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Building resilience: Farmers' challenges and solutions to climate change in Marathwada

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Abstract

The present study was conducted during 2023–24 in the Marathwada region of Maharashtra, India, to examine the profile characteristics of farmers, identify the constraints they face due to climate change, and gather their suggestions for overcoming these challenges. Out of the eight districts in the Marathwada region, three districts i.e. 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 six tehsils for the study. Furthermore, 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 through a pre-designed interview schedule. Farmers were personally contacted to ensure accuracy, validity, and completeness of the responses. Statistical tools such as frequency, percentage, mean, standard deviation and ranks were employed for data analysis and interpretation. The findings revealed several major constraints faced by farmers due to climate change, including high costs of agricultural inputs (80.56%), lack of knowledge about effective climate change adaptation strategies (77.22%), low market prices for agricultural produce (75.56%), limited understanding of long-term climate change impacts (71.67%), increased frequency and severity of crop losses due to natural calamities (70.56%), and delays in settling crop insurance claims (66.11%). Farmers suggested that agricultural inputs should be made available at reasonable prices (81.67%), extension services should be strengthened to guide them on climate change adaptation strategies (78.33%), minimum support prices should be determined based on the cost of cultivation (76.11%), awareness campaigns should highlight the effects of climate change on agriculture (72.22%), government policies should support farmers during natural calamities (71.11%), and prompt crop assessments should facilitate early settlement of insurance claims (68.33%). These findings underscore the need for targeted interventions to address the identified constraints and implement the suggested measures, enabling farmers to better adapt to climate change impacts.

Keywords: Climate change, farmers' constraints, adaptation strategies, and resilience

Introduction

Climate change poses significant challenges to the agricultural sector, particularly in regions like Marathwada, Maharashtra, where agriculture remains the primary livelihood for the majority of the population. The region's vulnerability is exacerbated by its dependence on monsoon rainfall, erratic weather patterns, and limited access to adaptive resources. Over the years, farmers in Marathwada have faced increasing difficulties due to rising temperatures, irregular rainfall, and a higher frequency of extreme weather events, which directly impact crop productivity and agricultural income. To address these challenges, it is essential to gain a comprehensive understanding of both the socio-economic and agronomic profile characteristics of farmers and the constraints they face due to climate change. Additionally, gathering farmers' suggestions for overcoming these issues is crucial to developing effective strategies for resilience. This study aims to explore two key objectives: (1) to analyze the profile characteristics of farmers in the Marathwada region, and (2) to identify the constraints faced by farmers due to climate change and gather their proposed solutions.

By addressing these objectives, this research seeks to provide actionable insights that can guide policymakers, extension agencies, and other stakeholders in formulating strategies to mitigate the adverse effects of climate change on agriculture. Such efforts are vital to ensure sustainable agricultural practices, improve farmers' livelihoods, and promote climate resilience 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, identify the constraints they face due to climate change, and gather their suggestions for overcoming these challenges. 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, percentage, and rank analysis were employed to analyze and interpret the data, allowing for a clear understanding of the constraints faced by farmers and their suggested solutions to mitigate the effects of climate change.

Results and Discussion

1. Profile characteristics of farmers in the Marathwada region

Table 1 indicated that, the demographic and socio-economic profile of the 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%).

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.

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).

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

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.

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.

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.

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.

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

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.

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

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

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%.

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.

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.

2. Constraints faced by farmers due to climate change

An attempt was made to find out the constraints faced by the farmers due to climate change. The data concerning constraints is resented in table 2. Ranks were given on the basis of frequency and percentage.

Table 2: Constraints faced by farmers due to climate change (n- 180)

Sr. No.	Constraints	Frequency	Percent	Rank
1.	High cost of agricultural inputs. (Seeds, Fertilizers, and Pesticides etc.)	145	80.56	I
2.	Limited understanding of long term climate change impacts.	129	71.67	IV
3.	Delayed availability of essential agril. inputs disrupts planting schedules and crop management.	74	41.11	IX
4.	Lack of access to effective weather forecasting services.	65	36.11	X
5.	Lack of knowledge about effective climate change adaptation strategies.	139	77.22	II
6.	Increasing labour wage rates escalate production costs and reduce profitability.	103	57.22	VIII
7.	The frequency and severity of crop losses due to natural calamities have increased in recent years.	127	70.56	V
8.	Banks don't provide loans to farmers on time.	106	58.89	VII
9.	Low market prices for agricultural produce.	136	75.56	III
10.	Delay in settling crop insurance claims.	119	66.11	VI

The study revealed a range of constraints faced by farmers in the Marathwada region due to climate change, highlighting the significant challenges impacting agricultural productivity and sustainability (Table 2).

The high cost of agricultural inputs, such as seeds, fertilizers, and pesticides, emerged as the most critical constraint, reported by 80.56% of farmers and ranked first. This reflects the increasing burden of input costs on farmers, limiting their ability to adopt advanced farming practices and affecting overall profitability. A lack of knowledge about effective climate change adaptation strategies was identified as the second most significant constraint, with 77.22% of respondents acknowledging this issue. Limited awareness and understanding of adaptation practices hinder farmers' ability to mitigate the adverse impacts of climate change. The low market prices for agricultural produce ranked third, with 75.56% of farmers reporting this as a major challenge. Fluctuating market prices, coupled with inadequate support systems, undermine farmers' income stability and reduce their capacity to invest in resilient agricultural practices.

Farmers also cited a limited understanding of the long-term impacts of climate change (71.67%, Rank IV) and the increased frequency and severity of crop losses due to natural calamities (70.56%, Rank V) as critical challenges. These constraints underscore the urgent need for awareness campaigns and risk management strategies tailored to local climatic conditions. The delay in settling crop insurance claims (66.11%, Rank VI) and untimely provision of bank loans (58.89%, Rank VII) were also significant barriers, reflecting systemic inefficiencies in financial support

mechanisms. These issues exacerbate the financial vulnerability of farmers, especially during times of crisis.

Other notable constraints included increasing labour wage rates (57.22%, Rank VIII), which escalated production costs, and the delayed availability of essential agricultural inputs (41.11%, Rank IX), which disrupted planting schedules and crop management. Lastly, the lack of access to effective weather forecasting services was ranked tenth, with 36.11% of farmers reporting this issue. Accurate and timely weather forecasting is critical for planning and decision-making in agriculture, and its absence leaves farmers ill-prepared for climatic variations.

The findings highlight the multifaceted challenges faced by farmers due to climate change, emphasizing both systemic and operational issues. The predominance of cost-related constraints reflects broader economic challenges in the agricultural sector, exacerbated by inflation and supply chain inefficiencies. Additionally, the lack of knowledge and understanding about climate adaptation points to gaps in extension services and educational outreach. The issues related to market prices, financial support, and insurance delays suggest the need for policy interventions to ensure timely and adequate assistance to farmers. Furthermore, strengthening weather forecasting services and promoting access to real-time climate information can empower farmers to make informed decisions. Addressing these constraints through targeted programs and infrastructure development is essential for building resilience and ensuring the sustainability of agriculture in the region.

The above findings are in line with Shankara (2010) ^[5], Lal (2014) ^[3] and Chouksey (2019) ^[2].

3) Suggestions to overcome the effects of climate change

An effort was made to gather suggestions from farmers on

how to overcome the constraints they faced. The data concerning the farmer's suggestion is presented in table 3.

Table 3: Suggestions obtained from farmers to overcome constraints (n=180)

Sr. No	Suggestions	Frequency	Percent	Rank
1.	Strengthen the extension services to provide guidance on climate change adaptation strategies.	141	78.33	II
2.	Set up weather alert system that provides timely updates via SMS.	65	36.11	IX
3.	Agricultural inputs should be available on reasonable price.	147	81.67	I
4.	Minimum support price has to be given to crop produce based on cost of cultivation.	137	76.11	III
5.	Efforts should be made to create awareness among farmers about the effect of climate change on agriculture.	130	72.22	IV
6.	Conduct prompt crop assessment and surveys to facilitate early claim settlement.	123	68.33	VI
7.	Government policies should be made to support the farmers during natural calamities.	128	71.11	V
8.	Supply chain should be streamlined to ensure timely delivery of inputs.	74	41.11	VIII
9.	Loans should be made available to farmers in a timely and efficient manner.	108	60.00	VII

The study revealed several actionable suggestions from farmers to mitigate the constraints posed by climate change (Table 3). The most frequently suggested measure was ensuring the availability of agricultural inputs at reasonable prices, supported by 81.67% of respondents. High input costs have been a persistent challenge for farmers, and addressing this issue could alleviate financial stress and improve productivity. The second most emphasized suggestion was to strengthen extension services to provide guidance on climate change adaptation strategies, as indicated by 78.33% of the farmers. This reflects the critical need for targeted interventions and educational programs to empower farmers with the knowledge and skills required to adopt climate-resilient practices. Additionally, 76.11% of respondents suggested providing minimum support prices (MSP) based on the cost of cultivation, which could ensure income stability and encourage investment in sustainable agricultural practices.

Farmers also highlighted the importance of creating awareness about the effects of climate change on agriculture (72.22%) and implementing government policies to support farmers during natural calamities (71.11%). These recommendations underscore the necessity of bridging knowledge gaps and offering institutional support to enhance farmers' resilience to climate variability. Prompt crop assessments and early claim settlements (68.33%) and timely access to loans (60.00%) were also seen as vital measures to reduce financial vulnerability and facilitate quicker recovery from climate-induced losses.

Additional suggestions included streamlining the supply chain for timely delivery of agricultural inputs (41.11%) and establishing a weather alert system to provide updates via SMS (36.11%). While these measures ranked lower, they are essential for effective planning and risk management. Together, these recommendations highlight the importance of integrating economic, institutional, and technological solutions to address the multifaceted challenges faced by farmers. Collaborative efforts between government bodies, research institutions, and private entities will be crucial for implementing these suggestions and promoting climate-resilient agriculture.

The above findings are in line with Murthy (2019) ^[4] and Yadav (2021) ^[6].

Conclusion

The present study highlights the critical challenges faced by farmers in the Marathwada region due to climate change and

provides insights into their socio-economic profile, constraints, and potential solutions. The findings reveal that the majority of farmers are middle-aged, possess small landholdings, and fall under the medium-income category, reflecting the structural limitations in the region's agricultural landscape. The predominance of borewells as the primary source of irrigation further underscores the region's dependence on groundwater, highlighting the urgent need for sustainable water management practices.

Climate change has exacerbated existing challenges, with high agricultural input costs, inadequate knowledge of climate-resilient practices, and low market prices for produce emerging as the most significant constraints. These issues, combined with systemic inefficiencies in financial and insurance support mechanisms, hinder farmers' ability to adapt to changing climatic conditions.

Farmers' suggestions provide a roadmap for addressing these challenges. Ensuring affordable agricultural inputs, strengthening extension services, and implementing minimum support prices based on cultivation costs were among the most emphasized measures. Additionally, creating awareness about climate change, streamlining financial and insurance processes, and enhancing access to timely weather alerts were recommended to mitigate climate-related risks. Implementing these suggestions requires coordinated efforts from policymakers, research institutions, and extension agencies to create sustainable and resilient agricultural systems in the Marathwada region. Addressing these concerns can significantly improve the livelihoods of farmers while safeguarding the region's agricultural productivity against the impacts of climate change.

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