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Bhosale GB

Ph.D. Scholar, Department of
Agricultural Extension Education,
COA, V.N.M.K.V, Parbhani,
Maharashtra, India.

Kadam RP

Professor and Head, Department
of Agricultural Extension
Education, V.N.M.K.V, Parbhani,
Maharashtra, India

Kapse PS

Associate Professor,
Department of Agricultural
Extension Education, V.N.M.K.V,
Parbhani, Maharashtra, India

Jadhav AS

Senior Agronomist, Cotton
Research Scheme, V.N.M.K.V,
Parbhani, Maharashtra, India

Profiling farmers' socio-economic and agronomic attributes for climate resilience management in Marathwada

Bhosale GB, Kadam RP, Kapse PS and Jadhav AS

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Abstract

The present study was conducted during 2023–24 in the Marathwada region of Maharashtra to examine the profile characteristics of farmers. Out of the eight districts in the region, Nanded, Dharashiv, and Hingoli were purposively selected based on their significant climatic variability in terms of rainfall and temperature. Within each selected district, two tehsils were randomly chosen, resulting in a total of six tehsils. Further, two villages were randomly selected from each tehsil, and 15 farmers from each village were randomly chosen, making a total of 180 respondents. An ex-post facto research design was adopted, and data were collected using a pre-designed interview schedule. To ensure accuracy, validity, and completeness, farmers were personally contacted. Statistical tools such as frequency, percentage, mean, and standard deviation were employed for data analysis and interpretation. The findings revealed that the majority of farmers were middle-aged (58.89%) and educated up to the high school level (33.33%). Most farmers were small landholders (40.00%) and had a medium level of annual income (Rs.72,601 to Rs. 2,50,743) (75.00%). A majority had medium farming experience (54.44%) and relied on borewells as their primary source of irrigation (56.66%). The cropping pattern was found to be fair (67.22%). In terms of behavioral characteristics, most farmers exhibited a medium level of scientific orientation (55.00%), mass media exposure (58.89%), economic motivation (63.89%), risk orientation (65.56%), and awareness of climate-resilient agricultural (CRA) technologies (49.44%). Additionally, a medium level of farm mechanization (62.22%) and extension contact (61.67%) was observed among the respondents. These insights highlight the socio-economic and agronomic profile of farmers in the region, providing a foundation for developing targeted interventions to enhance their climate resilience management.

Keywords: Climate resilience, profile characteristics, Marathwada region

Introduction

Climate change poses significant challenges to the agricultural sector, particularly in regions like Marathwada, Maharashtra, where agriculture serves as the primary livelihood for the majority of the population. The region's vulnerability is exacerbated by its heavy dependence on monsoon rainfall, erratic weather patterns, and limited access to adaptive resources. Over the years, farmers in Marathwada have faced increasing hardships due to rising temperatures, irregular rainfall, and a higher frequency of extreme weather events, which directly affect crop productivity, soil health, and overall agricultural income. These climatic uncertainties have intensified risks in farming, making it essential to assess how farmers manage their agricultural resources and adapt to changing conditions. Understanding the socio-economic and agronomic profile characteristics of farmers is critical to formulating effective strategies that enhance climate resilience. Key factors such as age, education, landholding size, annual income, farming experience, source of irrigation, cropping pattern, scientific orientation, mass media exposure, economic motivation, risk orientation, awareness about climate-resilient agricultural (CRA) technologies, and extension contact influence farmers' ability to cope with climate variability. A comprehensive assessment of these characteristics will provide insights into the current state of climate resilience management among farmers and highlight the areas that require policy interventions and support. This study aims to analyze the profile characteristics of farmers in the Marathwada region, focusing on their socio-economic and agronomic conditions. By addressing

Corresponding Author:

Bhosale GB

Ph.D. Scholar, Department of
Agricultural Extension Education,
COA, V.N.M.K.V, Parbhani,
Maharashtra, India

this objective, the research seeks to generate actionable insights that can assist policymakers, agricultural extension agencies, and other stakeholders in designing targeted interventions to enhance farmers' adaptive capacity. Strengthening climate resilience in agriculture is crucial for ensuring sustainable farming practices, improving rural livelihoods, and mitigating the long-term impact of climate change in the region.

Materials and Methods

The present study was conducted during 2023–24 in the Marathwada region of Maharashtra, India, to examine the profile characteristics of farmers. The study area was selected purposively from the eight districts of the Marathwada region, focusing on three districts—Nanded, Dharashiv, and Hingoli—based on their significant climatic variability in terms of rainfall and temperature. Within each selected district, two tehsils were randomly chosen, resulting in a total of six tehsils for the study. Furthermore, two villages were randomly selected from each tehsil, and 15 farmers from each village were randomly chosen

as respondents, ensuring comprehensive representation. This sampling procedure resulted in a total of 180 respondents. An ex-post facto research design was adopted for the study, as it facilitates the investigation of existing phenomena without manipulation of variables. Data were collected using a pre-designed interview schedule to ensure the systematic collection of relevant information. Farmers were personally contacted to enhance the accuracy, validity, and completeness of their responses. Statistical tools such as mean, standard deviation, frequency and percentage were employed to analyze and interpret the data, allowing for a clear understanding of the socio-economic and agronomic profile characteristics of farmers and formulating effective strategies that enhance climate resilience.

Results and Discussion

1) Socio-economic and agronomic profile characteristics of farmers in the Marathwada region

Table 1: Profile characteristics of farmers

Sr. No.	Characteristics	Farmers (n = 180)	
		Frequency	Percentage
1	Age		
	Young (Up to 36 years)	32	17.78
	Middle (37 to 58 years)	106	58.89
	Old (59 years & above)	42	23.33
2	Education		
	Illiterate	16	8.89
	Primary school level	49	27.22
	High school level	60	33.33
	Jr. College level	28	15.56
	Diploma/ Graduation	27	15.00
3	Land holding		
	Marginal (up to 1.00 ha)	55	30.56
	Small (01 to 2.00 ha)	72	40.00
	Semi medium (2.01 to 4.00 ha)	39	21.67
	Medium (4.01 to 10.00 ha)	12	6.67
	Large (above 10.00 ha)	2	1.11
4	Annual income		
	Low (Up to Rs. 72,600)	22	12.22
	Medium (Rs. 72,601 to Rs. 2,50,743)	135	75.00
	High (Rs.2,50744 & above)	23	12.78
5	Farming Experience		
	Low (up to 9 years)	41	22.78
	Medium (10 to 35 years)	98	54.44
	High (36 years & above)	41	22.78
6	Source of Irrigation*		
	Well	65	36.11
	Borewell	102	56.66
	Canal	8	4.44
	River	3	1.67
	Farm Pond	2	1.11
	Pond	0	0.00
	No Source	20	11.11
7	Cropping Pattern		
	Poor	34	18.89
	Fair	121	67.22
	Good	25	13.89
8	Scientific orientation		
	Low	37	20.56
	Medium	99	55.00
	High	44	24.44
9	Mass media exposure		
	Low	47	26.11
	Medium	106	58.89

	High	27	15.00
10	Economic motivation		
	Low	36	20.00
	Medium	115	63.89
	High	29	16.11
11	Risk orientation		
	Low	28	15.56
	Medium	118	65.56
	High	34	18.89
12	Awareness about CRA Technologies		
	Low	52	28.89
	Medium	89	49.44
	High	39	21.67
13	Farm mechanization level		
	Low	51	28.33
	Medium	112	62.22
	High	17	9.44
14	Extension contact		
	Low	32	17.78
	Medium	111	61.67
	High	37	20.56

(*Multiple sources)

Table 1 indicated that, socio-economic and agronomic profile characteristics of farmers surveyed in the Marathwada region highlights the diversity and challenges in their agricultural practices.

Age: The majority of the farmers (58.89%) were in the middle age group (37 to 58 years), followed by older farmers (23.33%) and younger farmers (17.78%).

The findings reveal that the majority of the respondents belong to the middle-aged group. This demographic distribution indicates a significant predominance of middle-aged farmers in agricultural activities, which can be attributed to various socio-economic and cultural factors prevalent in the region. One probable reason for this observation is that middle-aged farmers are at a stage in their lives where they are actively involved in farming as a primary occupation, possessing both physical capability and adequate experience. They are more likely to have inherited farmland from their predecessors and are actively engaged in managing and expanding agricultural practices to sustain their livelihoods. The above results are in line with findings of Raghuvanshi, *et al.* (2017)^[11] and Chirde *et al.* (2024)^[3].

Education: A significant proportion of the farmers had attained high school education (33.33%), while 27.22% had completed primary education, 15.56% had educate up to Jr. College level, 15% had Diploma/Graduation level, however, 8.89% of the respondents were illiterate, indicating the need for targeted educational interventions.

The above finding shows that the majority of the respondents educated up to high school level. This indicates a moderate level of educational attainment among farmers, which can be attributed to increased access to primary and secondary education in rural areas over recent decades. High school education equips farmers with basic literacy and numeracy skills, enabling them to understand and adopt modern farming techniques and climate-resilient practices to some extent. The lower percentage of farmers with higher education levels, such as junior college or diploma/graduation, may reflect limited access to advanced education in rural areas and the necessity for many to join farming at an early age to support their families. The above results are in line with findings of Chouksey (2019)^[4] and Kanade (2020)^[7].

Landholding: Most farmers had small to marginal landholdings, with 40% classified as small farmers (1.01 to 2.00 ha) and 30.56% as marginal farmers (up to 1.00 ha), 21.67% had semi medium farmers. Only a small fraction (7.78%) owned medium or large farms (above 4.00 ha).

The above findings indicate that majority of the respondents belonged to the small landholding category. This distribution reflects the fragmented nature of agricultural land in the region, a common trend in rural India due to generational division of land among family members. Small and marginal farmers dominate the agrarian landscape, as these categories account for the majority of agricultural households. Such landholding patterns pose challenges for climate resilience, as small and marginal farmers often face resource constraints, limiting their capacity to adopt advanced agricultural practices or technologies. These findings underscore the importance of tailored interventions, such as promoting efficient resource utilization, access to credit, and climate-resilient technologies, to enhance the adaptive capacity of small and marginal farmers in the region. The above results are in line with findings of Kanade (2020)^[7] and Chirde *et al.* (2024)^[3].

Annual Income: The majority of farmers (75%) fell into the medium-income category (R.s 72,601 to R.s 2,50,743), while 12.78% earned high incomes and 12.22% had low annual incomes.

The findings reveal that the majority of respondents in the Marathwada region fall into the medium-income category. This indicates that most farmers have a stable yet modest source of income, likely derived from a combination of agriculture and supplementary activities such as livestock or seasonal labour. The lower proportion of farmers in the high-income category could be attributed to limited access to large-scale farming resources, advanced technologies, and high-value markets, while those in the low-income group may face constraints such as small landholdings, erratic rainfall, and inadequate financial support. These findings highlight the need for interventions such as income diversification, access to credit, and market linkages to improve financial stability and enhance the climate resilience of farmers in the region. The above results are in line with findings of Raghuvanshi, *et al.* (2017)^[11] and Chirde *et al.* (2024)^[3].

Farming Experience: Over half of the farmers (54.44%) had moderate farming experience (10 to 35 years), while the remaining were evenly split between low (up to 9 years) and high (36 years and above) experience levels.

The findings reveal that majority of respondents had a medium level of farming experience. This indicates that most farmers have accumulated a moderate duration of farming experience, which likely combines practical knowledge of traditional agricultural practices with some exposure to modern techniques. Farmers with medium experience are typically in their middle age, actively engaged in decision-making and farm management. The smaller proportion of farmers with high experience reflects the gradual transfer of responsibilities from older to younger generations. Similarly, the low-experience group may include younger farmers who are relatively new to farming or those returning to agriculture after pursuing alternative livelihoods. These findings suggest that medium-experience farmers are pivotal in adopting and implementing climate-resilient practices, as they have both the knowledge and willingness to adapt to changing climatic conditions. Strengthening their capacity through training and extension services can enhance resilience at the farm level. The above results are in line with findings of Chouksey (2019) [4] and Yadav (2021) [14].

Source of Irrigation: Borewells were the predominant source of irrigation (56.66%), followed by wells (36.11%). Other sources like canals (4.44%), pond (1.11%) and rivers (1.67%) were less common, while 11.11% of farmers lacked any irrigation source.

The findings reveal that majority of respondents in the Marathwada region rely on borewells as their primary source of irrigation, followed by wells. This highlights the dominance of groundwater-based irrigation in the region, which can be attributed to the arid and semi-arid climatic conditions of Marathwada and the limited availability of surface water resources. The above results are in line with findings of Raviya (2017) [12].

Cropping Pattern: The cropping pattern was rated as fair for most farmers (67.22%), while 18.89% had poor cropping practices, and 13.89% demonstrated good practices.

The findings indicate that majority of respondents in the Marathwada region had a fair cropping pattern. The seasonal distribution of crops shows a dominance of soybean as the primary Kharif crop (93.89%), followed by gram (61.1%) as the leading Rabi crop. This cropping pattern reflects the reliance on short-duration and drought-tolerant crops, given the region's semi-arid climate and water scarcity. The fair cropping pattern suggests that farmers are moderately diversifying their crops, incorporating a mix of cereals, pulses, and cash crops such as soybean and cotton, which provide income security. However, the low percentage of farmers with good cropping patterns and the presence of poor patterns indicate limited adoption of advanced crop diversification strategies. Factors such as small landholdings, dependence on rainfall and lack of awareness about climate-resilient cropping systems may contribute to this trend. Promoting crop rotation, mixed cropping, and integrated farming systems could enhance resilience and ensure better utilization of available resources. The above results are in line with findings of Ankita (2023) [11].

Scientific Orientation: A medium level of scientific orientation was observed in 55% of farmers, with 24.44% having a high orientation and 20.56% scoring low.

The findings reveal that majority of respondents in the

Marathwada region had a medium level of scientific orientation. This indicates that most farmers have a moderate inclination towards adopting scientific methods and technologies in agriculture, which may be influenced by exposure to extension services, awareness campaigns, or education. Farmers with medium scientific orientation are likely aware of the benefits of modern practices but may face barriers such as limited resources or technical support in fully implementing them. The above results are in line with findings of Haddimani (2016) [5] and Chouksey (2019) [4].

Mass Media Exposure: More than half of the farmers (58.89%) had medium exposure to mass media, while 26.11% had low exposure, and only 15% were highly exposed.

The findings indicate that most farmers in the Marathwada region had a medium level of mass media exposure, mainly accessing general agricultural updates and weather forecasts. Factors like time constraints, financial limitations, and inadequate infrastructure affected their engagement. High exposure was limited due to a lack of tailored content and digital literacy, while low exposure stemmed from barriers like illiteracy and affordability. Improving access to localized agricultural information and digital inclusion could enhance climate resilience awareness and decision-making. The above results are in line with findings of Chouksey (2019) [4] and Nirmal (2020) [10].

Economic Motivation: The economic motivation of farmers was predominantly medium (63.89%), with smaller percentages exhibiting low (20%) and high (16.11%) motivation levels.

The findings indicate that most farmers in the Marathwada region had a medium level of economic motivation, showing a balanced drive to improve income while facing constraints like limited resources and market challenges. High economic motivation was hindered by income uncertainties, while low motivation stemmed from risk aversion and subsistence farming. Enhancing credit access, market linkages, and capacity-building programs can strengthen farmers' economic motivation for sustainable agricultural growth. The above results are in line with findings of Murthy (2019) [9] and Nirmal (2020) [10].

Risk Orientation: The majority (65.56%) displayed a medium level of risk orientation, while 18.89% had high and 15.56% had low orientation.

The findings indicate that most farmers in the Marathwada region exhibited a medium level of risk orientation, showing cautious openness to new practices amid uncertainties like weather variability and market fluctuations. High risk orientation was limited due to resource constraints and lack of support, while low risk orientation was linked to traditional mindsets and subsistence farming. Strengthening policies on crop insurance, market access, and climate-resilient technologies can help mitigate risks and enhance farmers' resilience. The above results are in line with findings of Bhong (2019) [2] and Kharatmal (2021) [8].

Awareness about CRA Technologies: Awareness of climate-resilient agricultural (CRA) technologies was medium for 49.44% of farmers, low for 28.89%, and high for 21.67%.

The findings indicate that most farmers in the Marathwada region had a medium level of awareness about Climate-Resilient Agriculture (CRA) technologies, mainly limited to basic practices like water conservation and crop diversification. Moderate awareness reflects varying exposure to extension services and media campaigns, while low awareness stems from

literacy barriers and limited access to information. The low proportion of highly aware farmers highlights gaps in outreach on advanced CRA practices. Strengthening awareness programs, improving access to localized information, and enhancing capacity-building initiatives are essential for effective adoption of CRA technologies. The above results are in line with findings of Haddimani (2016)^[5] and Nirmal (2020)^[10].

Farm Mechanization: Most farmers (62.22%) had a medium level of farm mechanization, while 28.33% had low mechanization and only 9.44% were highly mechanized.

The findings reveal that the majority of respondents in the Marathwada region had a medium level of farm mechanization. This indicates that most farmers have access to and utilize some basic machinery for agricultural activities, such as ploughing, sowing, or threshing. Medium levels of mechanization are likely due to financial constraints, small landholdings, or a lack of awareness about advanced farm equipment, which limit the ability of farmers to invest in or adopt higher levels of mechanization. The smaller percentage of farmers with high mechanization levels highlights the challenges of affordability and limited availability of modern machinery in rural areas. Meanwhile, low levels of mechanization among some farmers may be attributed to reliance on traditional farming methods, lack of technical knowledge, or insufficient access to rental services for machinery. These findings emphasize the need for policies that promote affordable access to farm machinery, strengthen custom hiring centres, and provide training to farmers on the benefits and operation of advanced mechanization tools to improve productivity and resilience. The above results are in line with findings of Sangeetha (2013)^[13] and Hussain (2018)^[6].

Extension Contact: A medium level of contact with agricultural extension services was reported by 61.67% of farmers, with 17.78% having low and 20.56% having high levels of interaction.

The findings reveal that majority of respondents in the Marathwada region had a medium level of extension contact. This indicates that most farmers have periodic interactions with extension personnel, primarily those working at the village level, such as development officers or agricultural assistants, who are more accessible. These personnel play a crucial role in providing guidance on agricultural practices, climate-resilient technologies, and government schemes. However, less frequent contact with higher authorities may limit farmers' access to specialized or advanced agricultural advice. The medium level of extension contact can be attributed to the availability of village-level personnel and farmers' reliance on them for routine guidance. Limited contact with higher authorities might be due to logistical challenges, perceived inaccessibility, or a focus on immediate issues rather than long-term planning. Strengthening the extension system by improving the reach and quality of village-level services and encouraging higher authorities to engage more directly with farmers can help enhance the overall effectiveness of extension activities. The above results are in line with findings of Bhong (2019)^[2] and Chirde et.al (2024)^[3].

Conclusion

The socio-economic and agronomic profile of farmers in the Marathwada region reveals that the majority belong to the middle-aged group with moderate education, farming experience, and economic motivation. Small and marginal landholdings dominate, posing challenges for resource access and climate resilience. Farmers largely rely on groundwater for irrigation and follow a fair cropping pattern, primarily

cultivating soybean and gram. A medium level of mass media exposure, scientific orientation, and extension contact indicates partial awareness and adoption of modern agricultural practices. Similarly, farmers exhibit moderate risk orientation and awareness of Climate-Resilient Agriculture (CRA) technologies, reflecting cautious adoption due to uncertainties like climate variability and financial constraints. While mechanization and market access remain limited, strengthening extension services, improving access to credit, and promoting climate-resilient practices can enhance the adaptive capacity and sustainability of farmers in the region.

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