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An assessment of farmers' knowledge and constraints regarding climate-smart agricultural practices

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Abstract

The present study was conducted in Panna district of Madhya Pradesh to assess the adoption of Climate-Smart Agriculture (CSA) practices among farmers and to identify the major constraints faced by them. A descriptive research design was adopted, and 120 farmers were selected from six villages of Panna and Ajaygarh blocks through purposive and random sampling techniques. Data were collected through a structured interview schedule and analysed using frequency, percentage and other appropriate statistical techniques. The findings revealed that the majority of respondents were middle-aged, had medium-sized families, were primarily engaged in agriculture, and possessed marginal landholdings. Most respondents had low annual income and medium levels of farming experience, extension contact, economic motivation, scientific orientation and risk orientation. Regarding adoption of CSA practices, 46.67 per cent of respondents had a low level of adoption, followed by 35.00 per cent with medium adoption and 18.33 per cent with high adoption. The major constraints faced by farmers were lack of technical knowledge and training on CSA technologies (90.83%), lack of awareness about CSA practices (90.00%), small landholding size (84.16%), inadequate financial support or difficulty in obtaining agricultural credit (72.50%) and high cost of CSA practices and technologies (64.17%). The study suggests strengthening farmer training, improving awareness and extension services, and facilitating access to institutional credit and affordable CSA technologies to enhance the adoption of climate-smart agricultural practices.

Keywords: Climate-smart agriculture, adoption, farmers, climate resilience, socio-economic characteristics, Panna district

Introduction

Agriculture plays a vital role in India's food security, employment generation, rural livelihood and economic development. The sector contributed about 18.3 per cent to India's Gross Domestic Product (GDP) in 2022–23 (MoA&FW, 2023) ^[5]. However, Indian agriculture is highly vulnerable to climate change due to increasing temperature, erratic rainfall, droughts, floods and other extreme weather events. Nearly 50 per cent of India's net sown area is rainfed and contributes around 40 per cent of the country's total food production, making a large proportion of agricultural production dependent on climatic conditions (FAO, 2023). Moreover, small and marginal farmers account for more than 86 per cent of the total operational landholdings in the country (Agriculture Census, 2015–16) ^[1]. Climate variability therefore poses a serious challenge to farm productivity, income and livelihood security, particularly for resource-constrained farmers. Climate change is expected to increase production risks and adversely affect agricultural systems unless appropriate adaptation measures are adopted (IPCC, 2019) ^[4].

Climate-Smart Agriculture (CSA) has emerged as an important approach for addressing the impacts of climate change while maintaining sustainable agricultural

development. According to FAO (2013) ^[2], CSA aims to achieve three major objectives: sustainably increasing agricultural productivity and incomes, strengthening resilience and adaptive capacity to climate change and reducing or removing greenhouse gas emissions wherever possible. CSA practices include crop diversification, conservation agriculture, efficient irrigation and water management, soil-moisture conservation, use of climate-resilient varieties, integrated nutrient management, crop rotation, rainwater harvesting and weather-based agricultural advisories. In India, the National Innovations in Climate Resilient Agriculture (NICRA) programme has promoted climate-resilient technologies and demonstrated their potential to reduce climatic risks and improve agricultural productivity (ICAR, 2023) ^[3].

Materials and Methods

The present study was conducted in Panna district of Madhya Pradesh, India, to assess the extent of adoption of climate-smart agriculture (CSA) practices among the farmers. Panna district is situated between 23°45' and 25°10' North latitudes and 79°45' and 80°40' East longitudes, covering an area of approximately 7,135 km², with an average elevation of about 416 metres above mean sea level. The Ken River flows

through the district and agriculture is an important source of livelihood for the rural population. According to the 2011 Census, Panna district had a population of 1,016,028, a population density of 142 persons per km², a sex ratio of 907 females per 1,000 males and a literacy rate of 66.08 per cent. Panna district was selected purposively due to the relevance of climate-related agricultural challenges in the area and the limited research available on the adoption of climate-smart agriculture practices among farmers. A descriptive research design was adopted for the present investigation, as it was considered appropriate for assessing and describing the existing level of adoption of recommended climate-smart agriculture practices among the selected farmers.

A combination of purposive and random sampling techniques was employed for the selection of the study area and respondents. Panna and Ajaygarh blocks were selected purposively from the five blocks of Panna district. Three villages from each selected block were chosen randomly, namely Pahadi Kheda, Diya and Umari from Panna block and Hardi, Dharpur and Khora from Ajaygarh block. From each selected village, 20 farmers were selected randomly, constituting a total sample of 120 respondents. The variables were selected in accordance with the objectives of the study and were categorized into independent and dependent variables. The independent variables comprised selected socio-personal, socio-economic, communication and psychological characteristics of the respondents, whereas the dependent variable was the extent of adoption of climate-smart agriculture (CSA) practices. The adoption level of respondents was assessed using a structured interview schedule comprising relevant climate-smart agricultural practices followed by the farmers. Appropriate scoring procedures and statistical techniques were employed to measure and analyse the adoption level and its association with the selected independent variables.

Data were collected through a structured interview schedule developed according to the objectives and variables of the study. The schedule was pre-tested and suitably modified before final data collection. The researcher personally interviewed the selected farmers at their farms or residences after establishing proper rapport with them and the responses were recorded systematically. The collected data were coded, scored and entered into a master sheet for analysis. Appropriate statistical techniques, including frequency, percentage, arithmetic mean, standard deviation, correlation coefficient and multiple regression analysis, were employed to analyse the data and determine the extent of adoption of climate-smart agriculture practices and the relationship of adoption with the selected independent variables.

Results and Discussion

This chapter presents the findings of the study entitled "Adoption of Climate-Smart Agriculture Practices among Farmers of Panna District of Madhya Pradesh." Data were collected from 120 randomly selected farmers from the selected villages of Panna and Ajaygarh blocks through a structured interview schedule and were systematically analysed and presented in tabular form. The chapter primarily focuses on the extent of adoption of recommended climate-smart agriculture (CSA) practices among the respondents. It presents the adoption status of farmers with respect to different climate-smart agricultural practices and further

examines the association between the adoption level and selected independent variables of the respondents.

Profile of the Respondents

The majority of respondents (65.84%) belonged to the middle-age group (36–55 years), followed by 21.60 per cent in the young-age group and 12.50 per cent in the old-age group. Thus, most respondents were middle-aged and actively engaged in farming activities.

The highest proportion of respondents (20.00%) had junior high school education, followed by 17.50 per cent each with primary and high-school education. About 16.66 per cent had intermediate education, while 15.83 per cent were illiterate and 12.50 per cent were graduates and above. Thus, the respondents had varying levels of educational attainment.

The majority of respondents (40.00%) belonged to the OBC category, followed by 25.84 per cent from the General category, 18.33 per cent from SC and 15.83 per cent from ST categories. Hence, OBC respondents constituted the largest social group in the study area.

The findings showed that 60.00 per cent of respondents belonged to joint families, whereas 40.00 per cent belonged to nuclear families. This indicates that the joint family system was more prevalent among the respondents.

A large majority of respondents (70.83%) had a medium-sized family (6–12 members), followed by 16.66 per cent with small families and 12.50 per cent with large families. Thus, medium-sized families predominated among the respondents.

Three-fourths of the respondents (75.00%) lived in pucca houses, while 25.00 per cent lived in mixed houses. None of the respondents reported living in kuccha houses, indicating comparatively better housing conditions among the respondents.

The largest proportion of respondents (40.00%) depended solely on agriculture, followed by 30.00 per cent who combined agriculture with labour. Agriculture along with service and business was reported by 17.50 and 12.50 per cent of respondents, respectively. Thus, agriculture was the main occupation of the respondents.

Nearly half of the respondents (48.33%) were marginal farmers with less than 1.00 ha of land, followed by 20.00 per cent medium farmers, 18.33 per cent small farmers and 13.34 per cent large farmers. This indicates that marginal landholders were predominant in the study area.

More than half of the respondents (52.00%) belonged to the low-income category (below ₹1 lakh), while 34.67 per cent had medium income and 13.33 per cent had high income. Thus, the majority of respondents had relatively low annual income.

The findings revealed that 44.16 per cent of respondents had low social participation, followed by 31.67 per cent with high and 24.17 per cent with medium social participation. Hence, a considerable proportion of farmers had limited participation in social organizations and activities.

The majority of respondents (58.33%) had sometimes contacted extension personnel, while 21.67 per cent had frequent and 20.00 per cent had rare contact. Thus, most respondents had a moderate level of interaction with extension agencies.

The majority of respondents (60.00%) had medium farming experience, followed by 23.33 per cent with low and 16.67

per cent with high experience. Therefore, most respondents possessed a moderate level of experience in farming.

About 65.00 per cent of respondents had a medium level of economic motivation, followed by 23.33 per cent with high and 11.67 per cent with low motivation. Thus, the majority showed a moderate desire to improve their economic condition through farming.

The largest proportion of respondents (45.00%) had a medium level of scientific orientation, followed by 30.83 per cent with high and 24.17 per cent with low scientific orientation. This indicates a moderate inclination towards scientific agricultural practices among most respondents.

The majority of respondents (60.00%) had a medium level of risk orientation, followed by 21.67 per cent with low and 18.33 per cent with high risk orientation. Thus, most

respondents showed a moderate tendency to take risks in agricultural decision-making.

Overall, the findings showed that most respondents were middle-aged, had medium-sized families, were mainly engaged in agriculture and possessed marginal landholdings. A majority had low annual income, medium farming experience, moderate extension contact, economic motivation, scientific orientation and risk orientation. These findings are broadly supported by Singh *et al.* (2020), Kumar *et al.* (2021), Meena *et al.* (2022), Patel *et al.* (2023) and Sharma *et al.* (2024), who reported that farmers' age, education, landholding, income, farming experience, extension contact and scientific orientation influence their adoption of improved and climate-resilient agricultural practices.

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

S. No.	Socio-economic characteristics	Category	Frequency	Percentage
1	Age	Young (up to 35 years)	26	21.60
		Middle (36–55 years)	79	65.84
		Old (above 55 years)	15	12.50
		Total	120	100.00
2	Education	Illiterate	19	15.83
		Primary school	21	17.50
		Junior high school	24	20.00
		High school	21	17.50
		Intermediate	20	16.66
		Graduate and above	15	12.50
		Total	120	100.00
3	Caste	ST	19	15.83
		SC	30	18.33
		OBC	48	40.00
		General	31	25.84
		Total	120	100.00
4	Family type	Nuclear family	48	40.00
		Joint family	72	60.00
		Total	120	100.00
5	Family size	Small (up to 5 members)	20	16.66
		Medium (6–12 members)	85	70.83
		Large (13 and above)	15	12.50
		Total	120	100.00
6	Housing pattern	Kuccha	0	0.00
		Pucca	90	75.00
		Mixed	30	25.00
		Total	120	100.00
7	Occupation	Agriculture	48	40.00
		Agriculture + labour	36	30.00
		Agriculture + service	21	17.50
		Agriculture + business	15	12.50
		Total	120	100.00
8	Land holding	Marginal (<1.00 ha)	58	48.33
		Small (1.00–2.00 ha)	22	18.33
		Medium (2.00–4.00 ha)	24	20.00
		Large (4.00 ha and above)	16	13.34
		Total	120	100.00
9	Annual income	Low (below ₹1 lakh)	63	52.00
		Medium (₹1–2 lakh)	41	34.67
		High (above ₹2 lakh)	16	13.33
		Total	120	100.00
10	Social participation	Low (up to 13)	53	44.16
		Medium (14–15)	29	24.17
		High (16 and above)	38	31.67
		Total	120	100.00
11	Extension contact	Rarely (6–9)	24	20.00
		Sometimes (10–12)	70	58.33

		Frequently (13–15)	26	21.67
		Total	120	100.00
12	Farming experience	Low (6–10)	28	23.33
		Medium (11–14)	72	60.00
		High (15–18)	20	16.67
		Total	120	100.00
13	Economic motivation	Low (up to 20)	14	11.67
		Medium (21–24)	78	65.00
		High (25 and above)	28	23.33
		Total	120	100.00
14	Scientific orientation	Low (10–12)	29	24.17
		Medium (13–14)	54	45.00
		High (15–16)	37	30.83
		Total	120	100.00
15	Risk orientation	Low (up to 19)	26	21.67
		Medium (20–24)	72	60.00
		High (25 and above)	22	18.33
		Total	120	100.00

Adoption level

The findings revealed that 46.67 per cent of the respondents had a low level of adoption of climate-smart agriculture practices, followed by 35.00 per cent who had a medium level of adoption. Only 18.33 per cent of the respondents showed a high level of adoption.

Table 2: Distribution of respondents according to their adoption level of climate-smart agriculture practices (N = 120)

S. No.	Adoption level	Frequency	Percentage (%)
1	Low (49–52)	56	46.67
2	Medium (53–55)	42	35.00
3	High (56–58)	22	18.33
	Total	120	100.00

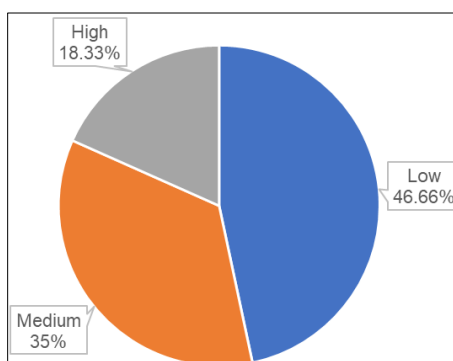


Fig 1: Distribution of respondents according to their adoption level of climate-smart agriculture practices (N = 120)

Constraints faced by farmers regarding Climate-Smart Agriculture practices

The findings indicated that lack of technical knowledge and training on Climate-Smart Agriculture (CSA) technologies was the major constraint, reported by 90.83 per cent of respondents and ranked first, followed by lack of awareness about CSA practices (90.00%) and small landholding size (84.16%), ranked second and third, respectively. Inadequate financial support or difficulty in obtaining agricultural credit (72.50%) and high cost of CSA practices and technologies

(64.17%) were ranked fourth and fifth.

Other constraints included non-availability of quality seeds and agricultural inputs (62.50%), limited access to extension and advisory services (43.33%), and lack of timely weather and climate information (37.50%). Poor market facilities and low prices (30.00%) and lack of irrigation facilities and water resources (14.17%) were ranked ninth and tenth, respectively. Overall, inadequate technical knowledge, awareness, landholding limitations and financial constraints were the major barriers to CSA adoption.

Table 3: Constraints Faced by Farmers in Adoption of Climate-Smart Agriculture Practices

S. No.	Constraint	Frequency (%)	Rank
1	Lack of awareness about Climate-Smart Agriculture practices	108 (90.00)	II
2	Lack of technical knowledge and training on CSA technologies	109 (90.83)	I
3	High cost of adopting CSA practices and technologies	77 (64.17)	V
4	Inadequate financial support or difficulty in obtaining agricultural credit	87 (72.50)	IV
5	Non-availability of quality seeds and other agricultural inputs	75 (62.50)	VI
6	Limited access to extension services and advisory support	52 (43.33)	VII
7	Lack of timely weather and climate information	45 (37.50)	VIII
8	Small landholding size limiting the adoption of CSA practices	101 (84.16)	III
9	Lack of irrigation facilities and water resources	17 (14.17)	X
10	Poor market facilities and low prices for agricultural produce	36 (30.00)	IX

Conclusion

The study concluded that the adoption of Climate-Smart Agriculture (CSA) practices among farmers of Panna district was generally low, with 46.67 per cent of respondents having a low level of adoption, followed by 35.00 per cent with medium and 18.33 per cent with high adoption. The major constraints were lack of technical knowledge and training (90.83%), lack of awareness (90.00%), small landholding size (84.16%), and inadequate financial support (72.50%). Therefore, strengthening farmer training and awareness programmes, improving extension support, and facilitating affordable credit and CSA technologies are essential for increasing the adoption of climate-smart agricultural practices in the study area.

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