

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 12; December 2025; Page No. 885-893

Received: 06-09-2025
Accepted: 15-10-2025

Indexed Journal
Peer Reviewed Journal

Profiling farmers' personal, socio-economic and psychological attributes influencing the adoption of climate-smart agricultural technologies in Chhattisgarh State

¹Saikiran Chintakindi, ²RS Sengar and ³Shaik Muneer

¹Assistant Professor, Department of Agriculture Extension, Chaitanya Deemed to be University, Hyderabad, Telangana, India

²Professor, Department of Agriculture Extension, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

³Senior Research Fellow, Economics and Policy Division, Global Centre of Excellence on Millets, IIMR, Hyderabad, Telangana, India

DOI: <https://www.doi.org/10.33545/26180723.2025.v8.i12l.2890>

Corresponding Author: Saikiran Chintakindi

Abstract

The present investigation was undertaken to study the profile characteristics of farmers practicing Climate-Smart Agricultural Technologies (CSATs) in Chhattisgarh State under varying agro-climatic conditions. An ex-post facto research design was adopted for the study. The sampling framework covered all three agro-climatic zones of the state, namely the Northern Hills, Chhattisgarh Plains, and Bastar Plateau. Using proportional random sampling, six districts were selected, followed by a multistage simple random sampling technique, resulting in the selection of 360 respondents from 24 villages across 12 blocks. Data were collected using a structured interview schedule and analyzed using frequency and percentage analysis. The findings revealed that a majority of the respondents were educated up to the middle school level (35%) and possessed medium farming experience (11–15 years). Most respondents belonged to the semi-medium farm size category, followed by medium holdings, and predominantly lived in nuclear families. Agriculture was the primary occupation for all respondents, with a considerable proportion combining it with business activities (33.05%). Livestock ownership was common, particularly cows, poultry, and buffaloes, contributing to livelihood diversification. Most respondents reported an annual family income of ₹2,00,001–3,00,000, with tubewells, canals, and wells as major sources of irrigation. Social participation was moderate, with over half of the respondents holding membership in two organizations, and medium extension contact (58.88%), mainly through input dealers and extension personnel. A majority exhibited medium levels of innovative proneness and risk orientation. Farm mechanization was moderate, with ownership of tractors, use of desi ploughs for tillage, pumps for irrigation, and knapsack sprayers for plant protection. Most respondents had medium perception of climate change (68.89%), medium ICT utilization, medium information needs, moderately favourable attitude towards CSATs and medium engagement with Weather-Based Agro-Advisory Services (69.72%).

Keywords: Adoption, climate change, personal, socio-economic and psychological profile

Introduction

Climate change is widely recognized as a major environmental and societal challenge confronting agriculture globally. Interactions among climate variability, unsustainable land management, land degradation, and greenhouse gas fluxes have adversely affected agricultural systems, leading to declining productivity and increased threats to food security (Barros *et al.*, 2014) [6]. These impacts are reflected in irregular rainfall, frequent droughts and floods, increased pest and disease incidence, and disrupted cropping calendars, resulting in higher production costs and reduced crop and livestock performance (Huho, 2012; Kangogo *et al.*, 2020) [14, 18]. In response to these challenges, Climate-Smart Agriculture (CSA) has emerged as a key approach to enhance agricultural productivity, resilience to climate change, and mitigation of greenhouse gas emissions (FAO, 2010; 2013).

Despite the recognized potential of CSA technologies, their adoption across farming systems remains limited. Empirical studies identify several constraints influencing adoption,

including institutional arrangements, limited technical skills and capacities, increased labour requirements, and the need for new knowledge and competencies (Lee, 2017; Andrieu *et al.*, 2017; Totin *et al.*, 2018; Anuga *et al.*, 2019; Fusco *et al.*, 2020; Tsige *et al.*, 2020; Mazhar *et al.*, 2021; Raj and Garlapati, 2020; Shahbaz, 2022) [25, 2, 45, 46, 29, 39, 44]. Additional barriers such as inadequate awareness, insufficient access to information, limited prior experience with new technologies, and farmers' perceptions and attitudes towards technological change further constrain adoption (Nyasimi *et al.*, 2017; Senyolo *et al.*, 2018; Ouédraogo *et al.*, 2019; Khoza *et al.*, 2021; Mashi *et al.*, 2022) [33, 43, 34, 21, 28].

Adoption decisions are further shaped by financial and non-financial incentives and disincentives. High initial investment costs, perceived incompatibility with existing farming practices, and uncertainty regarding expected benefits discourage uptake, whereas trialability, social learning, peer influence, visibility of benefits, and institutional support through extension, training, and

technical and financial assistance enhance adoption (Makate, 2019; Raile *et al.*, 2021; Totin *et al.*, 2018; Antwi-Agyei *et al.*, 2021; Casey *et al.*, 2021; Kabir *et al.*, 2022; Dey and Mishra, 2022; Waaswa *et al.*, 2022) [26, 38, 45, 3, 7, 17, 10, 47].

Beyond these factors, farmers' behavioural and psychological attributes such as innovative proneness, risk orientation, and perceptions of costs and risks significantly influence adoption decisions (Barzola and Dentoni, 2020; Kangogo *et al.*, 2021) [18]. Supported by theoretical frameworks including diffusion of innovations, the Theory of Planned Behavior, and utility-based approaches (Ajzen, 1991) [1], the adoption of CSA technologies is understood as a function of personal, socio-economic, institutional, and psychological factors. Accordingly, the present study examines the personal, socio-economic, and psychological profile characteristics of farmers practicing climate-smart agricultural technologies in Chhattisgarh State.

Methodology

The present study adopted an ex-post facto research design. According to Kerlinger (1973) [20], ex-post facto research is a form of systematic empirical enquiry in which the researcher does not have direct control over the independent variables, since their manifestations have already occurred or are inherently non-manipulable and continue to exist. The study was conducted in Chhattisgarh State, which is divided into three agro-climatic zones, namely Northern Hills, Chhattisgarh Plains, and Bastar Plateau. To ensure representation from all agro-climatic regions, districts were selected using proportional random sampling, wherein twenty per cent of the districts from each agro-climatic zone were selected. Accordingly, Surguja district was selected from the Northern Hills, Raipur, Rajnandgaon, Bemetara, and Dhamtari districts from the Chhattisgarh Plains, and Kanker district from the Bastar Plateau, making a total of six districts for the study. A multistage simple random sampling technique was employed for the selection of respondents. In the second stage, two blocks were randomly selected from each selected district, resulting in a total of twelve blocks. From each selected block, two villages were randomly selected, constituting a total of twenty-four villages. In the final stage, fifteen farmers were selected randomly from each village, resulting in a total sample size of 360 respondents ($24 \times 15 = 360$). The study focused on farmers practicing climate-smart agricultural technologies. Data were collected using a structured interview schedule. The collected data were coded, tabulated, and analyzed using appropriate statistical tools such as frequency distribution and percentage analysis and the results were presented accordingly.

Results and Discussion

The profile characteristics of the farmer respondents comprised education, farming experience, farm size, family type, cropping pattern, occupation, livestock possession, family annual income, availability of irrigation facilities, social participation, extension contact, innovative proneness, risk orientation, level of farm mechanization, farmers' perception towards climate change, ownership and extent of utilization of information and communication technologies (ICTs), sources of information on Climate-

Smart Agricultural Technologies, information needs related to Climate-Smart Agricultural Technologies, attitude of farmers towards Climate-Smart Agricultural Technologies and access to Weather-Based Agro-Advisory Services (WBAAS). Respondents were categorized into appropriate classes for each profile characteristic using the class-interval technique, and the resulting data were systematically analysed and discussed.

Education

Table 1 shows that 35.00 per cent of the respondents were educated up to middle school, followed by high school (21.11%) and primary education (16.67%). A small proportion were illiterate (7.50%), while only 6.11 per cent had attained graduation. Overall, 92.50 per cent of the respondents were literate, ranging from primary to college level. Education plays a vital role in enhancing access to information and is presumed to positively influence the adoption of Climate-Smart Agricultural Technologies. The above results are broadly supported by Chadachal (2017) [8], Nayak (2018) [32] and Chandrashekhara (2019) [9].

Table 1: Distribution of respondents according to their education (n=360)

Sl. No.	Education	Frequency	Percentage
1.	Illiterate	27	7.50
2.	Primary school	60	16.67
3.	Middle school	126	35.00
4.	High school	76	21.11
5.	Higher secondary school	49	13.61
6.	College graduate	22	6.11

Farming experience

Table 2 reveals that 31.94 per cent of the respondents had 11–15 years of farming experience, followed by 16–20 years (26.11%) and up to 10 years (22.50%), while 19.45 per cent had more than 20 years of experience. Overall, the majority of respondents possessed more than 10 years of farming experience. Farming experience increases with age and contributes to skill development and maturity in decision-making. Such experience is likely to facilitate the adoption of Climate-Smart Agricultural Technologies, as also reported by Laxman (2016) [24] and Prasad (2016) [37].

Table 2: Distribution of respondents according to their farming experience (n=360)

Sl. No.	Farming Experience	Frequency	Percentage
1.	Up to 10 years	81	22.50
2.	11-15 years	115	31.94
3.	16-20 years	94	26.11
4.	Above 20 years	70	19.45

Farm size

Table 3 shows that 38.06 per cent of the respondents possessed semi-medium farm size, followed by medium (24.72%), small (19.72%) and marginal holdings (12.50%). Only 5.00 per cent of the respondents had large landholdings. The predominance of semi-medium and medium farms may be attributed to ancestral landholdings and agriculture as the primary occupation. Larger farm size is presumed to facilitate greater adoption of Climate-Smart Agricultural Technologies, which is in conformity with the findings of Chadachal (2017) [8] and Pabba *et al.* (2021) [35]

Table 3: Distribution of respondents according to their farm size (n=360)

Sl. No	Farm size	Frequency	Percentage
1.	Marginal (Up to 1.0 ha)	45	12.50
2.	Small (1.01 to 2.0 ha)	71	19.72
3.	Semi medium (2.01 to 4.0 ha)	137	38.06
4.	Medium (4.01 to 10.0 ha)	89	24.72
5.	Large (Above 10.0 ha)	18	5.00

Family type

Table 4 indicates that two third (66.94%) of the respondents belonged to nuclear family and one third of respondents belonged to joint family.

Table 4: Distribution of respondents according to their Family type n=360

Sl. No	Family type	Frequency	Percentage
1.	Nuclear	241	66.94
2.	Joint	119	33.06

Cropping pattern

Regarding the cropping pattern, data presented in Table 5 indicate distinct zone-wise variations across the agro-climatic regions of Chhattisgarh. In the Chhattisgarh Plains, the predominant cropping pattern was Rice-Fallow, adopted by 25.00 per cent of the respondents. This was followed by Rice-Gram/Wheat/Sunflower (23.06%), Soybean +

Arhar/Kodo/Urd/Moong/Til + Arhar (14.17%), Maize-Urd/Chickpea (9.17%) and Soybean-Gram/Wheat (8.06%). Vegetable-Vegetable systems accounted for 6.94 per cent, while Rice-Rice/Maize (5.83%) and Sugarcane cultivation (5.00%) were less common. The Soybean + Arhar system was the least adopted, followed by only 2.78 per cent of the respondents.

In the Bastar Plateau, Rice-Fallow was the most prevalent cropping pattern (20.00%), followed by Millets/Niger-Fallow (16.67%) and Rice-Maize (15.00%). Pulse-based systems such as Arhar + Moong/Urd-Fallow were practiced by 13.33 per cent of farmers. Maize-Gram/Mustard (11.67%) and Rice-Wheat/Gram (10.00%) reflected a balanced cereal-legume combination. Vegetable-Vegetable and Maize-Fallow systems were each adopted by 5.00 per cent, while Sugarcane was the least practiced crop (3.33%). In the Northern Hills, Rice-Fallow emerged as the dominant cropping pattern (20.00%), followed by Millets/Niger-Fallow (16.67%) and Rice-Maize (15.00%). Both Arhar + Moong/Urd-Fallow and Rice-Wheat/Gram systems were practiced by 13.33 per cent of the respondents. Maize-Wheat/Mustard accounted for 10.00 per cent, while Fallow-Horse gram/Niger was followed by 13.33 per cent of farmers. Vegetable-Vegetable and Sugarcane cultivation were least prevalent, each adopted by 5.00 per cent of respondents.

Table 5: Distribution of respondents according to their Cropping pattern (n=360)

Agro climatic region	Cropping pattern	Frequency	Percentage
Chhattisgarh Plains n=240	Rice - Fallow	90	25.00
	Soybean - Gram / Wheat	29	8.06
	Soybean + Arhar / Kodo / Urd / Moong / Til + Arhar	51	14.17
	Rice - Gram / Wheat / Sunflower	83	23.06
	Maize - Urd / Chickpea	33	9.17
	Rice - Rice / Maize	21	5.83
	Vegetable - Vegetable	25	6.94
	Soybean + Arhar	10	2.78
	Sugarcane	18	5.00
Bastar Plateau n=60	Rice - Fallow	12	20.00
	Maize - Fallow	3	5.00
	Arhar + Moong / Urd - Fallow	8	13.33
	Millets / Niger - Fallow	10	16.67
	Maize - Gram / Mustard	7	11.67
	Rice - Maize	9	15.00
	Rice - Wheat / Gram	6	10.00
	Vegetable - Vegetable	3	5.00
	Sugarcane	2	3.33
Northern Hills n=60	Rice - Fallow	12	20.00
	Maize - Fallow	4	6.67
	Fallow - Horse Gram / Niger	8	13.33
	Arhar - Fallow	10	16.67
	Rice - Wheat	8	13.33
	Sugarcane	9	15.00
	Maize - Wheat / Mustard	6	10.00
	Vegetable - Vegetable	3	5.00

Occupation

The respondents' occupation is their primary source of income and helps to meet their basic needs. All respondents in the study area depend on agriculture for their livelihood.

Distribution of respondents according to their occupation

Table 6.1 indicates that 100 per cent of the respondents were engaged in agriculture and allied activities. In addition,

33.05 per cent combined agriculture with business, 14.16 per cent were involved in labour, 9.72 per cent pursued agriculture with other occupations, and only 2.50 per cent combined agriculture with service. These results confirm agriculture as the primary occupation of farm families, with other activities serving as supplementary income sources. Similar findings were reported by Joshi (2016) ^[16], Parganiha (2016) ^[36] and Nayak (2018) ^[32].

Table 6.1: Distribution of respondents according to their occupation

Sl. No	Occupation	Frequency*	Percentage
1.	Agriculture and allied occupation	360	100
2.	Agriculture + Labour	119	33.05
3.	Agriculture + Service	9	2.5
4.	Agriculture + Business	51	14.16
5.	Agriculture + Other occupation	35	9.72

*Based on multiple response

Involvement in Agricultural and allied occupation

Table 6.2 indicates that 100 per cent of the respondents were engaged in agriculture, followed by horticulture (76.66%), animal husbandry (54.44%), goaterly (8.04%), fishery (5.27%), poultry (4.16%) and piggery (1.66%). Engagement in allied activities reflects occupational diversification alongside agriculture, which may support adaptation to climate-related risks.

Table 6.2: Distribution of respondents according to their agricultural and allied occupation

Sl. No	Occupation	Frequency*	Percentage
1.	Agriculture	360	100
2.	Horticulture	276	76.66
3.	Animal husbandry	196	54.44
4.	Fishery	19	5.27
5.	Goaterly	29	8.05
6.	Poultry	15	4.16
7.	Piggery	6	1.66
8.	Other (Mushroom, Agroforestry, Sericulture etc.)	26	7.22

*Based on multiple response

Livestock possession

With respect to livestock possession, Table 4.14 shows that 31.94 per cent of the respondents owned cows, followed by poultry (23.88%) and buffaloes (18.05%). Goat and sheep ownership was reported by 10.83 per cent and 5.27 per cent of the respondents, respectively, while only 3.61 per cent possessed pigs. Ownership of multiple livestock species reflects diversified income sources among farm households.

Table 7: Distribution of respondents according to their livestock possession

Sl. No	Livestock Possession	Frequency	Percentage
1.	Buffalo	65	18.05
2.	Cow	115	31.94
3.	Poultry	86	23.88
4.	Goats	39	10.83
5.	Sheep	19	5.27
6.	Pig	13	3.61

*Based on multiple response

Family annual income

Annual income is defined as the sum of total earnings from all sources in a year. Because agriculture is the respondent's primary source of income, implementing new agricultural technologies necessitates significant financial resources. Farmers with limited income and resources were unable to afford the transaction costs required for adaptation measures, and they were sometimes unable to make effective use of the knowledge they do have.

The data of the annual income of the respondents is given in table 8 that 35.00 per cent of the respondents had an annual income between Rs. 200001- 300000 followed by 21.94 per cent, 19.17 per cent and 16.67 per cent with annual income Rs. 100001-200000, Rs. 300001-400000, and up to Rs. 100000 respectively, whereas only 7.22 per cent respondents had annual income More than 400000.

Table 8: Distribution of respondents according to their Family annual income n=360

Sl. No	Family annual income	Frequency	Percentage
1.	Up to 100000	60	16.67
2.	100001-200000	79	21.94
3.	200001-300000	126	35.00
4.	300001-400000	69	19.17
5.	More than 400000	26	7.22

The majority of the respondents belonged to the annual family income category of ₹2,00,001–3,00,000. This may be attributed to the predominance of semi-medium to medium farm sizes and agriculture as the primary occupation among respondents. Similar findings were reported by Laxman (2016) ^[24] and Prasad (2016) ^[37].

Irrigation facilities

Irrigation facilities have a direct influence on agricultural production and productivity. Climate change is expected to affect agriculture primarily through its impacts on the water cycle, including increased evaporative demand and changes in rainfall volume and distribution, which in turn influence crop performance. Availability of irrigation is also closely linked with area coverage during the rabi season. Table 9.1 reveals that 73.06 per cent of the respondents had access to irrigation facilities, whereas 26.94 per cent did not have any irrigation facilities.

Table 9.1: Distribution of respondents according to availability of Irrigation facilities n=360

Sl. No	Irrigation facilities	Frequency	Percentage
1.	Available	263	73.06
5.	Unavailable	97	26.94

Table 9.2 indicates that 70.28 per cent of the respondents used tubewells as the primary source of irrigation, followed by canals (30.00%), wells (10.55%), ponds (5.55%), rivers (2.50%) and other sources (1.94%). The predominance of tubewell irrigation reflects its importance in the study area. Similar findings were reported by Chandrashekhar (2019) ^[9] and Kapuria.

Table 9.2: Distribution of respondents according to source of Irrigation facilities

Sl. No	Irrigation facilities	Frequency*	Percentage
1.	Well	38	10.55
2.	Pond	20	5.55
3.	Tubewell	253	70.28
4.	Canal	108	30
5.	River	9	2.5
6.	Others (Water Tank)	7	1.94

*Based on multiple response

Social Participation

Human beings are social entities and function within organized social systems. In the present study, social participation refers to respondents' involvement in formal and informal organizations as members, office bearers, or both. Data presented in Table 10 show that the majority of respondents (55.83%) were members of two organizations, followed by membership in one organization (14.17%) and more than two organizations (13.61%). About 12.22 per cent of respondents served as office bearers, while 4.17 per cent had no membership in any organization. Regular participation, particularly in cooperative societies and Gram Sabha, may enhance awareness and information exchange related to Climate-Smart Agricultural Technologies. These

findings are in agreement with Manjusha *et al.* (2019) and Sardhara *et al.* (2020) ^[42], but are contrary to the observations of Atheequilla *et al.* (2021) ^[5] and Kumar (2023) ^[23].

Table 10: Distribution of respondents according to their social participation n=360

Sl. No.	Social participation	Frequency*	Percentage
1.	No participation	15	4.17
2.	Member of one organization	51	14.17
3.	Member of two organization	201	55.83
4.	Member of more than two organization	49	13.61
5.	Office bearer	44	12.22

Extension contact

With regards to contact of respondents with extension personnel, the respondents were asked about their contact with six enlisted personnel (RAEO, Progressive farmers, RAEs/RHEOs/VFOs, SMS/Agricultural scientist, Cooperative institutes, NGOs and Input dealers). Table 11 describes that the respondent had extension contact with Input dealers ranked 1st followed by RAEs/RHEOs/VFOs and Progressive farmers ranked 2nd and 3rd with extension contact.

Table 11.1: Distribution of respondents according to their extension contacts

Sl. No	Items	Regularly		Occasionally		Never	
		F	%	F	%	F	%
1.	Input dealers	258	71.66	94	26.11	8	2.22
2.	Progressive farmers	193	53.61	126	35	41	11.38
3.	RAEOs/RHEOs/VFOs	251	69.72	12	3.33	97	26.94
4.	SMS/Agricultural scientist	52	14.44	164	45.55	114	31.67
5.	Cooperative institutes	78	21.66	184	51.11	98	27.23
6.	NGOs	30	8.33	119	33.05	210	58.33

Where, F= Frequency

Table 11.1 indicates that input dealers ranked first in terms of extension contact, followed by RAEs/RHEOs/VFOs and progressive farmers. A majority of the respondents (71.66%) had regular contact with input dealers, while 26.11 per cent and 2.22 per cent reported occasional and no contact, respectively. Regular contact with RAEs/RHEOs/VFOs was reported by 69.72 per cent of respondents, whereas 26.94 per cent had no contact and 3.33 per cent had occasional contact. About 31.67 per cent of

respondents never contacted subject matter specialists/agricultural scientists, while 45.55 per cent and 14.44 per cent reported occasional and regular contact, respectively. Most respondents (58.33%) had no contact with NGOs, whereas 33.05 per cent and 8.33 per cent reported occasional and regular contact. These findings are in agreement with Renuka (2020) ^[40], Sardhara *et al.* (2020) ^[42], and Muralikrishnan *et al.* (2021) ^[31].

Table 11.2: Distribution of respondents according to their overall level of extension contacts n=360

Sl. No.	Category	Frequency	Percentage
1.	Low extension contact (Score up to 6)	33	9.17
2.	Medium extension contact (Score 6 to 9)	212	58.89
3.	High extension contact (Score more than 9)	115	31.94

Table 11.2 further reveals that the majority of respondents (58.89%) had a medium level of extension contact, followed by high (31.94%) and low (9.17%) levels. The predominance of medium to low extension contact suggests the need for enhanced technical guidance to promote the adoption of Climate-Smart Agricultural Technologies. Similar observations were reported by Khuspe and Kadam (2012) ^[22] and Jamadar (2012) ^[15]. Engagement with extension services, including access to subsidies under

agricultural development programmes, may further motivate farmers to participate in extension activities and acquire knowledge related to improved technologies and practices Innovative proneness.

Table 12 reveals that the respondents exhibited an average level of innovative proneness, indicating a moderate socio-psychological inclination toward accepting change and adopting new ideas and practices. Respondents with higher innovative proneness are more likely to adopt Climate-

Smart Agricultural Technologies. Similar findings were reported by Nayak (2018) ^[32] and Chandrashekhar (2019) ^[9].

Table 12: Distribution of respondents according to their level of innovative proneness n=360

Sl. No.	Innovative proneness	Frequency	Percentage
1.	Low (Score Up to 9)	86	23.89
2.	Medium (Score 9 to 13)	182	50.55
3.	High (Score more than 13)	92	25.56

Table 13: Distribution of respondents according to their level of Risk Orientation n=360

Sl. No.	Risk Orientation	Frequency	Percentage
1.	Low (Score Up to 11)	100	27.78
2.	Medium (Score 11 to 16)	219	60.83
3.	High (Score more than 16)	41	11.39

The majority of the respondents exhibited medium to low risk orientation, indicating a moderate willingness to adopt Climate-Smart Agricultural Technologies. A smaller proportion with high risk orientation may be attributed to larger farm size and greater farming experience. These findings are in conformity with the results reported by Parganiha (2016) ^[36] and Nayak (2018) ^[32]

Farm mechanization level

Table 14 indicates that under the prime mover category, 14.73 per cent of the respondents owned tractors, while only 1.39 per cent possessed power tillers. For tillage and seedbed preparation, the majority of respondents used desi

Risk Orientation

Individual's risk-bearing ability is determined by their personal, psychological, and socio-economic qualities. The degree to which a respondent is oriented toward risks and uncertainty due to changing climatic circumstances, and have the capacity to face various hazards associated with farming, and other activities.

The data in table 13 is revealed that more than half (60.83%) of the respondents belonged to medium level of risk orientation followed by low (27.78%) and high (11.39%) level of risk orientation category.

ploughs (38.05%), followed by cultivators (16.11%) and rotavators (12.78%). About 11.94 per cent of the respondents owned drum seeders for sowing operations. For irrigation purposes, most respondents (80.83%) used pumps, whereas only 8.61 per cent owned engines. Knapsack sprayers were predominantly used for plant protection by 70.83 per cent of respondents, while 26.67 per cent and 6.11 per cent used power sprayers. Only 0.55 per cent of respondents owned combine harvesters for harvesting operations. These findings are in agreement with the results reported by Salini (2017) ^[41] and Aruna *et al.* (2024) ^[4].

Table 14: Distribution of respondents according to level of farm mechanization

Operations	Equipment's	Frequency*	Percentage
Prime movers	Tractor	53	14.73
	Power tiller	5	1.39
Tillage and seedbed preparations	Cultivator	58	16.11
	Rotavator	46	12.78
	Desi Plough	137	38.05
	Cage wheels	26	7.22
Sowing/planting	Leveller	13	3.61
	Harrow	19	5.28
	Disc harrow	8	2.22
	Paddy transplanter	11	3.06
	Drum seeder	43	11.94
	Engines	31	8.61
Irrigation	Pumps	291	80.83
	Power sprayer	96	26.67
Plant protection	Foot sprayer	22	6.11
	Knapsack sprayer	255	70.83
Harvesting and threshing	Combine harvester	2	0.55
	Winnowing fan	36	10

*Based on multiple response.

Perception of farmers towards Climate change

Farmers' perception is crucial in understanding the extent to which a region experiences direct or indirect agricultural impacts of climate change. Perception influences farmers' preparedness and willingness to adopt and implement new technologies, as successful adoption depends on their ability to perceive and respond favourably to changes in climate and the environment. In the present study, farmers' perception of climate change was measured using the scale developed by Eysenck and Crown (1949) ^[11]. Complete responses were obtained from all respondents, and their

perception levels were computed accordingly. The classification of respondents based on perception level is presented in Table 15.

Table 15: Distribution of respondents according to their level of perception of farmers towards Climate change n=360

Sl. No.	Perception	Frequency	Percentage
1.	Low (Score Up to 47)	47	13.05
2.	Medium (Score 47 to 65)	248	68.89
3.	High (Score more than 65)	65	18.06

The data in Table 15 reveal that a majority of the farmers (68.89%) exhibited a medium level of perception about climate change, followed by 18.06 per cent with a high level and 13.05 per cent with a low level of perception. The predominance of medium perception may be attributed to factors such as moderate levels of education, farming experience, social participation, extension contact, innovativeness, and risk-bearing ability, which contribute to a better understanding of climate-related issues. These findings are in agreement with the results reported by Laxman (2016) ^[24], Chadachal (2017) ^[8], and Chandrashekhar (2019) ^[9].

Ownership and extent of utilization of ICTs by farmers

The overall extent of utilization of ICTs by respondents were determined and given in table 16 that the maximum number of respondents (60%) had medium extent of utilization followed by 21.39 per cent had low level and 18.61 per cent had high extent of utilization of ICTs.

Table 16: Distribution of respondents according to their extent of overall utilization of ICTs n=360

Sl. No.	Extent of utilization of ICTs	Frequency	Percentage
1.	Low (Score Up to 7)	77	21.39
2.	Medium (Score 7 to 9)	216	60
3.	High (Score more than 9)	67	18.61

It can be concluded that respondents with high extent of utilization of ICTs can have more information about Climate Smart Agriculture Technologies (CSATs) and that will enhance adoption of Climate Smart Agriculture Technologies (CSATs). Kumar (2023) ^[23] also reported similar findings.

Source of information on Climate Smart Agriculture Technologies (CSATs)

The respondents' source of information covers both the information sources from which they obtain information and the respondents' perceptions of the credibility of these sources. also, It refers to the source used by respondents to obtain information about various aspects of farm technologies. Sources of information help respondents in obtaining information about many areas of agriculture and various agricultural schemes available to them, which in turn helps respondents in increasing their knowledge. Table 17 explains the distribution of respondents according to their overall utility of information source for Climate Smart Agriculture Technologies. The majority of the respondents (55.83%) belonged to medium category, followed by 40.56 per cent and 3.61 per cent of the respondents were from high and low level of category, respectively.

Table 17: Distribution of respondents according to their Source of information on Climate Smart Agriculture Technologies n=360

Sl. No.	Source of information	Frequency	Percentage
1.	Low (Score Up to 8)	146	40.56
2.	Medium (Score 8 to 14)	201	55.83
3.	High (Score more than 14)	13	3.61

Information needs for Climate Smart Agriculture Technologies (CSATs)

The data regarding the overall information needs compiled

in table 18 revealed that the majority (41.39%) of the respondents had medium level of information need followed by high and low that were 33.61 per cent and 25.00 per cent. It can be concluded that the majority of the respondents had medium (41.39%) to high (33.61%) level of information needs. It may be due to they are much aware with the benefits of climate smart agricultural technologies.

Table 18: Distribution of respondents according to their overall information needs for Climate Smart agriculture technologies (CSATs) n=360

Sl. No.	Information needs	Frequency	Percentage
1.	Low (Score Up to 5)	90	25.00
2.	Medium (Score 5 to 9)	149	41.39
3.	High (Score more than 9)	121	33.61

Attitude of farmers towards Climate Smart Agriculture Technologies (CSATs)

Understanding respondents' attitudes towards Climate-Smart Agricultural Technologies (CSATs) is essential, as a positive attitude facilitates their adoption and provides insights useful for policy formulation. The overall attitude of respondents towards CSATs was assessed and the results are presented in Table 19. The findings reveal that a majority of the respondents (52.50%) exhibited a moderately favourable attitude towards CSATs, followed by 30.56 per cent who had a favourable attitude. However, 16.94 per cent of the respondents showed a less favourable attitude towards CSATs. These results indicate that most respondents held moderate to favourable attitudes towards Climate-Smart Agricultural Technologies.

Table 19: Distribution of respondents according to overall attitude level towards Climate Smart Agricultural Technologies n=360

Sl. No.	Category	Frequency	Percentage
1.	Less favourable	61	16.94
2.	Moderately favourable	189	52.50
3.	Favourable	110	30.56

Weather based Agro advisory services (WBAAS)

Data presented in Table 20 indicate that the majority of respondents (69.72%) seeking and receiving Weather-Based Agro-Advisory Services (WBAAS) belonged to the medium category, followed by low (27.23%) and high (3.05%) categories. This pattern may be attributed to traditional farming practices, where advisory services are used less frequently, whereas educated and progressive farmers tend to access WBAAS through text messages, mass media, and scientific personnel to plan farm operations. Similar findings were reported by Pabba *et al.* (2021) ^[35]

Table 20: Distribution of respondents according to Weather based Agro Advisory Services (WBAAS) n=360

Sl. No.	WBAAS	Frequency	Percentage
1.	Low (Score Up to 9)	98	27.23
2.	Medium (Score 9 to 14)	251	69.72
3.	High (Score more than 14)	11	3.05

Conclusion

The above results conclude that the majority of the respondents possessed basic to moderate educational status, with most educated up to the middle school level, and had

medium farming experience (11–15 years). A considerable proportion of farmers belonged to the semi-medium farm size category, followed by medium, small, and marginal holdings, with most respondents living in nuclear family systems. Agriculture was the principal occupation of all respondents, with a sizeable proportion supplementing their income through business and allied activities. Most respondents reported a medium level of annual family income (₹2,00,001–3,00,000) and primarily depended on tubewells, canals, and wells as sources of irrigation. The findings further revealed that the majority of respondents exhibited medium levels of social participation, extension contact, innovative proneness, and risk orientation. Farm mechanization was moderate, characterized by ownership of tractors, use of desi ploughs for tillage, pumps for irrigation, and knapsack sprayers for plant protection. Most farmers demonstrated a medium level of perception towards climate change, medium utilization of ICTs, medium information needs, and a moderately favourable attitude towards Climate-Smart Agricultural Technologies (CSATs). Engagement with Weather-Based Agro-Advisory Services (WBAAS) was also predominantly at a medium level. Keeping in view the socio-economic, institutional, and psychological characteristics of the farmers, it is suggested that extension agencies and policymakers may design need-based, context-specific strategies and strengthen information delivery mechanisms to further enhance the effective adoption of Climate-Smart Agricultural Technologies among the farming community.

Acknowledgement

I would like to extend my heartfelt gratitude to my esteemed major advisor, Dr. R.S. Sengar, for his trust, insightful discussions, invaluable advice, and unwavering support throughout the entire study. I am especially grateful for his patience and guidance during the writing process.

Conflict of Interest

The authors of the paper declare no conflict of interest.

References

1. Ajzen I. The theory of planned behaviour. *Organ Behav Hum Decis Process*. 1991;50(2):179-211.
2. Andrieu N, Sogoba B, Zougmore R, Howland F, Samake O, Bonilla-Findji O, *et al*. Prioritizing investments for climate-smart agriculture: lessons learned from Mali. *Agric Syst*. 2017;154:13-24.
3. Antwi-Agyei P, Abalo EM, Dougill AJ, Baffour-Ata F. Motivations, enablers and barriers to the adoption of climate-smart agricultural practices by smallholder farmers: evidence from the transitional and savannah agroecological zones of Ghana. *Reg Sustain*. 2021;2(4):375-386.
4. Aruna TN, Bharath K, Ramappa K, Sachin CH, Kavan KV, Kishan K, *et al*. Assessment of mechanization index of sugarcane cultivation in Mandya district, Karnataka. *Arch Curr Res Int*. 2024;24(5):251-256.
5. Atheequlla GA, Anirban M, Lal RM, Nirmal C. Mobile based agro-advisory service and farmer's willingness to pay: a case study in Bageshwar district of Uttarakhand. *Indian J Ext Educ*. 2021;16(3):976-986.
6. Barros VR, Field CB, Dokken DJ, Mastrandrea MD, Mach KJ, Bilir TE, *et al*. Climate change 2014: impacts, adaptation, and vulnerability. Part B: regional aspects. Cambridge: Cambridge University Press; 2014. p. 1-1820.
7. Casey J, Bisaro A, Valverde A, Martinez M, Rokitzki M. Private finance investment opportunities in climate-smart agriculture technologies. 2021.
8. Chadachal RI. A study on perceived impacts of climate change and coping mechanisms by rice farmers in Raichur district of Karnataka state. Hyderabad: Professor Jayashankar Telangana State Agricultural University; 2017.
9. Chandrashekhar KP. Farmers' perception about climate change in Marathwada district of Maharashtra state. Parbhani: Vasantrao Naik Marathwada Krishi Vidyapeeth; 2019.
10. Dey K, Mishra PK. Mainstreaming blended finance in climate-smart agriculture: complementarity, modality, and proximity. *J Rural Stud*. 2022;92:342-353.
11. Eysenck HJ, Crown S. An experimental study in opinion attitude methodology. *Int J Attitude Res*. 1949;3:47-86.
12. Food and Agriculture Organization of the United Nations. Climate-smart agriculture: policies, practices and financing for food security, adaptation and mitigation. Rome: FAO; 2010.
13. Food and Agriculture Organization of the United Nations. A policymakers' guide to crop diversification: the case of the potato in Kenya. Rome: FAO; 2013.
14. Huho JM. The changing rainfall pattern and the associated impacts on subsistence agriculture in Laikipia East District, Kenya. *J Geogr Reg Plann*. 2012;5(7):198-206.
15. Jamadar R. Farmers' awareness of climate change and their adaptations. Dharwad: University of Agricultural Sciences; 2012.
16. Joshi. Extent of use of ICT tools by hill farmers and associated social factors. *Indian Res J Ext Educ*. 2018;18:30-33.
17. Kabir KH, Sarker S, Uddin MN, Leggette HR, Schneider UA, Darr D, *et al*. Furthering climate-smart farming with the introduction of floating agriculture in Bangladeshi wetlands: successes and limitations of an innovation transfer. *J Environ Manage*. 2022;323:116258.
18. Kangogo D, Dentoni D, Bijman J. Adoption of climate-smart agriculture among smallholder farmers: does farmer entrepreneurship matter? *Land Use Policy*. 2021;109:105666.
19. Kapuriya TD. Assessment of resource use management behaviour and farm managerial ability of cotton growers. Junagadh: Junagadh Agricultural University; 2021.
20. Kerlinger FN. Foundations of behavioral research. New York: Holt, Rinehart and Winston; 1973.
21. Khoza S, de Beer LT, van Niekerk D, Nemakonde L. A gender-differentiated analysis of climate-smart agriculture adoption by smallholder farmers: application of the extended technology acceptance model. *Gender Technol Dev*. 2021;25(1):1-24.
22. Khuspe SB, Kadam RP. Adoption gap in recommended production practices of chickpea. *Agric Update*.

- 2012;7(3-4):301-303.
23. Kumar S, Singh M, Singh P, Rohit. Utilization pattern of ICT tools by paddy growers in Uttar Pradesh. *Indian J Ext Educ*. 2023;59(2):135-137.
 24. Laxman MH. Farmers' perception about climate change and their adaptation in South Gujarat. Navsari: Navsari Agricultural University; 2016.
 25. Lee J. Farmer participation in a climate-smart future: evidence from the Kenya agricultural carbon market project. *Land Use Policy*. 2017;68:72-79.
 26. Makate C. Effective scaling of climate-smart agriculture innovations in African smallholder agriculture: a review of approaches, policy and institutional strategy needs. *Environ Sci Policy*. 2019;96:37-51.
 27. Manjunath KV. Knowledge and adoption of climate resilient technologies among paddy growers in Mandya district. Bengaluru: University of Agricultural Sciences; 2018.
 28. Mashi SA, Inkani AI, Oghenejabor OD. Determinants of awareness levels of climate-smart agricultural technologies and practices of urban farmers in Abuja, Nigeria. *Technol Soc*. 2022;70:102030.
 29. Mazhar R, Ghafoor A, Xuehao B, Wei Z. Institutional factors and adoption of multiple climate-smart agricultural practices among new entry organic farmers in Pakistan. *J Clean Prod*. 2021;297:124620.
 30. Morgan EH, Severs MM, Hanson KL, McGuirt J, Becot F, Wang W, *et al*. Gaining and maintaining a competitive edge: evidence from CSA members and farmers on local food marketing strategies. *Sustainability*. 2018;10(7):2177.
 31. Muralikrishnan L, Padaria RN, Choudhary AK, Das A, Shokralla S, Zin El-Abedin TK, *et al*. Climate change-induced drought impacts, adaptation and mitigation measures in semi-arid pastoral and agricultural watersheds. *Sustainability*. 2022;14(1):6.
 32. Nayak D. Farmers' perception on climate change and its impact on agriculture in Jagatsinghpur district of Odisha. Bhubaneswar: Odisha University of Agriculture and Technology; 2018.
 33. Nyasimi M, Kimeli P, Sayula G, Radeny M, Kinyangi J, Mungai C. Adoption and dissemination pathways for climate-smart agriculture technologies and practices for climate-resilient livelihoods in Lushoto, northeast Tanzania. *Climate*. 2017;5(3):63.
 34. Ouédraogo M, Houessionon P, Zougmore RB, Partey ST. Uptake of climate-smart agricultural technologies and practices: actual and potential adoption rates in Mali. *Sustainability*. 2019;11(17):4710.
 35. Pabba AS, Naik RV, Rani SV, Naik BB. Profile characteristics of beneficiaries of NICRA project in Nalgonda district of Telangana state. *Multilogic Sci*. 2021;X(XXXVI):1-5.
 36. Parganiha O. Farmers' perception about climate change and its impact on agriculture and allied activities in Chhattisgarh plains. Raipur: Indira Gandhi Krishi Vishwavidyalaya; 2016.
 37. Prasad SS. Effect of climate change on agriculture and livestock as perceived by farmers. Akola: Panjabrao Deshmukh Krishi Vidyapeeth; 2016.
 38. Raile ED, Young LM, Kirinya J, Bonabana-Wabbi J, Raile ANW. Building public will for climate-smart agriculture in Uganda. *J Agric Food Ind Organ*. 2021;19(1):39-50.
 39. Raj S, Garlapati S. Extension and advisory services for climate-smart agriculture. In: Venkatramanan V, Shah S, Prasad R, editors. *Global climate change: resilient and smart agriculture*. Singapore: Springer; 2020. p. 273-299.
 40. Renuka K. Impact of weather-based agro-advisory services on cropping pattern in Sehore district of Madhya Pradesh. Gwalior: Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya; 2020.
 41. Salini RC. Extent of mechanization on paddy cultivation in Kerala. *Int J Res Appl Nat Soc Sci*. 2017;5(10):17-22.
 42. Sardhara AD, Jadav NB, Kanpuriya TD. Relationship of technological gap in adoption of plant protection practices with socio-economic characteristics of cotton growers. *Young*. 2020;22:24-45.
 43. Senyolo MP, Long TB, Blok V, Omta O. How the characteristics of innovations impact their adoption: climate-smart agricultural innovations in South Africa. *J Clean Prod*. 2018;172:3825-3840.
 44. Shahbaz P, ul Haq S, Abbas A, Batool Z, Alotaibi BA, Nayak RK. Adoption of climate-smart agricultural practices through women involvement in decision-making process. *Agriculture*. 2022;12(8):1161.
 45. Totin E, Segnon AC, Schut M, Affognon H, Zougmore RB, Rosenstock T, *et al*. Institutional perspectives of climate-smart agriculture: a systematic literature review. *Sustainability*. 2018;10(6):1990.
 46. Tsige M, Synnevåg G, Aune JB. Gendered constraints for adopting climate-smart agriculture amongst Ethiopian women farmers. *Sci Afr*. 2020;7:e00250.
 47. Waaswa A, Nkurumwa AO, Kibe AM, Kipkemai JN. Climate-smart agriculture and potato production in Kenya: determinants of practice. *Clim Dev*. 2022;14(1):75-90.