfall was ranked first with mean score of 60.22 followed by Irregular electricity supply (mean score: 60.11), high cost and shortage of labour (mean score: 58.27), high cost of plant protection (mean score: 46.29), High cost of fertilizer (mean score: 44.69), high cost of seed (mean score: 44.49),

Damage by Wild animals (mean score: 44.38), reduction of soil fertility for next season (mean score: 41.56) was ranked second to eighth respectively . The problem of Lack of storage was ranked first with mean score of 59.62 followed by Distress sale of produce (mean score: 58.79), Govt procurement system is not much effective (mean score: 58.27), Location of market (mean score: 46.92), Lack of market intelligence (mean score: 44.38), Monopolistic position of intermediates (mean score: 44.36), Lack of information about foreign market (mean score: 43.95), Improper weighment (mean score: 43.71) was ranked second to eighth respectively.

CONCLUSIONS

On the basis of results obtained from study, following conclusions are drawn.

1. Per hectare cost of cultivation of rabi maize at cost C3 was highest in the large group i.e. (Rs. 74684.27.) followed by medium group (Rs. 74051.57) and small group (Rs. 65131.43). The gross returns per hectare increased with the increase in size of farms.
2. The benefit cost ratio of rabi maize at cost 'C3' was 1.75 in small group, 1.58 in medium group,1.61 in large group and 1.67 at overall level. This indicates that, cultivation of rabi maize crop was economically profitable.
3. The mean level of technical efficiency has been estimated as 86.81 per cent for farms as a whole Hence, on an average, approximately 13 per cent of technical potentials were not realized. Therefore, it is possible to improve the yield by 13 per cent by following efficient crop management practices.
4. The economic efficiency of selected farmers ranges from 66.80 to 99.81 with a mean efficiency of 90.50 per cent. For the average efficient farmers in the area, to achieve the economic efficiency level of the most efficient farmers could only bring about (99.81-90.50/99.81) 9.32 per cent increase in profit. The least efficient farmers can increase the profit of (99.81-66.80/99.81) 33.07 per cent to achieve the required economic efficiency of the most efficient farmers.
5. The mean allocative efficiency of the sample farms was 77.31 per cent which means, the potential to further improve the allocative efficiency by 22.69 per cent. In the area the allocative efficiency ranges from 57.00 to 147.64 per cent with a mean efficiency of 77.31 per cent. For the average efficient farmers in the area, to achieve the allocative efficiency level of the most efficient farmers could only bring about (147.64-77.31/147.64) 47.63 per cent increase in production. The least efficient farmers can increase the production of (147.64-57.00/147.64) 61.40 per cent to achieve the required allocative efficiency of the most efficient farmers.
6. Producer - Wholesaler - Retailer - Consumer was the important channel through which maximum quantity was sold by the cultivators.
7. In case of rabi maize, Producer's share in consumer's rupees was highest in Channel I (Producer - Consumer) i.e. 94.53 per cent followed by channel II (Producer - Retailer - Consumer) i.e. 84.60 per cent. And channel III (Producer - Wholesaler - Retailer - Consumer) i.e. 73.94 per cent. From this, it was concluded that channel-I was most profitable than channel lI and channel III.
8. The major constraints faced by rabi maize cultivators was uncertain rainfall (mean score :60.62) and lack of storage (mean score: 69.49).

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RESEARCH ARTICLE

Profile analysis of farmers across various zones of Andhra Pradesh

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ABSTRACT

Agriculture forms the backbone of Andhra Pradesh's economy, employing a significant portion of its population. This research presents a detailed analysis of the personal, socio-economic and psychological profiles of farmers across various agro-climatic zones of Andhra Pradesh. By examining factors such as landholding size, income levels, education, access to technology and various psychological attributes, this study aims to understand the regional variations and challenges faced by farmers in different zones. The findings highlight disparities in resource availability, education and income levels and agricultural resilience across the Coastal, Rayalaseema and Northern zones of Andhra Pradesh. Additionally, the study identifies key areas for policy intervention to enhance agricultural sustainability and farmer welfare, offering insights into tailored strategies to address the distinct needs of these regions.

KEYWORDS: Socio-economic variables, Psychological attributes, Agro-climatic zones, Andhra Pradesh, Profile analysis

INTRODUCTION

Andhra Pradesh stands as a state with a rich intricate of history, culture and diverse landscapes. Agriculture is the backbone of Andhra Pradesh and accounts for 37.27 percent of Andhra Pradesh's gross value added (GVA) which is nearly twice as high as the national average of 19.70 percent and the highest after bifurcation of the State (New Indian Express, 2021). Agriculture in Andhra Pradesh is diverse and characterized by regional variations driven by differing agro-climatic conditions, soil types, water availability and crop patterns. The state, divided into distinct zones—Coastal Andhra, Rayalaseema and the Northern districts—exhibits significant diversity in terms of agricultural practices and challenges. The Coastal region, with fertile deltaic soils and abundant water resources, contrasts sharply with the semi-arid Rayalaseema, where water scarcity and dryland farming dominate. Meanwhile, the Northern region has its unique challenges, including erratic rainfall and limited infrastructure.

The agriculture sector is the principal source of livelihood for over 70 percent of the total population in Andhra Pradesh and is dominated by small and marginal farmers. The agricultural sector of the state, however, is confronted with serious problems such as the growing number of farmer suicides, rising costs of production, declining farm profits, deteriorating quality of soil and water resources, and growing number of smallholders that highlight the urgent need to revitalize the agricultural sector (Parthasarathy Rao *et al.*,

2008). It is therefore, important to explore alternative options to accelerate agricultural growth, reduce disparities and improve the quality of life of the rural people. The question therefore is: how can the increasing number of smallholders be a part of the transition in the agricultural sector? It is therefore, important to explore alternative options to accelerate agricultural growth, reduce disparities and improve the quality of life of the rural people.

The multifaceted world of agriculture thus is an intricate mosaic of diverse individuals, each contributing to the cultivation of the land with their unique attributes, challenges and aspirations. Farmers are not uniform in their experiences; they hail from various backgrounds, regions, cultures and socioeconomic circumstances (Sandeep *et al.*, 2023). Understanding the profile of farmers across various agro climatic zones is crucial for identifying regional disparities, challenges and opportunities within the farming communities.

In light of this, the study "Profile Analysis of Farmers across Various Zones of Andhra Pradesh" has been undertaken. In order to draw reliable conclusions that could enable the researcher to propose more practical, location-specific solutions for increasing efficiency in the study area, socioeconomic analysis is necessary to obtain a precise, thorough understanding of the respondents in the study area (Samarpitha *et al.*, 2016). The study investigates the socio-economic factors such as landholding size, education levels and financial status on farming practices, thereby shedding light on the broader socio-economic context influencing agricultural outcomes in Andhra Pradesh. By offering a comparative analysis of farmers across different zones, this research aims to contribute to a more nuanced understanding of regional agricultural dynamics, enabling more effective resource allocation, developing targeted policies and programs that address the specific needs of different regions and support for farmers in the state.

OBJECTIVE

(1). To assess the personal, socio-economic and psychological characteristics of farmers across various zones of Andhra Pradesh.

METHODOLOGY

Locale of the study: The study was conducted in three regions of Andhra Pradesh viz., Coastal Andhra, Rayalaseema and Northern regions during the agricultural year 2023-24.

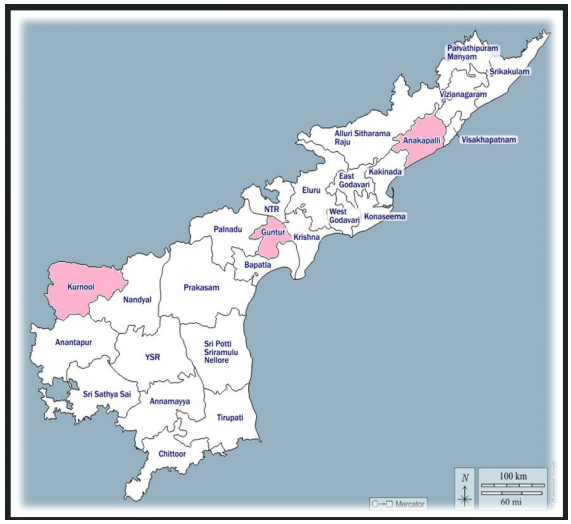


Figure 1. Map showing Andhra Pradesh state with selected districts

Research design: *Ex post-facto* research design has been adopted for the study.

Sampling procedure: The selection of the districts, mandals, villages and respondents was done using simple random sampling technique.

Selection of districts: One district from each region, i.e. from Coastal Andhra, Rayalaseema and Northern regions namely Guntur, Kurnool and Anakapalli, respectively were selected randomly. Thus, a total of three districts were selected for the study.

Selection of mandals: From selected districts, one mandal from each district were chosen randomly. The selected mandals were- Ponnur mandal from Guntur district, Maddikera mandal from Kurnool district and Chodavaram mandal from Anakapalli district.

Selection of villages: Two villages from each selected mandal were randomly selected thus comprising a total of 6 villages under the study area.

Selection of respondents: A purposive random sampling method was employed to select 40 farmers from each of the selected village from each distinct Agroclimatic zone of state Andhra Pradesh. This process ensured representation from all three zones, constituting a total of 240 farmer respondents for the study.

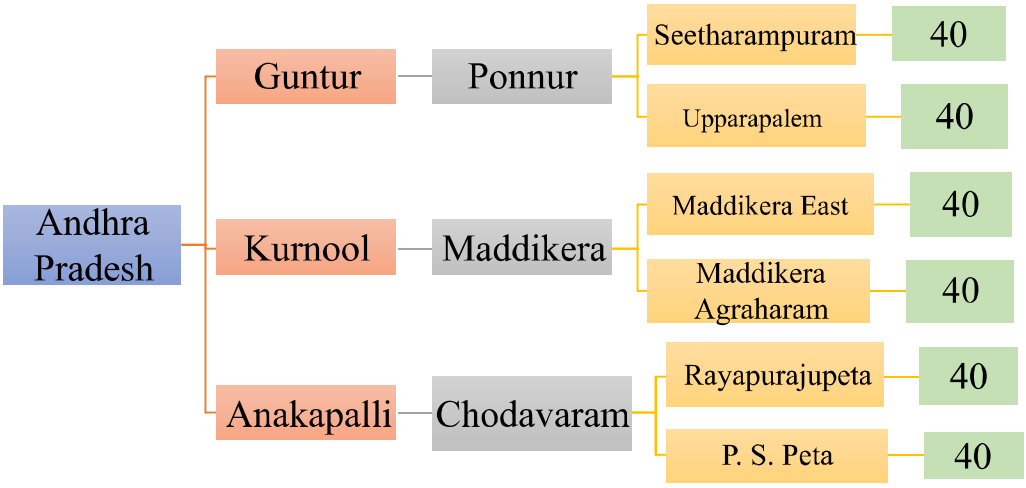


Figure 2. Schematic representation of sampling procedure

Variables selected for the study: Based on thorough review of literature and experts' advice, a total of thirteen variables were selected for the study. The variables selected for the study were Personal variables constituting age, education; Economic variables like land holding, annual income; Communication variables like sources of information, localiteness- cosmopoliteness, sources of credit, social participation and extension contact; Psychological variables like economic motivation, innovativeness, scientific orientation, risk orientation.

Data collection: Keeping in view the objectives and variables of the study, a structured interview schedule was developed by consulting experts and referring to the relevant literature. The primary data for this analysis was collected from the farmers through personal interview method in an informal atmosphere. The collected data was coded, tabulated, classified and analyzed in order to make the findings meaningful. The findings were suitably interpreted and necessary conclusions and inferences were drawn accordingly.

Statistical tools for analysis: Descriptive/ tabular analysis involving the computation of mean, frequency, standard deviation and percentages were employed to categorize respondents into low, medium and high levels and present the data regarding the socio-economic profile of the respondents. Chi-square was applied to determine significant difference among personal, socio-economic, communicational and psychological variables of respondents across three zones.

RESULTS AND DISCUSSION

Age: A critical analysis has classified the respondents under three groups namely, young, middle and old on the basis of their chronological age. It is evident from Table 1 that more than half of the farmers were middle aged (52.50%) followed by old age (39.16%) and young age (8.33%) categories. Similar findings were reported by Yamini *et al.* (2024), Jyothi and Vijayabhinandana (2024), Surkal *et al.* (2023). Chi-square test showed that there was no significant difference in age categories among the

respondents of three selected districts, $\chi 2 = 8.16$, Critical value= 9.488 at 5% level of significance.

The insights from the results indicated that majority of the respondents were old aged and middle aged and highlighted a significant presence of experienced and relatively older individuals engaged in agricultural activities compared to younger ones with nearly half of the respondents being old-aged. This indicates a potential challenge concerning a need for policies and programs aimed at attracting and supporting younger individuals to enter and sustainably manage agricultural enterprises.

Education: The results from the Figure 3 revealed that nearly one third (29.58%) of the respondents were illiterate followed by middle school (22.08%), high school education (19.17%) whereas 14.17 per cent of the farmers were found to have primary school education and 10.84 per cent had studied up to intermediate level and only 4.16 per cent of them had education up to graduation level. The results were similar to the findings of Rao *et al.* (2024), Rathwa and Patel (2023). Chi-square test showed that there was statistically significant difference in education levels among the respondents of three selected districts, $\chi 2 = 37.914$, Critical value= 18.307 at 5% level of significance.

When examining the education levels of farmers across these districts, several factors come into play. Guntur and Kurnool districts being more developed regions with a long history of agriculture might exhibit higher average education levels among farmers compared to Anakapalli district, located in the eastern ghats of Andhra Pradesh which might have experienced less access to educational resources and infrastructure historically. Addressing the education gap among farmers in Anakapalli compared to Guntur and Kurnool requires a multifaceted approach. Investments in rural education infrastructure, extension services, vocational training programs tailored to agricultural needs and initiatives promoting digital literacy can all contribute to bridging this gap.

Land holding: The results from the Table 2 regarding the distribution of farmers of Guntur district according to landholding inferred that nearly half (43.75%) of the respondents were semi- medium farmers with the land holdings from 5 to 10 acres. Two fifth (40.00%) of the respondents of Kurnool district were medium farmers with the land holdings from 10 to 25 acres and nearly three fifth (58.75%) of the respondents of Anakapalli district were small farmers with the land holdings from 2.5 to 5 acres. The results were in conformity with that reported by Jegoda *et al.* (2022) and Mishra (2022). Chi-square test showed that there was statistically significant difference in land holdings among the respondents of three selected districts, $\chi 2 = 198.512$, Critical value= 15.507 at 5% level of significance.

The differences in landholdings among farmers in Guntur, Kurnool and Anakapalli districts can be attributed to various socio-economic and geographical factors unique to each region. In Guntur district, the availability of arable land suitable for intensive cultivation facilitating higher agricultural productivity per unit of land might be a contributing factor. As a result, farmers with medium landholdings might find it economically viable to operate efficiently within this size range by maximizing their returns without facing significant scale-related constraints. Conversely, Kurnool district is characterized by vast tracts of land suitable for extensive cultivation such as large-scale mechanized farming of diversified crops. This landscape combined with factors like historical land consolidation, inheritance patterns and government policies promoting large-scale agriculture might have led to the concentration of land in the hands of fewer individuals or families resulting in a higher prevalence of large landholdings among farmers. In contrast, Anakapalli situated in the Eastern Ghats is characterized by rugged terrain and fragmented

lands making it challenging to cultivate large contiguous plots. Additionally, historical land redistribution measures, land ceiling laws and socio-economic factors might have contributed to the prevalence of smaller landholdings among farmers in this district.

Annual Income: It was observed from Table 3 that great majority of the farmers of Guntur district had medium (61.25%) annual income, followed by low (21.25%) and high (17.50%) annual income. Majority of the farmers of Kurnool district had medium (80.00%) annual income followed by high (13.75%) and low (6.25%) annual income. Majority of the farmers of Anakapalli district had medium (71.25%) annual income followed by low (18.75%) and high (10.00%) annual income. The findings were relevant to the findings reported by Abhijeet *et al.* (2022). Chi-square test showed that there was statistically significant difference in annual income levels between respondents of three selected districts, $\chi 2$ =9.999, Critical value= 9.488 at 5% level of significance.

The difference in annual income among farmers in Guntur, Kurnool and Anakapalli districts can be attributed to various factors including agricultural productivity, cropping patterns, market access and socio-economic conditions prevalent in each region. Guntur district known as a major agricultural hub with favourable agro-climatic conditions, availability of irrigation facilities and adoption of modern agricultural practices could contribute to increased yields and higher income levels among farmers in Guntur. Kurnool district known for its larger landholdings and extensive agricultural operations might benefit from economies of scale enabling farmers to achieve higher levels of production and income. Higher levels of education, access to credit facilities and supportive government policies in Kurnool district might enhance farmers' ability to invest in agricultural inputs, adopt modern technologies and improve productivity thereby increasing their annual income.

Anakapalli district, situated in the Eastern Ghats have limitations in terms of available arable land and suitable agro-climatic conditions. Farmers in Anakapalli district predominantly cultivate subsistence crops such as pulses, millets and oilseeds which generally have lower market value. Anakapalli district being a remote geographical location may face challenges related to limited market access and inadequate marketing infrastructure, poor transportation networks, low levels of education, marginal and small land holdings, socio-economic constraints and limited support systems might constrain farmers' income-earning opportunities resulting in the lower annual income of farmers in Anakapalli district.

Sources of Credit: The data presented in the Table 4 elucidated the heterogeneous landscape of agricultural credit in Guntur, Kurnool and Anakapalli districts shaped by a complex interplay of institutional, economic and socio-cultural factors. Addressing the challenges associated with credit access, enhancing the reach and effectiveness of formal credit institutions and promoting financial literacy and inclusion are imperative for fostering agricultural development and improving the livelihoods of farmers across all the selected districts. The results were in line with the findings reported by Kareem and Olayemi (2019) and Varghese and Devi (2012).

Sources of Information: The data presented in Table 5 offer insights into the diverse sources of information accessed by farmers of Guntur, Kurnool and Anakapalli districts. The findings were similar to the results reported by Yamini *et al.* (2024), Jyothi and Vijayabhinandana (2024). Dominance of input dealers and extension personnel as primary sources of information underscores their pivotal role in shaping farmers' practices and decision-making. Friends, neighbors, relatives and social networks emerged as significant sources of information particularly

for occasional and frequent use. This highlighted the importance of informal communication channels and peer learning in knowledge sharing and technology adoption within agricultural communities. Moreover, the increasing reliance on digital platforms such as YouTube, WhatsApp and social media for accessing agricultural information underscores the growing influence of technology in agricultural extension and communication.

Despite the availability of formal institutions such as research institutes and seminars/workshops their utilization remains relatively low among farmers. Similarly, traditional media channels like newspapers, magazines and Vyavasaya panchangam are accessed occasionally indicating potential gaps in information dissemination and outreach efforts. Addressing barriers to access and enhancing the relevance and effectiveness of these channels could improve their utilization among farmers. Utilizing a mix of traditional and digital media, leveraging social networks and strengthening linkages between formal institutions and grassroot organizations can enhance the relevance and accessibility of agricultural information for farmers.

Localiteness-Cosmopoliteness: An overview of Table 6 indicated that more than half (55.00%) of the respondents had medium cosmopoliteness followed by high (23.33%) and low (21.67%) level of cosmopoliteness. The results were in conformity with that reported by Sowmya (2009). Chi-square test showed that there was statistically significant difference in their level of localiteness-cosmopoliteness among the respondents of three selected districts, $\chi 2$ =43.747, Critical value= 9.488 at 5% level of significance.

Farmers of Guntur and Anakapalli districts showed a relatively similar pattern while the farmers of Kurnool district exhibited a slightly different distribution. In Kurnool district, the cultivation of diversified crops involving more technologies can indeed contributed to higher levels of cosmopolite contacts among farmers. Moreover, higher levels of education and literacy rates among farmers in Kurnool district might contribute to greater cosmopoliteness (Rohit *et al.* 2024). The lower levels of cosmopoliteness among farmers in Anakapalli district can be attributed to a combination of various factors such as geographical isolation, adherence to traditional socio-cultural practices, limited exposure to external information sources, reliance on subsistence farming, limited market access and a lack of diversification in livelihood options, lower levels of formal education. Addressing these barriers requires targeted efforts to enhance access to information, promote education and literacy, strengthen agricultural extension services and foster inclusive development initiatives tailored to the unique needs and contexts of rural communities in Anakapalli district.

Extension Contact: An overview of Table 6 revealed that nearly three fourth (72.08%) of the respondents had medium extension contact while 17.50 per cent of them had high extension contact followed by 10.42 per cent of them with low extension contact. The results were in line with the findings reported by Mishra (2022) and Revathi *et al.* (2020). Chi-square test showed that there was statistically significant difference in the extension contact among the respondents of three selected districts, $\chi 2$ =11.111, Critical value= 9.488 at 5% level of significance.

The low extension contact among farmers in Anakapalli district could be influenced by several factors like geographical isolation or lack of interest or motivation to engage with extension workers. Addressing these challenges requires targeted efforts to improve extension accessibility, enhance communication channels, raise awareness about the benefits of extension services and tailor extension interventions to local contexts and farmers' needs.

Social participation: Table 6 illustrated that nearly half (46.67%) of the respondents had medium social participation followed by high (32.91%) and low (20.42%) level of social participation. The results were in conformity with that reported by Dechamma *et al.* (2020). Chi-square test showed that there was no significant difference in the social participation among the respondents of three selected districts, $\chi 2$ = 3.673, Critical value= 9.488. The data indicated relatively similar patterns of social participation across the three districts with comparable proportions of respondents falling into low, medium and high categories.

Despite the relatively similar levels of social participation observed across Guntur, Kurnool and Anakapalli districts, it is essential to recognize and address barriers to social engagement such as social exclusion, gender inequalities and ensuring equitable access to social opportunities, addressing power imbalances and promoting inclusivity in community initiatives are crucial for fostering sustainable and resilient rural communities.

Scientific Orientation: Table 7 indicated that three fifth (57.91%) of the respondents had medium scientific orientation followed by high (21.25%) and low (20.84%) levels of scientific orientation. The results were in conformity with that reported by Khan *et al.* (2020) and Tiwari *et al.* (2018). Chi-square test showed that there was statistically significant difference in the scientific orientation among the respondents of three selected districts, $\chi 2$ =10.567, Critical value= 9.488 at 5% level of significance.

Kurnool district like many other regions in India, faces challenges related to water scarcity due to erratic rainfall patterns and climatic variability and inefficient water use in agriculture leading to uncertainties in agricultural production constraining the cultivation of diverse crops. Farmers seeking to adapt to changing climatic conditions were motivated and are increasingly turning to the scientific techniques. Despite the overall positive trend in scientific orientation levels, challenges such as limited access to extension services, inadequate infrastructure and socio-economic constraints may hinder farmers' ability to fully embrace scientific innovations. Addressing these challenges requires targeted efforts to improve extension outreach, enhance farmers' access to information and training and foster collaborative partnerships between research institutions, extension agencies and the farming community.

Risk Orientation: The data furnished in table 7 revealed that nearly two third (64.17%) of the respondents had medium risk orientation followed by low (21.25%) and high (14.58%) levels of risk orientation. The results were in conformity with that reported by Revathi *et al.* (2020). Chi-square test showed that there was no significant difference in the risk orientation among the respondents of three selected districts, $\chi 2$ = 5.42, Critical value= 9.488 at 5% level of significance.

Understanding farmers' risk orientation is essential for designing policies and programs and tailoring risk management interventions to farmers' needs, preferences and contexts can enhance their resilience to shocks, reduce vulnerability and unlock their potential for innovation and growth. Policy measures such as crop insurance schemes, price stabilization mechanisms, input subsidies and risk-sharing arrangements can help mitigate farmers' exposure to risks and incentivize productive investments in agriculture.

Economic Motivation: Table 7 illustrated that more than half (62.08%) of the respondents had high economic motivation followed by medium (29.58%) and low (8.34%) levels of economic motivation. The results were similar to the findings reported by Yamini *et al.* (2024). Chi-square test showed that there was no statistically significant difference in the economic motivation among the respondents of three selected districts, $\chi 2$ = 5.897, Critical value= 9.488 at 5% level of

significance. The data revealed a similar pattern of distribution in economic motivation levels among farmers across the three districts.

The prevalence of high economic motivation among farmers underscores the importance of profit orientation and market dynamics in agricultural decision-making. Farmers are increasingly driven by the desire to maximize returns on investment, optimize resource allocation and capitalize on market opportunities. Factors such as market demand, price volatility, input costs and access to credit influence farmers economic motivation, shaping their production choices, cropping patterns and marketing strategies.

Innovativeness: It was observed from table 7 that nearly two third (65.42%) of the respondents had medium innovativeness followed by low (20.00%) and high (14.58%) level of innovativeness. The results were in line with the findings reported by Rao *et al.* (2024). Chi-square test showed that there was no statistically significant difference in the level of innovativeness among the respondents of three selected districts, $\chi 2$ = 9.111, Critical value= 9.488 at 5% level of significance.

Innovativeness reflected farmers' willingness and ability to adopt new technologies, practices and management strategies**.** Several factors influence farmers' levels of innovativeness including access to information and knowledge, market incentives, institutional support, peer networks and socio-economic characteristics may hinder farmers' adoption behavior. Constraints such as limited access to finance, lack of technical support, inadequate infrastructure and risk aversion may impede farmers' willingness or ability to adopt new technologies and practices. Addressing these barriers requires targeted interventions including capacity-building programs, technology transfer initiatives and policy incentives to create an enabling environment for innovation in agriculture.

CONCLUSION

In conclusion, the relevant findings of the study shed light on various critical aspects of farmers' characteristics and their implications for agricultural development. The analysis across Tables and Figures provides valuable insights into the dynamic interplay between personnel, socio-economic and psychological attributes. The study highlighted the dominance of middle age farmers (52.50%), illiterate (31.25%) with (32.50%) of them with small landholdings ranging from 2.5 to 5 acres with medium level of annual income. More than half (55.50%) of the respondents had medium cosmopoliteness and (72.08%) medium extension contact. Nearly half (46.67%) of the respondent farmers had medium social participation while (57.91%) of them had medium scientific orientation. Nearly two third of the respondents had medium risk orientation (64.17%) and (62.08%), high economic motivation and (65.42%) medium innovativeness. By incorporating these findings, policymakers, extension agents, researchers can develop targeted interventions and strategies that can effectively address the challenges faced by farmers and promote holistic growth through the implementation of programs that support socio-political engagement, empower farmers across age groups, acknowledge achievements, optimize land use and promote psychological well-being fostering improved livelihoods and strengthening rural communities' resilience and progress.

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Table 1. Distribution of respondents according to age **(n=240)**

S.No.	Category	Guntur		Kurnool		Anakapalli		Total	
		F	%	F	%	F	%	F	%
1.	Young age (Below 35 years)	12	15.00	2	2.50	6	7.50	20	8.33
2.	Middle age (35-55 years)	37	46.25	42	52.50	47	58.75	126	52.50
3.	Old age (Above 55 years)	31	38.75	36	45.00	27	33.75	94	39.16
	Total	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**240**	**100.00**
χ^2= 8.16				Critical value= 9.488					

F=Frequency %= Per cent

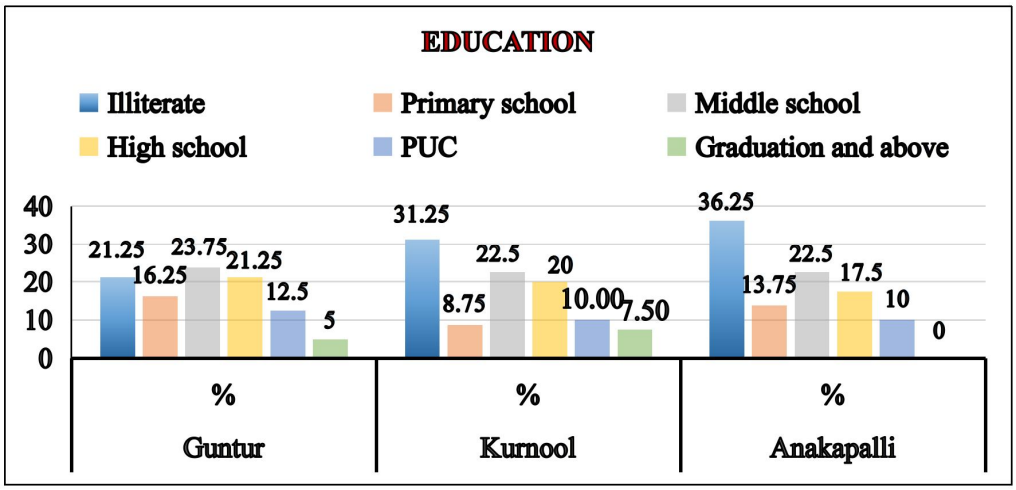


Figure 3. Distribution of respondents according to their education

Table 2. Distribution of respondents according to land holding **(n=240)**

S.No.	Category	Guntur		Kurnool		Anakapalli		Total	
		F	%	F	%	F	%	F	%
1.	Marginal farmer (<2.50 acres)	8	10.00	0	0.00	33	41.25	41	17.08
2.	Small farmer (2.50 to 5.00 acres)	23	28.75	8	10.00	47	58.75	78	32.50
3.	Semi- medium (5.01 to 10.00 acres)	35	43.75	28	35.00	–	–	63	26.25
4.	Medium farmer (10.01 to 25.00 acres)	14	17.50	32	40.00	–	–	46	19.17
5.	Big farmer (> 25.00 acres)	0	0.00	12	15.00	–	–	12	5.00
	Total	**80**	**100.00**	**80**	**100.00**	**80**	**100.00**	**240**	**100**
χ^2= 198.512*						Critical value= 15.507			

F=Frequency %= Per cent

Table 3. Distribution of respondents according to annual income **(n=240)**

S.No.	Category	Guntur		Kurnool		Anakapalli	
		F	%	F	%	F	%
1.	Low	14	17.50	5	6.25	15	8.75
2.	Medium	49	61.25	64	80.00	57	71.25
3.	High	17	21.25	11	13.75	8	10.00
	Total	80	100.00	80	100.00	80	100.00
		Mean = 282241.30 SD = 158470.90		Mean = 213337.50 SD = 142120.20		Mean = 144675.00 SD = 80555.90	
χ^2= 9.999*				Critical value= 9.488			

F = Frequency % = Per cent

Table 4. Distribution of respondents according to source of credit **(n=240)**

S.No.	Category	Guntur		Kurnool		Anakapalli	
		F	%	F	%	F	%
1.	Crop loans in nationalized banks	54	67.50	73	91.25	7	8.75
2.	Personal loans in private banks	0	0.00	0	0.00	0	0.00
3.	Gold loan in private banks/firms	19	23.75	8	10.00	12	15.00
4.	Cooperatives	2	2.50	0	0.00	66	82.50
5.	Money lenders	34	42.50	26	32.50	13	16.25
6.	Mortgaging land/house documents/ gold with money lenders	4	5.00	2	2.50	0	0.00
7.	Friends and Relatives	41	51.25	39	48.75	38	47.50

F = Frequency % = Per cent

Table 5. Sources of information **(n=240)**

S.No.	Information source	Frequently		Occasionally		Never	
		F	%	F	%	F	%
1.	Input dealer	198	82.5	96	40.00	--	--
2.	Extension Personnel	182	75.83	54	22.50	--	--
3.	Progressive farmer	70	29.17	166	69.17	--	--
4.	Friends/neighbours/relatives	30	12.50	206	85.83	--	--
5.	Television	22	9.17	152	63.33	62	25.83
6.	You-tube/whatsapp/social media	129	53.75	56	23.33	46	19.17
7.	News papers/magazines/vyavasaya panchangam	--	--	140	58.33	96	40.00
8.	Seminars/workshops/conferences	--	--	134	55.83	102	42.50
9.	Trainings/exhibitions/exposure visits	134	55.83	56	23.33	46	19.17
10.	Research institutes/scientists	--	--	50	20.83	186	77.50

F = Frequency % = Per cent

Table 6. Distribution of respondents according to communication variables **(n=240)**

Variable	Category	Guntur		Kurnool		Anakapalli		Total	
		F	%	F	%	F	%	F	%
Loacaliteness - cosmopoliteness									
	Low	16	20.00	13	16.25	23	28.75	52	21.67
	Medium	47	58.75	41	51.25	44	55.00	132	55.00
	High	17	21.25	26	32.50	13	16.25	56	23.33
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 13.05 SD = 1.59		Mean = 11.77 SD = 1.75		Mean = 12.22 SD = 1.70			
		χ^2= 43.747*				Critical value= 9.488			
Extension contact									
	Low	7	8.75	5	6.25	13	16.25	25	10.42
	Medium	61	76.25	54	67.50	58	72.50	173	72.08
	High	12	15.00	21	26.25	9	11.25	42	17.50
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 21.36 SD = 1.67		Mean = 21.05 SD = 1.74		Mean = 19.81 SD = 1.42			
		χ^2=11.111*				Critical value= 9.488			
Social participation									
	Low	17	21.25	14	17.50	18	22.50	49	20.42
	Medium	36	45.00	37	46.25	39	48.75	112	46.67
	High	27	33.75	29	36.25	23	28.75	79	32.91
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 9.91 SD = 1.50		Mean = 9.99 SD = 1.37		Mean = 9.53 SD = 1.47			
		χ^2=3.673*				Critical value= 9.488			

F=Frequency %= Per cent

Table 7. Distribution of respondents according to psychological characteristics (n=240)

Variable	Category	Guntur		Kurnool		Anakapalli		Total	
		F	%	F	%	F	%	F	%
Scientific orientation									
	Low	18	22.5	12	15	20	25.00	50	20.84
	Medium	49	61.25	47	58.75	43	53.75	139	57.91
	High	13	16.25	21	26.25	17	21.25	51	21.25
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 12.72 SD = 1.44		Mean = 12.36 SD = 1.64		Mean = 12.80 SD = 1.73			
		χ^2= 10.567*				Critical value= 9.488			
Risk orientation									
	Low	22	27.50	15	18.75	14	17.50	51	21.25
	Medium	48	60.00	52	65.00	54	67.50	154	64.17
	High	10	12.50	13	16.25	12	15.00	35	14.58
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 13.02 SD = 1.98		Mean = 12.70 SD = 1.92		Mean = 12.54 SD = 1.87			
		χ^2 = 5.42*				Critical value= 9.488			
Economic motivation									
	Low	6	7.50	5	6.25	9	11.25	20	8.34
	Medium	25	31.25	29	36.25	17	21.25	71	29.58
	High	49	61.25	46	57.50	54	67.50	149	62.08
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 13.84 SD = 1.93		Mean = 13.93 SD = 1.92		Mean = 14.05 SD = 1.91			
		χ^2=5.807*				Critical value= 9.488			
Economic motivation									
	Low	12	15	19	23.75	17	21.25	48	20.00
	Medium	58	72.5	49	61.25	50	62.5	157	65.42
	High	10	12.5	12	15	13	16.25	35	14.58
	Total	80	100.00	80	100.00	80	100.00	240	100.00
		Mean = 10.55 SD = 1.61		Mean = 10.77 SD = 1.56		Mean = 10.78 SD = 1.54			
		χ^2=9.111*				Critical value= 9.488			

F=Frequency %= Per cent

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RESEARCH ARTICLE

Perception and adoption of post-harvest management technologies among smallholder farmers in Telangana

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ABSTRACT

Post-harvest losses are a persistent challenge in Indian agriculture, especially for smallholder farmers lacking access to improved technologies and training. The study was conducted in Suryapet district of Telangana to assess perceptions and adoption of post-harvest management technologies among 120 farmers. Results indicated that practices such as moisture monitoring (70.00%), mechanical threshing (65.00%), and packaging (60.00%) had higher adoption due to clear benefits and ease of use. Conversely, value addition activities (23.37% adoption), government support utilization (25.00%), and training participation (31.73%) were limited by insufficient awareness, inadequate infrastructure, and perceptions of high cost or complexity. While most farmers agreed improved storage and handling reduce losses, many perceived technologies as difficult to use. To improve adoption, the study recommends strengthening training programs, simplifying access to financial and institutional support, and showcasing successful examples. These steps can enhance post-harvest management, reduce losses, and contribute to rural livelihoods and food security.

INTRODUCTION

Globally 13.2 percent is food loss1 from harvest up to retail (FAO, 2021). Post-harvest losses remain a critical constraint in Indian agriculture, due to poor handling, inadequate storage, and inefficiencies in the supply chain. India with 86 percent farmers below 2 hectares of land face more post-harvest losses due to labour intensive cropping practices (Gulati et al., 2024). Telangana, a major contributor to India's grain and pulse production, faces severe challenges in managing post-harvest operations effectively. Smallholders in the region often lack access to scientific storage facilities, training in recommended practices, and affordable technologies (Singh & Grover, 2013). Even when awareness of improved methods exists, adoption remains low due to financial constraints, fragmented extension services, and limited exposure to demonstrations (Barrett, 2008; Ishangulyyev et al., 2019). Addressing these barriers is essential, as improved post-harvest management can significantly reduce food losses, increase household income, and enhance food security. Understanding farmers' perceptions and actual usage of available technologies provides critical insights for designing effective extension strategies and targeted interventions. In Telangana, smallholders face challenges such as lack of training, limited infrastructure, and high costs of improved tools. Despite awareness of better practices, adoption has remained low. Assessing farmers' perceptions and actual usage of these technologies can guide extension strategies for further improvement in the post-harvest handling of the food grains by reducing losses and improving the farmers economic condition.

Objectives:

1. To assess the perception of farmers toward post-harvest technologies.
2. To examine the extent of adoption of post-harvest practices.

METHODOLOGY

The study was conducted in Suryapet district of Telangana, purposively. Four blocks were selected. From each block, three villages were selected through random sampling, and from each village, ten farmers engaged in active cultivation were selected, resulting in a sample size of 120. A structured interview schedule was prepared through literature review and pre-testing. Perception was defined as the process through which farmers assess the usefulness, relevance, and ease of use of post-harvest technologies, measured on a 3-point continuum to measure the degrees of agreement and clarity of understanding. Adoption referred to actual use of practices, adoption was measured farmers who adopted and not adopted with score of 1,0 respectively. The data were analyzed using descriptive statistics, including frequency and percentage, to interpret the distribution and perception levels among the sample respondents.

RESULTS AND DISCUSSION

Table 1. Perception of Post-Harvest Technologies **(n=120)**

S.NO	Statement	Agree (F/%)	Neutral (F/%)	Disagree (F/%)
1.	Improved storage reduces losses	72 (60.0%)	30 (25.0%)	18 (15.0%)
2.	Grading improves prices	65 (54.2%)	32 (26.7%)	23 (19.1%)
3.	Drying on clean surfaces prevents spoilage	78 (65.0%)	28 (23.3%)	14 (11.7%)
4.	Mechanical threshers save time	68 (56.7%)	34 (28.3%)	18 (15.0%)
5.	Packaging reduces losses	60 (50.0%)	40 (33.3%)	20 (16.7%)
6.	Technologies are profitable in the long term	58 (48.3%)	42 (35.0%)	20 (16.7%)
7.	Technologies are easy to use	25 (20.9%)	40 (33.3%)	55 (45.8%)
8.	Moisture meters help improve storage	62 (51.7%)	38 (31.7%)	20 (16.6%)
9.	Lack of awareness is a barrier to adoption	80 (66.7%)	28 (23.3%)	12 (10.0%)
10.	Only large farmers can afford these technologies	30 (25.0%)	36 (30.0%)	54 (45.0%)

DISCUSSION

The results from the table-1 indicate that farmers generally hold positive perceptions toward many postharvest technologies, especially those offering visible and immediate benefits. The highest agreement was for the statement that lack of awareness is a barrier to adoption (66.7%), highlighting that many farmers simply do not have enough information or exposure to these innovations. Similarly, drying on clean surfaces to prevent spoilage (65.0%) and improved storage to reduce losses (60.0%) received strong support, suggesting that practices perceived as straightforward and clearly beneficial are more readily accepted. On the other hand, the lowest agreement was for the idea that technologies are easy to use, with only (20.9%) agreeing and (45.8%) disagreeing, indicating that many farmers find them complicated or challenging. Although (48.3%) believe these technologies are profitable in the long term, a significant proportion (35.0%) remained neutral, reflecting uncertainty about economic returns. While cost concerns exist, the fact that (45.0%) disagreed that only large farmers can afford these technologies suggests that affordability may be addressed through appropriate financial support. These findings show that while farmers recognize the value of improved storage and handling practices,

adoption is often limited by lack of awareness, perceived complexity, and doubts about profitability. To enhance uptake, it is essential to increase awareness through demonstrations and training, simplify technologies to make them more user-friendly, provide financial assistance such as subsidies or microcredit, and generate local evidence demonstrating clear economic benefits over time. The findings were similar with (Elemasho etal., 2017) and (Kumar etal., 2019).

Table 2. Adoption of Post-Harvest Technologies **(n=120)**

Sr. No.	Statements	Adopted (F/%)	Not Adopted (F/%)
1.	Improved storage bins are used for preserving produce	50 (41.7%)	70 (58.3%)
2.	Grading practices are implemented to separate produce quality	46 (38.3%)	74 (61.7%)
3.	Produce is dried on clean sheets after harvest	62 (51.7%)	58 (48.3%)
4.	Mechanical threshers are utilized for threshing activities	78 (65.0%)	42 (35.0%)
5.	Packaging materials are used for storage and marketing	72 (60.0%)	48 (40.0%)
6.	Moisture content is monitored during storage	84 (70.0%)	36 (30.0%)
7.	Cleaning of stored produce is carried out regularly	66 (55.0%)	54 (45.0%)
8.	Value addition activities such as processing are practiced	28 (23.3%)	92 (76.7%)
9.	Training related to post-harvest practices is attended	38 (31.7%)	82 (68.3%)
10.	Government support for post-harvest activities is availed	30 (25.0%)	90 (75.0%)

The results from the table-2 indicate that the adoption of post-harvest practices varies considerably among farmers, with some practices being widely implemented and others remaining limited. The majority of farmers adopted the practices such as monitoring moisture content during storage (70.00%), use of mechanical threshers (65.00%), and use of packaging materials for storage and marketing (60.00%). These practices are likely more widely adopted because they offer clear, immediate advantages such as reducing spoilage, saving labor, and improving produce quality for sale. Their ease of integration into existing routines and proven benefits also encourage uptake. In contrast, the practices with the majority non-adoption rates were value addition activities like processing (76.73%), availing government support (75.00%), and participation in training (68.37%). Low adoption here reflects barriers including limited awareness, lack of technical skills, inadequate infrastructure, and perceptions that these practices are costly or complicated. Complex procedures for obtaining support and the limited reach of extension services further discourage farmers. To improve adoption, it is essential to strengthen farmer education through training, demonstrations, and peer learning while simplifying access to government schemes and support programs. Establishing local processing facilities, offering incentives, and showcasing clear evidence of profitability can motivate farmers to adopt value addition and other underused practices. Sustaining momentum in widely accepted methods like moisture monitoring and mechanization, while addressing the challenges limiting other practices, will be vital for strengthening post-harvest management overall. The findings were similar with (Ghanghas etal., 2017); (Sahu etal., 2021) and (Mishra etal., 2021).

CONCLUSION

The study revealed that while smallholder farmers in Telangana recognize the benefits of many post-harvest technologies, adoption remains uneven. Practices offering immediate, visible gains, such as moisture

monitoring, mechanized threshing, and packaging, showed higher uptake. In contrast, value addition, training participation, and accessing government support were poorly adopted due to lack of awareness, perceived complexity, and limited institutional support. Addressing these gaps requires targeted training, simplified procedures, and financial incentives to build farmers' confidence and capacity. Strengthening extension services and demonstrating economic benefits will be essential to enhance adoption, reduce losses, and improve farmers' income and food security.

POLICY RECOMMENDATIONS

Policies should strengthen extension services, offer subsidies or easy credit for essential tools, simplify access to government support, set up community processing units, provide local training, and monitor adoption to boost post-harvest technology use among smallholders.

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RESEARCH ARTICLE

Assessing the effectiveness of extension services in improving market access among small farmers in Assam

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ABSTRACT

The study assessed the effectiveness of agricultural extension services in improving market access among smallholder farmers in conducted in Dhemaji district of Assam. Data were collected from 120 farmers engaged in farming through a structured interview schedule covering market price advisories, buyer identification, branding support, and training in post-harvest practices. Findings showed most farmers valued extension services for timely price information (65.00%) and help in identifying buyers (60.00%), aiding marketing decisions. Degree of disagreement training from extension functionaries on grading and packaging (51.67%), the usefulness of grading, branding and collective marketing support, highlighting gaps in training and implementation. The study concludes that while extension services assist in basic marketing functions, strengthening digital literacy, practical skills, and institutional linkages is essential to improve farmers' access to diverse markets.

Key words: Extension Services, Market access, Small Farmers

INTRODUCTION

Effective market linkages are critical for strengthening smallholder livelihoods and fostering resilient rural economies. When farmers can access reliable markets, information they are more likely to secure better prices, reduce post-harvest losses, and reinvest in their farms to improve productivity and income stability (Gogoi & Saha, 2020). In Assam, is one of the major agrarian states among the north-eastern states, smallholder farmers face systemic barriers such as inadequate transport, limited buyer networks, volatile pricing, and a lack of reliable market intelligence (Singh & Grover, 2013, Deori & Rajalakshmi, 2023). These constraints restrict their bargaining power and keep them dependent on intermediaries. Challenges are further compounded by small landholdings, low capital investment, and limited exposure to modern marketing practices, making it difficult for farmers to secure fair returns.

Agricultural extension has the potential to act as a catalyst in overcoming these limitations by providing market-oriented services in addition to technical guidance. Extension personnel facilitate knowledge sharing on post-harvest handling, packaging, branding, and buyer engagement. By building farmers' capacity to participate in collective marketing and negotiate contracts, extension systems can help bridge the gap between producers and profitable markets. Furthermore, the involvement of farmers in the group marketing activities and collective decision-making had been observed to boost their confidence and negotiation ability (Glendenning et al., 2010,Hussain & Guha,2023). Digital tools and ICT-based advisory platforms are also emerging as new avenues for connecting producers with buyers, though their adoption

remains low in many rural regions. However, the true impact of extension on market access outcomes depends on regular contact, farmer receptiveness, institutional support, and contextual customization of services. Hence, this study aims to explore how effectively extension services are contributing to market access and what gaps remain in their implementation.

OBJECTIVES

1. To assess the socio-economic profile of smallholder farmers.
2. To evaluate the effectiveness of the extension services in improving market access.

METHODOLOGY

The study was conducted in Dhemaji district of Assam purposively. A total of four blocks from the district were selected using random sampling procedure. From each block, three villages were selected randomly. From each village, ten farmers were randomly selected based on their availability and engagement in active farming such that a total of 120 farmers were selected. A pre-tested interview schedule was developed comprising statements on effectiveness through literature review, and expert consultation. Statements covered aspects such as market price advisories, buyer identification, branding support, and training in post-harvest practices. Each item was rated on a 3-point Likert scale (Disagree = 1, Neutral = 2, Agree = 3). The data were analyzed using descriptive statistics, including frequency and percentage, to interpret the distribution and perception levels among the sample respondents.

RESULTS AND DISCUSSION

Table-1 Socio-Economic Profile of Farmers **n=120**

Variable	Category	Frequency	Percentage
Age	<30 years	26	21.77%
	30–50 years	60	50.00%
	>50 years	34	28.37%
Education	Illiterate	40	33.37%
	Primary–Secondary	68	56.76%
	Higher Secondary & Above	12	10.00%
Farming Experience	<5 years	28	23.36%
	5–10 years	54	45.00%
	>10 years	38	31.76%
Mass Media Contact	Regular	66	55.00%
	Occasional	38	31.73%
	None	16	13.37%
Social Participation	Member in ≥1 group	72	60.00%
	Not a member	48	40.00%
Risk-taking Behaviour	High	36	30.00%
	Moderate	58	48.33%
	Low	26	21.77%
Extension Contact	Regular	62	51.73%
	Occasional	42	35.00%
	Rare	16	13.36%
Market Information Access	Regular	72	60.00%
	Occasional	34	28.34%
	Rare	14	11.7%

DISCUSSION

The results from table-1 indicate that the majority of farmers (50.00%) were middle-aged (30–50 years), suggesting they were in an active working phase and more involved in farming decisions. Regarding education, most respondents (56.67%) had primary to secondary education, likely due to limited access to higher schooling in villages. For farming experience, (45.00%) had 5–10 years, showing adequate familiarity with cultivation practices. In mass media contact (55.00%) had regular exposure, which helps them receive timely market and extension information. A significant proportion (60.00%) reported membership in at least one social group, reflecting good participation in community networks that can facilitate knowledge sharing. Concerning risk-taking behaviour, nearly half (48.33%) were in the medium category, suggesting a balanced approach to adopting new ideas. Regarding extension contact (51.67%) had regular interactions with extension personnel, indicating opportunities to access advice and services. The findings are similar with (Rajkonwar, & Baruah, 2010);(Das, 2019); (Singha etal., 2019).

Table 2. Adoption of Post-Harvest Technologies **(n=120)**

Statement	Agree (F/%)	Neutral (F/%)	Disagree (F/%)
Extension services helped me identify buyers for my produce.	72 (60.00%)	30 (25.00%)	18 (15.00%)
Training provided by extension functionaries on grading and packaging was useful for marketing.	28 (23.33%)	30 (25.00%)	62 (51.67%)
Market price information shared by extension services helped me make decisions.	78 (65.00%)	28 (23.33%)	14 (11.67%)
Guidance from extension staff on collective marketing and group selling was practical.	36 (30.00%)	34 (28.33%)	50 (41.67%)
Advice offered by advisory services on branding and labeling improved the value of my products.	30 (25.00%)	32 (26.67%)	58 (48.33%)
Information from extension personnel about digital marketing options was relevant to my needs.	40 (33.33%)	50 (41.67%)	30 (25.00%)
Support related to contract farming opportunities was accessible through extension services.	36 (30.00%)	54 (45.00%)	30 (25.00%)
Extension services assisted me in arranging transport and logistics to reach markets.	44 (36.67%)	42 (35.00%)	34 (28.33%)
Extension field staff helped me negotiate better prices with traders or buyers.	38 (31.67%)	48 (40.00%)	34 (28.33%)

The findings from table-2 show that the majority of farmers agreed that market price information shared by extension services (65.00%) and buyer identification support (60.00%) were the most beneficial components. These results highlight the importance of timely advisories in marketing decisions, as accurate price data and knowledge of potential buyers can help farmers avoid distress sales, plan harvest timing, and negotiate more confidently with traders. Information from extension personnel about digital marketing (33.33% agreement) and contract farming (30.00% agreement) had only moderate acceptance. Limited digital literacy, unreliable internet access, and apprehension about engaging with private companies could be reasons why fewer farmers saw these as effective.

In contrast, more than half (51.67%)

disagreed that training from extension functionaries on grading and packaging was useful. This suggests that either such training sessions were not frequent enough or the methods taught were not practical for smallholder conditions. Some farmers may also lack access to necessary materials and infrastructure, which limits their ability to implement grading standards. Similarly, advice from advisory services on branding (48.33%) and guidance on collective marketing (41.67%) received lower positive responses. This may be due to the fact that branding requires coordinated efforts, packaging facilities, and market linkages, which are still underdeveloped in many rural areas. Group marketing also depends on trust and cooperation among farmers, which can take time to establish. This suggests that extension services currently focus more on information dissemination than on providing hands-on support for moving produce to markets or bargaining with buyers. Such operational aspects are critical but often overlooked in traditional extension programs. Overall, the data suggest that while conventional marketing support provided by extension services is widely appreciated, there is a need to strengthen practical components especially those related to value addition, collective action, and integration of digital tools to make market linkages more effective and sustainable. The findings are similar with (Sarma etal., 2021); (Boro, K., & Barman, R. D. 2022); (Subash etal., 2021).

CONCLUSION

The study shows that extension services were effective in delivering timely market price information and facilitating buyer identification, which most farmers found valuable for making informed sales decisions. However, a considerable proportion of respondents indicated that support for grading, branding, collective marketing, and the use of digital tools was either insufficient or not well aligned with their practical realities. Assistance with transport logistics and price negotiation was also perceived as limited, highlighting gaps in end-to-end market facilitation. To enhance their impact, extension efforts should prioritize more hands-on training in value addition practices, build farmers' digital literacy, and invest in infrastructure linkages that enable smoother market participation. Strengthening collaboration with cooperatives, agri-businesses, and marketing institutions will also be essential to create integrated support systems. By addressing these areas, extension services can help smallholder farmers engage more confidently and competitively in modern agricultural markets.

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RESEARCH ARTICLE

Analyzing the role of tribal farmer demographics in utilization of Rythu Bharosa Kendras in Andhra Pradesh.

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ABSTRACT

The current agricultural landscape involves a complex interplay of factors that influence the lives of farmers and the broader agrarian economy. To address these challenges, one notable initiative of government is the establishment of Rythu Bharosa Kendra (RBK), a demand-driven agricultural extension system in Andhra Pradesh. RBKs aim to offer a comprehensive array of agricultural services, information, and resources to farmers at the grassroots level, with the overarching objective of improving productivity, income, and the general well-being of farmers. The current research, titled "Analyzing the Role of Tribal Farmer Demographics in Utilization of Rythu Bharosa Kendras in Andhra Pradesh" employed an ex post facto research design. The study was conducted in the districts-Visakhapatnam, Vizianagaram, and Eluru. Three mandals and Four villages from each mandal were chosen, totaling 120 respondents, and data was collected through pre-tested structured interview schedules and analyzed using appropriate statistical methods and tools including frequency, percentage, mean score and Pearson correlation coefficient. Ten independent variables are correlated with dependent variable-Extent of utilization. Out of ten variables, four variables viz., educational status, extension agency contact, Occupational status, mass media utilization, trainings undergone had shown a positive and significant relationship with extent of utilization of RBK services by farmers. Whereas, Age and Farming experience had shown negative and significant relationship with the dependent variable of extent of utilization of RBK services by farmers.

Key words: Rythu Bharosa Kendras, Tribal farmers, Agriculture, Andhra Pradesh

INTRODUCTION

Andhra Pradesh, a prominent agricultural state in India known as the country's "rice bowl", has recognized the need for a robust integrated platform at the village level to effectively cater to the requirements of each farmer (Anantha Damodara Reddy et al., 2022)[7]. In response to this, the government established 10,641 Rythu Bharosa Kendras (RBKs) on May 30, 2020, in every village secretariat across the state. These RBKs serve as a vital resource for farmers, offering information on the latest agricultural production technologies and providing quality inputs (Reddy, 2020)[6].

To manage these RBKs at the grassroots level, the Department of Agriculture has recruited 6,758 village agriculture assistants (Babu et al., 2021)[3]. These RBKs are also known as Farmer Assurance Centres, where agricultural input shops and knowledge centers are integrated (Chowdary et al., 2022) [4]. RBKs supply government-certified agricultural, animal

husbandry, and fisheries inputs to farmers. Additionally, they house workshops or knowledge centers to offer scientific agricultural advisory services to farmers. Community Hiring Centres (CHCs) within RBKs provide machinery to groups of five to six village members with a 50% subsidy and access to a 40% bank loan. These machinery groups are maintained by local farmers and made available to marginal and small farmers at affordable rates (Krishna et al., 2022)[5].

RBKs offer a wide range of services, including farmer training, soil testing, crop insurance, demonstrations, beneficiary identification for various schemes, market intelligence, and the issuance of animal health cards (Reddy, 2020) [6]. This comprehensive approach has transformed the agricultural sector by addressing farmers' needs from seed to sale (Anuhya et al., 2022)[1,2].

The Rythu Bharosa Kendras (RBKs) have gained international recognition, having been nominated for United Nations Organization (UNO) awards, bringing pride to the nation (Anuhya et al., 2022) [1,2]. The RBK system has bridged the gap between the extension system and the farming community, enhancing transparency (Reddy, 2020)[6]. However, despite its global acclaim, the initiative faced various implementation challenges from the beginning. The success of the program hinges on farmers' knowledge of RBKs (Saifuddin et al., 2023)[8,9]. Limited research has been conducted on farmers' awareness of RBKs and the difficulties they encounter (Anuhya et al., 2022)[1,2]

METHODOLOGY

Andhra Pradesh, one of the Indian states, primarily relies on agriculture and livestock for its economy. The selection of Andhra Pradesh for this study is deliberate, as the state government launched the RBKs (Rythu Bharosa Kendras) with an innovative approach to support farmers at the grassroots level. An ***ex post facto*** research design was selected because the phenomenon has already transpired, making this design suitable.

According to 2001 Census the tribal population of Andhra Pradesh is 50.24 lakh with 33 tribes constitute about 6.6 percent of the total population of the stat

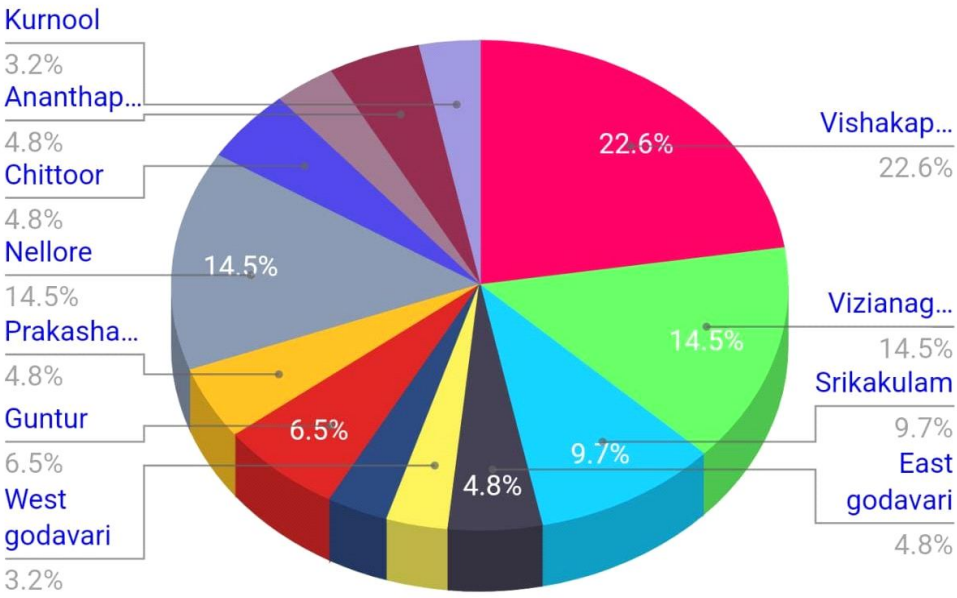


Fig.1 Distribution of tribal population in the districts of Andhra Pradesh

As per Venkatanarayan M. (2013)[10], Visakhapatnam, Vizianagaram, and West Godavari districts were purposefully selected for their significant tribal population, as well as to enhance the geographical diversity in the sample. These three districts, namely Visakhapatnam, Vizianagaram and West Godavari, exhibit tribal populations of 13.4%, 10.05%, and 2.77%, respectively. Araku Valley in Visakhapatnam, Parvathi Puram in Vizianagaram, and Buttaigudem in West godavari district were intentionally chosen as the tribal mandals for this study. Specifically, in the Araku Valley Mandal, out of its 172 villages, the study randomly selected Peddapuram, Doravalasa, Dolliguda, and Pedalabudu. Similarly, in the Parvathipuram Mandal with 49 villages, the study included Gochekka, Tonki, Adaru, and Budhuruvada as its random selections for research. In the Mandal of Buttaigudem there are 53 villages. Out of them four villages namely Sithapagudem, Tellamvarigudem, Doramamidi and K.R Puram were randomly selected for the study. The collected data were analyzed using appropriate statistical methods and tools, such as frequency, percentage, mean score and garrett ranking.

Pearson correlation coefficient:

Pearson's correlation coefficient, often denoted as "r," is a statistical measure that quantifies the strength and direction of the linear relationship between two continuous variables. It provides a value between -1 and 1, where:

r = 1 indicates a perfect positive linear relationship.

r = -1 indicates a perfect negative linear relationship.

$r \approx 0$ indicates a weak or no linear relationship.

The formula for Pearson's correlation coefficient (r) is as follows:

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

whereas,

- r = Pearson Coefficient
- n= number of pairs of the stock
- $\sum xy$ = sum of products of the paired stocks
- $\sum x$ = sum of the x scores
- $\sum y$= sum of the y scores
- $\sum x^2$ = sum of the squared x scores
- $\sum y^2$ = sum of the squared y scores

Software used:

i. R software

Data analysis in this study have been conducted by using R programming language. R is a free and open-source programming language. In the field of statistics and data analysis it is widely used. A wide range of tools and libraries are provided for data manipulation, visualization, and statistical modelling. Various tasks, such as data cleaning, exploratory data analysis, machine learning have been done by this R programming language. R is a beneficial tool for teaching and learning because it also has great graphics and programming abilities.

RESULTS AND DISCUSSION

Pearson's correlation coefficient (r) is as follows:

To know the relationship of independent variables with the utilization level correlation was carried out. Analysis was done by using R studio software.

Table 1. Simple correlation coefficient of profile with the utilization level of RBK services by tribal farmers.

Sr. No.	Variables	Correlation Coefficient	t-value	p-value
1.	Age (X_1)	-0.245**	-2.7453	0.006992
2.	Educational status (X_2)	0.515**	6.527	$1.76*10^{-09}$
3.	Occupational status (X_3)	0.845**	17.139	$2.2*10^{-16}$
4.	Land holding (X_5)	0.0014 ^{NS}	0.015952	0.9873
5.	Annual income (X_6)	0.012 ^{NS}	0.13314	0.8943
6.	Farming experience (X_7)	-0.221*	-2.4666	0.01508
7.	Extension agency contact (X_8)	0.323**	3.7171	0.0003097
8.	Mass media utilization (X_9)	0.415 **	4.9631	$2.359*10^{-06}$
9.	Trainings undergone (X_{10})	0.566**	7.4699	$1.523*10^{-11}$

****=Significant at 1 % level; *=Significant at 5 % level; NS=non-significant**

The result from Table 25 was interpreted as out of ten independent variables, four variables viz., educational status (X2), Occupational status (X3), extension agency contact (X8), mass media utilization (X9), trainings undergone (X10) had shown a positive and significant relationship with the dependent variable of utilization level of RBK services by farmers at one per cent level of significance.

Whereas, Age (X1) had shown negative and significant relationship with the dependent variable of extent of utilization of RBK services by farmers at one percent level of significance. Farming experience (X7) exhibited a negative and significant relationship with the extent of utilization of services of RBKs by farmers at five per cent significance level.

Whereas the variables, family type (X4), land holding (X5) and annual income (X6) shown a non-significant relationship with the utilization level of RBK services by the farmers.

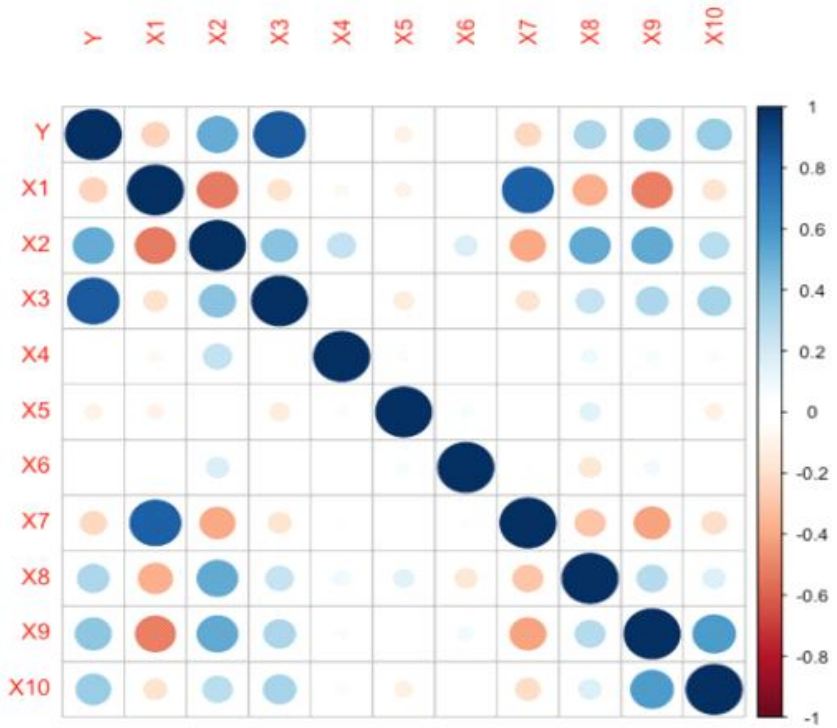


Fig.2. Heat map representing correlation between Extent of utilization and the ten independent variables generated in R software.

The fig 5 represents the correlation heatmap that allows us to visualize correlation between the combination of dependent variable with ten independent variables. In this particular heatmap, the correlation coefficients take on the following colors:

- Blue if they are positively correlated
- White if there is no correlation
- Red if they are negatively correlated

Educational status (X2), Occupational status (X3), Extension agency contact (X8), Mass media utilization (X9), and Trainings undergone (X10) variables are with blue color it indicates that they are positively correlated with dependent variable Y. Age (X1), Farming experience (X7) variables are having negative correlation. Variables with no correlation are Family type (X4), Land holding (X5), and Annual income (X6). Among all these, Occupational status (X3) is dark blue in color which means it is highly positively correlated when compared to remaining variables.

CONCLUSION

The study provides valuable insights into the relationship between the socio-economic profile of tribal farmers and the extent of utilization of Rythu Bharosa Kendras (RBKs) in Andhra Pradesh. The findings reveal that five key variables - educational status, occupational status, extension agency contact, mass media utilization, and trainings undergone—are positively and significantly associated with the level of RBK service utilization. These factors appear to enhance farmers' awareness, access, and willingness to engage with the RBK services. Age and farming experience were found to have a negative and significant relationship with utilization, suggesting that older and more experienced farmers may be less inclined to adopt new institutional support systems, possibly due to entrenched traditional practices or skepticism towards new interventions. Variables like land holding, annual income, and family type showed no significant relationship, indicating that these factors do not directly influence the use of RBKs.

Overall, the study underscores the importance of targeted extension strategies that prioritize education, communication, and training to enhance the effectiveness and outreach of RBKs among tribal communities. Strengthening the linkage between extension agents and farmers, increasing exposure to mass media, and offering more inclusive training programs can significantly increase the RBK utilization rates, leading to improved agricultural outcomes and better livelihoods for tribal farmers in Andhra Pradesh.

The insights from this research can help policymakers and agricultural extension planners to fine-tune their strategies, ensuring that the RBKs continue to act as a cornerstone of inclusive and effective agricultural development in the tribal regions of the state.

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RESEARCH ARTICLE

Suggestions of stakeholders towards preference of gladiolus varieties

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ABSTRACT

Gladiolus is known as the queen of the bulbous plants and it is one of the most cultivated, economically important cut flowers in India. Production of gladiolus in India estimated to be 259.77 thousand tonnes of total flowers and loose flowers production is 10.46 thousand tonnes and 249.31 thousand tonnes of cut flowers production in 2021-2022. About 0.34 thousand hectares of the area were under cultivation of gladiolus in Maharshtra. The research work was performed in the Department of Floriculture and Landscape Architecture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra during 2022-23. This study was conducted to know the suggestions of stakeholders towards preference of gladiolus varieties. The findings revealed that good quality flowers should be made available by the flower growers, visit of stakeholders to university demonstration plots and flower cafeteria and discuss different issues of gladiolus cultivation and marketing were the suggestions given by the stakeholders.

HIGHLIGHTS

- 83.33% of the university scientists suggested flower growers should be critical while going for commercial cultivation of gladiolus and try to acquire more scientific knowledge of production technology.
- 73.33% of the of the shopkeepers suggested that flower growers should made available the good quality flowers in proper time on special occasion.
- **Data Collection :** A total of 120 stakeholders of four categories i.e 30 flower growers, 30 shop keepers, 30 consumers, 30 university scientists using structured interview schedule.
- **Research Design:** Exploratory design was employed for the present study.

Keywords: Stakeholders, Suggestions, Gladiolus,

INTRODUCTION

Gladiolus is known as the queen of the bulbous plants and it is one of the most cultivated, economically important cut flowers in India grown commercially in different parts of India such as Madhya Pradesh, Karnataka, Gujarat, Andhra Pradesh, Haryana, West Bengal, Maharashtra, Tamil Nadu and Sikkim etc. Commercial floriculture has assumed immense significance in the diversification of agriculture and in national economy. Floriculture is being increasingly popular not only as an essential part of good living but also as commercial enterprise with huge potential for export. Compared to other cut flowers, Gladiolus ranks first in terms of returns. The present study was performed in the

Department of Floriculture and Landscape Architecture, College of Horticulture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. Department of Floriculture and Landscape Architecture has a history of successful research in developing new varieties in flowers like Gladiolus, Chrysanthemum and Gaillardia which are suitable to cultivate in Vidarbha region of Maharashtra. In gladiolus crop varieties like P.D.K.V. Gold and P.D.K.V. Roshani were developed which are well known for its adaptability in Vidarbha region. In chrysanthemum crop varieties like P.D.K.V. Ragini and Bijali supers were developed both of them were high yielding varieties. In gaillardia P.D.K.V. Roshani was developed which is also a high yielding variety. A part from these accomplishments every year experimental trails are being conducted to develop a new varieties in flower crops that are suitable for Vidarbha conditions, also training programs are conducted under National Horticultural Mission. This study was helpful to know the suggestions of stakeholders towards preference of gladiolus varieties. Categories of stakeholders that are considered for the study was flower growers, shopkeepers, consumers and university scientists.

MATERIALS AND METHODS

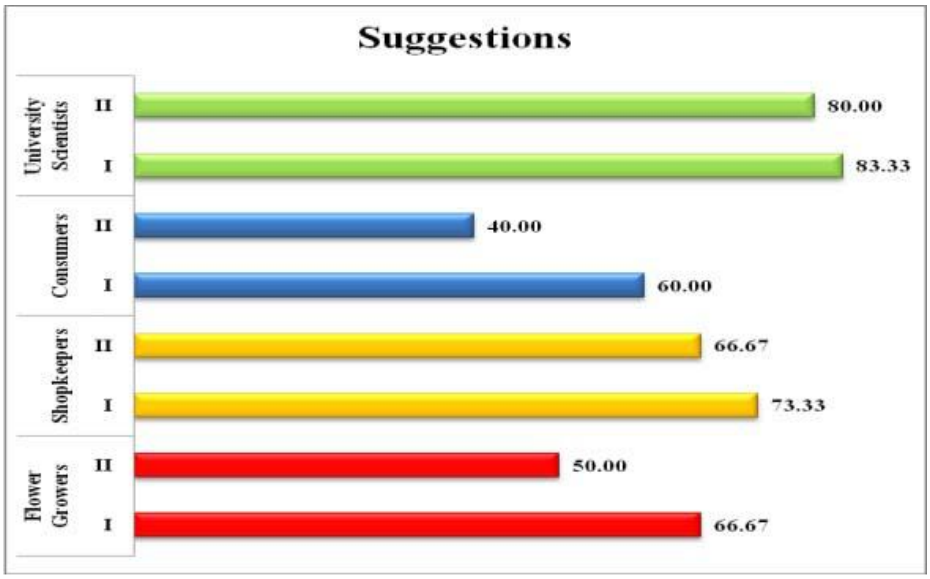
Over a past few years many varieties of gladiolus were growing and trails are being conducted in the Department of Floriculture and Landscape Architecture. To make awareness of different varieties of Gladiolus department appealed all the stakeholders i.e. flower growers, shopkeepers, consumers, university scientists and university students to visit the gladiolus flower demonstration trails. Number of stakeholders visited to the gladiolus trail plots during flowering stage. Accordingly the visiting stakeholders were contacted and are selected through simple random sampling method. Exploratory research design was used. Structured interview schedule was prepared in the light of objectives and data was collected. Frequencies and mean were employed for interpreting the results. Total number of respondents were 120 consists of four groups of stakeholders. They were flowers growers, shopkeepers, consumers and university scientists are selected. Each group of stakeholders consists of 30 respondents.

RESULTS AND DISCUSSIONS

In the present study suggestions that are given by the stakeholders are presented below Table 1 and Figure 1. Suggestions that are given by the stakeholders in Table 1 it can be seen that majority (66.67%) of the flower growers suggested that planting material of Arka Tilak, Arka Kesar, Yellow stone and Arka Naveen varieties should be made available and ranked as I followed by Scientific knowledge for commercial cultivation should be given by government agencies (50.00%) and was ranked as II

Majority(73.33%) of the shopkeepers suggested that flower growers should made available the good quality flowers in proper time on special occasion and ranked as ranked as I followed by market facility should be made available to sale the flowers specially gladiolus(66.67%) and was ranked as II .Majority(60.00%) of the consumers suggested that prices of garland , bouquet should be less and reasonable and ranked as ranked as I followed by different coloured flowers of Gladiolus should be made available(40.00%) and was ranked as II.

Figure 1 Distribution of stakeholders according to the suggestions given for preference of gladiolus varieties



Majority (83.33%) of the university scientists suggested that flower growers should be critical while going for commercial cultivation of gladiolus and try to acquire more scientific knowledge of production technology and ranked as ranked as I followed by flower grower and shopkeepers may visit university demonstration plots and flower cafeteria and discuss different issues of gladiolus cultivation (80.00%) and marketing and was ranked as II.

Table 1 Distribution of stakeholders according to the suggestions given for preference of gladiolus varieties

S.No	Statements	Frequency	Percentage	Rank
I.	**Flower Growers(n=30)**			
1.	Planting material of Arka Tilak, Arka Kesar, Yellow stone and Arka Naveen varieties should be made available.	20	66.67	I
2.	Scientific knowledge for commercial cultivation should be given by government agencies.	15	50.00	II
II.	**Shopkeepers(n=30)**			
1.	Flower growers should made available the good quality flowers in proper time on special occasion	22	73.33	I
2.	Market facility should be made available to sale the flowers specially gladiolus.	20	66.67	II
III.	**Consumers(n=30)**			
1.	Prices of garland , bouquet should be less and reasonable	18	60.00	I
2.	Different coloured flowers of Gladiolus should be made available	12	40.00	II
IV.	**University scientists(n=30)**			
1.	Flower growers should be critical while going for commercial cultivation of gladiolus and try to acquire more scientific knowledge of production technology.	25	83.33	I
2.	Flower grower and shopkeepers may visit university demonstration plots and flower cafeteria and discuss different issues of gladiolus cultivation and marketing	24	80.00	II

CONCLUSION

On the basis of findings according to flower growers, access to scientific knowledge for commercial production through government organizations is crucial, as is the timely availability of high-quality planting materials of selected types including Arka Tilak, Arka Kesar, Yellow Stone, and Arka Naveen. Improved market facilities, notably for gladiolus sales and a steady supply of high-quality flowers, particularly on special occasions were top priorities for shopkeepers. Customers suggested for more availability of various colored gladiolus flowers and primarily recommended that arrangement costs be fair. In order to promote information sharing and address issues related to cultivation and marketing, university scientists emphasized the value of growers gaining advanced scientific knowledge and suggested that growers and shopkeepers visit university demonstration plots on a regular basis.

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RESEARCH ARTICLE

Utilization pattern of Integrated Call Centre (ICC) services by the farmers in the Andhra Pradesh

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ABSTRACT

The utilization pattern of services of ICC by the farmers was studied i.e. by analyzing the calls received during the period of one year from April 2022 to March 2023 in the state of Andhra Pradesh. Three districts were viz. Ananthapuram, Annamayya and Alluri Seetha Ramaraju districts were selected purposively according to the pattern of calls received and A total of 90 farmers were randomly selected for the study. The results showed that majority of the respondents belonged to medium level of utilization behaviour (54.44%). Less than half of the respondents (42.20%) made 1 to 2 calls to ICC, more than half (54.50%) of the farmers utilized information related to agriculture, followed by horticulture (45.50%) and government subsidies (16.70%).

Keywords: Utilization pattern, ICC

INTRODUCTION

Information and Communication Technology (ICT) offers a cost-effective means to provide accurate, relevant, and timely information and advisories to farmers, making it a more efficient option compared to traditional extension services for supporting farm management. Mobile phones, as a key ICT tool, significantly reduce communication and information costs for rural farmers. They also create new opportunities for farmers to access additional sources of information beyond conventional extension services. Mobile technologies in particular are seen as transformative for smallholder agriculture The potential benefits of ICT include improving smallholder incomes, connecting poor farmers to markets, enhancing rural services and governance, fostering agricultural innovation, aiding risk management, enabling participation in higher-value agriculture and supporting rural families in making informed decisions about their productive activities (McNamara, 2009)

Andhra Pradesh is making significant progress in leveraging mobile agro-advisory services to assist farmers, with initiatives led by public, private, and non-governmental organizations (NGOs). In the public sector, the Acharya N.G. Ranga Agricultural University (ANGRAU) and the State Department of Agriculture are key players, providing SMS-based advisories to farmers across the state. ANGRAU has established itself as a prominent technology provider noted for its large subscriber base, extensive geographical outreach, and wide coverage of agricultural technologies. Its SMS-based advisory services play a vital role in supporting farm management and decision-making.

Additionally, the Integrated Call Centre (ICC), a major initiative in Andhra Pradesh, was established in the year May 30th 2020, located in Gannavaram, Krishna district with a toll-free number 155251 accessible to any mobile phone.

It operates on all working days and provides information to queries of farmers. The service is available in vernacular language i.e., Telugu. The ICC functions as a bridge between farmers, researchers and subject matters for providing information to the farmers at three levels based on their inquiries. In the first level calls were received at three desks managed by 52 technical functionaries called Call Centre Executives (CCE), who attend to the calls from 7.00 am to 7.00 pm on all working days. The receiver of the queries at the first level maintains a record of the calls made with details such as Name, Phone No, Address, Village, District, Problem type, Crop type, query detail, reply level-I, escape to level-II, escape reason, etc with the help of CRM software. The Call Centre Executive (CCE) also sends text messages about control measures to the telephone number of the farmers. If the farmer could not convey the query correctly through phone, they can take the pictures of their affected fields and send the pictures through WhatsApp for the six dedicated WhatsApp numbers for best suggestions. ICC provides real-time assistance on a range of issues including crop management, pest control animal husbandry and weather updates. Farmers can call the ICC for expert advice and this service has been crucial in addressing immediate concerns, thereby enhancing the overall accessibility of agricultural support.

The e-Extension services provided by ANGRAU also offer free SMS facilities, delivering critical information on the latest agricultural technologies, weather forecasts, market prices, and input-related updates. These advisories and the ICC help farmers stay informed and adapt to dynamic agricultural conditions, further supporting the state's push towards improved agricultural productivity and sustainability. Through these platforms, Andhra Pradesh continues to empower its farmers with timely and relevant information, significantly enhancing their decision-making and resilience to climatic challenges.

The main objective of the present study is to understand the utilization pattern of the advisory services rendered by ICC among the farmers of Andhra Pradesh

2. MATERIALS AND METHODS

In the present study Exploratory design was followed. An exploratory study investigates a topic to gain initial insights and to identify key issues for future research. The state of Andhra Pradesh was selected for the study as the state was pioneer in establishing ICC in 2020

Utilization Behavior is defined as the observable actions exhibited by individuals towards a product, service, or program, gauged through factors like usage frequency, duration, and the extent of involvement in utilizing the offering. The utilization behavior of ICC beneficiaries has been studied by focusing on the dimensions such as level of utilization, utilization and farming practices improvement scoring, perception of message characteristics, preference and post listening behaviour of farmers. The schedule was administered to 90 sampled farmers from the districts of Ananthapuram, Annamayya and Alluri Seetha Ramaraju districts of Andhra Pradesh

2.1 Utilization behaviour

The total score of the respondent on the scale was obtained by summing up the scores of all the statements in the scale. The possible minimum and maximum scores were 7 and 35 respectively. The respondents were grouped 58 into the following three categories based on the scores obtained by each of them duly following mean and standard deviation. The farmers' utilization behavior was subsequently categorized into low, medium, or high levels based on the obtained scores.

2.2 Utilization and Farming Practices Improvement Scoring

The assessment also involved the quantification of information related to the frequency of calls made to ICC, utilization of the

RBK YouTube channel, and engagement with various subject matter areas.

2.3 Perception of message characteristics.

Perception of message was operationalised as the meaning attached to the message by the callers of ICC. In the present study perception of message characteristics by the callers of ICC was measured on five dimensions viz., understandability, completeness, timeliness, accuracy, practicability, usefulness. The scale consisted of seven-point continuum with a score ranging from one to seven, with seven assigned to the desirable quantity of the message. The farmers were asked to indicate the way in which they perceived the advice/message given by the specialists on the seven-point continuum. The perceived message characteristics of each respondent were recorded. The message characteristics were given ranking based on mean scores obtained.

2.4 Preference and post listening behaviour of farmers

The post listening behaviour was operationalised as all the possible actions taken by the respondent after listening to the advice of the specialist. The study listed six possible actions ranging from no action to complete adoption of the practice.

3. RESULTS AND DISCUSSION

3.1 Utilization behaviour

Distribution of farmers according to their utilization behaviour is furnished in the table 1.

It could be inferred from the table 4 that majority of the respondents belonged to medium level of utilization (54.44%), followed by low (28.89%) and high level (16.67%) of utilization behaviour.

Table 1 Distribution of farmers according to their utilization behaviour (n=90)

S.No	Level of utilization behaviour	f	%
1	Low (< 3.50)	26	28.89
2	Medium (3.50 – 7.24)	49	54.44
3	High (>7.24)	15	16.67
	Total	90	100
Mean =5.37 S.D = 1.86			

f= Frequency %= Percentage

3.2 No of calls made by the farmers

Distribution of farmers according to the no. of calls made by farmers to ICC is furnished in the table 2.

The No.of calls made by farmers to the ICC shows how often farmers contact the center for advice or information about farming. It indicates how much they depend on the ICC for help with farming issues, weather updates, and market information. This data helps to measure how well the ICC supports farmers.

From the table 2 it could be specified that less than half of the respondents (42.20%) made 1-2 calls to ICC, followed by 3-5 calls (35.56%), >5 calls (22.22%). The research findings were in line with the findings of Sowmyashree (2006).

Table 2. Distribution of farmers according to number of calls made to ICC (n=90)

S.No	Number of calls made	Frequency	Percentage
1.	1-2 calls	38	42.22
2.	3-5 calls	32	35.56
3.	>5 calls	20	22.22
	Total	90	100
Mean = 1.86 S.D = 0.83			

3.3 Utilization of subject matter information

Distribution of farmers according to the utilization of subject matter information is furnished in the table 3.

The utilization of subject matter information by farmers from the ICC refers to how farmers use the advice and knowledge they receive on topics like agriculture, horticulture, and government schemes. It indicates the extent to which the ICC's guidance helps them in making informed decisions in their farming activities

A panoramic view of table 3 indicates that little more than half (54.50%) of the farmers utilized information related to agriculture, followed by horticulture (45.50%), government subsidies (16.70%), animal husbandry (11.10%), marketing information (11.10%), fisheries (10.00%), sericulture (7.77%), weather (5.56%) and post-harvest handling (3.33%).

Table 3. Distribution of farmers according to the utilization of subject matter information (n=90)

S.No	Subject matter	Frequency	Percentage
1.	Agriculture	49	54.50
2.	Horticulture	41	45.50
3.	Animal husbandry	10	11.10
4.	Fisheries	9	10.00
5.	Sericulture	7	7.77
6.	Government subsidies	15	16.70
7.	Weather	5	5.56
8.	Marketing info	10	11.10
9.	Post-harvest handling of produce	3	3.33

Note: The percentage exceeds 100 as a respondent can give more than one response

3.1 Utilization of RBK YouTube channel information.

Distribution of farmers according to Utilization of RBK YouTube channel information is furnished in the table 4

The utilization of the RBK (Rythu Bharosa Kendram) YouTube channel information by farmers refers to how farmers access and apply the content provided on the channel, such as agricultural tips, government schemes, and market updates. It shows how effectively farmers use this digital resource to enhance their farming practices and decision-making.

A cursory look at the Table 4 depicted that 81.11 per cent of the farmers were viewing the RBK channel and 65.56 per cent of the farmers utilized the RBK YouTube channel to enhance the new farming practices.

More than half (58.89%) of the farmers reported that there were notable improvements in their farming practices as a result of utilizing the RBK YouTube channel information, followed by 33.33 percent of the farmers stated that they were watching the RBK YouTube channel regularly.

Table 4. Distribution of farmers according to the utilization of RBK YouTube channel information (n=90)

S.No	Particulars	Frequency	Percentage
1	Are you Viewing the RBK channe	16	481.11

S. No.	Particulars	Frequency	Percentage
2.	Are you utilizing the RBK YouTube channel to enhance the new farming practices?	59	65.56
3.	Have You reported any notable improvements in their farming practices as a result of utilizing the RBK YouTube channel?	53	58.89
4.	Were the topics telecasted in the RBK Channel is timely	57	63.33
5.	How often do you rely on the RBK YouTube channel for guidance or information?		
	a. Regularly	30	33.33
	b. Occasionally	22	24.44
	c. Rarely	12	13.33
	d. Not utilized	26	28.90

3.5 Perception of message characteristics

Distribution of farmers based on perception of message characteristics is furnished in the table 5.

Perception of message characteristics is how farmers view and interpret the usefulness, accuracy, completeness, understandability, timeliness, practicality of the information they receive through ICC communication. This includes their opinions on how easy the messages are to understand, how timely they are, and how well the content addresses their specific agricultural needs and challenges.

The results in Table 5 indicated usefulness obtained the highest mean score (6.78) ranked first indicating that the messages were beneficial, followed by accuracy which obtained a mean score of 5.72 (Rank 2) highlighting the correctness of the information, completeness with a mean score of 5.21 (Rank 3) suggesting messages were adequately comprehensive, understandability with a mean score of 4.84 (Rank 4) indicating the information was timeliness with a mean score of 4.25 (Rank 5) delivery and practicality with a mean score of 3.16 (Rank 6).

Table 5. Distribution of farmers based on perception of message characteristics (n=90)

S.No	Message characteristics	Mean score	Rank
1.	Usefulness	6.78	I
2.	Accuracy	5.72	II
3.	Completeness	5.21	III
4.	Understandability	4.84	IV
5.	Timeliness	4.25	V
6.	Practicality	3.16	VI

3.6 Post learning behaviour

Distribution of farmers according to their post listening behaviour is furnished in the table 6.

The post-learning behavior of farmers refers to the changes and actions they take in their farming practices based on the information received from the ICC

An overview of table 6. revealed that great majority (92.20%) of the farmers had adopted the suggestions obtained from ICC and a little more than one fourth (28.90%) of the farmers discussed with the neighbours for further clarification of doubt followed by the farmers contacted the extension workers for more details.

In terms of extent of adoption more than three fourth of farmers (77.80%) completely adopted the practice.

A majority (84.40%) of farmers adopted the advice as given by specialists and 60.00 per cent of farmers adopted the advice in

combination with the suggestion by the local input dealers.

Indeed, all these farmers have provided testimony affirming that the ICC consistently delivers its services promptly resulting in reduced input costs and substantial improvements in yield.

Table 6. Distribution of farmers according to their post listening behaviour (n=90)

S. No	Behaviour type	Frequency	Percentage
1.	Did act on advice	83	92.20
2.	Discussed with neighbour for further clarification	26	28.90
3.	Contacted extension worker for more details	43	47.80
4.	Completely adopted the practice	70	77.80
5.	Adopted the advice as given by specialist	76	84.40
6.	Adopted the advice in combination with the suggestion by the local input dealers	54	60.00

CONCLUSION

The study highlights the significant role of the Integrated Call Centre (ICC) in providing timely and relevant agricultural advisories to farmers in Andhra Pradesh. Most farmers exhibited a medium level of utilization, with frequent calls made for agricultural guidance. The RBK YouTube channel also proved valuable, with many farmers reporting improvements in their practices. Farmers perceived the messages as highly useful and accurate, leading to high adoption rates of recommended practices.

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RESEARCH ARTICLE

Constraints faced by soybean growers in employing adaptation measures towards climate change

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ABSTRACT

Climate change represents a significant threat to agriculture, greatly affecting crop yields and the livelihoods of farmers. This research was carried out in the Akola district of Maharashtra to evaluate the challenges encountered by soybean producers in adapting to climate change. A total of 150 participants were chosen through simple random sampling from ten villages. Data were gathered via structured interviews and analysed using percentage analysis. The results indicated that the primary challenges include a lack of precise weather forecast information (82.67%), limited technical knowledge regarding climate change (78.66%), reliance on monsoon rains (75.33%), and insufficient awareness of climate-resilient crop varieties (72%). Other concerns include inadequate institutional support, water scarcity, and a lack of extension training. Farmers recommended the establishment of local weather stations, the promotion of mobile applications in local languages, and the encouragement of climate-resilient varieties along with contract farming. Tackling these challenges through targeted interventions can greatly enhance farmers' ability to adapt to climate variability and ensure sustainable soybean production in the area. Keywords: Soybean, Climate change , Adaptation, constraints

INTRODUCTION

Climate change is the one of the major issues the world is currently confronting in the twenty-first century. Changes in the mean or variability of the climate's qualities that last for a long time typically decades or longer can be used to identify long-term changes in the climate. The major environmental issue of climate change has an impact on agricultural production worldwide. The Akola district of Maharashtra is not exempted to the escalating average temperatures and unpredictable rains plaguing India. Perhaps the most urgent problem facing humanity is climate change. Because of lags in the climate system, climate stressors will persist to materialize despite massive mitigation measures (IPCC, 2007). Planning for adaptation aims to create and execute plans and policies that that aim to moderate or reduce harm associated with observed and projected climate hazards (IPCC, 2007). Climate change is expected to influence crop production, hydrological balance, input supplies and other components of agricultural systems. However, the nature of these bio-physical effects and human responses to them are complex and uncertain. Climate change and

agriculture are interrelated processes. Due to its sensitivity, any change in the climate can have significant alterations in the crop yields (Rosezwerig and Parry 2007). The majority of farmers have difficulties when attempting to implement climate change adaptation measures. Long-term climate change is poorly understood, and there are no financial incentives for planting supplies. The increased cost of agricultural inputs and the low market price of products are the additional limitations. The study also suggested that weather forecast data be disseminated and made available in real time via social media (TV and radio) and agricultural extension workers to farmers. The goal should be to raise one's educational level to the point when vulnerability may be avoided (Suryawanshi, 2022). Considering this, a study on the assessment of constraints to the adaptation of coping mechanisms for climate change was carried out at the farmer level to know the constraints faced by soybean growers while adaptation is assessed.

METHODOLOGY

Maharashtra is a state with about most of the population depending on the agricultural sector for their livelihood. Climate variability and climate change have potential threats to the agriculture sector in Maharashtra state. The present study was undertaken in Akola district of Maharashtra out of eleven districts in Vidarbha region of Maharashtra State; Akola, district was purposively selected for the study. From, selected district, two tahsils were purposively selected viz. Akola and Barshitakli tahsils of Akola. These two tahsils were also selected based on area under the soybean cultivation. From each selected tahsils, 5 villages were selected for the present study from each tahsil. Thus, in all, 10 villages were selected for this study. From each selected village 15 respondents were selected for the present study who have been growing soybean crop for the last five years. Thus, in total 150 respondents were selected the for present study by using a simple random method. The selected respondents were interviewed personally with the help of pre-tested and well-structured interview schedule was used for collecting information on paddy cultivation. The collected data was analysed using the following statistical techniques; 1) percentage analysis with a well-structured and interview schedule. This study therefore identified the constraints encountered by the farmers in the selection of adaptation strategies in the study area.

Percentage analysis: It refers to a special kind of rates, percentages are used in making comparison between two or more series of data collected from the respondents. A percentage is used to show the relationship between the series.

Percentage = (No. of respondents/ Total No. of respondents) * 100

The Percentage was calculated to measure variables. Percentage analysis was used in descriptive analysis for making simple comparison.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussions have been summarized below.

Table 1: Distribution of respondents according to the constraints faced by soybean growers during adaptation of management practices towards climate change. (N=150).

Sr. No.	Constraints	Respondents (n=150)		
		Frequency	Percentage	Rank
1.	Lack of information about accurate weather forecasts.	124	82.67	1
2.	Inadequate knowledge about climate resilient crop varieties	108	72.00	4
3.	Lack of training on adaptation strategies by extension personnel	94	62.67	7
4.	Water shortage during critical growth period	103	68.66	5

Sr. No.	Constraints	Respondents (n=150)		
		Frequency	Percentage	Rank
5.	Fluctuation market in price of produce	89	59.33	9
6.	Lack of Institutional/governmental support	102	68.00	6
7.	Lack of effective advisory system on climate change	93	62.00	8
8.	Difficult to work in the field due to severe temperature	82	54.66	10
9.	Low literacy level of soybean growers	67	44.66	12
10.	Dependence on monsoon	113	75.33	3
11.	Lack of technical know-how on climate change	118	78.66	2
12.	Small size and fragmented landholding	78	52.00	11

From the Table 1, it can be concluded that, majority of the soybean growers i.e., 82.67 per cent expressed that lack of information about accurate weather forecast is the major constraint in adapting management practices for climate change followed by lack of technical know-how on climate change is another constraint expressed by majority of the farmers i.e., 78.66 per cent, about (73.33 %) soybean growers considered that dependence on monsoon is one of the major constraint,likewise, 72.00 per cent of growers said that Inadequate knowledge about climate resilient crop varieties is also a major constraint. 68.66 per cent growers believe that water shortage during critical growth period is one of the important problems to be addressed, other constraints faced by soybean growers, lack of Institutional/governmental support (68.00%),lack of training on adaptation by extension personnel (62.67%),lack of effective advisory system on climate change (62.00%), fluctuation in market price of produce (59.33%). About (54.66 %), respondents expressed that it is difficult to work in the field due to severe temperature. Half of the respondents (50.00%) felt small size and fragmented landholding is a constraint for adapting new technologies for combating climate change. Less than half i.e., 44.66 per cent of soybean growers concluded that low literacy level of soybean growers is also a constraint in adaptation of management practices for combating climate change in soybean crop. The results obtained from the present investigation as well as relevant discussions have been summarized below.

Table 2: Distribution of respondents according to the suggestions perceived by soybean growers during adaptation of management practices towards climate change. (N=150).

Sr. No.	Suggestions	Respondents (n=150)		
		Frequency	Percentage	Rank
1.	Establish local weather stations for easy accessibility of weather information	126	84.00	1
2.	Encourage the usage of mobile weather forecast apps in local languages.	108	72.00	2
3.	Increase drought management at the local level	102	68.00	4
4.	Adaptation of climate resilient soybean varieties	103	68.66	3
5.	Encourage contract farming arrangements with reasonable pricing criteria	89	59.33	6
6.	Introduce farmer-friendly smartphone apps that include voice navigation	94	62.67	5

From the table 2, it can be concluded that, majority of the soybean growers i.e., 82.00 per cent expressed that, establish local weather stations for easy accessibility of weather information is advisable, followed by encourage the usage of mobile weather forecast apps in local languages i.e., 72.00 per cent, about (68.66%) adaptation of climate resilient soybean varieties is suggested. 68.00 per cent growers suggested that,increase drought management at the local level. About (62.67 %), respondents, introduce farmer-friendly smartphone apps that include voice navigation. More than half (59.33%), encourage contract farming arrangements with reasonable pricing criteria.

CONCLUSION

Our study underscores that the major constraint faced by soybean growers is lack of information about accurate weather forecasts and lack of technical know - how on climate change and other constraints like this dependence on monsoon and lack of training on adaptation strategies by extension personnel and some other major constraints like inadequate knowledge about climate resilient varieties , water shortage and lack of institutional support and difficulty to work in severe temperature and low literacy level of soybean growers is also expressed by some of the growers. Above constraints are need to be addressed by considering suggestions given by soybean growers is crucial enhances farmer readiness to combat the effects of climate change in the region.

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RESEARCH ARTICLE

Training needs of technical functionaries working at integrated call centre in Andhra Pradesh

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ABSTRACT

The agricultural sector in India has been considerably boosted through the integration of Information and Communication Technologies (ICTs), with telecom sector playing a pivotal role in providing advisory services to farmers. This study aimed to assess the training needs of technical functionaries working at the Integrated Call Centre located in Gannavaram, Andhra Pradesh. An exploratory research design was employed, and a structured questionnaire was administered to a sample of 40 respondents comprising Nodal Officers, Scientists, and Call Centre Executives selected through simple random sampling. The data were analyzed using descriptive statistics and the Garrett Ranking Technique. The results indicated that a majority of the technical functionaries exhibited a medium level of training need, with agronomic practices, horticultural practices, and knowledge of government programmes and subsidies emerging as the most critical training areas. Constraints identified included lack of location-specific technologies, absence of incentives and reward systems, and inadequate promotional opportunities. Suggestions offered by respondents for improving service delivery included access to updated information on government schemes, the latest technological developments, and increased staff training. The findings underscore the need for continuous, structured training programs tailored to the evolving demands of the agricultural extension ecosystem. Such interventions can greatly enhance the responsiveness and efficiency of ICC personnel, ultimately benefiting the farming community.

Keywords: Training needs, Call Centre Executives, ICC.

INTRODUCTION

Agriculture remained to be a primary source of livelihood for a significant proportion of India's rural population. In recent years, the integration of ICTs in agricultural extension has transformed traditional service delivery models which enabled timely and accurate dissemination of information to the farmers. The Government of Andhra Pradesh launched the Integrated Call Centre (ICC) on May 30th 2020, with a toll- free number 155251, which serves as a platform for providing farmers with expert advice on various agricultural issues. The service is available in vernacular language i.e., Telugu. This centre was staffed with trained professionals, including call centre executives, scientists, and nodal officers, who interact with farmers to address their queries and provide guidance on best practices.

ICC extends the services for providing information to farmers at three levels. At level-I, Call Centre Executives (CCE) respond to the queries raised by the farmers. In Level-II, the scientists providing solution to the critical problems faced by the farmers over lane and

mobile connectivity. The Level -III is the management group that ensure the ultimate response and resolution of all queries not resolved by either Level-II or Level-I.

However, the efficiency of ICCs is intrinsically linked with training and preparedness of their technical functionaries. As agricultural technologies and government schemes continue to evolve, there is a pressing need to ensure that these functionaries are regularly trained to keep pace with emerging developments. In this regard, assessing the training needs of ICC staff becomes crucial for planning effective capacity-building interventions.

This study was undertaken with the primary objective of identifying the training needs of technical functionaries working at the ICC in Gannavaram, Andhra Pradesh. The study also aimed to identify the constraints faced by the staff in delivering services and to gather suggestions for improving their effectiveness.

METHODOLOGY

An exploratory research design was selected to comprehensively understand the training needs of technical functionaries. The study was conducted at the Integrated Call Centre in Gannavaram, Andhra Pradesh, which serves as a major hub for farmer advisory services in the state. A total of 40 technical functionaries were selected for the study using the simple random sampling technique. The sample included five Scientists and 35 Call Centre Executives (CCE). The Data were collected through a structured questionnaire that included a section on socio-economic profile, training exposure, perceived training needs, constraints in service delivery, and suggestions for improvement. The training needs were assessed using a checklist of 10 major thematic areas, where respondents were asked to indicate whether training was "Required" or "Not Required." Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize the data. The Garrett Ranking Technique was employed to analyze constraints and suggestions provided by the respondents.

RESULTS AND DISCUSSION

Age

Age refers to the classification of technical functionaries based on their chronological years, categorized into young (<35 years), middle-aged (35–50 years), and old (>50 years), to analyze training needs across different age groups.

Table 1: Distribution of technical functionaries according to age **(n=40)**

S.No	Age	Frequency	Percentage
1.	Young (< 35years)	20	50.00
2.	Middle (35-50years)	18	45.00
3.	Old (>50years)	2	5.00
	Total	**40**	**100.00**
Mean = 1.72 S.D = 0.81			

From the Table 1, it is indicated that half of the respondents (50.00%) were below 35 years of age, followed by middle age (45.00%) and old age (5.00%). The higher proportion of young respondents can be attributed to the recent recruitment of agriculture graduates as Call Centre Executives, who typically join the service soon after completing their degrees.

Educational Qualification

Education brings desirable changes of the individual behavior in terms of Knowledge, Skill and Attitude. The distribution of technical functionaries according to their education is furnished.

Table 2: Distribution of technical functionaries according to their education (n=40)

S.No	Education level	Frequency	Percentage
1.	Graduation	31	77.50
2.	Post-graduation	9	22.50
	Total	**40**	**100.00**
Mean = 1.25 S.D = 0.42			

From the table 2, it could be revealed that more than three fourth of the respondents (77.50%) had educated completed graduation, followed by post-graduation (22.50%). The majority of participants possessed a bachelor's degree, this can be attributed to the fact that many of them joined in the service right after graduation.

Training Exposure

Training exposure refers to the extent and frequency to which technical functionaries have participated in training programs related to agriculture, extension, and communication. In this study, training exposure was measured to understand how often staff attended relevant

Table 3: Distribution of technical functionaries based on training exposure (n=40)

S.No	Level of Exposure	Frequency	Percentage
1	Low exposure (< 10.56)	4	10.00
2	Medium exposure (10.56 – 13.98)	27	67.50
3	High exposure (>13.98)	9	22.50
	Total	**40**	**100.00**
Mean = 12.37 S.D = 1.61			

It could be inferred from the table 3 that majority (67.50%) of the respondents had exposed to medium level of trainings, followed by high (22.50%) and low (10.00%) level of training exposure. The technical functionaries had medium level of training exposure, this might be due to the fact that in wrap up session, refresher training was given by the scientists working at ICC.

Assessment of Training Needs

Assessment of training needs refers to the process of identifying the gaps between the existing knowledge and skills of technical functionaries and the competencies required for effective service delivery at the Integrated Call Centre (ICC). It helps in determining the specific areas where staff require capacity building to enhance their performance.

Table 4: Distribution of technical functionaries based on training need (n=40)

S.No	Training need	Frequency	Percentage
1	Low (<12.42)	8	20.00
2	Medium (12.42 – 23.07)	26	65.00
3	High (>23.07)	6	15.00
	Total	**40**	**100.00**
Mean = 17.75 S.D = 5.32			

From the table 4, it is indicated that the majority (65.00%) of the respondents exhibited medium training need, followed by low (20.00%) training need and high (15.00%) training need

Table 5: Item analysis of training Needs of technical functionaries (n=40)

Sr. No.	Training areas	Required		Not required	
		Frequency	Percentage	Frequency	Percentage
1	Seeds Manures and Fertilizers	32	80.00	8	20.00
2	Agronomic Practices	36	90.00	4	10.00
3	Irrigation Management	31	77.00	9	22.50
4	Plant Protection	34	85.00	6	15.00
5	Horticultural Practices	35	87.50	5	12.50
6	Veterinary Science	30	75.00	10	25.00
7	Fishery science	21	52.50	19	47.50
8	Sericulture	27	67.50	13	32.50
9	Post-harvest handling of produce	25	62.50	15	37.50
10	Government programmes and subsidies	35	87.50	7	65.00

An over view of table 5 revealed that greater majority (90.00%) of the respondents stated that they require training in areas of agronomic practices, followed by horticultural practices (87.50%), government programmes and subsidies (87.50%), plant protection (85.00%), seeds manures and fertilizers (80.00%), Irrigation management (77.00%), veterinary science (75.00%), sericulture (67.50%), post-harvest

Constraints Faced by Technical Functionaries working at ICC in effective delivery of the services

Garrett ranking technique was employed to rank the constraints encountered by the technical functionaries in effective delivery of services to the farmers. The responses on the constraints faced by the technical functionaries were furnished in the Table 6

Table 6: Constraints faced by technical functionaries working at ICC (n=40)

S. No.	Constraints	Mean Score	Rank
1.	Lack of location specific technology	70.55	I
2.	Lack of incentives and reward system for better performance	66.40	II
3.	Lack of promotional opportunities	57.13	III
4.	Lack of sufficient transport facilities	50.68	IV
5.	Lack of sufficient knowledge in the latest agricultural technology	49.90	V
6.	Inadequate administrative support	48.55	VI
7.	Lack of proper training to the staff	40.95	VII
8.	Lack of training in communication skills	40.65	VIII
9.	Lack of proper guidance and supervision by superior officers	35.07	IX
10.	Lack of adequate staff in Integrated Call Centre	34.02	X
11.	Excessive office work	27.15	XI

The results from the table 6 illustrates the constraints related to the technical functionaries at ICC. These constraints were organized in descending order and ranked accordingly, revealing technical functionaries perspectives on the limitations. The major constraint expressed by technical functionaries was lack of location specific technology with a mean score of 70.55 (Rank 1), followed by lack of incentives and reward system for better performance with a

mean score of 66.40 (Rank 2), lack of promotional opportunities with a mean score of 57.13 (Rank 3), lack of sufficient transport facilities with a mean score of 50.68 (Rank 4), lack of sufficient knowledge in the latest agricultural technology with a mean score of 49.90 (Rank 5), inadequate administrative support with a mean score of 48.55 (Rank 6), lack of proper training to the staff with a mean score of 40.95 (Rank 7), lack of training in communication skills with a mean score of 40.65 (Rank 8), lack of proper guidance and supervision by superior officers with a mean score of 35.07 (Rank 9), lack of adequate staff in Integrated Call Centre with a mean score of 34.02 (Rank 10) and excessive office work with a mean score of 27.15 (Rank 11).

Suggestions given by technical functionaries for effective delivery of services to farmers

The suggestions provided by the technical functionaries for effective delivery of services were presented in table 7. The ranking of suggestions provided by technical functionaries for effective delivery of services were determined using Garrett ranking technique.

Table 7: Suggestions given by technical functionaries for effective delivery of services (n=40)

S. No.	Suggestions	Mean Score	Rank
1	Need recent information on central and state government subsidy programmes.	77.23	I
2	Information on the latest developments in technology	60.75	II
3	Incentives are to be provided.	45.28	III
4	Maintenance of coordination among employees	43.05	IV
5	More number of trained staff required	27.06	V

From the table 7, the data indicated that the primary suggestion given by the technical functionaries for the effective delivery of their services to farmers was need recent information on central and state government subsidy programmes with a mean score of 77.23 (Rank 1), followed by information on the latest developments in technology is needed to provide farmers with recent up-to-date information with a mean score of 60.75 (Rank 2), incentives are to be provided with a mean score of 45.28 (Rank 3), maintenance of coordination among employees with a mean score of 43.05 (Rank 4), more number of trained staff required with a mean score of 27.06 (Rank5).

CONCLUSION

The research highlights the medium level of training requirements among technical functionaries employed in the Integrated Call Centre in Gannavaram, Andhra Pradesh.

Major areas of training identified are agronomic and horticultural practices, and government scheme knowledge. Major constraints such as absence of localized technology, inadequate incentives, and poor prospects for promotion hamper the effectiveness of these functionaries. In order to fill these gaps, it is necessary to introduce need-based, periodic training programs and policy reforms leading to high motivation levels and operational efficiency. Providing access to up-to-date information and improved infrastructural support will further enhance the role of ICCs in reorienting agricultural advisory services

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RESEARCH ARTICLE

Analysis of constraints associated with sustainable livelihood systems of small and marginal farmers

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ABSTRACT

A livelihood is sustainable when it can cope with and recover from the stresses and shocks and maintain or enhance its capabilities and assets both now and in the future without undermining the natural resource base. The present study was study was about the constraints associated with sustainable livelihood among small and marginal farmers of Nellore district of Andhra Pradesh . The study was conducted in four blocks i,e. Voletivaripalem, Ulavapadu, Lingasamudram, Kandukur in Nellore district of Andhra Pradesh with 384 respondents selected from eight villages through simple random sampling. To address the identified constraints, study recommends promoting education and awareness, strengthening assets, enhancing market access, supporting government schemes, improve raw material access to establish supply chain partnerships to facilitate easier access to raw materials for local producers, improving storage facilities to make their livelihood sustainable.

Key words: Livelihood, Sustainable, Constraints

INTRODUCTION

Livelihoods are the actions that people sustain themselves, endure and flourish. People combines technology, labour, power, knowledge and social ties to modify their environment and meet their needs, often which leads to livelihoods. Livelihoods are influenced by the economical and political systems in which they operate.

In the state of Andhra Pradesh, Agriculture plays a crucial role in the state's economy, contributing significantly to both employment and GDP. The region is known for its diverse crop production, including rice, pulses and various fruits. Recent initiatives have focused on promoting sustainable practices, such as organic farming and water conservation, to enhance productivity and environmental health. The government also supports farmers through various schemes, subsidies and access to technology to improve yields and reduce risks. Despite these advancements, challenges like water scarcity, fluctuating market prices and climate change continue to impact agricultural stability in the region.

Small and marginal farmers commonly adopt sustainable livelihood strategies to preserve the environment and their own financial security. Many of the farmers in Andhra Pradesh's Nellore district rely on cattle, small-scale farming and rainfed agriculture as their main sources of income. They are frequently the most susceptible to environmental and economic stresses. To support these farmers, various government initiatives and programs aim to enhance their productivity and provide resources for

sustainable farming practices. Government projects and development interventions frequently aim at improving the livelihoods of small and marginal farmers.

METHODOLOGY

The study was conducted in four blocks i.e., Voletivaripalem, Ulavapadu, Lingasamudram, Kandukur in Nellore district of Andhra Pradesh. Total of 384 respondents were selected from eight villages through simple random sampling. Exploratory research design is a type of research design that is used when a researcher aims to gain insights and understanding. In order to determine the constraints as experienced by the study area's respondent's, a systematic schedule was created. Rankings of the respondent's specified limits were based on reporting frequency and proportion. Considering the feedback obtained from pilot study the constraints were placed under four categories i.e., Social constraints, Assets and capital constraints, market infrastructure constraints and Government policies and programme constraints were measured through three point, "Not a constraint", "Constraint and not severe" and "Constraint and severe".

RESULTS AND DISCUSSIONS

Securing livelihoods is the first and foremost challenge under diverse and risk prone agri-ecosystem more particularly for small and marginal farmers with limited access to resources. Strengthening the livelihood strategies under resource constrained situations demands adjustments of resources and managing the limitations. Identification of constraints more particularly as perceived by the primary stake holders would benefit the policy makers for formulating programmes and extension advisory services to improve the livelihoods. In the present study constraints as perceived by the respondents were identifies under four categories and are present below.

Distribution of constraints faced by the respondents **(n=384)**

Sr. No.	Constraints	Not a constraint		Constraint and not severe		Constraint and severe		MS	Rank
		f	%	f	%	f	%		
A.	**Social Constraints**								
1.	Lack of family encouragement, shyness, and restricted societal norms and values	112	29.17	272	70.83	0	0.00	1.70	**IV**
2.	Lack of education, awareness and training	0	0	209	54	175	46	2.45	**I**
3.	Lack of opportunities	53	14	144	38	188	49	2.35	**II**
4.	No experience in the new	149	39	213	55	22	6	1.66	**V**
5.	Lack of successful entrepreneurs	170	44	127	33	87	23	1.78	**III**
B.	**Assets & Capital Constraints**								
1.	Lack of creditfacilities	86	22.40	249	64.84	49	12.76	1.90	**III**
2.	Lack of raw materia	1113	29.35	111	28.83	161	41.82	2.12	**I**
3.	Inadequate family labour	134	34.90	245	63.80	5	1.30	1.65	**IV**
4.	Poor asset base	15	3.91	331	86.20	38	9.90	2.05	**II**
C.	**Market & infrastructure Constraints**								
1.	Lack of road & communication facilities	108	28.13	240	62.50	36	9.38	1.81	**V**
2.	Market competition	144	37.50	124	32.29	116	30.21	1.92	**IV**

Sr. No.	Constraints	Not a constraint		Constraint and not severe		Constraint and severe		MS	Rank
		f	%	f	%	f	%		
3.	Lack of storage Facilities	37	9.64	164	42.71	183	47.66	2.38	I
4.	Lack of change Agent	94	24.48	140	36.46	150	39.06	2.14	III
5.	Lack of adequate Financial institutions	30	7.81	194	50.52	160	41.67	2.33	II
D.	**Government Policies & programme Constraint**								
1.	Lack of subsidies for certain crops	47	12.24	280	72.92	57	14.84	2.02	IV
2.	Lack of MSP for certain crops	57	14.84	195	50.78	132	34.38	2.19	I
3.	Absence of crop insurance scheme for horticultural crops	108	28.13	131	34.11	145	37.76	2.09	III
4.	Lack of adequate disbursement of claim by govt. under any scheme	75	195	195	50.78	114	29.69	2.10	II

Social Constraints

The above table clearly explains that lack of education, awareness and training (ranked I) among the statements with highest mean score 2.45, followed by lack of opportunities (rank II), with mean score of 2.35, lack of successful entrepreneurs in the locality (rank III) with mean score1.78, lack of family encouragement, shyness and restricted societial norms and values (rank IV) with mean score1.70, no experience in the new occupation(rank V) with mean score 1.66.

Due to lack of education, awareness and training farmers may struggle to implement modern techniques or diversify their income sources, leaving them reliant on traditional, less efficient methods. The absence of sufficient opportunities for growth, development and market linkages restricts their potential to improve their livelihoods.

Assets and Capital Constraints

The results in the table clearly explains that lack of raw material was (ranked I) among all the statements with highest mean score 2.12, followed by poor asset base (rank II) with mean score 1.90, lack of credit facilities (rank III) with mean score of 1.90, inadequate family labour (rank IV) with mean score 1.65.

Lack of raw material was a major constraint under assets and capital constraints as farmers facing problems in procurement of good quality seed, fertilizers. Poor asset base due to lack of proper machinery and small land holdings. Inadequate family labour is not a significant constraint as family members were actively involving in field works.

Market and Infrastructure Constraints

The table clearly explains that lack of storage facilities was (ranked I) among all the statements with highest mean score 2.38, Lack of adequate financial institution, (rank II) with mean score2.33, lack of change agent, (rank III) with mean score 2.14, market competition (rank IV) with mean score1.92, lack of road & communication facilities (rank V) with mean score 1.81.

Lack of proper storage facilities leads to reduced quality of the produce, until market conditions are favourable often forces farmers to sell immediately after harvest when prices tend to be lower, further reducing their income. Small and marginal farmers have limited access to credit facilities due to the high interest rates. Roads and transportation services were available, but they may not be in the best condition, making it harder to transport goods

efficiently.

Government Policies and Programme Constraints

It clearly explains that lack of MSP for certain crops was (ranked I) among all the statements with highest mean score 2.19, lack of adequate disbursement of claim by govt. under any scheme (rank II) with mean score 2.10, Absence of crop insurance for horticultural crops (rank III) with mean score 2.09, lack of subsidies for certain crops (rank IV) with mean score 2.02.

Lack of MSP for certain crops leading farmers to get less returns for their produce leading to income insecurity and discouraging diversification in farming.

Delayed or insufficient disbursement of claims such as under loan, insurance or input subsidies, hinders their effectiveness. Farmers rely on timely support and delays in claim settlements, especially during crises like droughts or crop failures and lack of subsidies for certain crops was not a significant constraint but it was leading to further perpetuates the monoculture of subsidized crops, while discouraging farmers from diversifying into other crops. The lack of subsidies also increases production costs, directly impacting the farmers income.

CONCLUSION

The major social constraint faced by the respondents were lack of education, awareness and training (rank-I) with mean score of 2.45. Lack of raw material with mean score 2.12 was the major constraint faced by the respondents under asset and capital constraints. In case of Market and Infrastructure Constraints, lack of storage facilities with highest mean score 2.38 was the most important constraint faced by respondents. The most prioritized constraint faced by the respondents under government Policies and Programme Constraints was lack of MSP for certain crops with a highest mean score 2.19.

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RESEARCH ARTICLE

Problems faced by the farmers after adopting paddy straw management technologies in Punjab

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ABSTRACT

The study was conducted across five agro-climatic zones in Punjab, the study randomly selected one district from each zone: Moga, Ferozpur, Gurdaspur, Jalandhar, and Shaheed Bhagat Singh Nagar. Two villages were selected randomly from four villages which were adopted by particular KVK in 2018-19 and one non-adopted village from each selected district was selected. From all selected villages, 20 respondents were selected randomly. Thus, a total of 300 respondents were chosen for study. The study revealed that high diesel consumption was the problem faced by 40.11 per cent of respondents in adopted villages and 40.98 per cent in non-adopted villages. Attack of insect pests in wheat was highest for Happy Seeder, with 71.34 per cent of respondents faced in adopted villages and 81.4 per cent in non-adopted villages. Rodent problems in wheat field were also faced by 54.26 per cent of respondents in adopted villages and 90.7 per cent in non-adopted Happy Seeder. While adopting mulcher in the field, 16.09 per cent of the respondents from the adopted village faced the problem that the effectiveness of mulcher decreases in moist soil, as the blades slip and can't cut the straw effectively whereas, in the non-adopted village, the same proportion of respondents faced the same problem. Among adopted villages, 91.78 per cent of respondents identified that this machinery required a high Hp tractor, while a slightly lower proportion, 82.97 percent of respondents in non-adopted villages reported the same issue in MB plough.

Keywords: CRM Scheme, Happy Seeder, Paddy, Problems, Surface Seeder

INTRODUCTION

Rice-wheat is the dominant cropping system in the northern plains of India. Paddy is being cultivated on more than 10 million hectares in Punjab, Haryana, and Uttar Pradesh. Burning crop residue causes phenomenal pollution problems in the atmosphere and a huge amount of loss and physical health deterioration to the soil. The time available between rice harvesting and wheat sowing is very narrow and in the range of 20-30 day. The burning of one ton of paddy straw releases 3 kg particulate matter, 60 kg CO, 1460 kg CO_2, 199 kg ash and 2 kg SO_2. One ton of paddy straw contains approximately 5.5 kg N, 2.3 kg P_2O_5, 25 kg K_2O, 102 kg S, 50-70 percent of micro-nutrients absorbed by the rice, and 400 kg of carbon which are lost due to the burning of paddy straw (Anonymous 2020a). The number of paddy straw occurrences recorded in Punjab in 2021 and 2022 was 71,304 and 49,922, respectively (Anonymous 2022a). Stubble-burning events decreased from 78,550 in 2021 to 53,792 in 2022 in Punjab, Haryana, NCR-UP, NCR-Rajasthan, and Delhi-NCT, a reduction of 31.5 per cent, according to figures based on the Standard ISRO Protocol for monitoring paddy crop residue burning events between September 15 and November 30 in the five regions (Anonymous 2022b). Appropriate solutions for in-situ and ex-

situ crop residue management have been suggested for successful implementation to achieve zero burning. To address the problem of crop residue burning holistically, the Ministry of Agriculture & Farmers' Welfare, Government of India initiated the Central Sector Scheme on "Promotion of agricultural mechanization for in-situ management of crop residue in the state of Punjab, Haryana, Uttar Pradesh and NCT of Delhi" popularly known as Crop Residue Management (CRM) scheme. "The objective of the scheme envisages the promotion of agricultural mechanization for in-situ management of crop residue". This scheme is being implemented by ICAR-ATARIs through 60 Krishi Vigyan Kendras (KVKs) of Punjab (22), Haryana (14), Delhi (1), and UP (23). The Scheme has following major components (100% Central Share): (i) "Establishment of Farm Machinery Banks or Custom Hiring Centers for Crop residue management machinery" (ii) "Procurement of Agriculture Machinery and Equipment for crop residue management" (iii) "Information, Education and Communication for awareness on crop residue management". KVKs executed the activities under Information, Education, and Communication (IEC) component. The KVK implemented various methods to popularize the happy seeder, mulcher, and zero-till drill as solutions to the issue of paddy straw, aiming to transform this waste into a valuable resource. These methods included conducting on-site demonstrations at farmers' fields, demonstrations at the KVK farm, arranging visits for farmers to Punjab Agricultural University in Ludhiana, organizing farmer camps in collaboration with the state agricultural department, delivering radio and TV talks, hosting field days at the KVK farm, employing multimedia for mass awareness, and distributing informative literature (Jaidka *et al* 2018). Since, so many funds, time and efforts were put into this scheme by KVK, so its evaluation was necessary in a state like Punjab where stubble burning was major issue and this scheme is of much importance. After implementation of scheme, the problems faced by the farmers were found in this study.

METHODOLOGY

The study was conducted in Punjab state in 2023. All the five agro-climatic zones were selected. From every agro-climatic zone, one district was selected randomly namely Moga, Gurdaspur, Ferozpur, Jalandhar and Shahid Bhagat Singh Nagar. Each KVK has adopted 4 villages in 2018-19 under this scheme. Among 4 adopted villages, two villages were selected of that particular district and one non-adopted village was selected purposively. Hence, from each district total three villages were selected i.e. two adopted and one-non adopted. Thus, a total of 15 villages were chosen for the study area. From every selected village, 20 respondents were selected randomly. Thus, a total of 200 respondents from adopted villages and 100 respondents from non-adopted Villages were chosen. A total of 300 respondents were chosen from the study area. Problems were the difficulties faced by the respondents for adopting the paddy straw management technologies in Punjab. The technologies such as in-situ and ex-situ technologies for managing paddy straw were selected for the study. The in-situ management technologies like Happy seeder, Super seeder, Smart seeder, Surface seeder, Mulcher, MB plough were selected whereas for in-situ management of paddy straw, the baler was selected. The response regarding problem faced by the farmers regarding particular technology was recorded through open-ended questions Data collection was done personally by interviewing the respondents by visiting the study area.

RESULTS AND DISCUSSION

Problems faced by respondents on different paddy straw management machineries

Happy Seeder: The majority of respondents from adopted villages choose Happy Seeder. A similar per cent of respondents from adopted or non-adopted villages was reported that urea remain unavailable to plants because it remains on the straw and attack of insects pest at the time of paddy straw management by happy seeder.

Table 1: Distribution of respondents on the basis of problems faced by respondents after adopting Happy Seeder

Problem	Adopted village n_1=164, f* (%)	Non-adopted village n_2= 43, f* (%)
Urea remain unavailable to plants because it remains on the straw	96 (58.53)	25 (58.13)
Loose straw affect the functioning of machinery	67 (40.85)	27 (62.8)
More seed required for sown wheat	55 (33.53)	25 (58.13)
Costly	43 (26.21)	37 (86.04)
Wheat crop sown Require more fertilizer	71 (43.29)	29 (67.44)
Problem of rodents	89 (54.26)	39 (90.7)
Yellowing in wheat after Ist irrigation/rainfall	69 (42.07)	29 (67.44)
Attack of insects pest	117 (71.34)	35 (81.4)

***Multiple responses**

Table1 showed that 40.85 per cent of adopted villages respondents gave reason that loose straw affect the functioning of machinery while, 62.8 per cent of respondents from non-adopted villages faced it. The percentage of the respondents in adopted villages faced problem of loose straw affect the functioning of machinery, more seed required for sown wheat, Costly, Wheat crop sown require more fertilizer, Problem of rodents, Yellowing in wheat after Ist irrigation/rainfall and attack of insects pest were 40.85, 33.53,26.21,43.29,54.26, 42.07 and 71.34 per cent respectively.

The percentage of the respondents in non-adopted villages faced problem of loose straw affect the functioning of machinery, more seed required for sown wheat, Costly, Wheat crop sown require more fertilizer, Problem of rodents, Yellowing in wheat after first irrigation/rainfall and attack of insects pest were 62.8, 58.13, 86.04, 67.44, 90.7, 67.44 and 81.4 per cent respectively.

Table 2: Distribution of respondents on the basis of problems faced by respondents after adopting Super Seeder

Problem	Adopted village n_1=172, f* (%)	Non-adopted village n_2= 61, f* (%)
Loose straw affect the functioning of machinery	57(33.13)	35(57.37)
Attack of insects pest	27 (15.69)	19 (31.14)
High rent	161 (93.60)	57 (93.44)
High Hp tractor	117 (68.02)	49(80.32)
Lodging problem	43 (25)	17 (27.86)
Diesel consumption	69 (40.11)	25 (40.98)
High maintenance cost	73 (42.44)	12 (19.67)
Doesn't work in hybrid basmati due to plant height	37 (21.51)	13 (21.31)

***Multiple responses**

Super Seeder: Table 2 shows that 33.13 per cent of adopted villages respondents gave reason that loose straw affect the functioning of machinery while, 57.37 per cent of respondents from non-adopted villages faced it. The percentage of the respondents in adopted villages faced problem of Attack of insects pest, High rent, High Hp tractor, Lodging problem, Diesel consumption, High maintenance cost and Doesn't work in hybrid basmati due to plant height were 15.69, 93.60, 68.02, 25.00, 40.11, 42.44 and 21.51 per cent respectively.

The percentage of the respondents in non-adopted villages faced problem of Attack of insects pest, High rent, High Hp tractor, Lodging problem, Diesel consumption, High maintenance cost and Doesn't work in hybrid basmati due to plant height were 31.14, 93.44, 80.32, 27.86, 40.98, 19.67 and 21.31 per cent respectively.

Table 3: Distribution of respondents on the basis of problems faced by respondents after adopting Smart Seeder

Problem	Adopted village n_1=9, f* (%)
Poor seed-soil contact	6(66.67)
High cost of cultivation	4 (44.44)
Lodging problem	2(22.22)

***Multiple responses**

Smart Seeder: The percentage of the respondents in adopted villages faced problem of Lodging, poor seed-soil contact and High cost of cultivation were 22.22, 66.67 and 44.44 per cent respectively showed in Table 3.

Table 4: Distribution of respondents on the basis of problems faced by respondents after adopting Surface Seeder

Problem	Adopted village n_1=73, f* (%)	Non-adopted village n_2= 2, f* (%)
Urea remain unavailable to plants because it remains on the straw	49(67.12)	1(50)
More wheat seed required for sowing	56(76.71)	2(100)
Attack of insects pest	12(16.43)	
Poor germination	55(45.34)	

***Multiple responses**

Surface Seeder: In Table 4, the percentage of the respondents in adopted villages faced problem of urea remain unavailable to plants because it remains on the straw, More seed required for sown wheat, Attack of insects pest and poor germination were 67.12, 76.71, 16.43 and 45.34 per cent respectively. On the same hand problem of urea remain unavailable to plants because it remains on the straw and more seed required for sown wheat were 50, 100 per cent respectively.

Baler: The percentage of the respondents in adopted villages faced problem of costliness, Non availability, Delay in shifting, Factory not available and laborious were 53.70, 40.12, 29.01, 15.43 and 3.08 per cent respectively. On the same hand in the case of non-adopted villages Non availability, Delay in shifting and factory not available were 39.06, 20.31 and 15.62 per cent respectively showed in Table 5

Table 5: Distribution of respondents on the basis of problems faced by respondents after adopting Baler

Problem	Adopted village n_1=162, f* (%)	Non-adopted village n_2=84, f* (%)
Costly	87 (53.70)	
Non -availability	65 (40.12)	25 (39.06)
Delay in shifting bales from field	47 (29.01)	13 (20.31)
Factory not available	25 (15.43)	10 (15.62)
Laborious	5 (3.08)	-

***Multiple responses**

Mulcher: In Table 6, the majority of respondents (63.21%) faced the problem of high cost of mulcher by adopted villages and 72.22 per cent of respondents in non-adopted villages faced the same problem of high cost of mulcher. Among adopted villages, 64.36 per cent of respondents identified the need of leveller and in non-adopted village, 87.03 per cent of respondents faced the same problem of requirement of leveller. In adopted village, 16.09 per cent of respondents faced the problem that effectiveness of mulcher decreases in moist soil, as the blades slip and can't cut the straw effectively whereas in non-adopted village, same number of proportion of respondents faced the same problem.

Table 6: Distribution of respondents based on problems faced by respondents on Mulcher

Problem	Adopted village n_1=162, f* (%)	Non-adopted village n_2=84, f* (%)
Requirement of Leveller	56 (64.36)	47 (87.03)
It can't be used in moist soil as the blades slip and can't cut the straw effectively	14 (16.09)	9 (16.66)
Costly	55 (63.21)	39 (72.22)

***Multiple responses**

Mould board plough.

In table 7, a large proportion of both adopters and non-adopters indicated that using this equipment requires a high horsepower tractor, which consequently leads to higher diesel consumption. Among adopters, 91.78 per cent identified that this machinery required high hp tractor, while a slightly lower proportion, 82.97 per cent of respondents in non-adopters reported the same issue. The use of MB plough is restricted in soils that are infertile or sandy. Around 32.87 per cent of respondents in adopted village and 31.91 per cent of respondents in non-adopted villages mentioned this as a limitation. The close percentages between adopters and non-adopters suggest that the plough's effectiveness in various soil types was similarly perceived across both groups.

Table 7: Distribution of respondents based on problems faced by respondents on Mould board plough

Problem	Adopted village n_1=73, f* (%)	Non-adopted village n_2= 47, f* (%)
It requires high hp tractor and associated diesel consumption is higher	67 (91.78)	39 (82.97)
MB plough can't be used in cases where the sub-soil is infertile or sandy	24 (32.87)	15 (31.91)
Organic matter not added, field fully dependent on chemical fertilizer leading to large sized soil clod formation	27 (36.98)	10 (21.27)

***Multiple responses**

Problem of organic matter not added and field fully dependent on chemical fertilizer leading to large sized soil clod formation was highlighted by 36.98 per cent of respondents of adopted village compared to 21.27 per cent of respondents of non-adopted villages. Chaudhary (2020) found that a large quantity of straw hinders sowing operations and leads to less germination of wheat was reported as the major problem by the respondents of adopted and non-adopted villages for Happy Seeder which is in line with the study findings.

DECLARATION

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

AUTHOR'S CONTRIBUTION

Akshdeep Kaur performed the study, statistical analysis and wrote the draft of the manuscript, Dr. Kuldeep Singh designed the study, Dr. Lavleesh Grag managed the analyses of the study and Sunil Kumar helped in data collection and managed the literature searches.

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RESEARCH ARTICLE

Satatistical modeling for forecasting fertilizer consumption in Odisha

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ABSTRACT

In Odisha, where a majority of the population depends on agriculture for livelihood, ensuring sustainable and productive farming systems remains a critical developmental priority". Fertilizer, as a crucial agricultural input, plays a significant role in sustaining agricultural growth. Accurate forecasting of fertilizer consumption is vital for ensuring food security, optimizing agricultural inputs, and addressing crop yield disparities in rice-producing regions like Odisha. The present study aimed to analyze fertilizer consumption at the district level in Odisha using forecasting. Data for the analysis were obtained from government publications covering the period from 1993–1994 to 2018–2019. To understand the levels of fertilizer consumption and thereby to propose sustainable fertilizer management forecasting is conducted. In forecasting the models with least values are the best fit models. Here are the best fit models, ARIMA (1,1,1) for N, ARIMA (0,1,0) for P, ARIMA (0,1,1) for K, ARIMA (1,1,0) and ARIMA (1,1,1) for total consumption per ha. The forecasted 42 values are from the year 2019-20 to 2023-24 for nitrogen is increased from 348.06 in the year 2019-20 to 381.13 in the year 2023-24. For potassium a gradual increase is observed from 74.86 to 82.81. In similar to potassium the forecasted values increased from 74.13 to 80.10 in total consumption per ha. A constant value of 152.34 for the next five years is observed in phosphorous.

Key words: Crop yield, Fertilizer consumption, Forecasting, ARIMA.

INTRODUCTION

Agriculture is the cornerstone of Odisha's rural economy, with over 60% of the population depending on it for their livelihoods, either directly or indirectly. It is one of the major rice-producing states of Eastern India, which contributes to about one-tenth of the nation's rice production [Dar *et al.* (2017)]. It is one of the. But still it is noted with significantly lower average rice yields than the national average [Das (2012)]. Several production constraints, such as low fertilizer use, a lack of machinery, problematic soils (acid, saline, and waterlogged), inadequate irrigation infrastructure, low seed replacement rates, frequent natural disasters like tropical cyclones, etc., may be to blame for the lower average yields.

Given, this significance, ensuring

sustainable rice production is essential not only for the state's food security but also for its socio-economic development and environmental stability. Among the various inputs for crop production, chemical fertilizers play a crucial role in this operation [Ji and Sang, 2022], as it directly influences crop yield and quality [Kumar *et al*., 2020]. Fertilizer is one of the basic agricultural inputs after seed and irrigation water which plays a crucial role in increasing agricultural productivity [Pani *et al*., 2021]. Fertilizer consumption is also affected by several other factors such as irrigation facilities, high-yielding varieties [Chadha and Meena, 2019]. A critical factor influencing rice productivity is the application of chemical fertilizers, which directly affect crop growth, yield, and soil health. Hence, understanding and anticipating trends in fertilizer usage is of growing importance in agricultural planning and policy.

While fertilizer consumption is acknowledged as a major driver of crop productivity, it is influenced by a complex interplay of factors such as the extent of arable land, availability of irrigation, adoption of high-yielding varieties, input supply chains, access to institutional credit, fertilizer pricing, and subsidy mechanisms. Additionally, the rate of fertilizer use varies significantly across Indian states and even between districts due to differences in agro-climatic zones, technological penetration, and infrastructure development.

In Odisha, rice yield remains below the national average—2318 kg/ha compared to the national mean of 2809 kg/ha [Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare, Economics & Statistics Division, 2023]. Multiple constraints contribute to this gap, including lower fertilizer application rates (53 kg/ha in Odisha vs. the national average of 113 kg/ha), limited mechanization, poor irrigation infrastructure, degraded soils (acidic, saline, or waterlogged), and vulnerability to natural disasters such as floods and cyclones. Major constraints in fertilizer use in study area were insufficient supply of fertilizers, untimely supply of fertilizers, household awareness about SHC, supply of adulterated fertilizers in the local markets, poor irrigation facilities, adverse climate conditions, etc [Tsay, 2000]. These environmental and socio-economic stresses mirror the broader challenges faced by many rice-farming regions in developing countries.

Organic fertilizers are known to improve soil quality and structure [Bronick and Lal, 2005] as well as stimulate soil microbial biomass [Masto *et al*., 2006], [Jannoura *et al*., 2014] and functional diversity and abundance in soil community structure. However, the effect of organic fertilizers on crop yield is slow and variable (Khaliq *et al.,* 2006). Thus, farmers prefer to use inorganic fertilizers rather than organic fertilizers to preserve crop yield, particularly in intensive agricultural systems under fluctuating environmental conditions [Smith *et al*., 2007]. However, the long-term oversupply of inorganic fertilizers, especially nitrogen fertilizer, has resulted in nitrate pollution of groundwater, eutrophication of surface waters, acid rain and soil acidification, greenhouse gas emissions, and other forms of air pollution [Ju *et al*., 2009].

Given this backdrop, it is crucial to

employ **forecasting methods** to analyze historical trends and project future fertilizer consumption patterns across the districts of Odisha. Forecasting is the operation of making assumption about the future values of studied variables. Unlike traditional statistical methods that only describe or compare historical data, forecasting techniques allow for **predictive insights**—which are essential for preemptive decision-making in agricultural planning, fertilizer supply logistics, and policy formulation. Forecasting models such as **ARIMA (Auto-Regressive Integrated Moving Average), Support Vector Regression,** have proven effective in capturing seasonal variations, identifying consumption trends, and predicting future inputs under uncertain scenarios.

These models can help quantify the likely demand for fertilizers in the coming years and identify which districts may experience rapid growth or stagnation in usage. Incorporating exogenous variables such as rainfall, irrigation coverage, or market access into forecasting models can further refine predictions, providing a more holistic understanding of the fertilizer-rice productivity nexus.

Therefore, the present study is designed to fill a crucial gap by focusing on **forecasting fertilizer consumption trends at the district level in Odisha**. This approach aims to provide data-driven insights into the effectiveness of nutrient management practices and pinpoint potential reasons for Odisha's lower-than-average rice yields. The study also seeks to classify districts based on projected consumption patterns, facilitating targeted interventions to improve productivity and sustainability.

By adopting robust time series and predictive modelling techniques, this research aspires to support policymakers, researchers, and stakeholders in designing tailored strategies that align with Odisha's unique agricultural landscape. Ultimately, the goal is to enhance food security, optimize resource utilization, and promote environmentally responsible agricultural development in the state.

OBJECTIVE OF THE STUDY

To forecast the fertilizer consumption in Odisha.

Materials and Methods

Data: For the study, time series data of fertilizer consumption (*i.e.,* nitrogen, phosphorous, potassium and total consumption per hectare) was collected from the year 1993-94 to 2019-2020 (27 years) for all the 30 districts of Odisha from Odisha Agricultural Statistics published by the Department of Agriculture & Farmers' Empowerment, Government of Odisha.

ARIMA Model

The ARIMA stands for auto regressive integrated moving average. In order to model certain time-varying events in the natural world, the economy, and other fields, we might utilize what is known as an auto regressive component, which is a representation of specific type of random process. It states that the output variable is linearly dependent on its past values as well as a stochastic term. Thia AR (p), often known as an autoregressive model of order p, can be defined as follows:

$$Yt = \mu + \sum \phi ipi = 1\ Yt\ -1 + \varepsilon t,$$

where ϕ1……. ϕp are the parameters of the model, μ is a constant, and εt is white noise

The second component of ARIMA is Moving Average (MA) model. The general MA process of order q can be defined as,

$$Yt = \mu + \theta 1\varepsilon t\text{-}1 + \theta q\varepsilon t - qYt = \mu + \varepsilon t + \theta 1\varepsilon t - 1 + \theta q\varepsilon t - q,$$

where μ is the mean of series the, Θ1…Θ qare the parameters of the model and the εt, εt−1,…, εt− q are the noise error terms. The value of q is called the order of the MA model

The AR and MA processes are now paired together, and the differencing step is integrated to eliminate non-stationary time series from non-seasonal time series. The ARIMA is commonly represented by ARIMA (p, d, q), where p is the order of 20 autoregressive model, d is the degree of differencing, and q is the order of moving average process. ARIMA (p, d, q) is an autoregressive integrated moving average time series, where p specifies the number of autoregressive terms, d the number differenced times the series must be before it becomes stationary, and q the number of moving average terms. The detailed description of ARIMA model and methodology to obtain a suitable order was given by [Box and Jerkins, 1976]. Thus, the ARIMA (p, d, q) model can be represented by the following equation:

$$Yt = \mu + \sum \phi ipi = 1Yt - 1 + \sum \theta j\varepsilon t, - jpj = 1 + \varepsilon t$$

Support Vector Regression

The development and use of new advanced techniques that can manage data was required due to the challenges involved in creating forecasting models for non-stationary and dynamic data. when a support vector algorithm is used for regression problems, it is known as Support Vector Regression (SVR). SVR is a supervised machine learning algorithm used for classification and forecasting problems.

It is different from traditional linear regression methods as it finds a hyperplane that fits the data points in a continuous space, instead of fitting a line to the data points. It enables us to select our level of error tolerance by giving us an acceptable error margin and tuning our tolerance for exceeding that acceptable error rate.

Instead of minimizing the squared error, like with OLS, SVR's objective function is to minimize the coefficients, or more precisely, the l2-norm of the coefficient vector. A cross-validation method was used to establish the SVR parameters' ideal values. The values of C and ε are used for this [Ojemakinde, 2006]. We can tune epsilon to gain the desired accuracy of our model. It performs both linear and non-linear modelling for forecasting.

Based on Vapnik's (1995) theory, the SVR equations are provided. Taking into account a training set of data, T, represented by:

$$T = \{(x1, y1), (x2, y2), \ldots., (xm, ym)\}$$

where, x is the training input and y is the training output

A non-linear function, f(x) given by: $f(x) = wT\varnothing(xi) + b$ where, w is the weight vector, b is the bias, and $\varnothing(xi)$ is the high dimensional feature space, linearly mapped from the input space x. The goal is to fit the data T by finding a function f(x) that is both as minimal as possible and has the largest deviations from the actual targets for all of the training data T.

RESULTS AND DISCUSSION

Forecasting of fertilizer consumption in the districts of Odisha

Model structures for forecasting of fertilizer consumption

In this study the table presents four potential models of ARIMA i.e., ARIMA (0,1,0), ARIMA (1,1,0), ARIMA (0,1,1), ARIMA (1,1,1) and support vector regression. In nitrogen the RMSE and MAPE is least for ARIMA (1,1,1) model with values 18.36 and 5.02. For phosphorous the RMSE and MAPE are least for ARIMA (0,1,0) model 39 with the values 6.24 and 4.06. In the

same way for potassium the RMSE and MAPE values are least for ARIMA (0,1,1) and the values are 7.91 and 10.37. In case of total consumption per ha. the RMSE and MAPE are least for ARIMA (1,1,0) and ARIMA (1,1,1) models and with equal values 3.82 and 4.70.

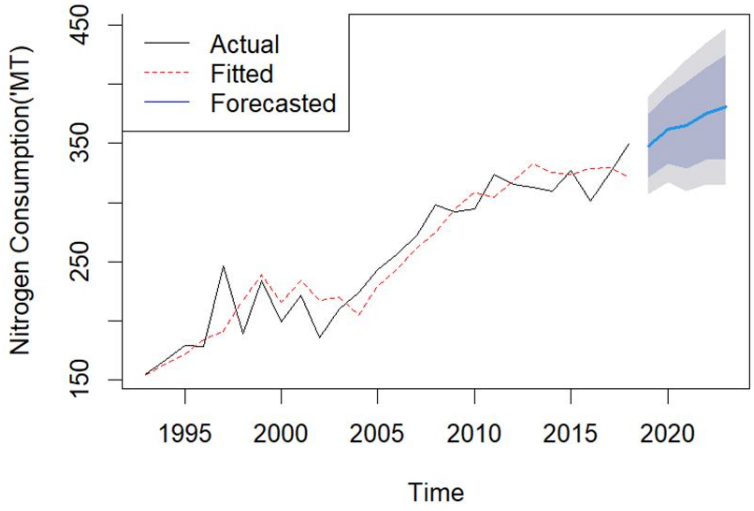
The models with least values are the best fit models. Here are the best fit models, ARIMA (1,1,1) for N, ARIMA (0,1,0) for P, ARIMA (0,1,1) for K, ARIMA (1,1,0) and ARIMA (1,1,1) for total consumption per ha.

Fertilizer	Model	Drift	AR1	Ma1	RMSE	MAPE
Nitrogen	ARIMA (0,1,0)	5.64	-	-	25.86 (22.15)	8.26 (5.68)
	ARIMA (1,1,0)	2.53	0.15	-	18.89 (18.23)	1.16 (5.03)
	ARIMA (0,1,1)	1.88	-	0.28	20.91 (22.66)	6.45 (5.83)
	ARIMA (1,1,1)	**2.59**	**0.22**	**0.32**	**18.76 (18.36)**	**6.15 (5.02)**
	SVR	σ =1.26 C = 1			18.09 (6.24)	10.68 (4.06)
Phosphorous	**ARIMA (0,1,0)**	**-**	**-**	**-**	**11.46 (6.24)**	**10.68 (4.06)**
	ARIMA (1,1,0)	3.21	0.20	-	11.02 (6.52)	10.71 (4.26)
	ARIMA (0,1,1)	2.98	-	0.19	11.05 (6.37)	10.62 (4.16)
	ARIMA (1,1,1)	3.17	0.54	0.53	11.02 (6.50)	10.68 (4.25)
	SVR	σ =0.74 C = 1			6.92 (9.75)	6.35 (6.10)
Total Consumption Per hectare	ARIMA (0,1,0)	1.03	-	-	4.73 (4.28)	7.83 (5.36)
	ARIMA (1,1,0)	**0.75**	**0.19**	**-**	**4.61 (3.82)**	**7.78 (4.70)**
	ARIMA (0,1,1)	1.61	0.22	-	4.61 (3.88)	7.74 (4.76)
	ARIMA (1,1,1)	**0.18**	**0.19**	**0.10**	**4.61 (3.82)**	**7.78 (4.70)**
	SVR	σ =0.35 C = 1			3.18 (10.74)	4.75 (13.39)

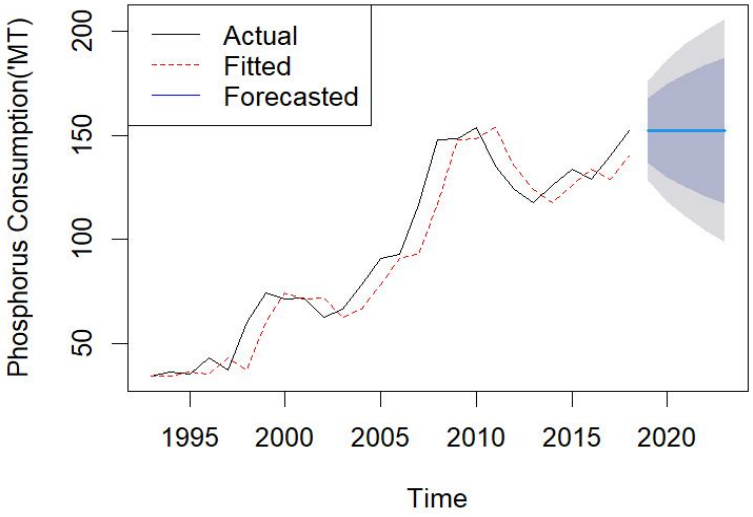
Year	N (‘MT)	P (‘MT)	K (‘MT)	Total (kg/ha)
2019-20	348.06	152.34	74.86	74.13
2020-21	361.94	152.34	76.85	75.25
2021-22	365.13	152.34	78.84	76.74
2022-23	375.63	152.34	80.82	78.38
2023-243	81.13	152.34	82.81	80.10

Forecasting projections of fertilizer consumption in Odisha districts

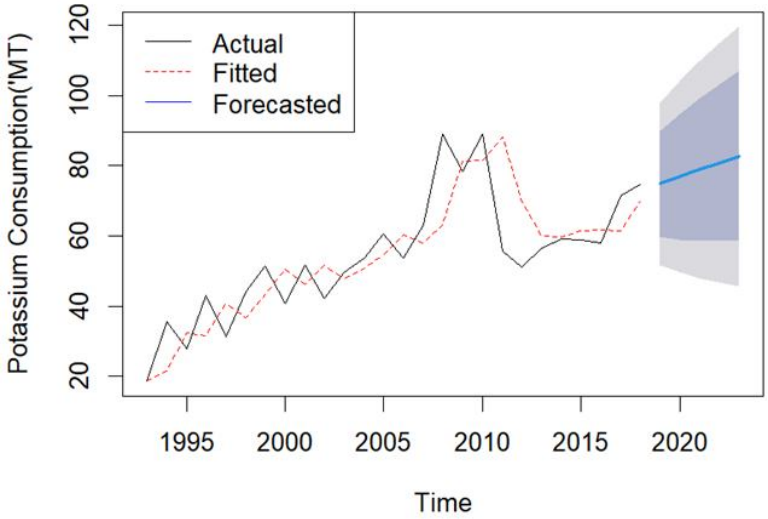
The above table presents the forecasted values of N, P, K and total consumption per ha. for next five years i.e., from 2019-20 to 2023-24. For nitrogen it has shown an increase in values from 348.06 MT in the year 2019-20 to 381.13 MT in the year 2023-24. In case of phosphorous the forecasted values remained constant for the next five years with the value 152.34 MT. For potassium there was a gradual increase in the value from 74.86MT to 82.81 MT. Similar to N & K the forecasted values of total consumption per ha. increased from 74.13kg/ha to 80.10kg/ha for the next five years. We can observe that the forecasted values for Potassium and total consumption per ha. nearby. The graphical representation of forecasting of fertilizer consumption is observed in the following figures a, b, c, d.



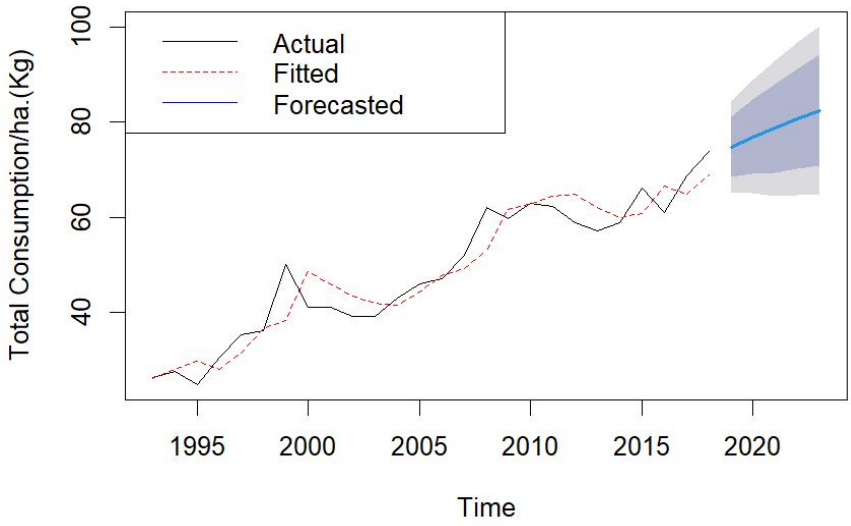
a. Forecasting of Nitrogen consumption in Odisha



b. **Forecasting of Phosphorous consumption in Odisha**



c. Forecasting of Potassium consumption in Odisha



d. **Forecasting of total consumption per ha. in Odisha**

CONCLUSION

In order to understand the levels of fertilizer consumption and thereby to propose sustainable fertilizer management forecasting is conducted. Here we concluded that there is a gradual increase in the consumption of fertilizers (N, K, and total consumption per ha.) thereby we can estimate the amount of fertilizers to be manufactured, imported in the coming five years according to this study. In forecasting the models with least values are the best fit models. Here are the best fit models, ARIMA (1,1,1) for N, ARIMA (0,1,0) for P, ARIMA (0,1,1) for K, ARIMA (1,1,0) and ARIMA (1,1,1) for total consumption per ha. The forecasted 42 values from the year 2019-20 to 2023-24 for nitrogen is increased from 348.06 in the year 2019-20 to 381.13 in the year 2023-24. For potassium a gradual increase is observed from 74.86 to 82.81. In similar to potassium the forecasted values increased from 74.13 to 80.10 in total consumption per ha. A constant value of 152.34 for the next five years is observed in phosphorous. Hence, integrating forecasting techniques serves as a vital tool for regulating fertiliser use, promoting balanced application and minimizing resource wastage and support sustainable development goals.

Limitations and Future studies

It is an exploratory study using secondary data that is currently available. Additional research in this field can be carried out by incorporating additional input variables and utilizing primary data.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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RESEARCH ARTICLE

From monoculture to multiplying incomes: The case for integrated farming in Punjab

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ABSTRACT

Declining operational farm holdings and stagnating agricultural growth in India necessitate innovative strategies to sustain farm incomes. Integrated Farming Systems (IFS) provide a holistic approach to enhance resource-use efficiency, farm productivity, and income diversification. This paper presents the case study of Sh. Narpinder Singh, an innovative farmer from Moga, Punjab, who adopted an IFS model integrating crop cultivation, apiculture, mushroom farming, backyard poultry, and value addition. With only 5.4 kanals of owned land and an equal area leased in, he transformed his farm into a profitable and sustainable enterprise generating an annual income exceeding ₹20 lakh. The paper highlights key interventions, value-added innovations, outcomes, and lessons for replication.

Keywords: Integrated Farming System, Apiculture, Income diversification, Value addition, Sustainable agriculture, Punjab

INTRODUCTION

Indian agriculture, dominated by small and fragmented landholdings with over 86% of farmers classified as small and marginal faces persistent structural challenges such as low farm incomes, soil degradation, overdependence on chemical inputs, and declining resource-use efficiency (Chand et al., 2011; Jha et al., 2020; FAO, 2019). In Punjab, once the heartland of the Green Revolution, intensive wheat-rice monocropping has led to severe environmental consequences including groundwater depletion, reduced soil fertility, biodiversity loss, and stagnating productivity and incomes (Dhaliwal & Singh, Ramesh et al., 2010). As conventional monoculture systems prove increasingly unsustainable, particularly for smallholders operating on less than 2 hectares of land, there is an urgent need for ecologically viable and economically resilient farming alternatives. In this context, **Integrated Farming Systems (IFS)** have emerged as a comprehensive solution, integrating crops with allied enterprises such as livestock, aquaculture, apiculture, mushroom cultivation, agro-processing, and agroforestry to optimize farm resources, diversify incomes, and minimize risk (Behera et al., 2004; NITI Aayog, 2018; Nair, 1993). These systems foster nutrient cycling, reduce external input dependence, and enhance resilience to market and climate shocks, thereby contributing to livelihood security and sustainability. Components such as apiculture and mushroom cultivation play a vital role in successful IFS models due to their low land requirements, high returns, and compatibility with other farm activities. Apiculture not only boosts pollination and crop yields but also enables income diversification through the production and value addition of honey, beeswax, and propolis. Likewise, agro-processing activities, particularly those led by women, contribute to rural employment,

entrepreneurship, and empowerment. These integrated approaches align closely with India's goals of doubling farmers' incomes and achieving Sustainable Development Goals (SDGs) related to poverty alleviation, gender equality, and environmental sustainability (NITI Aayog, 2018). This paper presents a case study documenting the innovative practices of Shri Narpinder Singh, a progressive farmer from Moga district, Punjab, who has adopted an IFS model by diversifying into high-value enterprises such as apiculture, mushroom production, agroforestry, and dairy farming. His model demonstrates how integrated, small-scale farming can lead to improved economic returns, ecological health, and rural livelihoods.

METHODOLOGY

The case study was documented during 2020-2021 by Krishi Vigyan Kendra, Budh Singh Wala, Moga. Participatory rural appraisal (PRA) techniques, including farm mapping, semi-structured interviews, and participant observation, were employed to gather comprehensive data on farm components, production practices, income streams, and innovations. The data were triangulated with training records, institutional documents, and photographic evidence to ensure accuracy. Income data were analyzed to determine net returns from each enterprise.

RESULTS AND DISCUSSION

Farm Profile and Resource Allocation

Sh. Narpinder Singh owns 5.4 kanal (0.675 acre) and leases an equal area from his brother, practicing IFS on a total area of 10.8 kanal (1.35 acre).

Integrated Farming System Components

Agriculture: Sh. Narpinder Singh practices organic farming with a focus on soil health and crop diversification (Table 1). He grows organic wheat (*Bansi*, *Navratna*) in rotation with ragi (*PES 400*), turmeric (*Salem*), and sugarcane (*CoPb92*). Turmeric powder production (~3 quintals annually) generates ₹57,000 in net income, while organic jaggery contributes an additional ₹18,000.

Table 1. Agricultural crops cultivated by Sh. Narpinder Singh

Name of Crop	Variety	Area (kanals)
Organic Wheat	Bansi, Navratna	4 (2 kanal each)
Organic Ragi	PES 400	4 (in rotation with wheat)
Turmeric	Salem	1.5
Sugarcane	CoPb92	0.3
Berseem + Rye grass	BL 10 + Punjab Rye grass No. 1	3.5 (mixed cropping)
Bajra + Maize	PHB 2884 + J1006	3.5 (mixed cropping)

Horticulture and Agroforestry: A wide variety of fruit and multipurpose trees are integrated into the farm system, enhancing biodiversity and resource cycling (Tables 2 and 3).

Table 2. Horticultural plants maintained on the farm

Name of Crop	Variety	No. of plants
Guava	Allahabad Safeda	4
Papaya	Red Lady 786	2
Kinnow	Daisy	1
Jamun/Black Plum	-	5
Peach	Early Grand	1
Pomegranate	Bhagwa	1

Table 3. Agroforestry species planted on the farm

Name of Species	Number of Plants
Moringa	10
Dhrek	60
Neem	2
Shisham	5
Sukhchain	2

Apiculture: Innovations and Income Diversification

Sh. Narpinder Singh has over 20 years of experience in beekeeping. In 1997, he received training in apiculture from the Department of Agriculture and began his enterprise with five bee colonies. His interest in beekeeping was inspired by Sh. Jagdev Singh of Chachradi village, District Ludhiana, who later proposed a partnership. Together, they managed 250 bee hives (100 owned by Sh. Narpinder Singh and 150 by Sh. Jagdev Singh). Favorable weather conditions and the availability of abundant bee flora in the early 2000s enabled rapid multiplication of colonies, increasing the total to 400 hives.

In 2006, Sh. Narpinder Singh established his independent venture under the name **"Dhaliwal Bee Farm".** Currently, he owns approximately 1,100 bee hives, producing nearly 200 quintals of honey annually, valued at ₹15–20 lakh. Initially, the honey was marketed in bulk to a Doraha-based trader. However, he has now shifted to retailing under his own labels, offering a diverse range of products including:

- Litchi Honey
- Honey
- Multiflora Honey
- Acacia Honey
- Jamun Honey
- Garlic Preserve in Honey
- Ginger Honey
- Vinegar Honey (*specially formulated for heart health and uric acid management*).

His migratory beekeeping schedule ensures year-round honey flow (Table 4).

Table 4. Migratory beekeeping schedule of Sh. Narpinder Singh

Month	Bee Flora	Location
November - end December	Raya	Kota, Rajasthan
January - mid February	Gobhi Sarson	Rewari, RajasthanMid
February - mid March	Eucalyptus	Canal banks (Punjab)
Mid March - end April	Multiflora/Shisham	Ropar/Rajasthan
May - mid July	Apple	Kashmir area
Mid July - end September	Cotton	Bathinda, Punjab
End September - October	Beri	Nagaur/Bhadra (Rajasthan)
October - November	Ajwain	Shivpuri (Madhya Pradesh)

Value Addition in Beekeeping

In 2012, prompted by personal health concerns regarding allergies, Sh. Narpinder Singh began collecting bee pollen after learning about its therapeutic properties. Initially starting with a single pollen trap, he now produces approximately 2 quintals of bee pollen annually, marketed as a "superfood" at ₹1,500/kg. To enhance its value, he encapsulates dried pollen pellets in gelatin capsules (sizes 0 and 00) for human consumption, with encapsulated pollen valued at ₹6,000/kg as compared to ₹500/kg for raw dried pollen.

For royal jelly production, he adopted the modified Doolittle method standardized by PAU for Punjab conditions. By supplementing his bee colonies with PAU's pollen substitute, he achieved an impressive yield of approximately 300 grams of royal jelly per colony during the spring season.

Recognizing the need for affordable beekeeping equipment, Sh. Narpinder Singh innovated by manufacturing bee boxes and accessories. Initially crafting hives from recycled wood and hired tools, he later invested in a wood-cutting machine and, in 2014, obtained a bee manufacturer's license. Currently, he produces and sells approximately 2,000 bee boxes annually, earning an additional ₹1.5 lakh. His innovation, the "Dhaliwal Bottom Board", an economical replacement for the conventional varroa bottom board, is now widely adopted by local beekeepers. Retailing at ₹85 per unit (compared to ₹400 for standard boards), he sells nearly 100 boards annually, generating an income of ₹8,500.

Other Farm Enterprises

Mushroom Cultivation

In addition to apiculture, Sh. Narpinder Singh cultivates Pleurotus spp. (Dhingri) mushrooms using agricultural and forestry waste. Annually, he produces around 3 quintals of mushrooms from 150 cultivation bags, realizing a net profit of ₹23,500.

Backyard Poultry

He maintains a flock of 50 indigenous hens, which produce approximately 5,000 eggs annually, yielding a net income of ₹35,000.

Dairy and Goat Farming

The farm also supports two cows (Jersey and Sahiwal breeds) and one Murrah buffalo, producing 20–25 liters of milk daily, sufficient for household needs. Additionally, he keeps two Beetal goats and three kids, which contribute approximately 3 liters of milk daily for domestic consumption.

Entrepreneurial Initiatives and Community Contribution

Beyond his own enterprises, Sh. Narpinder Singh supports budding beekeepers by facilitating exposure visits to PAU and Krishi Vigyan Kendra (KVK), Budh Singh Wala, Moga, for practical training and guidance. He is proactive in addressing quality concerns such as the presence of antibiotic residues in honey and maintains regular interactions with scientists from PAU and KVK for adopting the latest scientific beekeeping practices.

He has opened two retail outlets to enhance profitability: one under "ATMA Hut" supported by the Agricultural Technology Management Agency and another, "Kisan Hut", provided by the Punjab Mandi Board with assistance from KVK Budh Singh Wala. These outlets, along with a door-to-door marketing team of five employees, have improved access to premium honey products for local consumers.

His wife, Mrs. Rajandeep Kaur, complements the farm business by utilizing honey and farm produce for value-added products. Trained in bakery and pickle preparation at PAU and KVK respectively, she markets honey-based sweets such as *Khoya Barfi* and *Besan Barfi* (₹400/kg) during festive seasons. She also prepares Ragi-based snacks, selling around 25 kg of Ragi flour annually at ₹130/kg.

Recognition and Awards

Sh. Narpinder Singh's innovative efforts in apiculture and diversified farming have been widely recognized:

- Pandit Deen Dyal Upadhyay Antodya Krishi Puruskar (National Award- 2020)
- IARI Innovative Farmer Award (2019)
- Sardar Surjit Singh Dhillon Award, PAU, Ludhiana (2018)
- Best PAU Beekeeper Award by PAU Kisan Club (2016)

Trainings and Capacity Building

Over the years, Sh. Narpinder Singh has enhanced his technical expertise through various trainings:

- Bee-Keeping, Department of Agriculture, Moga (1997)
- Advanced Bee Breeding and Queen Rearing, PAU Ludhiana (2011)
- Specialized Training in Mushroom Cultivation, PAU (2013)
- Entrepreneurial Development Programmes, PAU (2013)
- Api-tour to Hungary and Slovenia, Aritours ApiRoutes Travel Agency (2016)
- Goat Farming, KVK Budh Singh Wala (2018)

Memberships

- Member, National Bee Board
- Executive Member, PAU Progressive Beekeeper Association, Ludhiana
- Cashier, Punjab Beekeeper Welfare Association, Moga
- Secretary, FPO "Khushali Food Processing and Marketing", Ajitwal, Moga
- Member, Natural Farming Network, Moga

Future Plans

Sh. Narpinder Singh envisions expanding his enterprise into Apitherapy, utilizing bee stings for their reported health benefits in managing conditions such as arthritis, hypertension, and stroke. He emphasizes quality over quantity in his operations, focusing on producing residue-free honey and premium bee products.

CONCLUSION

This case study demonstrates how diversification through IFS and value addition can significantly enhance smallholder incomes, ecological sustainability, and employment generation. Scaling up such models requires enabling policies, institutional support, and market linkages.

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RESEARCH ARTICLE

Applications and challenges of drones in agriculture: A review

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ABSTRACT

The agriculture sector in India, particularly in Maharashtra, faces challenges in productivity despite a significant rural population dependent on it. To address this, there's a growing need for precision agriculture. This paper explores various drone types and sensor technologies used in agricultural applications and their challenges. Drones have the potential to revolutionize farming practices by improving efficiency, enhancing crop yields, reducing costs, and enabling precision agriculture techniques. They have various applications in agriculture, including soil analysis, crop monitoring, sowing and plantation, livestock monitoring, crop spraying, irrigation, biomass estimation, disaster risk reduction, and more. While drones offer numerous benefits, there are also challenges that need to be addressed for widespread adoption in agriculture. These challenges include concerns about job loss, lack of knowledge and training, initial investment costs, regulatory barriers, operational costs, regulatory and legal constraints, flight endurance and battery life limitations, data management and analysis complexities, and ensuring a positive return on investment. To fully leverage the benefits of drone technology in agriculture and overcome these challenges, it will be essential for farmers and policymakers to collaborate, provide training and support to farmers, streamline regulatory processes, address cost concerns, and ensure sustainable farming practices. By addressing these challenges, the agriculture sector in India can potentially witness significant improvements in productivity, resource management, and overall efficiency.

Keywords: UAV, Drone, Agriculture, Applications and Challenges

INTRODUCTION

In India, 65 per cent (2021 data) of the population lives in the rural areas and 47% of the population is dependent on agriculture for livelihood (Anonymous, 2023 A). India is the largest country by population with 1.42 billion people (Anonymous, 2023 B). But the economic productivity of Indian agriculture sector particularly in Maharashtra is low as compared to other part of the country and hence there is a need to enhance productivity and input use efficiency. To sustain a growing population there is a need to improve productivity to ensure food security. etAI offers endless possibilities to develop efficient and cost-effective ways to grow healthier plants to meet the ever-increasing demand for food and other agricultural produce (Nilesh Ingle, 2022). Drone technology is one of the solutions to this and can be used for precision application of inputs and resource mapping in agriculture.

Therefore, this non-systematic review attempts to present an overview of the current status of Applications and Challenges of Drones

in Agriculture around the world. It may be noted that the review purposely avoids technical discussion of deep learning algorithms used to develop drones or unmanned aerial vehicles.

DISCUSSION

In this discussion section, various drone types, sensor technologies, benefits, applications and challenges of drones in Agriculture sector are discussed.

1.1 Types of Drones and Sensors

Before exploring into the Agricultural Drone Industry in India, let's explore various drone types and sensor technologies employed in this field:

1.1.1 Based on the drone style:

1. Fixed-wing drone:

The aerodynamic design of fixed-wing drones provides inherent stability, allowing them to withstand stronger winds. They are less affected by gusts and turbulent weather conditions, ensuring a smoother flight. Fixed-wing drones operate similarly to airplanes, utilizing principles of lift and drag to sustain their altitude. Typically, these drones are equipped with a single propeller. Consequently, fixed-wing drones enjoy extended battery life, enabling them to remain airborne for durations of up to 20 minutes. Their design facilitates higher speeds compared to rotary drones, allowing them to cover larger areas, capitalizing on their prolonged battery life. However, fixed-wing drones necessitate a landing area, similar to an airport runway, although some may be engineered to land by skidding across the ground. (Miller and Adkins, 2018)

Fixed-wing drones are most commonly used for large area mapping missions or long-range missions due to their longer flight durations. (Elizabeth Ciobanu, 2022 and Mohd, 2023).

2. Rotary Drones: These drones are equipped with electric motor-driven propellers, and their rotor count is often a distinguishing feature. Their vertical takeoff and landing capability transform field lanes and parking areas into convenient launch zones. Rotary drones excel at navigating through the fields and can easily survey problematic areas.

However, it's worth noting that rotary drones face a challenge in terms of battery life, as the power depletes more rapidly due to multiple propellers in operation. The flight duration for many quadcopters typically ranges from 10 to 20 minutes, and it can be even shorter in adverse wind conditions. Therefore, rotary drones are especially well-suited for tasks in smaller areas and surveillance applications.

They can be equipped with (Miller et al., 2018). h modern cameras and sensors to gather data on soil conditions, and crop health, capture high-resolution aerial pictures, detect crop health concerns, and monitor for pests and diseases (Mohd, 2023).

3. Hybrid Drones: Hybrid drones amalgamate the advantages of both fixed-wing and multi-rotor drones. They possess the versatility of vertical take-off and landing (VTOL), which renders them suitable for a wide range of agricultural tasks. These hybrid drones can ascend and descend vertically, including in constrained or uneven landscapes, and subsequently transition to sustained horizontal flight. They have sensors and cameras to help with activities including crop mapping, health evaluation, irrigation control, and pesticide spraying. Because of their enhanced range and durability, hybrid drones thrive in large-scale farming operations. Because of its VTOL capacity, it can also operate in a broader range of weather situations. They are, however, more sophisticated, and costly, and need specific training and maintenance (Mohd, 2023).

1.1.2 Based on Drone Weight:

The categorization of unmanned aircraft systems is determined by their weight (Anonymous, 2022)

This classification is as follows:

1. Nano drones: Weighing 250 grams or less.
2. Micro drones: Weighing over 250 grams, but not exceeding 2 kg.
3. Small drones: Weighing more than 2 kg, but not beyond 25 kg.
4. Medium drones: Weighing more than 25 kg, but not exceeding 150 kg.
5. Large drones: Weighing more than 150 kg.

1.2 Different Types of Sensors Used in Agricultural Drones

1. Visual Cameras: Inexpensive consumer drones often feature a Red-Green-Blue (RGB) visual camera, which is similar to the human eye, capable of capturing the full spectrum, making them suitable for efficient field scouting (Miller et al., 2018).
2. Multispectral Cameras: Plants emit wavelengths that fall beyond what the human eye can perceive, including near-infrared (NIR) light. One method for capturing both the visible and NIR spectrums involves conducting two distinct flights utilizing separate cameras. Multispectral cameras are equipped with multiple lenses, each tailored with specialized filters to focus on precise wavelengths, like nearinfrared and visible spectrums. The imagery obtained from multispectral cameras facilitates the computation of vegetation indices, directly linked to factors such as biomass and plant health (Miller et al., 2018).
3. Thermal Cameras: Thermal cameras can measure thermal radiation, associated with temperature, using longer infrared wavelengths. In cases of plants experiencing stress or mortality, reduced evapotranspiration often results in warmer temperatures, a phenomenon detectable by thermal imaging (Miller et al., 2018).
4. LiDAR: Laser technology is employed in Light Detection and Ranging (LiDAR) for precise object distance measurement, particularly in terrain mapping. However, LiDAR sensors are relatively expensive for drone applications. Alternatively, drones can determine elevation through the use of overlapping photos, a technique known as photogrammetry, which is more cost-effective but offers slightly lower precision compared to LiDAR (Miller et al., 2018).

1.3 Benefits of Drones in the Agriculture Sector

Drones have following key benefits of using in agriculture (Shah Tirth, 2023)

1. Improved efficiency: Drones can cover large areas of land quickly and efficiently, allowing farmers to gather data and monitor crops more effectively. This can help to identify issues early, leading to faster and more effective interventions in economical way (Shah *Tirth, 2023)*.
2. Enhanced crop yields: Drones are used to gather the crop health data, which helps to identify areas that require attention. By addressing these issues, farmers can improve their crop yields and increase their profits (Shah Tirth, 2023). Drones have the capacity to significantly enhance agricultural practices and increasing productivity (Prabhsimran Singh, 2023).
3. Reduced costs: Drones reduce costs by identifying areas that require attention, reducing the need for manual labour and reducing the use of agriculture inputs (Shah Tirth, 2023). Drone mounted method of spraying pesticides on Agricultural fields reduces the number of labours, time, cost and the risk involved to the personnel involved in spraying the liquids (Karan Kumar Shaw and Vimalkumar R, 2020). Quadcopter UAV and its spraying mechanism using simple cost-effective equipment. The universal sprayer system is used to spray for both liquid and solid content (Kurkute et al., 2018). Drones square measure designed to reduce time and improve the standard of labor.

4. Improved accuracy: Drones can capture high-resolution images and data, providing farmers with a detailed view of their crops. This can help to identify areas that require attention and ensure that interventions are targeted and effective (Shah Tirth, 2023). Application of unmanned aerial vehicles (UAV) as an evolving remote sensing technique in gathering rapid-high resolution spatial data at a lesser cost and in a short time (Nandakishore et al., 2024)

1.4 Applications of Drone in Agriculture

Drones, often referred to as unmanned aerial vehicles (UAVs), have made impressive advancements. They have transformed agricultural practices, offering farmers substantial cost reductions, enhanced operational effectiveness, and increased profitability.

Drones have the following applications in agriculture,

1. Soil and field analysis:

For efficient planning agricultural drones can be used for soil and field analysis. Remote sensing drones use electromagnetic spectrum cameras to gather ground data, distinguishing elements by their reflected wavelengths. Raw data is processed with algorithms, making drones valuable for monitoring various farming aspects, including crop health, vegetation, and plant growth. They can be used to mount sensors to evaluate moisture content in the soil, terrain conditions, soil conditions, soil erosion, nutrients content, and fertility of the soil (Debangshi, 2021 and Anonymous. 2023. C.)

2. Crop Monitoring & surveillance:

Crop monitoring is the only way that a farmer can ensure a timely harvest, especially when dealing with seasonal crops. Drones are increasingly crucial in crop monitoring and surveillance, offering real-time, high resolution aerial imagery of fields. One can easily supervised with precision regarding crop progress from the time of sowing to harvest the crop. Advanced sensor-equipped drones provide precise soil information, optimizing input use and reducing waste by providing fertilizers at the right time, checking for pest attack, and monitoring the effect of weather conditions. Drones can help in effective crop surveillance by inspecting the field with infrared cameras and based on their real-time information, farmers can take active measures to improve the condition of plants in the field. Drones save time and labor by swiftly assessing crop conditions (Anonymous. 2023. C. and Hafeez et al., 2023). AI enable early diagnosis of diseases and reduce agricultural waste (Nilesh Ingle, 2022). Security drones can be deployed to monitor fencing and perimeters of more valuable crops like cannabis instead of employing more security personnel. (Anonymous, 2023 F).

3. Sowing and Plantation:

Drones can help in planting trees and crops, which was done by farmers before. Drones can facilitate seed sowing through specialized containers equipped with a controlled dispersal mechanism, ensuring precise seed release from the air to the ground. This technology will not only save labor but also help in saving fuels (Anonymous. 2023. C. and Marzuki et al., 2021).

Drones can reduce planting costs by 85 % and can achieve an emergence rate of 90% (Debangshi, 2021, MaZur, 2016, Rejeb et al., 2022 and Wagh et al., 2020)

4. Livestock Monitoring:

The livestock management is laborious and expensive. Drones can be used to monitor and manage livestock as their sensors have high-resolution infrared cameras, which can detect a sick animal and swiftly take actions accordingly (Anonymous. 2023. C.) Livestock wearable Radio Frequency Identification (RFID) tags collect physiological or behavioral data and notify of any irregularities and offers more

comprehensive information than manual approaches (Herlin et al., 2021). Utilizing wearable Radio Frequency Identification (RFID) tags, the drone can point out locations of animals, simplifying the task of livestock supervision for farmers and reducing the need for specialized personnel, ultimately saves the cost (Banerjee, 2021). AI automating routine tasks in plant farming and animal husbandry may help to increase quality and production, create a safer working environment, reduce labor cost (Nilesh Ingle, 2022).

5. Crop Spraying:

Agro-chemicals like soluble fertilizers, herbicides and pesticides can be spray on crops precisely in very little time, as compared to traditional methods Drones (Anonymous. 2023. C). Drone spraying is environmentally friendly and minimizes human contact with hazardous chemicals. Drones excel in precise treatments, using sensors and cameras to address distressed areas while sparing the healthy ones. Their spraying capacity is up to five times more rapid compared to conventional techniques (Costa et al., 2012, Bruno et al., 2014, Pathak et al., 2020 and Rajput et al., 2021). The use of the unmanned aerial vehicles and the sensors to make adjustments to the routes could significantly reduce the waste of pesticides and fertilizers. (Faical et al. 2014).

6. Irrigation:

Drones provide data for precision irrigation systems, applying water only where needed. When the crop is growing, drones allow the calculation of vegetation indices, which describes the relative density and health of the crop, and show the heat signature, the amount of energy or heat the crop emits. Drones with hyperspectral, multispectral, or thermal sensors can identify which parts of a field are dry or need improvements (Barbedo, 2019, Mazur, 2016 and Anonymous. 2023. D.). Proper implementation of UAVs in the agricultural field almost 20%-90% savings in terms of water, chemical maltreatments and labor can be expected (Balaji et al., 2018).

7. Biomass estimation:

Drones can capture high-resolution aerial imagery of fields and forests for biomass estimation. Advanced sensors and 3D data enhance accuracy in complex vegetation. One can used this in enhancing the resources utilization, enhancing crop well-being, increasing production (Kachamba et al., 2016). The real-time and precise information provided by drones facilitates informed decision-making, ensuring that canopy management strategies are tailored to the specific needs of different sections within the crop (Berni *et al.* 2009).

8. Crop count and germination analysis:

Drones can conduct precise plant counting and germination analysis by capturing high-resolution images of fields. As compared to traditional i.e. manual method drones cover every area, giving instant and accurate data with in short period of time. One can easily calculate plant population with this (Mazur, 2016).

9. Disaster risk reduction: Drones rapidly evaluate natural disaster damage, offering real-time data for decision-making, aiding in planning and resource allocation and infrastructure development (Daud et al. 2022).

1.5 Challenges of using Drones in Agriculture

Drones offer many benefits to farmers. However, there are also some challenges that may be holding farmers back from adopting this technology. Here are some of the key challenges:

1.Fear of job loss:

Many farmers are concerned that the adoption of drone technology will lead to job loss, as fewer workers will be needed to perform manual labour on the farm.

2. Lack of knowledge and training:

Farmers may not have the knowledge or training necessary to operate drones effectively. This can make it difficult for them to adopt this technology, as they may not be confident in their

ability to use it.

Operating drones in agriculture requires expertise and training, which may not be readily available to all farmers. This can be a barrier to entry for some, as they need to invest time and resources in learning how to effectively use drones for their specific needs (Kuzmenko, Maryna, 2020.)

3. Initial investment:

The cost of purchasing and maintaining drones can be a significant upfront investment for farmers. However, the prices of drones have been decreasing over time, making them more accessible to a wider range of farmers (Anonymous. 2023. E.). Drones require a costly investment in technology (Kwonet al., 2017). Drones in logistics require investments in software, sensor packages and surveillance cameras for safety and efficiency. This employment may impact labor markets, potentially increasing social inequality. (Changet al., 2017 and Osakweet al., 2021).

4.Regulatory barriers:

There may be regulatory barriers to the use of drones in agriculture, which could make it difficult for farmers to adopt this technology.

5. Operational costs:

Drones require batteries, sensors, and other equipment, which may need to be replaced or upgraded periodically. Additionally, there may be costs associated with training operators and complying with regulations (Anonymous, 2023. E). The Unmanned aerial vehicle (UAV) – aircrafts can be used easily, where the equipment and labors difficulty to operate. (Mogili and Deepak, 2018)

6. Regulatory and legal constraints:

Drone operations are subject to various regulations and restrictions, which can vary by country and region. Obtaining the necessary permits and complying with these regulations can be time-consuming and complex. This can limit the widespread adoption of drone technology in agriculture (Howe, Scott, 2023)

7. Flight endurance and battery life:

A primary constraint of drones is their flight duration, which is restricted by the energy supplied by batteries. This limitation can prove challenging when tasked with covering extensive regions or conducting prolonged flights for data-gathering objectives (Mohsan et al., 2023)

8. Data management and analysis:

Drones have the capacity to produce substantial volumes of data, requiring processing and analysis to derive valuable insights. However, this process can become a bottleneck when farmers lack the essential tools or expertise to manage and decipher the data effectively (Delheimer Sara, 2023).

9. Costs and return on investment:

While drones can offer cost savings and efficiency improvements in the long run, the initial investment and ongoing maintenance costs can be a barrier for some farmers. The return on investment may vary depending on the specific application and the scale of the operation (Delheimer Sara, 2023).

CONCLUSIONS

The integration of drone technology into Indian agriculture, particularly in states like Maharashtra, presents a transformative opportunity to overcome the sector's longstanding challenges of low productivity and inefficiency. With their ability to support precision agriculture through accurate data collection, efficient input application, and large-scale resource mapping, drones can significantly enhance crop yields and sustainability. The variety of drone types arefixed-wing, rotary, and hybrid along with advanced sensors such as multispectral, thermal, and LiDAR, enables tailored solutions for diverse agricultural needs. However, to fully harness this potential, India must address critical barriers such as regulatory clarity, infrastructure readiness, affordability, and farmer training. A coordinated approach

involving government support, private sector innovation, and capacity building at the grassroots level is essential. By embracing drone-based precision agriculture, India can not only secure food for its growing population but also uplift the livelihoods of millions of farmers, driving a more resilient and technologically empowered agricultural future.

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RESEARCH ARTICLE

Factors influencing the perception of rice growers to climate change in Andhra Pradesh, India

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ABSTRACT

Climate change poses a significant threat to rice production, particularly in regions where rice is a staple food and a major economic crop. Understanding how rice farmers perceive climate change is essential for developing effective adaptation strategies. This study explores the awareness, beliefs, and attitudes of rice farmers towards changing climate conditions, including temperature rise, irregular rainfall, droughts, and floods. The findings reveal that while many farmers observe shifts in local weather patterns and acknowledge negative impacts on crop yield and farming practices, their level of understanding and response strategies vary widely. The main factors that influence perception of rice growers to climate change are farm size, farming experience, knowledge about local agro-climate, credit and subsidy orientation and information seeking behaviour.

INTRODUCTION

Rice cultivation in Andhra Pradesh plays a vital role in the state's agricultural economy, with the districts of East Godavari, West Godavari, and Krishna being key regions for its production. Located in the fertile coastal plains of the eastern part of India, these districts benefit from rich alluvial soils, a favorable climate, and a well-established irrigation infrastructure, making them ideal for rice farming. However, like many agricultural regions worldwide, Andhra Pradesh is increasingly facing the impacts of climate change, which is posing significant challenges to rice cultivation. The state's coastal districts, including East Godavari, West Godavari, and Krishna, are particularly vulnerable due to their dependence on monsoon rainfall, irrigation, and specific temperature conditions necessary for high yields.

Climate Change and Rice Cultivation in Andhra Pradesh

Monsoon rainfall is the lifeblood of rice farming in Andhra Pradesh. Traditionally, farmers have relied on predictable patterns of rainfall for sowing and harvesting rice. However, with climate change, monsoon patterns have become more unpredictable, leading to shifts in the timing, intensity, and distribution of rainfall. Extreme weather events (cyclones and floods) coupled with droughts are the common problems during cropping season for agriculture (Charyulu et.al., 2017). Some years witness delayed rains, while in others, rainfall is excessively heavy, causing floods that damage rice crops. In districts like East Godavari, West Godavari, and Krishna which are heavily dependent on canal irrigation systems, such fluctuations exacerbate water scarcity and increase the competition for water resources. The resultant dry spells can stunt rice growth, while excessive rainfall can lead to waterlogging, reducing yields. Additionally, in these regions, where rice cultivation depends on river-fed irrigation, there is a growing concern

over the reduced flow of water due to both climate change and over-extraction.

Rice cultivation thrives in moderate temperatures, typically between 25°C and 32°C. However, with the rise in average temperatures due to climate change, the growing seasons have become warmer. In tropical environments, high temperature is already one of the major environmental stresses limiting rice productivity, with relatively higher temperatures causing reductions in grain weight and quality (Krishnan et. al., 2011). Heat stress, particularly during the flowering and grain-filling stages, can lead to reduced pollination and lower grain production. In regions like West Godavari and Krishna, the increased heat during the crucial Kharif season can cause rice plants to prematurely mature or even wither before they reach full growth. Additionally, heat stress may cause higher evaporation rates, further depleting already stressed water resources, leading to a vicious cycle of water scarcity and poor crop yields.

Changes in temperature and humidity are also contributing to a rise in pest and disease outbreaks in rice fields. Warmer conditions favour the proliferation of pests such as the rice stem borer, brown plant hopper, and various fungal pathogens. In areas like West Godavari, where rice farming is often intensive, increased pest infestations are causing damage to crops, which adds to the economic burden of farmers. Temperature favors the abundance of insects whereas rainfall reduces the insect population (Morshed et.al., 2023). Additionally, increased rainfall and higher humidity levels create an environment conducive to fungal infections such as rice blast, which can wipe out large swathes of crop. Farmers are often forced to use more pesticides, leading to increased costs and potential environmental harm.

With the unpredictable onset of monsoons and rising temperatures, farmers are forced to adjust their crop calendars, which often results in reduced yields. The inability to plant at the right time or cultivate the right varieties for specific climatic conditions can reduce the overall productivity of rice fields. In regions like Krishna, East Godavari, and West Godavari where rice farming follows a strict schedule based on the monsoon and river irrigation patterns, any disturbance in these cycles due to climate variability can result in poor harvests. The inability to adapt quickly to changing conditions puts farmers at risk of financial losses.

Perception of Farmers on Climate Change

The perception of farmers about climate change is a crucial factor influencing their ability to adapt and respond to the challenges posed by changing climatic conditions. In regions like Andhra Pradesh, where agriculture forms the backbone of the economy and rice farming is especially prominent, understanding how farmers perceive climate change can significantly affect the effectiveness of adaptation strategies, policy-making, and sustainable agricultural practices. Farmers' perceptions of climate change directly affect their willingness to adopt new agricultural practices and technologies aimed at mitigating the impact of climate change. Understanding how farmers perceive climate change can guide the formulation of targeted, effective policies that provide the necessary support to farming communities. Farmers' perceptions of climate change also shape how they assess risks and manage their financial decisions. In regions where extreme weather events like droughts or floods have become more frequent, farmers who perceive climate change as a risk are more likely to diversify their income source and invest in risk management strategies. Also, sustainability in farming practices is heavily influenced by farmers' attitudes toward climate change. Farmers who recognize the long-term nature of climate impacts are more likely to adopt practices that ensure the continued productivity of their lands.

Considering the importance of farmer's perception to climate change in influencing their ability to adapt to climate change, this study was

undertaken to:

1. Understand the perception of farmers towards various climatic factors
2. Identify the factor's that influence the farmer's perception to climate change.

METHODOLOGY

Out of 13 districts of Andhra Pradesh, top three rice growing districts namely East Godavari, West Godavari and Krishna were selected purposively for the study as rice is cultivated extensively in these districts covering approximately 46 per cent of the total area under rice cultivation and also accounts 47 per cent of the total production of rice in the state. From each District, two Mandals and from each Mandal two villages were selected by following simple random sampling method. Thus, a total of four villages from each district were selected for the study. Twenty respondents from each village were selected using random sampling method, thus making a total of 240 respondents,

Variables and Their Empirical Measurement

Relevant variables were identified in consultation with experts and also based on extensive review of related literature (Table1).

Table 1: Variables and their empirical measurement

S. No	Variables	Empirical Measurement
	Dependent variables	
1.	Perception of rice farmers towards climate change	Schedule developed for the study
	Independent variables	
1.	Gender	Open ended question
2.	Age	Open ended question
3.	Education	Open ended question
4.	Size of household	Open ended question
5.	Farm size	Open ended question
6.	Farm income	Open ended question
7.	Farming experience in rice cultivation	Open ended question
8.	Farmer to farmer information exchange	Schedule developed for the study
9.	Knowledge about local agro-climate	Schedule developed for the study
10.	Credit and subsidy orientation	Schedule developed for the study
11.	Information seeking behavior	Schedule developed for the study
12.	Preparedness for adaptation	Schedule developed for the study
13.	Change resistance	Schedule developed for the study

Perception of rice growers towards climate change was operationalized as 'the ability of the individuals to perceive the climate change situations and / or their effects in rice cultivation'. For this, a set of 3 statements were framed to elicit the perception of respondents towards climate change. For statements no.1 and no.2, a score of one (1) was assigned to every correct answer and zero (0) for incorrect one. For statement no.3, a list of 26 areas was prepared to elicit the perception of rice growers towards the adverse effects of climate change with five-point continuum of strongly agree, agree, don't know, disagree and strongly disagree carrying the scores of five (5), four (4), three (3), two (2) and one (1) respectively. The total score of the farmers on their perception was arrived at by summing up the weightages of responses for each statement. The maximum score was 141 and minimum score obtained was 81. The respondents were

categorized into three classes based on class interval method as low, medium and high perception towards climate change. Further, step down regression was done to identify the independent variables that contributed maximum variation in perception of rice farmers towards climate change.

RESULTS AND DISCUSSION

Perception of Farmer's towards various climatic factors

(a) Perception of rice farmers towards annual rainfall

Majority (67.91%) of the respondents perceived that annual rainfall had decreased, 20.00 per cent perceived an increased rainfall and only 12.08 per cent perceived that there was no change in annual rainfall (Table 2). Guhathakurta et.al, 2020 in their study on rainfall variability in Andhra Pradesh also observed that Majority of the stations in West and East Godavari districts indicated downward trend in frequency of the dry days for south-west monsoon season.

Table 2: Distribution of respondents according to their perception towards annual rainfall (N=240)

S.No	Response	categories	Frequency(%)
1	Increased	48	20.00
2	Decreased	163	67.91
3	Unchanged	29	12.08

(b) Perception of rice farmers towards temperature

As shown in Table 3, majority of the respondents perceived that temperature has increased (81.66%) over the years, 14.58 per cent perceived that there was no change in temperature and only 2.50 per cent perceived that temperature had decreased. This is in line with the observations made by Patnaik and Baliarsingh (2018) in their study on weather forecasting in the coastal districts of Odisha and Andhra Pradesh, that the annual maximum temperature and solar radiation shows an increasing trend of 0.16 ^{0}C and 0.073 MJ/m^{2} per year respectively. Definitely, these changes in the temperature have had adverse effects on crop production and productivity. Coastal Andhra Pradesh has been experiencing a gradual rise in average temperatures over the past few decades, consistent with global climate change trends. This has implications for agriculture, water availability, and human health.

Table 3: Distribution of respondents according to their perception towards temperature (N=240)

S.No.	Response categories	Frequency	Percentage (%)
1	Increased	196	81.66
2	Decreased	6	2.50
3	Unchanged	38	15.83

(c) Perception of Rice Farmers towards Frequency of Drought

It could be inferred from Table 4 that majority (58.33%) of the respondents perceived that occurrence of drought has increased, 25.83 per cent perceived that there was no change in frequency of drought and only 15.83 per cent perceived that occurrence of drought has decreased. In Godavari river basin, rainfall is unpredictable and unevenly distributed. This is associated with frequent droughts, which affect agriculture production and socio-economic activities (Garg et al., 2016, Bhuvaneswari et al., 2013). The drought has impacted significantly maximum on food crops than other crop categories like fodder, cash, and oilseeds crops in the East Godavari district (Bharambe et.al., 2023).

Table 4: Distribution of respondents

according to their perception towards frequency of drought (N=240)

S.No.	Response categories	Frequency	(%)
1	Increased	120	58.33
2	Decreased	38	15.83
3	Unchanged	62	25.83

Rice cultivation in coastal Andhra Pradesh, particularly in the study districts is highly dependent on adequate and timely water supply. As a water-intensive crop, rice requires consistent irrigation, especially during the transplanting, vegetative, and reproductive stages. Drought, defined as a prolonged period of below-normal rainfall, poses a serious threat to the sustainability and productivity of rice farming in this region.

Perception of Rice Farmers towards different Adverse Effects of Climate Change in Rice Cultivation

The perception of rice farmers towards different adverse effects of climate change in rice cultivation is shown in Table 5.

Table 5: Distribution of respondents based on their perception towards effects of climate change in rice cultivation (N=240)

Sr. No	Items	A	B	C	D	E	Score	Rank
		F%	F%	F%	F%	F%		
	Physical effects							
1.	If stronger wind and heavy rainfall occurred soil erosion will increase.	195 (81.25)	45 (18.75)	0 0	0 0	0 0	1155	II
2	Run-off due to heavy rains damage the pond	97 (40.41)	143 (59.58)	0 0	0 0	0 0	1057	X
3	If stronger wind and heavy rainfall occurred, crop is damaged.	205 (85.41)	35 (14.58)	0 0	0 0	0 0	1165	I
4	Damage to production areas occurred due to heavy rainfall and strong wind.	145 (60.41)	95 (39.58)	0 0	0 0	0 0	1105	V
5	If heavy rainfall occurred, irrigation and water supply system are destroyed.	136 (56.66)	104 (43.33)	0 0	0 0	0 0	1096	VII
6	Landslide is common phenomenon in hilly areas as a result of heavy rains and storm.	168 (70.00)	72 (30.00)	0 0	0 0	0 0	1128	III
7	As a result of increase in run-off water, water logging occurred in low lying areas.	132 (55.00)	108 (45.00)	0 0	0 0	0 0	1092	VIII
8	Strong wind and storms result in heavy lodging and uprooting of crops.	159 (66.25)	81 (33.75)	0 0	0 0	0 0	1119	IV
9	Increase in frost occurrence increase the scope of pests and diseases.	87 (36.25)	153 (63.75)	0 0	0 0	0 0	1047	XI
10	Because of late onset of rains, there is a delay in farm operations and difficult to manage the crops.	139 (57.91)	101 (42.08)	0 0	0 0	0 0	1099	VI
11	Because of late onset of rains, there is a delay in sowing.	113 (47.08)	127 (52.91)	0 0	0 0	0 0	1073I	X
	Chemical effects							
1	Soil acidity increases in heavy rainfall situations.	3 (1.25)	3 (1.25)	234 (97.50)	0 0	0 0	729	V
2	If heavy rainfall occurred, soil salinity is decreased.	0 -	7 (2.91)	233 (97.08)	0 0	0 0	727	VI

Sr. No	Items	A F%	B F%	C F%	D F%	E F%	Score	Rank
3	As a result of heavy rains, toxic substances accumulation in soil increases and as a result wilting of crops occurs.	21 (8.75)	39 (16.25)	18 (75.00)	0	0	801	IV
4	Due to agricultural pesticide runoff, there is an increase in water pollution in supply water.	83 (34.58)	117 (48.75)	35 (14.58)	5 2.08	0 0	998	II
5	Due to washing of soil organic matters by heavy rains, there is a decrease in water holding capacity.	67 (27.91)	173 (72.08)	0 -	0 0	0 0	1027	I
6	If heavy rainfall occurred, there is a decrease in soil organic matter.	65 (27.08)	143 (59.58)	32 (13.33)	0	0	993	III
	Biological effects							
1	If there is heavy rainfall, drought and frost situations, there is abnormal growth of crops	17 (72.08)	367 (27.91)	0 0	0 0	0 0	1133	I
2	If there is heavy rainfall, drought and frost situations, there is poor germination	117 (48.75)	123 (51.25)	0 0	0 0	0 0	1077	III
3	If there is high rainfall and relative humidity there is an increase in disease problems	165 (68.75)	75 (31.25)	0 0	0 0	0 0	1125	II
4	If there is high rainfall and relative humidity, there is an increase in insect problems	67 (27.91)	173 (72.08)	0 0	0 0	0 0	1027	V
5	If there is high temperature and relative humidity, there is a poor keeping quality of the produce.	73 (30.41)	167 (69.58)	0 0	0 0	0 0	1033	IV
	Economic effects							
1	In heavy rainfall, drought and frost situations, productivity is low	176 (73.33)	64 (26.66)	0 0	0 0	0 0	1136	IV
2	In heavy rainfall, drought and frost situations, cost of cultivation increases.	214 (89.16)	26 (10.83)	0 0	0 0	0 0	1174	I
3	Low market price for poor quality of produce resulted due to un-favourable climatic situations.	183 (76.25)	57 (23.75)	0 0	0 0	0 0	1143	III
4	As a result of climatic change, there is increase in operational cost due to increased expenditure on inputs like seeds, chemicals, labour, etc.	193 (80.41)	47 (19.58)	0 0	0 0	0 0	1153	II

II*A=Strongly Agree, B=Agree, C=Dont know, D=Disagree and E=Strongly Disagree*

Perception of Rice Farmers towards Physical Effects of Climate Change in Rice Cultivation : It is evident from Table 5 that with regard to farmer's perception to physical effects of climate change, damage to crop due to stronger wind and heavy rainfall was ranked first by the rice farmers. The coastline districts of Andhra Pradesh are normally affected by cyclones and floods (Raahalya et. al., 2023). Washing off soil and crop due to heavy rainfall and storm, landslide, lodging and uprooting due to strong wind and storm, damage to production areas due to heavy rainfall and strong wind, delay in field operations, destruction of the irrigation and water supply system, water logging, delay in sowing or untimely sowing because of late onset of rains, damage to pond facilities and frost damage to crop were ranked from second to eleven, respectively.

Perception of Rice Farmers towards Chemical Effects of Climate Change in Rice Cultivation : Most of the rice farmers ranked decreasing water holding capacity due to washing of soil organic matters by heavy rains first among the perceived chemical effects of climate change in rice

cultivation. Heavy rainfall events significantly threaten crop health and yield, primarily due to water-related problems such as waterlogging, crop damage, yield reduction, soil erosion, disease outbreak, and complete crop failure (Muthiah et.al., 2025). This was followed by increase in water pollution in supply water due to agricultural pesticide runoff, decrease in soil organic matters due to heavy rainfall, buildup of toxic substances, increase in soil acidity due to heavy rainfall and salinity increase due to heavy rainfall which were ranked from second to sixth, respectively.

Perception of Rice Farmers towards Biological Effects of Climate Change in Rice Cultivation: Abnormal growth due to heavy rainfall, drought and frost was ranked first by the farmers, followed by increase in disease problems due to high rainfall and relative humidity, poor germination due to heavy rainfall, drought and frost, poor keeping quality and increase in insect problem due to heavy rainfall, drought and frost which were ranked from second to fifth, respectively.

Perception of Rice Farmers towards Economic Effects of Climate Change in Rice Cultivation: With regard to economic effects, higher cost of cultivation due to heavy rainfall, drought and frost was perceived as first rank. Water logged condition is mostly experienced in Coastal Andhra Pradesh in Kharif season. Due to water logged conditions there will be poor drainage which leads to poor tillering, incidence of BPH, sheath blight, blast etc., as a result there will be a heavy loss in yields (Cheralu, 2013). Other effects include increased operational cost due to increased expenditure on seeds, plant protection chemicals , lower market price due to poor quality and lower productivity due to heavy rainfall, drought and frost which were ranked from second to fourth ranks, respectively.

Prediction of Independent Variables that Contributed towards Maximum Variation in perception of rice farmers towards climate change

Step down regression was done to identify the independent variables that contributed maximum variation in perception of rice farmers towards climate change. It can be observed from Table 6 that total six variables contributed for 72 per cent variation in overall perception. The variance ratio for R^2 was found to be significant ($P<0.01$). The variables namely farm size, farming experience, knowledge about local agro climate, credit and subsidy orientation and information seeking behaviour explained 72 percent variation in perception of rice farmers towards climate change. This indicates that the remaining five variables contributed only 27 per cent variation.

Table 6: Step down multiple linear regression analysis at last step predicting the influence of important variables - Perception

Step Number	Independent Variables	b-value	SE of b	t-value
1	X3 Farm size	2.022	0.856	2.3615**
2	X4 Farm income	-1.528	0.809	1.8883ns
3	X5 Farming experience in rice cultivation	-0.330	0.054	6.1007**
4	X7 Knowledge about local agro climate	1.429	0.336	4.2539**
5	X8 Credit and subsidy orientation	1.127	0.329	3.4275**
6	X9 Information seeking behaviour	0.965	0.200	4.831**

R^2 = 0.7241 F = 7.4111**

CONCLUSION

Climate change poses significant challenges to rice cultivation, primarily through rising temperatures, unpredictable rainfall patterns, increased frequency of extreme weather events, and rising sea levels. These factors can reduce crop yields, affect grain quality, and disrupt traditional planting cycles. Farmers' perception of climate change plays a crucial role in how they choose to adapt their agricultural practices. If farmers recognize changes in weather patterns—such as rising temperatures, shifting rainfall, or increased drought—they are more likely to adopt adaptive strategies like changing planting dates, using drought-resistant rice varieties, or improving irrigation methods. However, if they do not perceive climate change as a serious or immediate threat, they may be less inclined to take action, even when scientific data supports the need for adaptation.

In this study it was found that majority of respondents have high level of perception towards physical effects, biological effects and economic effects, whereas the perception towards chemical effects was very low. Damage to crop due to stronger wind and heavy rainfall occurred was perceived as the main physical effect of climate change, increase in water pollution due to agricultural pesticide runoff was perceived as the main chemical effect, abnormal growth of the crops due to heavy rainfall, drought and frost was perceived as the main biological effect and higher cost of cultivation due to heavy rainfall, drought and frost was perceived as the main economic effect of climate change in rice cultivation. It was found that farm size, farming experience, knowledge about local agro climate, credit and subsidy orientation and information seeking behaviour are major factors that significantly influence perception of rice farmers towards climate change. Therefore, awareness, education, and access to reliable climate information are key to enhancing farmers' ability to respond effectively to climate change.

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RESEARCH ARTICLE

Knowledge of tribal women on value-added products under tribal sub plan scheme in Udham Singh Nagar district of Uttarakhand

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ABSTRACT

Tribal women play a crucial role in agricultural and rural economies, yet their access to knowledge and training in value-added products remains limited. This study assesses the impact of a structured training program on enhancing their understanding of food processing, branding, packaging, and marketing. A pre- and post-knowledge test was conducted among 250 tribal women in Udham Singh Nagar, Uttarakhand, to evaluate their learning outcomes. The findings revealed a significant increase in knowledge across all tested areas, with the highest gains observed in millets' nutritional benefits, vermicelli and pasta production, and value addition in food products. Improved awareness was also noted in storage and packaging practices, economic opportunities through value-added processing, and marketing strategies. The overall results highlight the effectiveness of targeted training programs in equipping tribal women with essential skills to enhance their economic prospects. The study emphasizes the need for continuous training, capacity-building, and market linkage support to ensure sustainable livelihood opportunities for tribal women through value-added agricultural products. Future initiatives should focus on integrating hands-on training with business development strategies to maximize the long-term impact of such programs.

Keywords: impact, knowledge, tribal women, value-added products, empowerment

INTRODUCTION

Tribal women play a vital role in the agricultural and rural economy, yet their access to training in value-added agricultural practices is limited. Enhancing their understanding of food processing, branding, and marketing can significantly improve their socio-economic status. Value addition in products like organic jaggery, honey, millets, and processed foods such as vermicelli and pasta can offer sustainable income opportunities. Various studies (Sharma et al., 2021; Patel & Verma, 2019) affirm that training programs focusing on food processing skills enhance market access and financial independence for rural women.

Women in tribal communities often rely on traditional agricultural practices with limited exposure to modern value-addition techniques. Studies (Kumar et al., 2020; Singh & Devi, 2018; Choudhury & Mehta, 2021) suggest that customized training for tribal women significantly improves their knowledge and entrepreneurial skills. Effective interventions combining theory and practice are crucial to bridge knowledge

gaps.

Research shows that post-training knowledge gains contribute to improved decision-making and product diversification (Gupta & Rani, 2017; Rao & Das, 2020). Mishra et al. (2022) emphasize that women engaged in value-added processing see greater economic returns and independence. Ghosh & Iyer (2022) also note the impact of such programs in enhancing tribal livelihoods.

To assess the training program's impact on tribal women's knowledge regarding value-added products, a pre- and post-knowledge test was conducted. The goal was to evaluate awareness of food processing, branding, storage, and marketing strategies.

METHODOLOGY

The study was conducted in Gadarpur and Khateema blocks of Udham Singh Nagar district, Uttarakhand. A total of 250 tribal women were selected. A pre- and post-knowledge test evaluated their understanding before and after training on food processing, branding, packaging, and marketing. The program included both theoretical sessions and hands-on training. Data collection methods included structured surveys, in-depth interviews, and focused group discussions (FGDs). These methods helped gather insights into their experiences, knowledge, and challenges. The effectiveness of the training was evaluated based on the difference in pre- and post-test results.

RESULTS AND DISCUSSION

The detailed knowledge gain results of the tribal women in 14 selected areas are presented below. The table reflects both the numerical and percentage values of participants' awareness before and after the training:

S. No.	Knowledge Statement	Pre-Test (n/250, %)	Post-Test (n/250, %)	Knowledge Gain (n)	Gain (%)
1.	Organic jaggery contains harmful chemicals	20 (8.0%)	200 (80.0%)	180	72.0%
2.	Millets provide high fiber and protein	10 (4.0%)	210 (84.0%)	200	80.0%
3.	Proper extraction and storage are key for honey quality	15 (6.0%)	205 (82.0%)	190	76.0%
4.	Branding organic products is essential for better market recognition	25 (10.0%)	195 (78.0%)	170	68.0%
5.	Sugarcane can be used for multiple value-added products	18 (7.2%)	208 (83.2%)	190	76.0%
6.	Value addition increases the market value of food products	12 (4.8%)	202 (80.8%)	190	76.0%
7.	Proper packaging and storage increase product shelf life	13 (5.2%)	203 (81.2%)	190	76.0%

S. No.	Knowledge Statement	Pre-Test (n/250, %)	Post-Test (n/250, %)	Knowledge Gain (n)	Gain (%)
8.	Branding is necessary for promoting organic products	18 (7.2%)	198 (79.2%)	180	72.0%
9.	Tribal women can earn more via value-added food processing and marketing	14 (5.6%)	204 (81.6%)	190	76.0%
10.	Steps involved in making vermicelli and pasta	11 (4.4%)	201 (80.4%)	190	76.0%
11.	Benefits of value addition for farmers and entrepreneurs	19 (7.6%)	209 (83.6%)	190	76.0%
12.	Key marketing factors of value-added food products	17 (6.8%)	197 (78.8%)	180	72.0%
13.	Best storage practices for jaggery and honey	16 (6.4%)	206 (82.4%)	190	76.0%
14.	Importance of training programs in empowering tribal women in food value addition	17 (6.8%)	207 (82.8%)	190	76.0%

1. Organic jaggery contains harmful chemicals

Prior to the training, only 8% (20 out of 250) of the tribal women were aware that jaggery may contain harmful chemicals such as sulfur dioxide, which are often used during commercial processing to improve color and shelf life. After the training, this number rose significantly to 200 (80%), resulting in a 72% knowledge gain. During the training sessions, participants were introduced to the concept of organic jaggery, its health benefits, and the risks associated with chemically adulterated alternatives. Practical demonstrations and side-by-side product comparisons helped women distinguish between pure and adulterated jaggery based on color, texture, and aroma. This finding supports the research of Rao and Das (2020), who emphasized the importance of food safety education in strengthening consumer awareness and promoting safe agri-enterprise practices among rural women.

2. Millets provide high fiber and protein

Only 4% (10 women) were initially aware of the nutritional benefits of millets, particularly their high fiber and protein content. Following the training, awareness jumped to 210 (84%), reflecting the highest gain among all indicators (80%). This substantial improvement shows the women's high receptivity to health and nutrition-related information, especially when it involves traditional foods. The training highlighted millet's role in combating malnutrition and its use in preparing various recipes like porridge, rotis, and cookies. Ready-to-eat samples and cooking demonstrations further reinforced their understanding. This is in line with Sharma et al. (2021) and Ghosh and Iyer (2022), who found that millet-based interventions are effective for improving both nutritional outcomes and income potential for tribal and rural women.

3. Proper extraction and storage are key factors for honey quality

Before training, only 6% (15 participants) understood the importance of hygienic honey extraction and proper storage methods. After training, the awareness level rose

to 205 women (82%), resulting in a 76% knowledge gain. Through hands-on sessions, the women were taught how to extract honey without introducing impurities, use sterilized tools, and store honey in airtight glass containers to maintain its natural quality. Discussions also covered issues like moisture content, fermentation risks, and storage temperature.

These results are consistent with Gupta and Rani (2017), who observed that practical training in food safety and quality significantly enhances confidence and competence among rural women engaged in microenterprise.

4. Branding organic products is essential for better market recognition

Only 10% (25 participants) initially understood the concept of branding in the context of agricultural products. Post-training, this awareness increased to 195 (78%), marking a 68% gain—the lowest among the 14 statements. This relatively lower improvement highlights that branding remains a less familiar and more abstract concept for tribal women. However, during the sessions, they were introduced to the basics of branding—such as creating a product name, designing a logo, and using attractive, informative packaging. They also viewed successful case studies of tribal SHGs who had built local product brands.

According to Roy and Banerjee (2019), branding plays a critical role in helping women-led agribusinesses gain visibility and differentiate their products in competitive markets.

5. Sugarcane can be used to produce various value-added products

Before the training, only 7.2% (18 women) were aware that sugarcane could be transformed into a range of products beyond traditional jaggery, such as flavored jaggery, syrup, candies, or jaggery-based bakery items. After the training, 83.2% (208 women) understood this, with a knowledge gain of 76%. The training emphasized the versatility of sugarcane as a raw material and demonstrated small-scale processing techniques using basic equipment. Participants were shown how to enhance the shelf life, visual appeal, and market value of jaggery through minimal value addition. These findings align with the research by Mishra et al. (2022), who emphasized the economic upliftment of tribal communities through value-added sugarcane enterprises.

6. Value addition in food products increases their market value

Only 4.8% (12 participants) initially understood the relationship between value addition and product pricing in the market. After the training, this awareness jumped to 202 (80.8%), reflecting a 76% gain. The training introduced real-life examples showing how simple practices like adding flavors, improving packaging, or creating ready-to-use versions of food products can significantly increase their market worth. Case studies of successful rural women entrepreneurs further illustrated how value addition directly impacts profitability.

This result supports Patel & Verma (2019), who found that knowledge of value addition significantly enhances women's income and decision-making in agribusiness.

7. Proper packaging and storage help extend the shelf life of honey

Prior to the intervention, only 5.2% (13 women) were aware of proper packaging and storage techniques for honey. Post-training, this increased to 81.2% (203 women), with a 76% gain. Women were taught how moisture levels, air exposure, and container types affect honey's shelf life. The importance of using sterilized glass jars and labeling practices was also covered. Demonstrations on how improper storage can cause fermentation or spoilage helped reinforce these concepts.

These insights are consistent with Kumar et al. (2020), who highlighted packaging and storage as key quality and safety factors in food entrepreneurship.

8. Branding is necessary for promoting organic products

Only 7.2% (18 women) had some understanding of branding for organic products prior to training, which rose to 79.2% (198 women) after the sessions, marking a 72% gain. The sessions focused on how branding builds customer trust, provides a unique identity, and distinguishes products in competitive markets. Women were shown examples of local and national-level organic brands and learned how to design their own packaging labels and brand names.

This corresponds with the findings of Singh and Devi (2018), who emphasized branding literacy as an emerging need for rural women engaged in niche product segments like organic food.

9. Tribal women can enhance their income through value-added product processing and marketing

Only 5.6% (14 women) initially believed they could enhance their income through value addition and marketing. After the training, 81.6% (204 women) recognized this potential, resulting in a 76% gain. Women were introduced to various marketing platforms—local haats, exhibitions, online platforms—and how value-added products have higher customer appeal and profitability compared to raw produce. Role-play exercises and simulation games helped build their confidence in pricing, selling, and customer communication.

This supports the observations of Choudhury & Mehta (2021), who stressed that income realization depends not only on production but also on post-harvest processing and marketing skills.

10. The steps involved in making vermicelli and pasta

Initially, only 4.4% (11 participants) knew about the preparation of millet-based vermicelli or pasta. Post-training, 80.4% (201 women) gained this knowledge, marking a 76% improvement. Participants learned step-by-step production processes including dough preparation, extrusion, drying, and hygienic packaging. The practical component of the training made this topic particularly engaging, and many expressed interest in starting micro-units.

According to Ghosh & Iyer (2022), such skill-oriented training is crucial for promoting micro-enterprise models in tribal belts where value addition has untapped potential.

11. Benefits of value addition in agricultural products for farmers and entrepreneurs

Pre-training awareness stood at 7.6% (19 women), which increased to 83.6% (209 women) after the training—a gain of 76%. This section helped women understand how value addition supports not only enhanced income but also job creation, reduced post-harvest losses, and year-round engagement. Real examples from Self-Help Groups and FPOs (Farmer Producer Organizations) made the concept more relatable.

This result corroborates the findings of Sharma et al. (2021), who emphasized the role of value addition in transforming producers into agripreneurs.

12. Key factors for successful marketing of value-added products

Only 6.8% (17 participants) were familiar with effective marketing strategies. After training, 78.8% (197 women) showed understanding—a 72% gain. The training emphasized factors like competitive pricing, attractive packaging, consistent quality, storytelling, and customer feedback. Group discussions helped women brainstorm branding slogans and marketing plans suitable for local markets.

These findings align with Roy and Banerjee (2019), who found that marketing is often the missing link in women-led agribusinesses and needs targeted attention.

13. Best storage practices for jaggery and

honey

Prior knowledge of proper storage practices was reported by only 6.4% (16 women), which rose to 82.4% (206 women) after the training, yielding a 76% knowledge gain. Women were taught the importance of storing jaggery in cool, dry, airtight containers to avoid moisture and fungal contamination, and similarly, to avoid fermentation in honey. Simple tools like moisture absorbers and traditional hacks were also introduced.

This supports earlier research by Mishra et al. (2022), who identified post-production storage as a crucial factor in reducing wastage and preserving value.

14. Role of training programs in empowering tribal women in food processing and marketing

Only 6.8% (17 participants) initially recognized the role of training in entrepreneurship. Post-training, 82.8% (207 women) acknowledged its impact—a 76% increase in awareness. Feedback forms, group reflections, and experience-sharing during the final training day revealed that women felt more confident, informed, and eager to pursue home-based processing units. They understood the importance of training in opening new income avenues and building a support network.

This reflects the conclusions of Choudhury & Mehta (2021) and Kumar et al. (2020), who affirm that repeated, skill-focused training is a cornerstone for building sustainable tribal livelihoods.

CONCLUSION

The findings from the pre- and post-training knowledge assessments clearly demonstrate the significant impact of the structured capacity-building program on tribal women's understanding of value-added agricultural products. Across all 14 selected knowledge areas, there was a remarkable improvement in awareness, ranging from 68% to 80%, with an average knowledge gain of over 74%. These results affirm that targeted interventions, combining theoretical instruction with practical demonstrations, are highly effective in empowering tribal women with relevant entrepreneurial skills.

The highest knowledge gain was observed in nutritional knowledge related to millets (80%), followed by improved understanding of processing techniques such as vermicelli and pasta preparation, food safety practices, and packaging standards. These outcomes reflect the participants' strong interest in practical, income-generating knowledge and their ability to absorb and retain technical content when delivered in a contextual and hands-on manner.

On the other hand, relatively lower gains in branding and marketing awareness highlight the need for more intensive engagement in areas that are less familiar to tribal communities. Branding, though critical for product differentiation and market recognition, remains a new and abstract concept for many rural women. This suggests that future training modules should include more examples, case studies, and visual learning tools to strengthen conceptual understanding in such domains.

Overall, the training program succeeded in bridging the knowledge gap by equipping tribal women with foundational skills in food processing, product development, and market orientation. The positive response and substantial knowledge gain indicate a high potential for translating this awareness into entrepreneurial ventures, particularly when combined with continued mentoring, institutional support, and access to marketing channels.

Going forward, it is essential to design follow-up training programs, establish market linkages, and promote collective branding under SHG or cooperative models. These steps will not only help sustain the knowledge acquired but

also translate it into tangible economic outcomes, thereby supporting the broader goal of women's empowerment and sustainable rural development.

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RESEARCH ARTICLE

Relationship between attitude towards job of the KVK Scientists and their selected variables

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ABSTRACT

The attitude of the KVK scientists towards their job is not independent itself, but is rather a complex process which is governed by personal, socio, economic, professional and psychological attributes. The research study was carried out to know relationship between profile characteristics of KVK scientists and their attitude towards job. Total all 140 KVK scientists were selected for the study in all thirty KVKs in Gujarat state . The findings revealed that majority 62.15 per cent of KVK scientists had favourable attitude towards job , followed by 19.28 per cent and 18.57 per cent most favourable and less favourable attitude towards job . This paper throws light on the profile characteristics of KVK scientists and their attitude towards job. Findings revealed that the independent variables viz. service experience, source of information, technical efficiency, communication ability , scientific orientation and group motivation exhibited positive and significant relationship at five per cent level of significance. Whereas, age, education, training received, managerial ability, stress management and decision making ability at one per cent level of significance. Achievement orientation exhibited on significant relationship with attitude towards job. Whereas, social participation, innovativeness and cosmopoliteness exhibited negatively non significant relationship with attitude towards job.

Keywords: Relationship, Profile, Attitude towards job.

INTRODUCTION

Attitude is a stable way of feeling or thinking with regard to something or someone and is reflected in the behaviour of a person. In the setting of a workplace, positive attitude is particularly important. The relationships and ultimately performance of any workplace is highly influenced by the attitude of the team. If workers for instance have the feeling that they are not valued by the organization or respected by their bests then the level of moral is likely to be low. On the other hand, when workers actually feel that the organization values, them recognizes and appreciates their contribution, then their motivation and commitment to the organization is higher. It is therefore very important that organization and leaders deliberate cultivate good workplace cultures by promoting positive attitudes among the employees. (Keith Harrell, 2009).

The organization through relevant trainings of the workforce and supervisory teams can help cultivate a culture of positive attitudes among its people with the resultant effective teamwork (Byers, 2009). Attitude towards job are the important indicators of the success and

health of any organization. The high relevance of individual performance is also reflected in work. Capable workforce in the organization greatly facilitates the task of the administrators as it creates promising conditions for the overall process of the organization. The performance of the employees seems to be relatedwith the satisfaction achieved after completion of the task. If workers are unsatisfied with their assigned task; it is insignificant to expect fruitful results.Hence, progress of any organization greatly depends mainly on attitude towards job. In an organization attitude towards job is the main determinants that will interfere with the role perception and role performance of the employee. (Sulaiman and Hall, 2003).

METHODOLOGY

The research study was conducted in Gujarat state. An Ex-post-facto research design was employed in the present investigation. One hundred and forty Krishi Vigyan Kendras' scientists were selected for present study from all 30 Krishi Vigyan Kendras' of Gujarat state. The data were collected by personal contact. Attitude towards job is a set of evaluations of one's job that constitute one's feelings toward, beliefs about, and attachment to one's job.Score was given to each response, viz., 3, 2 and 1 for strongly agree, agree and less agree for positive statements and reverse in case of negative statement .The total score was obtained by summing up all the items and respondents were classified in to 3 categories based on mean and standard deviation. The data was coded, classified, tabulated and subjected to frequencies and percentages to meaningfully interpret the findings. Profile characteristics of the KVK scientists such as age, education, social participation,service experience,source of information, training received,managerial ability, technical efficiency, communication ability, scientific orientation, group motivation, stress management, innovativeness, decision making ability, cosmopoliteness and achievement orientation were correlated with the attitude towards job of the scientists to know the significant and non-significant relationship between the variables

RESULTS AND DISCUSSION

Table1:Distribution of scientists according to their attitude towards job (n=140)

Sr. No.	Categories	Frequency	Percentage
1.	Less favorable attitude towards job (up to 49)	26	18.57
2.	Favorable attitude towards job (50-63)	87	62.15
3.	Most favorable attitude towards job (64 and above)	27	19.28
	Total	**140**	**100.00**

Mean=56.40 SD=6.88

Table 2: Relationship between attitude towards job of the KVK scientists and their selected variables (n=140)

Sr.	Personal profiles of scientists	Correlation coefficient
I	**Personal & Socio-economic variables**	
1.	Age	0.21564*
2.	Education	0.181949*
3.	Social participation	-0.2283NS
II	**Professional variables**	
4.	Service experience	0.257849**
5.	Source of information	0.25099985**
6.	Training received	0.189439*
7.	Managerial ability	0.186282*
8.	Technical efficiency	0.510119**
9.	Communication ability	0.398448**
10.	Scientific orientation	0.425896**
III	**Psychological variables**	
11.	Group motivation	0.415946**
12.	Stress management	0.202362*
13.	Innovativeness	-0.11289 NS
14.	Decision making ability	0.179272*
15.	Cosmopoliteness	-0.0513678NS
16.	Achievement orientation	0.110047NS

NS- Non significant

* Significant at 5 per cent

** Significant at 1 per cent

The data presented in table 1 revealed that majority of the scientists (62.15 %) possessed favourable attitude towards job followed by 19.28 and 18.57 per cent of them possessed most favourable and less favourable attitude towards job. In general, the majority of the scientists (81.43 %) possessed favourable to most favourable attitude towards job. The probable reason may be respect of people, opportunity to serve farmer, feeling of satisfaction are responsible factors. They believe that technology transfer work is partial fulfilment of their job. They are partial satisfaction to their job.

The result shown in table 2 reflects that there was positively significant relationship among age, education, training received, managerial ability, stress management and decision making ability of KVK scientists and their attitude towards job at 1 per cent level of significance .

Service experience, source of information, technical efficiency, communication ability, scientific orientation and group motivation had highly positive relationship with attitude towards job at 5 level of per cent level of significance.

Achievement orientation had non-significant with attitude towards job. Social participation, innovativeness and cosmopoliteness had negatively non-significant with attitude towards job.

CONCLUSION

The findings of this investigation showed that the degree of attitude towards job of KVK scientists was observed positive and significant with age, education, training received, managerial ability, stress management, decision making ability, service experience, source of information, technical efficiency, communication ability, scientific orientation and group motivation. While it was found non-significant with achievement orientation and negatively non-significant with social participation, innovativeness and cosmopoliteness.

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RESEARCH ARTICLE

Factors attributed to the success of awarded farmers of middle Gujarat

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ABSTRACT

The present investigation was carried out in 9 districts of middle Gujarat viz. Ahemdabad, Anand, Vadodara, Kheda, Dahod, Mahisagar, Panchmahal, ChhotaUdepur and Botad which fall under the jurisdiction of Anand Agricultural University and the study revealed that strong desire to innovate in agriculture/agri. allied fields (2.070 Mean Score), vast experience in agriculture/agri. allied fields (2.013 Mean Score), ability to maintain interpersonal relationships relevant to work (1.991 Mean Score), timely availability of useful information (1.992 Mean Score) and support of all concerned (1.987 Mean Score) were the major factors attributed to the success of awarded farmers as accorded by the respondents. The major important suggestions endorsed by the awarded farmers for the farming community to improve the farming were: input cost should be reduced (93.42 per cent), integrated farming system should be adopted (75.00 per cent), scientific approach in farming must be made (68.86 per cent), improved seeds must be used (59.21 per cent) and marginal and small farmers should be given priority in various farm promotional schemes (56.58 per cent).

KEY WORDS: Factors, suggestions, awarded farmers

INTRODUCTION

During the last two decades or so, there has been a major upsurge of farmers innovating new farming systems and going for newer kinds of farming models and farm level agribusinesses, creating highly profitable model farms. Such farmers need to be recognized and presented as role models for fellow farmers to learn and apply new technologies to their fields. In order to give due recognition to such farmers for their worthwhile efforts to strengthen agricultural development, awards are given to those farming personalities who have immense commitment to the field. These awards in India are given by different well-known institutions as well as the government at various levels; and Agricultural Technology Management Agency (ATMA) is one of them which appreciates the worthwhile efforts of such farmers by giving them due awards.

The Best ATMA Farmers Award (BAFA) is given to the farmers who adopt new things from their own resources. The farmers for awards are selected at three different levels *i.e.,* state, district and taluka level. There is a provision to give a total of 10 awards at the state level, 10 at the district level for each district and 5 awards at the taluka level for each taluka.

In the last few years, farmers, agricultural businesspeople, researchers and governments have recognized the need for a more entrepreneurial culture in the farming business (Gerard, 2006). The development of the entrepreneurial skills among farmers is a dire

need of the present time, in the context of which it was felt interesting to study the factors that can be attributed to the success of such awarded farmers. Further, seeking suggestions from these farmers in regards with bringing improvements in farming can also be of great help to other farmers. With all this consideration, the present study was thought carried out with the following objectives.

1. To study the factors attributed to the success of awarded farmers of Middle Gujarat
2. To explore the suggestions from the awarded farmers for the farming community to improve the farming

METHODOLOGY

The current investigation was carried out in 9 districts of middle Gujarat *viz.* Ahemdabad, Anand, Vadodara, Kheda, Dahod, Mahisagar, Panchmahal, ChhotaUdepur and Botad which fall under the jurisdiction of Anand Agricultural University. Farmers of Middle Gujarat (comprising of 9 districts as stated earlier) who were awarded at taluka level by Agricultural Technology & Management Agency, Gujarat for last five years (from 2014-15 to 2018-19) were selected using stratified probability-proportional-to-size sampling (40 per cent of the total sample size of each district). Thus, out of total 571 awarded farmers at taluka level, 228 awarded farmers were selected for the study. The interview schedule was prepared in accordance with the objectives. The data were collected personally, tabulated, analyzed and interpreted with descriptive statistical tools.

RESULTS AND DISCUSSION

Factors attributed to the success of awarded farmers

It can be observed from Table 2 that among enlisted factors attributed to the success of awarded farmers of Middle Gujarat, the most important factor as accorded by the farmers was strong desire to innovate in agriculture/agri. allied fields which ranked first (2.070 Mean Score) followed by vast experience in agriculture/agri. allied fields (2.013 Mean Score), ability to maintain interpersonal relationships relevant to work (1.991 Mean Score), timely availability of useful information (1.992 Mean Score) and support of all concerned (1.987 Mean Score) which ranked second, third, fourth and fifth, respectively. The other important factors in descending order were enough knowledge of agricultural subject (1.982 Mean Score), management skill (1.961 Mean Score), constant guidance of agricultural scientists/extension workers (1.952 Mean Score), support from the family members (1.947 Mean Score), training undertaken on the subject (1.943 Mean Score), strong affinity for agriculture/agri-allied fields (1.934 Mean Score), sharing of information with other progressive farmers/people (1.930 Mean Score), participation in agricultural exhibition/*Krishi Mahotsav*/field day (1.908 Mean Score) and adequate knowledge about the market (1.882 Mean Score).

This finding is partially supported by the findings reported by Pandian and Ganeshan (2019).

Table 2: Factors attributed to the success of awarded farmers **n = 228**

Sr. No.	Factors	Mean Score	Rank
1	Strong desire to innovate in agriculture/agri-allied fields	2.070	1
2	Strong affinity for agriculture/agri-allied fields	1.934	11
3	Vast experience in agriculture/agri allied fields	2.013	2
4	Constant guidance of agricultural scientists/extension workers	1.952	8
5	Enough knowledge of agricultural subject	1.982	6

Sr. No.	Factors	Mean Score	Rank
6	Adequate knowledge about the market	1.882	14
7	Training undertaken on the subject	1.943	10
8	Participation in agricultural exhibition/*Krishi Mahotsav*/field day etc.	1.908	13
9	Support from the family members	1.947	9
10	Management Skill	1.961	7
11	Sharing of information with other progressive farmers/people	1.930	12
12	Timely availability of useful information	1.992	4
13	Ability to maintain interpersonal relationships relevant to work	1.991	3
14	Support of all concerned	1.987	5

Suggestions from awarded farmers for the farming to improve their farming

As seen from the Table 3, the major important suggestions endorsed by the awarded farmers for the farming community to improve the farming descending order of rank were**:** input cost should be reduced (93.42 per cent), integrated farming system should be adopted (75.00 per cent) and scientific approach in farming must be made (68.86 per cent). The other important suggestions were: improved seeds must be used (59.21 per cent), marginal and small farmers should be given priority in various farm promotional schemes (56.58 per cent), timely vaccination to animals should be done(53.95 per cent), farmers should get involved in FPOs (51.32 per cent) and value addition should be increased (50.88 per cent), constant contact with agricultural expert should be maintained (48.68 per cent), calculated risk in farming should be taken(43.86 per cent) and farmers should go for natural farming (37.72 per cent).

Table 3: Suggestions from awarded farmers for the farming community to improve the farming **n = 228**

Sr. No.	Suggestions	Frequency	Per cent
1	Input cost should be reduced	213	93.42
2	Integrated Farming System should be adopted	171	75.00
3	Scientific approach in farming must be made	157	68.86
4	Improved seeds must be used	135	59.21
5	Marginal and small farmers should be given priority in various farm promotional schemes	129	56.58
6	Timely vaccination to animals should be done	123	53.95
7	Farmers should get involved in FPOs	117	51.32
8	Value addition should be increased	116	50.88
9	Constant contact with agricultural expert should be maintained	111	48.68
10	Calculated risk in farming should be taken	100	43.86
11	Farmers should go for natural farming	86	37.72
12	Proper diagnosis and treatment to animals should be done	67	29.39
13	Research on agricultural mechanization should be focussed	60	26.32
14	Suitable approach to protect crop from blue bull, pig and monkeys is needed	44	19.30
15	Balanced ration should be provided to the animals	33	14.47

Some other suggestions made by less than 30.00 per cent of farmers were: proper diagnosis and treatment to animals should be done (29.39 per cent), research on agricultural mechanisation should be focussed (26.32 per cent), Suitable approach to protect crop from blue bull, pig and monkeys is needed (19.30 per cent) and balanced ration should be provided to the animals (14.47 per cent).

The findings reported by Patel (2013) and Patel (2016) were partially in line with these findings.

CONCLUSIONS

To sum up the results, one could assert that most important factors as accorded by the awarded farmers attributed to their success were: strong desire to innovate in agriculture/agri. allied fields followed by vast experience in agriculture/agri. allied fields and ability to maintain interpersonal relationships relevant to work. The major important suggestions endorsed by them for the farming community to improve the farming were: input cost should be reduced, integrated farming system should be adopted and scientific approach in farming must be made.

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RESEARCH ARTICLE

Performance of Veterinary Services (PVS) in Andhra Pradesh, India – perceptions and reflections of veterinarians

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ABSTRACT

The objective of this study was to appraise the Performance of Veterinary Services (PVS) by Animal Husbandry Department (AHD) of Andhra Pradesh, India considering Veterinarians' perception on its effectiveness along with constraints and suggestions. The information was collected from 120 working veterinarians with 60 veterinarians from each of the two districts namely East Godavari and Chittoor of Andhra Pradesh. The key components of data collection were demographics, job profile, perception on effectiveness of different veterinary services, constraints and suggestions perceived regarding PVS. The study revealed that most of the respondent veterinarians were young aged graduates with low job experience. Veterinarians rated vaccination as most effective service among the PVS, followed by deworming, medical treatment, gynecological and obstetrical treatment, livestock advisory service and minor surgical treatment. Their perceived major constraints include insufficient staff, lack of field transportation, too many meetings, and same information is sought by head office repeatedly and engaging in general duties. In the light of the findings, it is recommended that necessary policy changes and budgetary provisions for infrastructure are to be provided and all the rural livestock units which are being manned by para-veterinarians hitherto should be upgraded to the level of veterinary dispensaries in a phased manner along with sufficient support staff for improving the PVS.

Keywords: Performance of Veterinary Services, PVS, Effectiveness, Perception, Constraints.

INTRODUCTION

Indian livestock sector, an engine of growth of the agricultural sector is both growing and adapting to emerging socio-economic, environmental and technological forces with direct implications for the Performance of Veterinary Services (PVS) (Rao *et al.,* 2015). For example, the milk production in India has consistently held global top position since 1997 with a compounded annual growth rate of 6% over the past decade (Shah, 2023). Further, India has produced 231 million tonnes of milk contributing 25% of global milk production in the year 2023 and is expected to touch 300 million tonnes by 2030 (Singh, 2024). The demand for milk and milk products will continue to grow in future due to increase in per capita income, rapid urbanization, purchasing power parity, change in food habits and increasing awareness about essential nutrients available in dairy products (Rao and Sasidhar, 2022; Singh 2024). India also made spectacular strides in the production of meat (9.29 mt), eggs (129.6 billions) and wool (33.04 m kgs) especially during the last decade.

The Gross Value Added (GVA) of livestock sector is more than Rs.11 lakh crores which is about 31 per cent of Agricultural and Allied sector GVA and about six per cent of total GVA (DAHD, 2023).

India's livestock sector is one of the largest in the world - 56.7% of world's buffaloes, 12.5% cattle, 20.4% small ruminants (sheep and goat), 2.4% camel, 1.4% equine, 1.5% pigs and 3.1% poultry. As per the 20th livestock census, India has nearly 536 million livestock in 2019 – an increase of 4.63% over the previous census in 2012. India has 192.49 million cattle, which accounts for 36% of total farm animals in the country. The female cattle number is 145.12 million – an increase of 18% over the 2012 census and the number of male cattle, on the other hand, dropped to 47.4 million - a decrease of 31% over the 2012 census. The male to female cattle ratio dropped to 1:3 in 2019 from 1:1.8 in the 2012 census. The indigenous cattle population has decreased by 6% and crossbred cattle have increased by 26.9% in 2019 census as compared to 2012 census. India has 109.85 million buffaloes population in 2019 as compared to 108.70 million in 2012. The buffaloes account for 20.45% of total farm animals in the country (20th Livestock Census, 2019). The 20th livestock census documented the increasing trends of crossbred population among the cattle, sheep, pigs and improved breeds of buffaloes while the male cattle, indigenous animal population showed the declining trend as compared to the 19th livestock census with direct implications to the PVS. The PVS in reality depends on effective multi-stakeholder livestock service delivery capable of addressing the various concerns like low productivity, food safety; disease control and adequate technology transfer (Chander *et al* 2010). Productivity is always an outcome of effective animal breeding practices, reduced animal disease incidences and increased accessibility of latest technological developments in animal feeding and management, resulting from effective animal health, breeding and extension services.

Though every Indian state has a number of organizations for the development of livestock sector, the Animal Husbandry Department (AHD) at the state level with its huge infrastructure and clear mandate of treatment of animals is the major stakeholder as far as PVS is concerned. Since 1950s, the horizons and expectations of society from PVS system have widened to a great extent. The changing role of veterinarians, emerging diseases and inadequate expertise in super specialty clinical subjects, information needs of livestock farmers etc were reported as major hurdles in effective PVS (Matthewman and Ashley, 1996; Ahuja *et al.,* 2000; Rao, 2003; Rao *et al,,* 2008; Chaco *et al.,* 2010, and; Chander *et al.,* 2010).

The PVS network of institutions under Andhra Pradesh state AHD includes 2916 rural livestock units (RLUs) at village level manned by para-veterinarians, 1794 veterinary dispensaries headed by graduate veterinarians or veterinary assistant surgeons (VASs), 281 veterinary hospitals headed by assistant directors and 22 veterinary polyclinics with team of veterinarians at district level functioning as referral hospitals providing specialized services in gynecology, surgery and medicine with X-ray and inpatient facilities. Further, there are 22 Animal Disease Diagnostic Laboratories are functioning, one each at district headquarters with facilities for disease investigation, quick diagnosis and for mapping out diseases to render timely and effective control measures. These are the district referral laboratories for effective diagnosis and vaccine distribution work under PVS.

To appraise the PVS delivery in Andhra Pradesh, an empirical exercise was carried out with an objective to ascertain the veterinarians' perceptions and reflections regarding the effectiveness of PVS along with constraints and suggestions.

METHODOLOGY

The study was carried out in East Godavari and Chittoor districts of Andhra Pradesh state. 120 veterinarians, 60 from each district were selected as respondents. The sample represents 47.62 % of total veterinarians of the study districts and 9.19% of state veterinarians strength. Pre-tested questionnaires were used to collect the data with key questions on demographics and job profile, type of species handled, various physical facilities available at work place, perception regarding effectiveness of PVS and constraints/ suggestions. The variables covered under demographics and job profile includes age, educational qualification, work load perception, job experience and trainings undergone, and type of species handled by veterinarians. The PVS was measured through a structured schedule consisting 16 different services under five categories such as curative, production, preventive, diagnostic and miscellaneous services and responses were recorded on five-point continuum viz., excellent, above average, average, below average and poor with scores of 5,4,3,2 and 1, respectively. Further, the data on the problems perceived by veterinarians in PVS and suggestions given by them were collected with an unstructured open-ended question and they were listed, classified and ranked according to their frequencies.

RESULTS AND DISCUSSION

Demographics and Job Profile: Majority of the veterinarians working in the study area were young (56.7%) with an average age of 34.85 years, graduates (85.80%), low level of job experience (48.30%) with a mean experience of 9.43 years. The data also revealed that majority of veterinarians felt their work load as heavy (54.17%) followed by too heavy (22.50%), average (23.33%) and light (0.83%). All the veterinarians (100%) were handling bovine, ovine, caprine and canine species of animals, while 14.17 per cent of them were handling the wild animals (Table 1). The heavy work load perception of veterinarians might be because of the more livestock population coverage, more distance travelled per day, overloaded administrative / extension responsibilities and shortage of supporting staff. The above results of the study are in line with the findings of Sasidhar (2002) and Ravikumar (2007) and partly in line with Channappagouda (2009).

Table 1: Demographic and Job Profile of Veterinarians

S No	Category	F	Per cent	Mean	SD	Range
1	**Age (In Years)**					
	Young (35 or less)	68	56.70			
	Medium (36-50)	48	40.00	34.85	7.9	23-55
	Old (51 or more)	4	3.30			
2	**Education**					
	BVSc&AH	103	85.8	__	__	__
	MVSc	17	14.2			
3	**Job Experience (In Years)**					
	Low (up to 6 yrs)	58	48.3	9.43	6.60	1-22
	Medium (7 – 12 yrs)	21	17.5			
	High (13 years or above)	41	34.2			
4	**Work Load Perception**					
	Light	1	0.83	__	__	1-4
	Average	28	23.33			

S No	Category	F	Per cent	Mean	SD	Range
	Heavy	65	54.17			
	Too Heavy	26	22.50			
5	**Type of species as % of total cases handled**					
	Bovines	120	100	60.5		
	Sheep and goats	120	100	14.5		
	Pets	120	100	15.38		
	Poultry	120	100	9		
	Wild Animals	17	14.17	1.61		
6	**Trainings undergone**					
	Low (1-4)	51	42.5	5.62	3.09	2-12
	Medium(4-7)	36	30.0			
	High(7-11)	33	27.5			

Veterinarians' Perception on PVS Effectiveness: Veterinarians rated various services provided by them and the results indicate that vaccination as most effective service among all with mean value of 4.00 out of 5.00, followed by many services rated above half way (>2.00 mean) such as deworming (3.08), medical treatment (3.03), gynecological & obstetrical treatment (3.03), livestock advisory service (3.03), minor surgical treatment (3.00), artificial insemination (2.97), pregnancy diagnosis (2.97), distribution of fodder seedlings (2.08), issue of health certificates (2.08) and post mortem certificates (2.04). They have perceived few other services as poor or less effective such as major surgical treatment (2.00), laboratory diagnosis (1.11), supply of publications (1.07) and radiography (1.00) (Table 2).

Table 2: Veterinarians' Perception on PVS Effectiveness

S No	Type of service	Mean effectiveness
I	**Curative Services**	
1	Medical treatment	3.03
2	Minor surgical treatment	3.00
3	Major surgical treatment	2.00
4	Gynecological & obstetrical treatment	3.03
II	**Production Services**	
1	Artificial insemination	2.97
2	Pregnancy diagnosis	2.97
III	**Preventive Services**	
1	Deworming	3.08
2	Vaccination	4.00
IV	**Diagnostic Services**	
1	Laboratory diagnosis	1.11
2	Post mortem	2.04
3	Radiography	1.00
V	**Miscellaneous services**	
1	Livestock advisory service	3.03
2	Distribution of fodder seedlings	2.08
3	Supply of publications	1.07
4	Issue of health certificates	1.10
5	Issue of Post Mortem certificates	2.08

The rating of vaccination as most effective PVS may be seen due to increased emphasis of state as well as central government towards disease prevention and monitoring through National Foot & Mouth Disease-Control programme (FMD-CP) or PPR vaccination programme and veterinarians are carrying out vaccination services on campaign mode. The AHD with its vast network is carrying out deworming, treatment of sick animals and advisory services. However, the comparative lower mean of artificial insemination and pregnancy diagnosis needs special mention here due to its importance in improvement in livestock productivity and higher budgetary spending from the government as priority area of livestock development. This perception might also be due to veterinarians' unhappiness over improper monitoring of lower staff especially *Gopalamitras* (Animal breeding

workers in Andhra Pradesh) and less skilled sub-ordinate staff etc. It needs to be thoroughly analyzed in depth for further effective implementation of PVS services with respect to breeding programmes.

Major surgical treatment, laboratory diagnosis, supply of publications and radiography which needs intensive infrastructure and technical specialization are dragging behind because of lack of budgetary provision and infrastructure. Though compared to other services the demand for major surgery and radiography is less, but the services like distribution of fodder seedlings, laboratory diagnosis and information delivery through publications are needed special attention of policy makers under changing livestock production system, increased market value of animals and increased literacy among the farmers.

The average effectiveness of PVS perceived by majority of veterinarians clearly suggests the further scope for further improving the quality of services. Similar results were also stated by Ravikumar (2007) and Channappagouda (2009) who reported that opinion of majority of veterinarians in Andhra Pradesh and Karnataka states on veterinary services as average, followed by good and poor.

Constraints Perceived and Suggestions Expressed by Veterinarians in Livestock Service Delivery:

The major constraints faced by veterinarians were "insufficient staff" (58.33%), followed by "lack of transportation in the field" (56.66%), "more meetings" (48.33%), "administrative work load" (46.66%), "travel time from work place to controlling office" (35.00%), "repeatedly same information sought by head office" (29.16%) and "engagement in non-relevant duties" (19.16%) (Table 3).

Table 3: Constraints Perceived by Veterinarians in Livestock Service Delivery

S No	Constraints	F (%)	Rank
1	Insufficient staff	70 (58.33)	I
2	Lack of field transportation	68 (56.66)	II
3	Too many meetings	58 (48.33)	III
4	Administrative work load	56 (46.66)	IV
5	Travel time from work place to controlling office	42 (35.00)	V
6	Same information is sought by head office repeatedly	35 (29.16)	VI
7	Engaging in general duties	23 (19.16)	VII

The major suggestions perceived by veterinarians were conversion of all rural livestock units into graduate veterinary institutions (87.50%) deploy full-fledged manpower with para-veterinarian and office subordinate (attendant) at every institution (76.67%), provision of adequate medicines for effective treatment at institution (72.50%) and provision of transport facility or adequate transportation allowance to offer doorstep veterinary services during emergencies (63.33%) (Table 4).

Table 4: Suggestions Expressed by Veterinarians for Improving Livestock Service Delivery

S No	Suggestions	F	%	Rank
1	Conversion of all Rural Livestock Units into graduate institutions.	105	87.50	I
2	Deploy full fledged manpower with para veterinarian and office subordinate (Attendant) at every institution.	92	76.67	II
3	Provision of advanced medicines and hormones for effective treatment at institution.	87	72.50	III

S No	Suggestions	F	%	Rank
4	Provision of transport facility or adequate transportation allowance to offer doorstep services during emergencies.	76	63.33	IV
5	Decentralize administration to reduce distance between controlling office and work place.	55	45.83	V
6	Reducing the administrative work load on veterinarians/ provision of office assistant/ computer operator to veterinary institutions.	40	33.33	VI

In a similar study conducted in Andhra Pradesh state itself, lack of basic materials, poor infrastructure and lack of mobility were identified as major constraints (Punjabi et al., 2005). It was reported that in India only 34,500 veterinarians are employed for the field services against the requirement of 67,000 with a gap of 49% (Anon, 2013). Shortage of veterinarians was also reported by researchers (Rama Rao et al., 2011; Anon, 2012; Anon, 2013 and Sasidhar and Gopal Reddy, 2013).

CONCLUSION

Though, the PVS in Andhra Pradesh state is commendable in spite of shortage of resources, the services are anticipated to become active to meet multidimensional needs with more client orientation. Being an important stakeholder in PVS, the veterinarians have responsible roles to play at the grass root level. The treatment orientation of veterinarians should also be inclined towards stringent action in prophylactic measures which would form a strong base for livestock disease management. Various veterinary services with varied effectiveness are delivered due to shortage of human resource, lack of field transportation, too many meetings and various other administrative/ extension issues. The results also revealed that there is also a wide scope for improvement of PVS in the state by addressing location specific bottlenecks. Necessary policy changes and budgetary provisions for infrastructure are required to address most of the issues. It is also recommended to upgrade all the rural livestock units which are being manned by para-veterinarians hitherto to the level of veterinary dispensaries in a phased manner. A multidimensional approach towards issues pertaining to delivery of PVS is the need of the hour.

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RESEARCH ARTICLE

Information and Communication Technology (ICT) in agriculture marketing - An important strategy for rural development

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ABSTRACT

Information and communication technologies (ICTs) have a significant role to bring changes in the existing traditional agricultural system in a developing country like India (Chiatoh and Gyau, 2016). Assam one of the important sates of North East India also witness a technological development in the field of agriculture in recent time. With the uses of ICTs in agricultural marketing, it is possible to provide efficient information and to bring take precise decision about agriculture and enhance market access of farmers.

Rural development is closely related to the development of agriculture sector. Marketing of agricultural products in turns, plays a vital role in the development of agriculture and rural development. It is because access to adequate and appropriate information is the most important issue that must be given priority by farmers to formulate decision relating to production, harvesting, post harvesting and marketing. Among them marketing of agricultural products is our thrust area. In the advent of modern ICT based world, agricultural marketing is also highly influenced by ICTs. ICT based information of market helps to disseminate the proper information to farmers on timely basis. Hence the present paper is an attempt to study the use of ICTS in agriculture marketing for rural development in Assam.

Keywords: ICT in Agriculture, ICT in Agriculture Marketing, Rural Development.

INTRODUCTION

Access to adequate and appropriate information is the most important issue that must be given priority by farmers to formulate decision relating to production, harvesting, post harvesting and marketing. Among them marketing of agricultural products is our thrust area. In the advent of modern ICT based world, agricultural marketing is also highly influenced by ICTs. ICT based information of market helps to disseminate the proper information to farmers on timely basis. Information asymmetry is the most serious problem for farmers. ICT enables to solve this problem and increase the performance of market. (Chiatoh and Gyau, 2016). ICTs facilitate transaction among farmers.

It allows information exchange and speed up transaction process between two parties. Getaw and Bahiigwa (2015) asserted that in Ethiopia use of ICTs is crucial to scale back transaction cost. Through ICTs use it is possible to minimize the information searching cost, cost of negotiation and improve the bargaining power of farmers. Okello et al. (2014) explained that in Kenya ICTs has the relevance in increasing market access through disseminating information. Information dissemination through ICTs is not only increase market access among farmers but also boost the knowledge of market, it enhances interaction between farmers and consumers which enables producers to get appropriate market share (Guiliani and Dalla,

2017). Okojie and Omoregbee (2012) in Nigeria ICTs helps farmers to form direct communications with buyers, to urge price information, to urge information concerning sources of agricultural inputs and knowledge related to market place. Similarly, the study by Yohannes (2017) showed that ICTs, particularly mobile phone, helped livestock producers to get price information, increase bargaining power of farmers, increase price negotiation and minimize market information searching cost.

The finding of Nekesa and Mulumba, (2016) in Uganda, Wyche and Steinfield (2015) in Kenya, and Kibambila (2017) in Tanzania showed that ICTs played an excellent role to disseminate up-to-date information on time of sale, place of sale, amount of sale and type of buyers. Access to such pertinent information supported farmers to make efficient and effective decision-making process production and marketing processes so as to support and make their livelihood sustainable. The result of Daisy and Tawanda (2015) in Zimbabwe, and Alhassan and Adjei (2012) in Ghana depicted that ICTs use and agricultural marketing has a positive correlation.

The prevalence of ICTs is now commonplace in many parts of the world, and have altered the way we communicate and interact. Smallholder agri-producers should acquire the appropriate knowledge in these new methods of communication in order to be competitive in an ever-evolving market, both in Greece, and abroad. By changing the underlying methods of communication through ICTs, this in turn may bring positive broader changes to the agricultural ecosystem.

In an economy like ours, production and marketing must go hand in hand. Marketing plays an important role to stimulate production and consumption and accelerates the pace of economic development of a country. Agricultural marketing deals with all the activities, agencies and policies involved within the procurement of farm inputs by the farmers and therefore the movement of agricultural products from the farms to the consumers. The expansion in the volume of farm output stimulates forward linkages, which encompasses transportation, storage, processing, packaging and retailing to the consumers.

2. ICT Initiatives for Agricultural in India

Approximately 45 per cent ICT projects of the whole world have been implemented in India and also maximum number of information kiosks has been employed in rural India. Nevertheless, it was found that majority of the ICT projects in agriculture were put into action in socio- economically developed states of South and North India, while deprived states are not benefitted by ICT initiatives. Some of the e-Agriculture initiatives in India are Agrisnet Digital green, eSagu Warana IKSL, Agmarknet, iKisan, Digital Mandi, eArik, Akashganaga , aAQUA (Almost All Questions Answered), Fisher Friend Mobile Advisory KCC, Reuters Market Light, SMS Portal/mKisan Portal, Mahindara Kisan Mitra ,Kisan Call Centers (KCCs), Village Knowledge Centers (VKCs), AGRONXT etc. Among them, KCC and VKC are very common in India. In the context of Assam KCC and VKC have started their operation during last few years.

3. Major components used for ICT initiatives in India

Major components which are used in our country for providing ICT services to the farmers are web portals, mobile applications on android phone, SMS and voice messages on simple phones, information kiosks, videos and video conferencing with the experts. Agriculture experts are the key component in the whole process of disseminating information to the farmers

The ICT components may disseminate relevant, real, customized information to the farmers at appropriate time. Hence, ICTs provide a forum to reach masses easily and to

make global and local information easily accessible to the stakeholders. Information dissemination in agriculture is cost effective, time saving and speedy through ICT. Mobile telephony has emerged as the foremost choice of the majority of the urban and rural people. Mobile phones were found as the most widely accessed tool among the farmers for communication and for accessing agriculture-related information particularly for the marketing of produce. Researchers also reported that mobile phones were the most used ICT tool and highly accessible by the farmers. It was found in a comparative study that the livestock farmers of Uttar Pradesh, who were using ICT-based information made significantly better decisions on various livestock practices as compared to ICT non-users. Further, few studies reported that the ICT based initiatives helped farmers of Madhya Pradesh, Uttar Pradesh and Tamil Nadu of India, in reducing transaction cost while acquiring information and doing transactions in input and output markets

4. Objectives of the Study:

The study is designed in the context of following objectives.

a) To find out some socio-economic factors and the use of ICT.

b) To find out the relations between socio-economic factors and use of ICT in agriculture marketing among farmers.

5. Research Question

Based on the above objectives the following research question is proposed.

(a) Is there is any relationship between use of ICT in agricultural marketing and socio-economic factors?

6. Methodology:

6.1: Universe of the study:

Sibsagar and Golaghat District of Assam are the universe of the present study. These two Districts have been selected because under the supervision of MS. Saminathan Research Foundation and Assam Agricultural University and under the aegis of Norway Government a project on climate resilience and uses of modern tools in agricultural production and marketing has been initiated in March, 2019.

6. 2: Sample Size:

A total of four villages from these Districts (two from Sivsagar and two from Golaghat) are considered for primary data study area where the project has been initiated. From each village a total of forty farmers are selected and hence total sample size is 160.

6.3: Sources of Data:

To analyse the ground reality both primary and secondary data of relevant aspects are collected from the selected Districts.

(i) Primary Data:

A structured questionnaire is designed for collecting the primary data. Through direct personal investigation and field visit in the selected places primary data have been collected. Purposive random sampling methods are used for collecting primary data.

(ii) Secondary Data:

Required secondary Data are collected from Annual Reports of Govt. of India, various reports of Govt. of Assam and other relevant books, journals and offices.

iii) Data Analysis:

To measure the uses and importance of different aspects of ICT in agricultural marketing relevant statistical tools like percentage methods and correlation are used.

7. Results

Based on the field study conducted in the four selected districts of upper Brahmaputra Valley Zone of Assam, findings can be discussed in the following way.

Table 1 : Socio-Economic Factors

Factors	Category	Number of farmers	Percentage of farmers
Age	Below 30	21	13.12
	30 to 40	56	35.00
	40 to 50	44	27.5
	50 and above	39	24.38
Education	Illiterate	26	16.2
	HSLC Passed	40	25.0
	HS Passed	64	40.0
	Graduate & above	30	18.8
Farming Experience	Up to 5 Years	22	13.75
	5 to 10 Years	58	36.25
	10 to 15 Years	36	21.75
	15 to 20 Years	15	9.37
	20 to 25 Years	17	10.62
	25 and above	12	7.5
Land Holding	Below 10	13	8.13
	10 to 15	59	36.87
	15 to 20	54	33.75
	20 to 25	24	15
	25 to 30	10	6.25
Income	Below 5000	76	47.5
	5000 to 10000	72	45.0
	10000 and above	12	7.5

Source: Field survey conducted by researcher

Findings relating to different socio-economic variables are represented in table 1. Through many stages of random sampling, a total of 160 samples from the districts of Sivasagar and Golaghat were obtained. It was discovered that 14.31 percent of respondents are under the age of 30, 35 percent are between the ages of 30 and 40, 27.5 percent are between the ages of 40 and 50, and 24.38 percent are beyond the age of 50.

During the study, entire respondents were male. It is because, in the study area no female farmers were found available. In in study, it was found that out of 160 respondents 73% were married and 23 % were unmarried.

Out of 160 respondents, 16.2% were illiterate, 25% had completed the HSLC, and 40% had completed high school. 18.8% of people had graduate degrees or above. It was discovered that 13.75% of respondents had up to five years of farming experience, compared to 36.25% of farmers who had five to ten years of experience, 21.75% of farmers who had twenty to twenty-five years of experience, 9.37% of farmers who had fifteen to zero years of experience, and 10.62% of farmers who had twenty to twenty-five years of experience. Among farmers, just 7.5% had more than 25 years of experience.

According to the survey, 8.13 percent of farmers had fewer than 10 bighas of land. 36.77% of respondents had between 10 and 15 bighas of land, 33.75% had between 15 and 20 bighas, and 15% of farmers had between 20 and 25 bighas. Only 6.25 percent of farmers own between 25 and 30 bighas.

It was discovered that the majority of respondents in the study region worked in agriculture. The major industry for generating income is agriculture. The respondents, who make up 77.5% of the sample, are from farming

families. The remaining 15 parentage families still practise agriculture, yet despite this, just 1% of respondents work in the government sector, while 11% work in the private sector.

It was seen that the monthly income of 47.5% of the respondents is up to Rs. 5000. The monthly income of 45% of the respondents is between Rs. 5000 and Rs. 10000. 7.5% of the respondents' total monthly income was greater than Rs. 10,000.

Table 2 : Percentage of Respondents regarding availability and participation in ICT

SL No	Items	Availability (Number and percentage)		Frequency of participation (%)		
				Regularly	Occasionally	Never
1	Reading news paper	16	10.0 %	62.5	25.0	13
2	Radio	30	18.75	66.67	23.33	10.0
3	TV	126	78.75	8.73	19.84	71.43
4	Mobile	160	100	24.37	38.75	36.88
5	Internet	126	78.75	19.84	46.82	33.33
6	Farm magazines & other literature	0	0	0	0	160

Source: Field Survey conducted by researcher

Table 2 reveals that 18.75 % respondents had radio, 10 % had newspaper,79.37 % TV, all farmers have Mobile, and 78.75 % had internet connectivity. No one had any subscription of any farm magazine. Although all respondents had mobile phones, 21.25% yet to have internet connectivity.

Table 2 also shows out 10% respondents having newspaper, only 66.25% of respondents read the newspaper on a regular basis, 25.0% occasionally, and 13% never. Similarly, 66.67% regularly listen radio programme, 23.33 occasionally and 10% never listen. TV programme was watched by 8.73% of respondents on a regular basis, 19.84 % watched it occasionally, and 71.43% never watched it. Mobile application was used frequently by 24.37% of respondents, occasionally by 38.75%, and never by 36.88%. 19.84 % used internet regularly, 46.82% of respondents used the internet occasionally, 33.33% never did, and 11.25% routinely. There are no subscriptions available in the study area for agriculture magazine.

It was discovered that 70.625 percent of respondents knew something about ICT in agriculture and 29.375 percent of respondents knew nothing about it. Interesting, they only comprehend using KCC, going to YouTube, using WhatsApp, and using Facebook when they refer to ICT in agriculture. Obviously, radio programmes related to agriculture are far more important to farmers. People rarely watched agricultural-based TV programming. Similar to this, they prefer to utilise the internet to learn about the weather. It was discovered that 65 percent of respondents had utilised ICT tools in agriculture, whereas 35 percent had never done so.

It was discovered that 26 farmers, or 16.25 percent, are illiterate. Only one farmer has used ICT for agriculture out of the 04 farmers that are familiar with it. Out of 40 farmers who completed the HSLC, 23 are ICT-savvy and 18 have used ICT tools in the agricultural industry. Similar to this, 59 of the 64 farmers with high school diplomas who had employed ICT. In terms of graduate farmers, 27 out of 30 respondents were aware of ICT tools, and all of them had used them.

Table 3 : Percentage distribution of respondents regarding extension contact

Sl No	Name of organization	Frequency of such visit/contact		
		Regularly	Occasionally	Never
1	Kishi Vigyan Kendra	2.5	41.25	56.25
2	Agricultural University	00	5.00	95.00
3	Officials of Agricultural Dept.	20.0	33.75	46.25
4	NGO etc.	0	1.25	98.75
5	Friends & Relatives	53.75	26.25	20.00
6	Local Traders	45.0	15.625	39.375

Source: Field Survey conducted by researcher

According to Table 3, 2.75% of respondents have kept in touch with KVK via extension on a regular basis, 41.25% have kept in touch via extension sometimes, and 56.25 percent have never kept in touch via extension with KVK. Extension interactions between agricultural universities and NGOs are practically nonexistent. Only 5% of farmers regularly communicate with the Agriculture University; the remaining 95% have never done so. Similar to this, just 1.25 percent of farmers have kept in sporadic touch with NGOs. The majority of farmers have kept in touch on a regular basis with neighbours, friends, and family. Of course, they also have other relationships, particularly with the panchayats and certain forward-thinking farmers in their communities.

Association between socio-economic variables and use of ICT

Association between use of ICT and some important factors are shown in the table 4. It is found that the farmers with high age is reluctant to use ICT than those of younger farmers. This is pretty true for the case as most are of younger generations are keen on the latest technologies. It is obvious that with increase in level of education and use ICT is more. Farming experiences are also found to have negative association between use of ICT. It is found that land has nothing to do with use of ICT in marketing. Income is found to have positive association in the study area. Extension contact is associated with use of ICT. Mass media participation is not found to be associated with use of ICT. It might be that farmers are using ICT tools just for entertainments rather than collecting information. There is a positive association between extension contact and utilization of ICT. This is because, farmers were getting information through the organisations and in meetings.

Table 4 : Association between socio-economic characteristics with utilisation of ICTs

Sl No	Variables	Correlation coefficient
		Use of ICT
1	Age	-.502**
2	Education	.440**
3	Farm Experience	-.371**
4	Land Holding	.010
5	Income	.205
6	Mass media participations	.550
7	Extension contacts	.202

**** Correlation is significant at the 0.01 level (2-tailed).**

Calculated by researchers based on primary data.

8. Relevance of ICT for agriculture marketing and rural development

8.1. Improve Efficiency

A market information system is an important tool used by modern management to for problem solving and decision making. Market Information System is the process of gathering, processing, storing and using information to make better marketing decisions

and to improve marketing exchange (Amrutha, 2009). Rahman (2003) reported that the growers received low prices because of lack of market information and low use of ICT which resulted in wide inter-market price variation. Improvement of agricultural market information services is necessary for domestic market efficiency and to integrate domestic agricultural market with regional and international market for sustainable development of agriculture sector and to ensure country's long run food security.

8.2. : Decision Support System

ICT has a great part as decision support system to the farmers. Through ICT, growers can be streamlined with the recent information about farming, rainfall, new kinds of crops and new ways to increase product and quality control. The dispersion of acceptable, effective and customized technologies related toagro-climatic zone, size of ranch and soil type etc. to the growers is deficient in Indian husbandry and it's the real challenge in front of policy makers, which in turn, promote economic conditions of rural farmers.

8.3: Widen Market Access

One of the major downsides in Indian husbandry is complex distribution channels for marketing of agrarian yield. growers do n't get acquainted with the streamlined prices of goods, proper place for dealing their inputs and consumer trends also. ICT has the great eventuality to widen marketing horizon of growers directly to the guests or other applicable druggies for maximum benefit. growers may connect directly with numerous druggies and may get information about current prices for their goods

8.4: Strengthen and empower farming community

ICT technologies can help for strengthening farming communities through wide networking and collaborations with various institutes, NGO's and private sectors. Further, farmers may enhance their own capacities through updated information and wide exposure to scientific, farming and trade community.

CONCLUSION

In every Indian state, rural development is given the top priority. The degree of economic development is determined by the effectiveness and strength of the connections made across different economic sectors and business cycles. Any sector of the rural economy's economic system of production is formed by the integration of these links. Among these connections, marketing is one of the key elements that has a direct bearing on the economy, mostly on agriculture. ICT can be really helpful in creating the connection in this situation. Marketing of agricultural products is a complicated topic. The key elements controlling the entire market operations are the involvement of several trade channels in the procurement of agricultural produce, the attitude of farmers towards selling their produce, and their need for quick returns. Therefore, the sale of farm products serves as the backbone of the rural economy since it is an agrarian one. To give farmers and produce end consumers value-added compensation, the agribusiness must be established and the agricultural produce marketing system must be diversified. The state governments in the area have improved the terms of agricultural marketing in a number of ways to promote the general welfare. A single active development agency needs to be identified to develop awareness on the diversified agricultural activity and to boost the marketing of agro-processed products tremendously in the region. Therefore, ICT is one of the important strategies to achieve the goal.

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RESEARCH ARTICLE

Study on credit utilization pattern and repayment behaviour of agriculture loan borrowers of lead bank

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ABSTRACT

An analysis of farmers who borrowed loans reveals that over half (55%) are middle-aged. A significant portion (39.16%) has primary education, and more than half (59.16%) have medium experience in farming. Around 30% of farmers have semi-medium land holdings, while 25% own small land holdings. Half (50.83%) have medium annual income. Most farmers (63.33%) find it easy to access credit, with 80% taking short-term loans. Over half (56.53%) rely on agriculture as their main occupation. Regarding social aspects, 60% of farmers have a medium level of social participation, 49.17% show low cosmopoliteness, 53.33% have medium extension contact, and 48.33% have a medium level of scientific orientation. These factors affect how farmers utilize credit depending on their situation.

Keywords: Characteristics of borrowers, Credit ,Lead Bank

INTRODUCTION

Credit enables individuals to borrow money for purchasing items and repaying the amount within an agreed-upon timeframe. In the agricultural sector, access to finance is particularly crucial since most farmers do not have sufficient personal capital to invest in their operations. As a result, they frequently rely on short-term loans to cover the costs of crop production and meet day-to-day expenses. Additionally, farmers often require medium-term loans for replacing or maintaining essential farm assets, such as machinery, equipment, or infrastructure, which are necessary for sustaining their agricultural activities over time. The availability and proper utilization of credit play a pivotal role in helping farmers manage these financial demands, ultimately contributing to the stability and growth of the agricultural sector. The effectiveness of credit utilization, however, varies depending on individual farmers' circumstances, including their financial needs, farming experience, and resources. In the context of rural development, the Lead Bank is tasked with playing a significant role in fostering the development of banking and credit services in specific regions, or allocated districts. This institution is expected to provide guidance and support to ensure that farmers and other borrowers can access the financial resources they need in a timely and efficient manner. By focusing on improving the availability of credit, the Lead Bank can help to promote agricultural productivity, enhance economic growth in rural areas, and empower farmers to achieve greater financial independence.

Objectives: I) To study the Personal, Socioeconomic and Psychological characteristics of the Loan borrower farmers. II) Constraints faced by borrowers in Obtaining loans and Repayment and Suggestions for effective Credit utilization.

METHODOLOGY

An *Ex post facto* research design was used to study the credit utilization pattern and repayment behavior of agriculture loan borrowers of lead bank in Pune district.*Ex post facto* is a Latin phrase that essentially means "retroactive" or affecting something that's already happened.(Kerlinger, F. N. (1964).

In Pune District, there are a total of 14 Tehsils. Among them, Baramati and Indapur were chosen purposively due to their higher number of loan beneficiaries. Five villages were purposively selected from each Tehsil based on the presence of loan beneficiaries. From each of these villages, 12 beneficiary farmers were randomly chosen. The data was collected through a structured comprehensive interview schedule and analysed using arithmetic mean, standard deviation, frequencies and percentage for drawing meaningful interpretations.

RESULT AND DISCUSSION

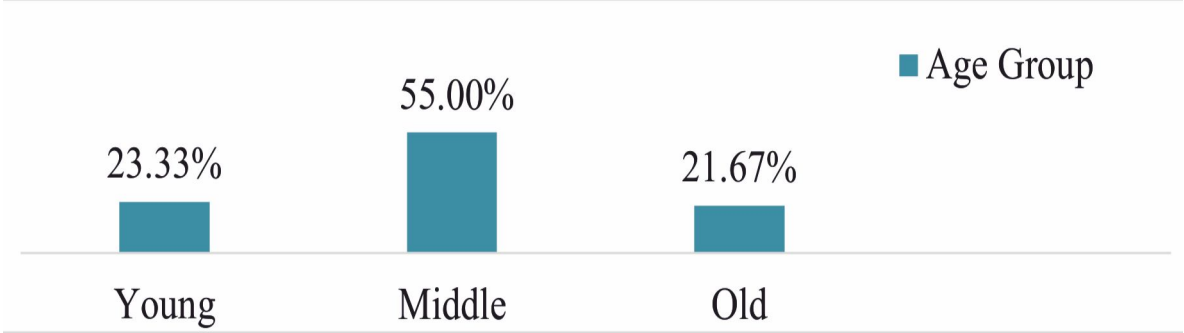
1)Age:

It was evident from the data presented in Table 1 and Fig 1 that more than half (55.00 percent) of the loan borrowed farmers were found in the middle age group followed by(23.33 percent) in young age group and (21.67percent) of loan borrowed farmers in Old age.

Table: 1 Classification of respondents according to their Age:

Sr. No	Age	Respondents (n=120)	
		Frequency	Percentage
1.	Young (Up to 35 years)	28	23.33
2.	Middle (36 to 55 years)	66	55.00
3.	Old (56 years and above)	8	21.67
	Total	**120**	**100.00**

It can be concluded that great majority of loan borrowers were from young to middle age (78.33percent) These findings are consistent with the finding of khodke *et al.*(2010), Reena rawat (2016).

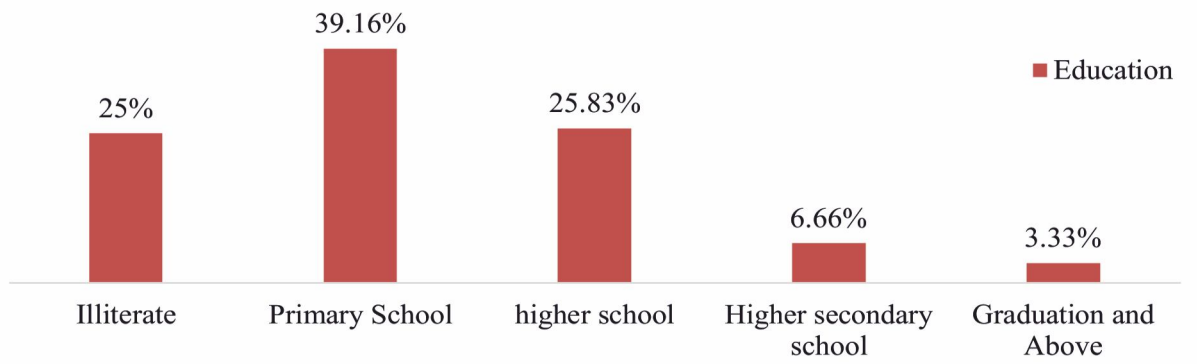


2)Education:

Generally, it is considered that formal education of the respondents plays an important role in Credit utilization pattern. Considering these aspects the formal education of Loan borrowed farmers was studied. The information pertaining to the education of the respondents were collected, tabulated and analyzed. Distribution of respondents by their level of education is given

Sr. No	Education	Respondents (n=120)	
		Frequency	Percentage
1	Illiterate	30	25.00
2	Primary school (1th to 4 th class)	47	39.16
3	Secondary school (5th to 10th)	31	25.85
4	Higher secondary school (11 and 12th)	08	06.66
5	Graduation and above	04	03.33
	Total	**120**	**100.00**

The data presented in table 2 revealed that (39.16 percent) of loan borrowed farmers had primary school education and (25.83percent) had secondary school education followed by (25.00 percent) illiterate, (6.66percent) higher secondary school,(3.33 percent)graduation and above respectively. It can be concluded that majority of the Loan borrowed farmers (64.99 percent) where educated up to Primary to Secondary school. These relates with khodke et al (2010)



3) Farming Experience:

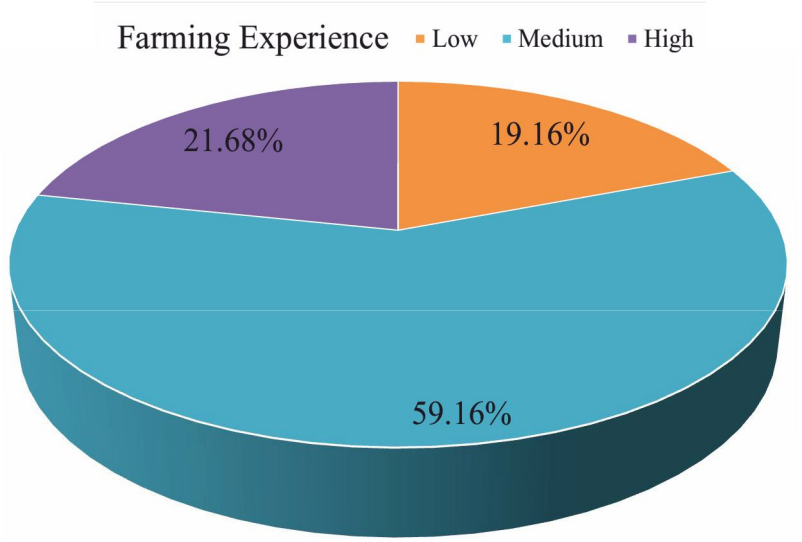
Experience is the number of years of familiarity of farmers in farming. Experience in farming measured in term experience of individual farmer in years.

Table: 3 Classification of respondents according to their Farming Experience

Sr. No	Farming Experience	Respondents (n=120)	
		Frequency	Percentage
1.	Low (below 8 years)	23	19.16
2.	Medium (9- 18 years)	71	59.16
3.	High (Above 18 years)	26	21.68
	Total	**120**	**100.00**

It was evident from the data presented in Table 3 and Fig 3 that nearly three fifth (59.16 percent) of the loan borrowed farmers were found medium farming experience followed by (21.68percent) high farming experience and (19.16percent) of loan borrowed farmers with low farming experience.

It is inferred that majority of the respondents (78.32 percent) belong to medium to low level of farming experience. These findings are consistent with the findings of Gopinath (2005) and Reena rawat (2016).



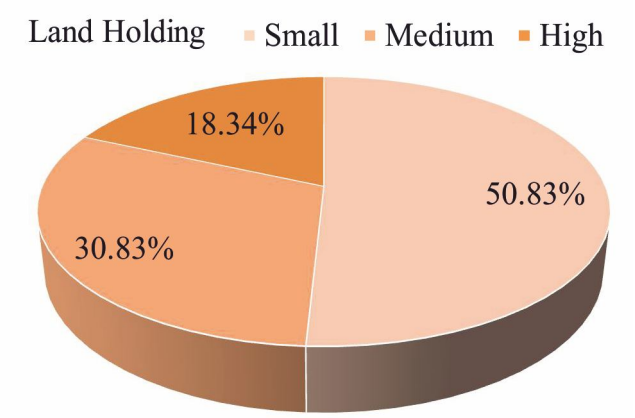
4) Land holding:

Size of land holding is directly co-related with the characteristics of borrowers

Table:4 Classification of respondents according to their Land holding.

Sr. No	Land holding	Respondents (n=120)	
		Frequency	Percentage
1	Marginal (up to 1.00 ha)	16	13.33
2	Small(1.01 to 2.00 ha)	30	25.00
3	Semi medium(2.01 to 4.00 ha)	36	30.00
4	Medium(4.01 to 10.00 ha)	22	18.34
5	Large(Above 10.01 ha)	16	13.33
	Total	**120**	**100.00**

The data in Table 4 shows that out of the total 120 respondents, more respondents (30.00 percent) had semi medium size of land holding i.e. (2.01 ha to 4.00 ha), followed (25.00 percent) respondents belonged to small size of land, followed medium land holding (18.33percent), The percentage of the marginal and large land holding is same(13.33 percent) each. Thus, it can be concluded that half of the respondents (55.00 percent) had small to semi medium size of land holding .These findings are consistent with the findings of Gottumukala bhavani (2018) .



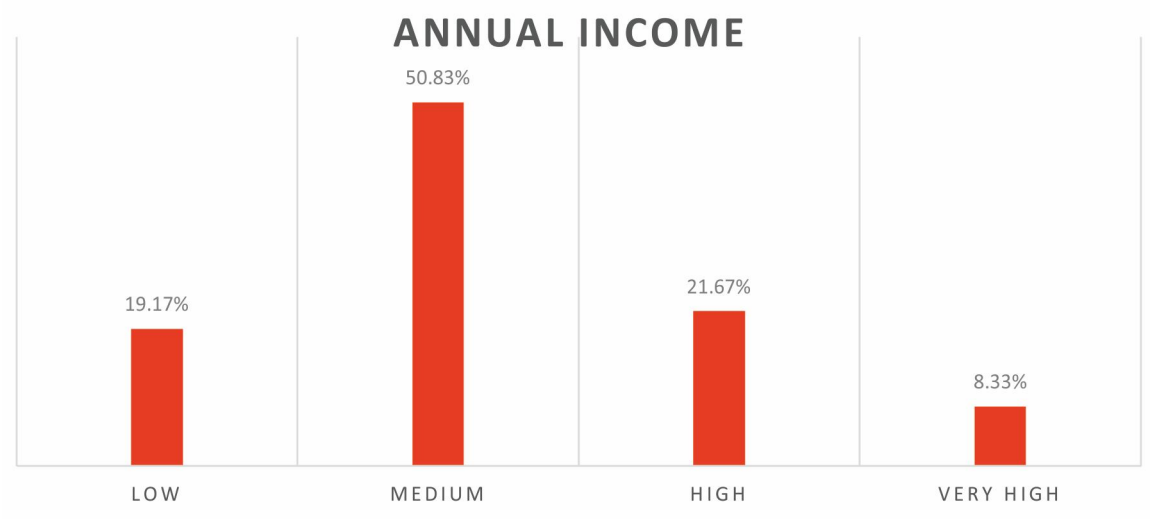
5) Annual Income:

For fostering rapid use of credit utilization pattern, the respondent must inculcate the nature of annual income.

Table:5 Classification of respondents according to their Annual Income

Sr. No	Annual Income	Respondents (n=120)	
		Frequency	Percentage
1	Low (up to 1,50,000 Lakh)	23	19.17
2	Medium (1,50,001 Lakh to 3,00,000 Lakh)	61	50.83
3	High (3,00,001 Lakh to 5,00,000 Lakh)	26	21.67
4	Very high (above 5,00,001 Lakh)	10	08.33
	Total	**120**	**100.00**

The data in Table 5 show that out of the total 120 respondents half of the (50.83percent) had medium level of annual income i.e (1,50,001 Lakh to 3,00,000 Lakh),while (21.67percent) were having high annual income later (19.17percent) were found to have low annual income,Only (8.33 percent) of respondents have very high income i.e (above 5,00,001 Lakh)Thus, it can be concluded that majority of the respondents (70.00 percent) were in medium to low level of annual income categoryThese findings are consistent with the findings of samuel *et al.* (2013).



6) Credit facilities:

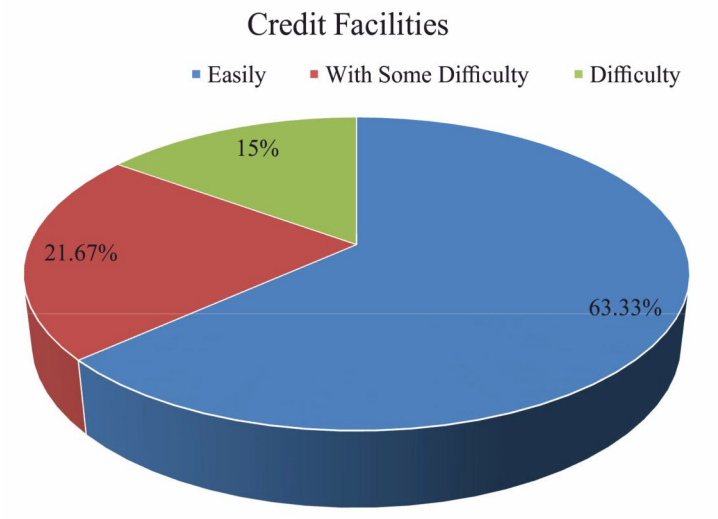
The data in Table 6 depicts that the majority of the respondents(63.33percent) stated easy available to credit facilities while (21.67percent) stated with some difficulty to available credit facilities and 15.00 percent reported difficulty for availing credit facilities.

Table: 6 Classification of respondents according to their Credit facilities

Sr. No	Credit facilities	Respondents (n=120)	
		Number	Percentage
1	Easy	76	63.33
2	With Some difficulty	26	21.67
3	Difficulty	18	15.00
	Total	**120**	**100.00**

Mean 8.3 S.D =1.38

Thus, it can be concluded that majority of the respondents (63.33 percent) possessed easily available to credit facilities. These findings are consistent with the findings of Reena rawat (2016).



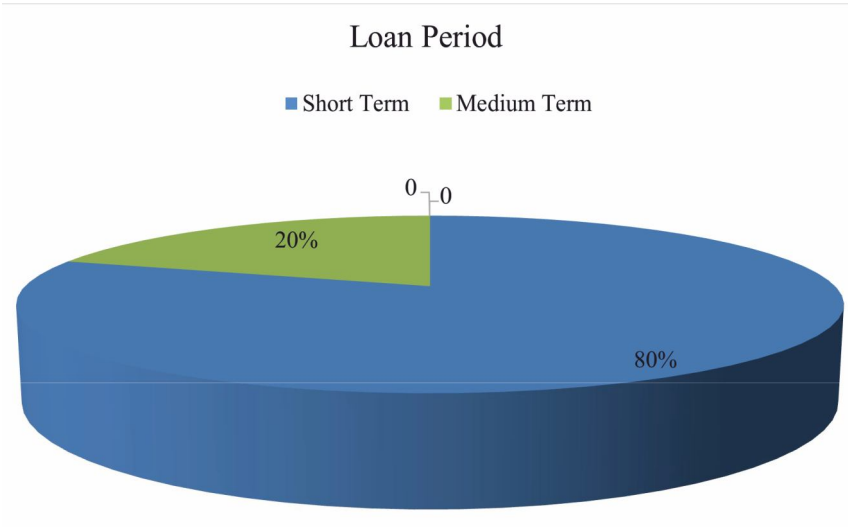
7) Loan period:

The data in table 7 and Fig 7 reported that majority(80.83 percent) of respondents were short term loan borrowers followed by medium term loan borrowers(19.17 percent).

Table 7 : Classification of respondents according to their Loan period

Sr. No	Loan period	Respondents (n=120)	
		Number	Percentage
1	Short term (6 months to 1 year)	97	80.83
2	Medium term (2 years to 5 years)	23	19.17
	Total	**120**	**100.00**

Thus, it can be concluded that majority of the respondent's are short term borrowers (80.00 percent)These findings are consistent with the findings of prasad (2004) and pamar (2008).



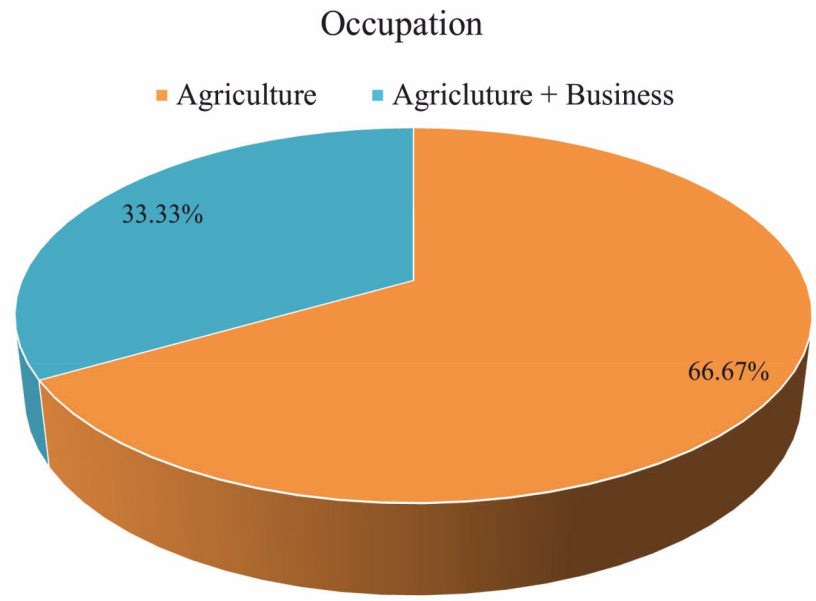
8) Occupation:

The proper use of credit utilizers increases the growth of Occupations. The data in Table 8 shows that out of the total 120 respondents, (66.67 percent) were engaged in agriculture, while (33.33 percent) were engaged in agriculture + business. Thus, it can be concluded that majority of the respondents have Agriculture as main source of income.

Table: 8 Classification of respondents according to their Occupation

Sr. No	Occupation	Respondents (n=120)	
		Frequency	Percentage
1	Agriculture	80	66.67
2	Agriculture + Business	40	33.33
	Total	**120**	**100.00**

Thus, it can be concluded that majority of the respondent's are doing Agriculture as main occupation. These findings are consistent with the findings of Ezihe *et al.* (2016)



9) Social participation:

Social participation denotes the extent to which an individual is actively involved in the affairs of the community. Those who have wider social participation are probably more community-oriented, knowledgeable and resourceful which may help better for credit utilization. Keeping this in view, social participation of the Loan borrowed farmers was studied and data are presented in Table 9 and Fig 9

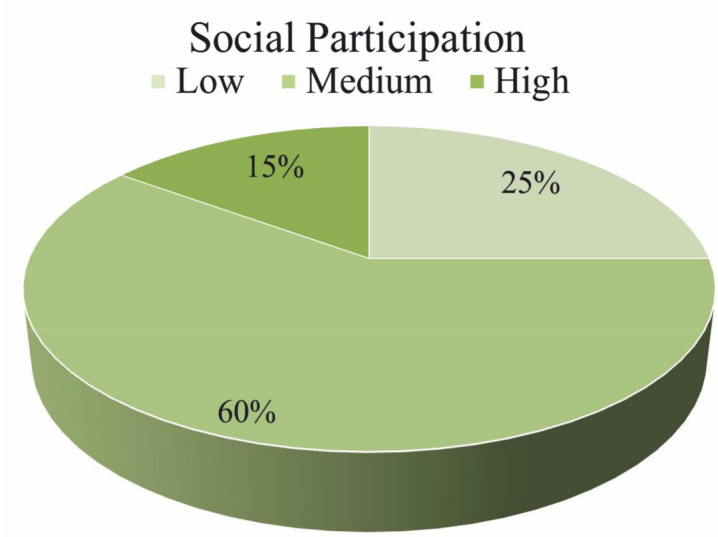
Table: 9 Classification of respondents according to their Social participation

Sr. No	Social participation	Respondents (n=120)	
		Frequency	Percentage
1	Low (up to 8.5)	30	25.00
2	Medium (8.6 to 15.9)	72	60.00
3	High (Above 15.9)	18	15.00
	Total	**120**	**100.00**

Mean 12.24 S.D = 3.74

The data depicted in Table 9 indicated that three fifth(60.00 percent) of the respondents had medium level of social participation, whereas, (25.00 percent)of respondents had low and (15.00 percent)respondents had high level of social participation.

From the above result, it can be concluded that majority(60.00 percent)of the Loan borrowed farmers had medium level of social participation.These findings are consistent with the findings of kumar (2002).



10) Cosmopoilteness:

The cosmopoilteness is the degree to which respondent is oriented to his immediate outside social system for various kinds of helps and guidance. This variable can play a vital role on the knowledge of the farmers. Person with high level of cosmopoilteness considers himself as an integral part of the larger world. Understanding importance of this variable, information was collected and based on analysis the Loan borrowed farmers were classified into three groups on the basis of their cosmopoilteness as shown in Table10

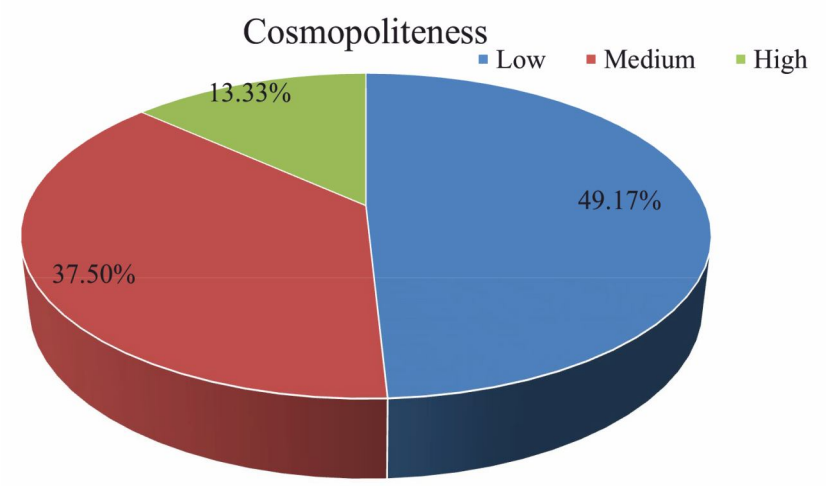
Table: 10 Classification of respondents according to their Cosmopoilteness

Sr. No	cosmopoilteness	Respondents (n=120)	
		Frequency	Percentage
1	Low (Up to 1)	59	49.17
2	Medium (1.1 to 3)	45	37.50
3	High (Above 3.1)	16	13.33
	Total	**120**	**100.00**

Mean 2.35 S.D =1.35

The data presented in Table 10 indicated that nearly half (49.17percent)had low level of cosmopoilteness followed by37.50 percent have medium leveland 13.33percentof the respondents had high level of cosmopoilteness.

From the above result, it can be concluded that large majority (86.67 percent) of the Loan borrowed farmers had low to medium level of cosmopoilteness.This result confirms the result reported by Reena rawat (2016).



11) Extension Contact:

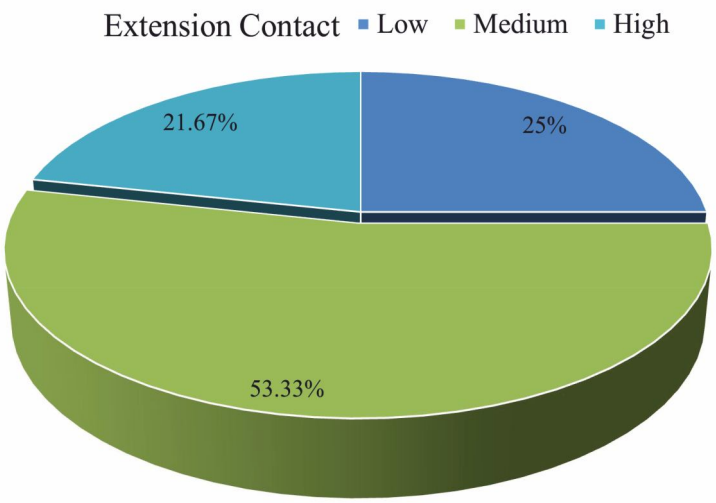
It was evident from the data presented in Table 11 that more than half (53.33 percent)of the loan borrowed farmers having medium extension contact,25.00 percent and 21.67 percent having low and high level extension contact, respectively

Table 11 : Classification of respondents according to their Extension Contact

Sr. No	Extension Contact:	Respondents (n=120)	
		Frequency	Percentage
1	Low (Up to 8.62)	30	25.00
2	Medium (8.63 to 15.48)	64	53.33
3	High (Above 15.49)	26	21.67
	Total	**120**	**100.00**

Mean 12.05 S.D =3.43

From the above result, it can be concluded that majority (78.33 percent) of the Loan borrowed farmers had mediumto low level of extension contact.This result confirms the result reported by Obaiah (2004) and Pradeep kumar *et al.* (2012).



12) Scientific orientation:

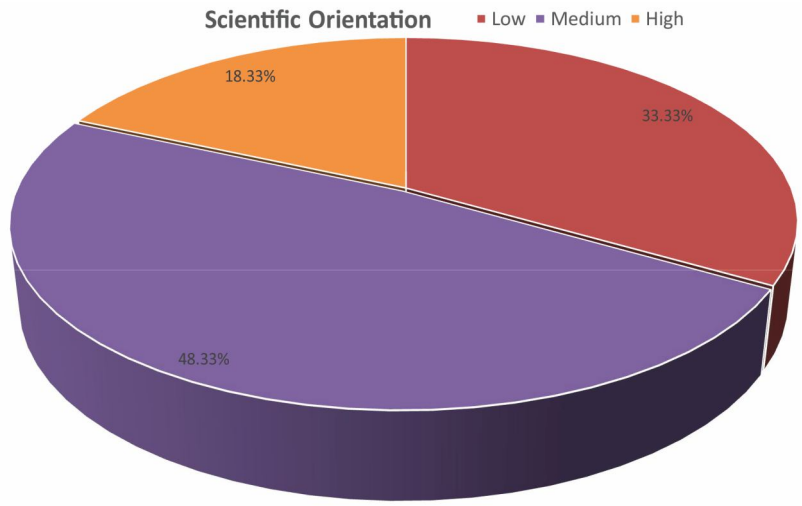
It was evident from the data presented in Table 12 that (48.33 percent) of the loan borrowed farmers having medium level of scientific orientation while 33.33 percent having low level and remaining 18.34 percent having high level Scientific orientation.

Table 12 : Classification of respondents according to their Scientific orientation

Sr. No	Scientific orientation	Respondents (n=120)	
		Frequency	Percentage
1	Low (Up to 15)	15	33.33
2	Medium (15.1 to 19)	58	48.33
3	High (Above 19)	22	18.34
	Total	**120**	**100.00**

Mean 17.29 S.D = 2.29

From the above result, it can be concluded that great majority (81.66 percent) of the Loan borrowed farmers have mediumto low level of scientific orientation.This result confirms the result reported by Rahul (2006) and Reena rawat (2016).



13) Risk Preference:

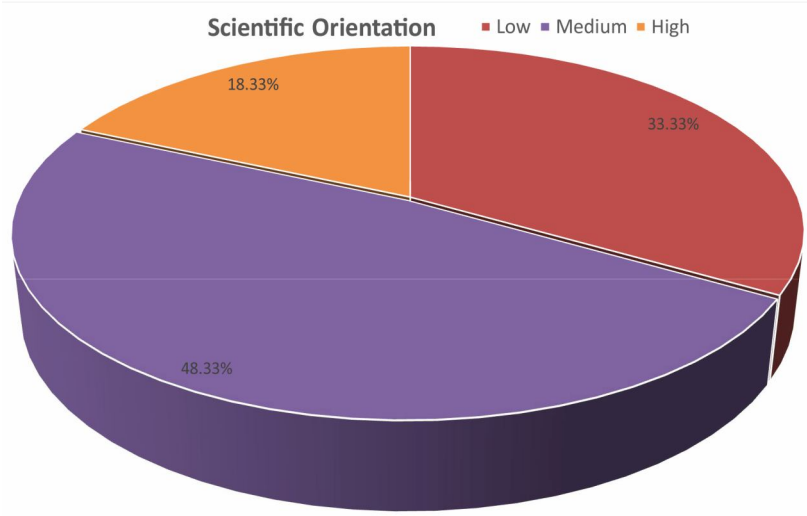
It was evident from the data presented in Table 13 That majority (63.33 percent) of the loan borrowed farmers were having medium level of risk preference followed by (26.67 percent) borrowers having high level and 10.00 percent having low level of risk preference.

Table 13 : Classification of respondents according to their Risk Preference

Sr. No	Risk Preference	Respondents (n=120)	
		Frequency	Percentage
1	Low (Up to 16.3)	12	10.00
2	Medium (16.4 to 19.1)	76	63.33
3	High (Above 19.2)	32	26.67
	Total	**120**	**100.00**

Mean 18.61 S.D = 1.31

From the above result, it can be concluded that great majority (90.00 percent) of the Loan borrowed farmers having medium to high level of risk preference .This result confirms the result reported by Kumar (2002) ,Suresh (2004) and Reena rawat (2016)



II) Constraints faced by borrowers in Obtaining loans and Repayment and Suggestions for effective Credit utilization.

Constraints faced by borrowers in Obtaining loans and Repayment

Constraints in credit utilization and repayment never end. However, they can be minimized. The respondents were requested to express the constraints faced by them Frequency and percentage for each constraint were calculated and on the basis of that and the results are presented below

S.No	Constraints	Frequency	Percentage
1	Providing Insufficient amount of Loan	120	100.00
2	Borrowing is lengthy process	104	86.60
3	More interest rate charges for late payment	86	71.60
4	Fulfillment of documentation	75	62.50
5	Insufficient time for repayment	67	33.50
6	If crop fails ,the recovery of loan period is not extending	65	54.10
7	Passbooks are retain at bank	62	51.60

As seen from the above table majority of respondents are stated major constraints viz. insufficient amount of loan (100.00 percent),Borrowing is lengthy process (86.60 percent) ,More interest rate charges for late repayment (71.60 percent) ,Fulfillment of documentation (62.50 percent), while slightly more than half told,If crop fails, the recovery of loan period is not extending (54.10 percent),and Passbooks are retain at bank (51.60 percent) are the constraints.

Suggestions for effective credit utilization:

Suggestions were invited from the respondents to overcome the constraints faced by them in management of ornamental nursery. In all five suggestions were made by the respondents as shown in the Table

Sr. No	Suggestions	Frequency	Percentage
1.	Loan should be available at proper time.	104	86.67
2.	Loan borrowing should be less documentation.	102	85.00
3.	Interest rate should be low.	96	80.00
4.	Recovery of loan period should be increased.	75	62.5
5.	Loan taken for hybrid and improved varieties crop finance should be given more.	60	50.00
6	Cooperation from bank staff.	35	29.16

It was observed from the above table majority of respondents suggested that Loan should be available at proper time (86.67 percent),Loan borrowing should be less documentation (85.00 percent),Interest rate should be low (85.00 percent), Recovery of loan period should be increased (62.50 percent), Loan taken for hybrid and improved varieties crop finance should be given more (50.00 percent) and Cooperation from bank staff (29.16 percent).

CONCLUSION:

Majority of the respondents had medium age group, primary level of education, medium level of farming experience, medium level of annual income and majority respondents possessing credit facilities easily. Majority of respondents taken short term loans, chosen main occupation as agriculture, medium level of social participation, low level of cosmopoilteness, medium level of extension contact, medium level of scientific orientation and medium level of risk preference. The major constraints faced by the loan borrowed farmers were that banks providing insufficient money , Borrowing procedure is time taking, more interest rate charges for late repayment and Fulfilment of

documentation were the major constraints faced by loan borrowed farmers.The majority of respondents suggested that loan should be available at proper time, Loan borrowing should be not be a lengthy process, interest rate should be low. Above are major suggestions given by loan borrowed farmers.

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