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Constraints faced by small and marginal farmers in the adoption of climate resilient agricultural technologies

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Abstract
Climate change is the critical challenge faced by agricultural communities, particularly for small and marginal farmers who are highly vulnerable to climate variability due to their limited access to resources, dependence on rainfed systems and socioeconomic constraints. Climate-resilient agricultural technologies such as soil and water conservation practices, improved agronomic methods, allied enterprises, and institutional interventions have the potential to mitigate risks and enhance farm productivity. However, the adoption of these technologies remains limited due to multiple constraints faced by the farmers. The present study is conducted to analyse the major barriers faced by farmers in the adoption of these technologies, which include socioeconomic, institutional, environmental and psychological constraints. The study is conducted in the Marathwada region of Maharashtra. A multistage random sampling technique was used to select 120 farmers from Parbhani and Hingoli districts who are primarily soyabean growers. The results reveal that farmers face multiple barriers, including a lack of timely information (100%), labour scarcity (99.17%), small landholdings (96.67%), and limited extension support. Financial constraints, such as high investment costs and inadequate credit support, further exacerbate these challenges. The study highlights the complex linkages of socioeconomic, institutional, financial, and psychological factors hindering technology adoption. To build climate resilience among small and marginal farmers, the study is important in recommending strengthening information delivery systems, enhancing extension support, improving credit and market facilities, and providing locally relevant training.

Keywords: Constraints, small and marginal farmers, climate-resilient technologies, climate vulnerability, adoption, Marathwada

Introduction

Agriculture in India is highly susceptible to climate risks, with small and marginal farmers being disproportionately affected due to limited resources and dependence on rainfall for irrigation. The Marathwada region of Maharashtra, characterised by a semi-arid climate and recurrent droughts, exemplifies one of the most climate-vulnerable areas. Within Marathwada, Parbhani and Hingoli districts are particularly vulnerable to climatic change, where farmers primarily cultivate soybean, cotton, sorghum, and pulses under rainfed conditions. Erratic monsoons, declining groundwater levels, and frequent crop failures increasingly affect the productivity and sustainability of agriculture in this region.

Climate-resilient technologies, including soil and water conservation measures, improved agronomic practices, allied enterprises, and institutional interventions, have been promoted to reduce climate risks and enhance resilience. However, their adoption among farmers is hindered by multiple barriers. Previous studies have highlighted various obstacles, including a lack of improved seeds and remunerative prices (Kalyan *et al.* 2011) [5], gaps in technical expertise and labour shortages (Tidke *et al.* 2012) [8], high input and labour costs (Kumar *et al.* 2014) [6], and difficulties in accessing timely and reliable weather information (Felke, 2015 and Rajesh *et al.* 2016) [3, 7]. In Maharashtra and other states, inadequate knowledge, weak extension services, financial limitations, and resistance to changing traditional practices have been identified as major obstacles (Bhong, 2019) [2]. Understanding these constraints is crucial for developing effective strategies to improve farmers' resilience to climate change, particularly for small and marginal farmers who are more vulnerable.

By identifying and addressing these challenges, policymakers can design targeted interventions that address farmers' needs and remove barriers, thereby enhancing the adoption of climate-resilient technologies.

Materials and Methods

The study was conducted in Parbhani and Hingoli districts of the Marathwada region of Maharashtra, which are among the highly vulnerable districts to climate variability due to erratic rainfall and frequent droughts (Adhav *et al*. 2021) [1]. From Parbhani district, Parbhani and Manwath tehsils were selected randomly, while Hingoli and Sengaon tehsils were chosen randomly from Hingoli district. Three villages were randomly selected from each tehsil, making a total of twelve villages. From each village, ten soybean farmers having small and marginal landholdings were selected using the nth sampling method, resulting in a sample size of 120 respondents.

Data were collected through personal interviews using a structured and pretested interview schedule in Marathi. Open-ended questions were used to allow farmers to freely express the constraints they faced in adopting climate-resilient technologies. Their responses were then categorised into three levels of severity: Severe, Partially Severe, and Not Severe, with scores of 3, 2, and 1 assigned, respectively. To determine the relative importance of each constraint, Weighted Scores were calculated. The constraints were then ranked according to their weighted scores to identify their relative severity. Descriptive statistics such as frequency, percentage, mean, and standard deviation were also used to support interpretation. The study followed an ex-post facto research design.

Results and Discussion

Table 1: Constraints faced by respondents in the adoption of climate-resilient technologies (N=120)

S. No.	Constraints	Frequency (%)			Weighted score (WS)	Rank
		Not severe	Moderately severe	Severe		
1	Inability to take risks	32 (26.67)	78 (65.00)	10 (8.33)	60.56	XV
2	Inability to accept new practices	37 (30.83)	73 (60.83)	10 (8.33)	59.17	XVI
3	Small size of the farm	0 (0.00)	4 (3.33)	116 (96.67)	98.89	III
4	More interested in following conventional practices	29 (24.17)	4 (3.33)	87 (72.50)	82.78	XIII
5	Increasing labour scarcity	0 (0.00)	1 (0.83)	119 (99.17)	99.72	II
6	High cost of inputs	0 (0.00)	6 (5.00)	114 (95.00)	98.33	V
7	Higher investment costs on farm implements	0 (0.00)	16 (13.33)	104 (86.67)	95.56	VII
8	Inadequate institutional financial support	6 (5.00)	48 (40.00)	66 (55.00)	83.33	XII
9	Lack of market access	21 (17.50)	32 (26.67)	67 (55.83)	79.44	XIV
10	Lack of savings	6 (5.00)	36 (30.00)	78 (65.00)	86.67	IX
11	Lack of awareness about climate change	112 (93.33)	8 (6.67)	0 (0.00)	35.56	XVII
12	Lack of timely information related to CRT	0 (0.00)	0 (0.00)	120 (100.00)	100.00	I
13	Lack of availability of improved seeds	0 (0.00)	59 (49.17)	61 (50.83)	83.61	XI
14	Poor information accessibility and utilisation of weather-based agro advisory services	0 (0.00)	52 (43.33)	68 (56.67)	85.56	X
15	Lack of support from extension agencies	0 (0.00)	17 (14.17)	103 (85.83)	95.28	VIII
16	Inability of the officials to provide services to all farmers during the peak period	1 (0.83)	8 (6.67)	111 (92.50)	97.22	VI
17	Insufficient need-based training on CRA	1 (0.83)	3 (2.50)	116 (96.67)	98.61	IV

As depicted in Table 1, the study identified multiple constraints that limit the adoption of climate-resilient technologies among small and marginal farmers. The most severe constraint reported by all farmers was a Lack of timely information related to climate-resilient technologies, with 100.00% of respondents rating it as severe (WS = 100.00, Rank I). This indicates that timely access to information is the most critical barrier, as also supported by the results found by Rajesh *et al*. (2016) [7], Feleke (2015) [3], and Sarita (2019). The second major constraint was increasing labour scarcity, reported as severe by 99.17 percent of farmers (WS=99.72, Rank II). Similarly, the small size of the farm (96.67% severe, WS=98.89, Rank III) and insufficient need-based training on Climate Resilient Agriculture (CRA) (96.67% severe, WS=98.61, Rank IV) were highly critical barriers limiting adoption. These results align with the findings of Jasna et. al. (2016) [4], Munde (2019), and Bhong (2019) [2], respectively.

High cost of inputs was a severe constraint for 95.00 percent of respondents (WS=98.33, Rank V), while the Inability of the officials to provide services to all farmers during the peak period (92.50% severe, WS=97.22, Rank VI) reflected institutional limitations. Higher investment costs on farm implements were reported as severe by 86.67% of respondents (WS=95.56, Rank VII), followed by Lack of support from extension agencies, severe for 85.83% (WS=95.28, Rank VIII). Financial difficulties such as lack of savings were reported as severe by 65.00% and partially severe by 30.00% of farmers (WS=86.67, Rank IX). Similarly, Inadequate institutional financial support was severe for 55.00% and partially severe for 40.00% of respondents (WS=83.33, Rank XII). These findings align with (2014), Bhong (2019) [2], and Mundhe (2019).

Information and input-related issues included Poor information accessibility and utilisation of weather-based agro advisory services (56.67% severe, 43.33% partially severe; WS=85.56, Rank X) and Lack of availability of improved seeds (50.83% severe, 49.17% partially severe; WS=83.61, Rank XI). Lack of market access was another key barrier, with 55.83% severe and 26.67% partially severe (WS=79.44, Rank XIV). Behavioural and psychological barriers were also reported, such as the respondents being more interested in following conventional practices was severe for 72.50% and partially severe for 3.33% (WS=82.78, Rank XIII). Inability to take risks was severe for only 8.33% but partially severe for 65.00% (WS=60.56, Rank XV). Similarly, the Inability to accept new practices was severe for 8.33% and partially severe for 60.83%

(WS=59.17, Rank XVI). Similar constraints were reported by Kumar et. al (2014) [6], Jasna et. al. (2016) [4], and (2014) The least important constraint was Lack of awareness about climate change, with 93.33% of respondents considering it not severe (WS=35.56, Rank XVII). Similar observations were made by Bhong (2019) [2] and Sarita (2019). This suggests that while awareness of climate variability exists, farmers are primarily constrained by structural, institutional, financial, and behavioural barriers.

Conclusion

Agriculture in Marathwada is highly vulnerable to droughts and irregular rainfall, which is more severe for small and marginal farmers due to a lack of access to resources and land fragmentation. Climate-resilient technologies (CRTs) can help minimise these risks, but their adoption is still very limited due to various constraints. This study found that the most serious constraints were a lack of timely information, labour scarcity, small farm size, insufficient training, and high input costs. Farmers also struggled with weak institutional support, lack of credit and savings, and problems in accessing quality seeds and markets. Some farmers were also hesitant to take risks or move away from traditional practices. On the other hand, the lack of awareness about climate change itself was not seen as a major barrier.

Overall, the study shows that adoption barriers are not caused by one factor alone but by a combination of technical, financial, institutional, and behavioural barriers. To improve adoption of climate-resilient technologies, farmers need better extension support, easier access to inputs and credit, practical and localised training and capacity development programs, and better institutional support, such as subsidies and crop insurance, to reduce risks. Addressing these issues is essential in strengthening the resilience and livelihoods of small and marginal farmers in climate-vulnerable regions like Marathwada.

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