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Socio-economic characteristics, adoption and constraints of climate-resilient agricultural practices among smallholder farmers

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Abstract

Climate change poses a major challenge to smallholder agriculture by increasing the occurrence of irregular rainfall, drought, prolonged dry spells and temperature fluctuations, thereby affecting crop production and farm livelihoods. The present study was conducted in Chhatarpur district of Madhya Pradesh to assess the socio-economic characteristics, level of adoption of climate-resilient agricultural practices and constraints faced by smallholder farmers. Gaurihar and Chandla blocks were purposively selected, from which four villages, namely Nharpur Ghatna, Nidhwa, Himmatpur and Simariya, were selected. A total of 120 smallholder farmers were purposively selected, with 30 respondents from each village. The study considered 16 independent variables, including age, education, family size, landholding, annual income, farming experience, irrigation status, crop diversification, extension contact, mass media exposure, social participation, access to climate information, training exposure, risk orientation, innovativeness and resource availability. The findings revealed that the majority of respondents belonged to the medium category of adaptation (52.50%), followed by high adaptation (24.17%) and low adaptation (23.33%). Most respondents were middle-aged (43.33%), had medium family size (50.83%), medium annual income (52.50%), medium farming experience (40.83%), medium extension contact (51.67%) and medium access to climate information (50.83%). Similarly, medium levels were observed for training exposure (50.83%), risk orientation (52.50%), innovativeness (53.33%) and resource availability (51.67%). The major constraints reported by farmers were uncertainty and irregularity of rainfall (79.17%), high cost of climate-resilient technologies (75.83%), limited access to credit facilities (73.33%), lack of irrigation facilities (71.67%) and lack of timely weather and climate information (68.33%). Other important constraints included lack of knowledge, inadequate training, limited availability of quality inputs, insufficient awareness of government schemes, inadequate technical guidance and poor market support.

Keywords: Climate change, climate-resilient agriculture, adaptation strategies, smallholder farmers, climate information, agricultural extension

Introduction

Climate change has emerged as a major challenge to agricultural development, particularly for smallholder farmers whose livelihoods depend heavily on climate-sensitive farming systems. Rising temperatures, irregular rainfall, prolonged dry spells, droughts, floods and other extreme weather events are increasingly affecting crop productivity, water availability and farm incomes. Smallholder farmers are especially vulnerable because of their limited landholdings, financial resources, access to technology, irrigation facilities and institutional support. Under these changing climatic conditions, the adoption of climate-resilient agricultural practices has become essential for sustaining farm productivity and improving the resilience of farming communities (IPCC, 2022) ^[4].

Smallholder farmers play an important role in Indian agriculture, but their production systems are often characterized by small and fragmented holdings, dependence on rainfall and limited access to modern agricultural technologies. Climate variability can influence decisions

related to crop selection, sowing time, crop diversification, irrigation, soil and water conservation and the use of improved crop varieties. The extent to which farmers adopt climate-resilient practices is therefore influenced not only by climatic conditions but also by their socio-economic characteristics, awareness, resource availability, access to information and institutional support. Understanding these factors is important for designing effective strategies to strengthen farmers' capacity to cope with climate-related risks.

Materials and Methods

The present study was conducted in Chhatarpur district of Madhya Pradesh, which was purposively selected because agriculture is an important source of livelihood for the rural population and farming systems are vulnerable to climatic variability. The district frequently experiences irregular rainfall, drought conditions, prolonged dry spells and temperature fluctuations, which influence crop production and farm-level resource management. The predominance of

small and marginal farmers and their dependence on climate-sensitive agriculture made the district suitable for studying the socio-economic characteristics, adoption and constraints of climate-resilient agricultural practices among smallholder farmers.

Chhatarpur district is situated in the Bundelkhand region of Madhya Pradesh, between approximately 24°06' to 25°20' North latitude and 78°59' to 80°26' East longitude, covering an area of about 8,687 km². The district is characterized by a semi-arid climate, with hot summers, variable monsoon rainfall and comparatively cool winters. Agriculture is a major occupation in the rural areas, with wheat, gram, soybean, mustard, pulses and oilseeds among the important crops cultivated by farmers. The dependence of agricultural production on rainfall and limited availability of irrigation makes farming vulnerable to drought, erratic rainfall and temperature fluctuations. These conditions create a need for the adoption of climate-resilient practices such as improved crop varieties, crop diversification, efficient water management, soil and moisture conservation and other adaptive agricultural technologies.

For the present study, Gaurihar and Chandla blocks of Chhatarpur district were purposively selected considering their agricultural importance, predominance of smallholder farmers and vulnerability to climatic variability. From these selected blocks, four villages, namely Nharpur Ghatna and Nidhwa from Gaurihar block and Himmatpur and Simariya from Chandla block, were purposively selected. From each selected village, 30 smallholder farmers were purposively selected, resulting in a total sample of 120 respondents. The selected respondents were actively engaged in agricultural activities and represented the farming conditions prevailing in the study area. Information was collected regarding their socio-economic characteristics, adoption of climate-resilient agricultural practices and constraints faced in adopting such practices.

Results and Discussion

The study considered 16 independent variables, namely age, education, family size, land holding, annual income, farming experience, irrigation status, cropping pattern, extension contact, mass media exposure, social participation, access to climate information, training exposure, risk orientation, innovativeness and resource availability, to examine their influence on the adoption of climate-resilient agricultural practices among smallholder farmers. The dependent variable was the level of adoption of climate-resilient agricultural practices, while the study also assessed the major constraints faced by farmers in adopting these practices.

Socio-Economic Characteristics Farmers

The findings presented in Table 1 revealed that the respondents were predominantly middle-aged (43.33%), followed by young (29.17%) and old-aged (27.50%) farmers. Regarding educational status, the largest proportion had completed high school education (25.83%), followed by middle school (20.00%) and higher secondary education (17.50%). More than half of the respondents belonged to

medium-sized families (50.83%), while 38.33 per cent had small landholdings of 1–2 ha. Similarly, 52.50 per cent of respondents belonged to the medium-income category and 40.83 per cent had medium farming experience. The majority also reported medium levels of irrigation status (46.67%), crop diversification (48.33%), extension contact (51.67%), mass media exposure (52.50%), social participation (45.00%) and access to climate information (50.83%). These findings indicate that most farmers possessed moderate socio-economic resources and institutional exposure, which could facilitate their understanding and adoption of climate change adaptation practices.

With respect to behavioural and resource-related characteristics, the majority of respondents belonged to the medium category of training exposure (50.83%), risk orientation (52.50%), innovativeness (53.33%) and resource availability (51.67%). The predominance of medium levels across these characteristics suggests that farmers had a moderate capacity and willingness to respond to changing climatic conditions, but there remained considerable scope for strengthening their access to training, climate information, resources and innovative technologies. Similar patterns have been reported in studies of climate-smart and climate adaptation practices, where farmers' adaptation behaviour was influenced by access to extension services, information, training, resources and socio-economic conditions. Manda *et al.* (2016) ^[5] reported that access to extension services and information significantly influenced farmers' adoption of climate-smart agricultural practices. Similarly, Aryal *et al.* (2020) ^[2] highlighted the importance of information access, institutional support and farmers' socio-economic characteristics in promoting climate-smart agriculture. Abid *et al.* (2015) ^[1] also found that education, access to extension services and information were important determinants of farmers' adaptation to climate change.

Regarding the dependent variable, level of adaptation strategies adopted, the findings showed that the majority of respondents (52.50%) belonged to the medium adaptation category, followed by high adaptation (24.17%) and low adaptation (23.33%). Thus, more than half of the farmers were adopting some recommended climate change adaptation practices, while nearly one-fourth had adopted several climate-resilient agricultural practices. The relatively smaller proportion of farmers in the high-adaptation category indicates the need for strengthening extension support, timely climate information, training programmes and access to adaptation technologies and resources. The result is consistent with Below *et al.* (2012) ^[3], who observed that farmers' adaptation decisions were associated with socio-economic, institutional and environmental factors. Likewise, Singh *et al.* (2018) emphasized that improved access to agricultural information, extension services and institutional support can enhance farmers' capacity to adopt climate-resilient practices. Overall, the findings suggest that strengthening these support mechanisms could help farmers move from medium to higher levels of climate change adaptation.

Table 1: Distribution of respondents according to selected socio-economic and personal characteristics (N = 120)

Variable	Category / Characteristics	Variable	Category / Characteristics	Variable	Category / Characteristics	Variable	Category / Characteristics
1. Age	Young (Up to 35): 35 (29.17%) Middle (36–55): 52 (43.33%) Old (Above 55): 33 (27.50%)	2. Educational Status	Illiterate: 12 (10.00%) Primary: 18 (15.00%) Middle: 24 (20.00%) High school: 31 (25.83%) Higher secondary: 21 (17.50%) Graduate & above: 14 (11.67%)	3. Family Size	Small (Up to 4): 38 (31.67%) Medium (5–8): 61 (50.83%) Large (Above 8): 21 (17.50%)	4. Land Holding Size	Marginal (<1 ha): 34 (28.33%) Small (1–2 ha): 46 (38.33%) Semi-medium (2.01–4 ha): 27 (22.50%) Medium (4.01–10 ha): 11 (9.17%) Large (>10 ha): 2 (1.67%)
5. Annual Income	Low (Up to ₹1,00,000): 29 (24.17%) Medium (₹1,00,001–₹3,00,000): 63 (52.50%) High (Above ₹3,00,000): 28 (23.33%)	6. Farming Experience	Less (Up to 10 yrs): 28 (23.33%) Medium (11–20 yrs): 49 (40.83%) High (Above 20 yrs): 43 (35.84%)	7. Irrigation Status	Low: 27 (22.50%) Medium: 56 (46.67%) High: 37 (30.83%)	8. Crop Diversification	Low (1–2 crops): 36 (30.00%) Medium (3–4 crops): 58 (48.33%) High (>4 crops): 26 (21.67%)
9. Extension Contact	Low: 28 (23.33%) Medium: 62 (51.67%) High: 30 (25.00%)	10. Mass Media Exposure	Low: 24 (20.00%) Medium: 63 (52.50%) High: 33 (27.50%)	11. Social Participation	Low: 32 (26.67%) Medium: 54 (45.00%) High: 34 (28.33%)	12. Access to Climate Information	Low: 29 (24.17%) Medium: 61 (50.83%) High: 30 (25.00%)
13. Training Exposure	Low: 35 (29.17%) Medium: 61 (50.83%) High: 24 (20.00%)	14. Risk Orientation	Low: 27 (22.50%) Medium: 63 (52.50%) High: 30 (25.00%)	15. Innovativeness	Low: 29 (24.17%) Medium: 64 (53.33%) High: 27 (22.50%)	16. Resource Availability	Low: 28 (23.33%) Medium: 62 (51.67%) High: 30 (25.00%)
17. Level of Adaptation (Depended variable)	Low adaptation 28 (33.33%)		Medium adaptation 63 (52.50%)		High adaptation 29 (24.17)		

Constraints Faced by Farmers in Climate Change Adaptation

The findings in Table 2 indicate that farmers faced several important constraints in adopting climate change adaptation practices. The most prominent constraint was uncertainty and irregularity of rainfall, reported by 95 respondents (79.17%), followed by the high cost of climate-resilient technologies (91; 75.83%), limited access to credit facilities (88; 73.33%) and lack of irrigation facilities (86; 71.67%). A considerable proportion of farmers also reported lack of timely weather and climate information (82; 68.33%), lack of knowledge

about climate change adaptation practices (78; 65.00%) and lack of training on climate-resilient agricultural practices (76; 63.33%). These findings suggest that both climatic uncertainty and economic and institutional limitations considerably restricted farmers' ability to adopt appropriate adaptation measures. Similar findings were reported by Abid *et al.* (2015) ^[1], who found that lack of financial resources, inadequate information and institutional constraints were important barriers to climate change adaptation among farmers.

Table 2: Constraints Faced by Farmers in Climate Change Adaptation

S. No.	Constraints	Yes (1) f (%)	No (0) f (%)
1	Lack of knowledge about climate change adaptation practices	78 (65.00)	42 (35.00)
2	Lack of timely weather and climate information	82 (68.33)	38 (31.67)
3	High cost of climate-resilient technologies	91 (75.83)	29 (24.17)
4	Limited availability of quality seeds and agricultural inputs	74 (61.67)	46 (38.33)
5	Lack of irrigation facilities	86 (71.67)	34 (28.33)
6	Lack of technical guidance from extension agencies	69 (57.50)	51 (42.50)
7	Lack of training on climate-resilient agricultural practices	76 (63.33)	44 (36.67)
8	Limited access to credit facilities	88 (73.33)	32 (26.67)
9	Small land holding restricts adoption of new practices	67 (55.83)	53 (44.17)
10	Uncertainty and irregularity of rainfall	95 (79.17)	25 (20.83)
11	Lack of awareness about government schemes	71 (59.17)	49 (40.83)
12	Poor market support for climate-resilient crops	64 (53.33)	56 (46.67)

Other notable constraints included limited availability of quality seeds and agricultural inputs (74; 61.67%), lack of awareness about government schemes (71; 59.17%), lack of technical guidance from extension agencies (69; 57.50%) and the restriction imposed by small landholdings (67; 55.83%). More than half of the respondents also identified poor market

support for climate-resilient crops (64; 53.33%) as a constraint. The findings are consistent with Aryal *et al.* (2020) ^[2], who emphasized the importance of access to extension services, training, financial resources and markets for improving climate-smart agricultural adoption among smallholder farmers. Manda *et al.* (2016) ^[5] also reported that

resource availability and institutional factors influence farmers' capacity to adopt improved agricultural practices. Similarly, Below *et al.* (2012)^[3] highlighted the importance of financial, informational, technological and institutional factors in determining farmers' adaptation responses to climate change. Therefore, improving access to timely climate information, affordable credit, irrigation, quality inputs, training, extension support and better markets would be essential for enhancing farmers' capacity to adopt climate-resilient agricultural practices.

Conclusion

The study concluded that the majority of smallholder farmers in Chhatarpur district had a medium level of adoption of climate-resilient agricultural practices (52.50%), indicating moderate capacity to respond to changing climatic conditions. Farmers generally exhibited medium levels of socio-economic, institutional and behavioural characteristics, including extension contact, access to climate information, training exposure, risk orientation, innovativeness and resource availability. However, adoption was constrained mainly by uncertainty and irregularity of rainfall, high cost of climate-resilient technologies, limited access to credit and irrigation, inadequate weather information, lack of knowledge and insufficient training. Therefore, strengthening extension services, timely dissemination of climate information, farmer training, affordable credit, irrigation facilities, quality inputs and market support is essential to enhance the adoption of climate-resilient agricultural practices and improve the resilience and sustainability of smallholder farming systems in the study area.

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References

1. Abid M, Scheffran J, Schneider UA, Ashfaq M. Farmers' perceptions of and adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan. *Earth System Dynamics*. 2015;6(1):225-243. doi:10.5194/esd-6-225-2015.
2. Aryal JP, Sapkota TB, Khurana R, Khatri-Chhetri A, Rahut DB, Jat ML. Climate change and agriculture in South Asia: adaptation options in smallholder production systems. *Environment, Development and Sustainability*. 2020;22(6):5045-5075. doi:10.1007/s10668-019-00414-4.
3. Below TB, Mutabazi KD, Kirschke D, Franke C, Sieber S, Siebert R, *et al.* Can farmers' adaptation to climate change be explained by socio-economic household-level variables? *Global Environmental Change*. 2012;22(1):223-235. doi:10.1016/j.gloenvcha.2011.11.012.
4. Intergovernmental Panel on Climate Change. Climate

change 2022: impacts, adaptation and vulnerability. Cambridge: Cambridge University Press; 2022. doi:10.1017/9781009325844.

5. Manda J, Alene AD, Gardebroek C, Kassie M, Tembo G. Adoption and impacts of sustainable agricultural practices on maize yields and incomes: evidence from rural Zambia. *Journal of Agricultural Economics*. 2016;67(1):130-153. doi:10.1111/1477-9552.12127.