



Factors Influencing Farmers' Adaptive Capacity to Climate Change

Swayangsu Sthitaprajna¹ and Simantini Shasani^{2*}

¹M.Sc. Scholar, ²Assistant Professor, Department of Agricultural Extension and Communication, SOADU, Bhubaneswar-751003, Odisha, India

*Corresponding author email id: simantinishasani@soa.ac.in

HIGHLIGHTS

- The variables education, scientific orientation, social participation showed a strong positive correlation towards the adaptive capacity.
- The determinants contributing 65% variance towards adaptive capacity were economic motivation, age, education, social participation, annual income, risk preference, and farming experience.
- Integrating climate literacy into local training and extension programs, encouraging farmer groups and community networks to promote peer learning was recommended.

ARTICLE INFO

Keywords: Adaptation, Adaptive capacity, Climate, Farmers, Vulnerability.

<https://doi.org/10.48165/IJEE.2026.621RN02>

Citation: Sthitaprajna, S., & Shasani, S. (2026). Factors influencing farmers' adaptive capacity to climate change. *Indian Journal of Extension Education*, 62(1), 195-199. <https://doi.org/10.48165/IJEE.2026.621RN02>

ABSTRACT

The study was carried out in the Kendrapara district of Odisha to assess the adaptive capacity of farmers to climate change with a view to analysing the socio-economic, communication and psychological profile attributes in the year 2024. India's agrarian economy is at risk from both gradual climatic shifts and sudden extreme weather events, emphasising the need for adaptation and resilience-building strategies. Both purposive and random sampling techniques were followed for the selection of the district, blocks, villages, and respondents, and primary data were collected from 120 respondents through a pre-tested structured interview schedule developed. Five dimensions, namely social capital, physical capital, economic capital, human capital and management capital, were considered to assess the adaptive capacity. (71.6%) of the respondents had a medium level of adaptive capacity, followed by low level (16.67%) and high level (11.67%). Among the independent variables taken, education, scientific orientation, and social participation showed a strong positive correlation with the adaptive capacity. 65% variance towards adaptive capacity was economic motivation, age, education, social participation, annual income, risk preference, farming experience, information source utilisation, extension participation, and scientific orientation.

INTRODUCTION

Climate change, as defined by the United Nations Framework Convention on Climate Change (UNFCCC), refers to alterations in the global climate system resulting from human activities that have modified the atmospheric composition. Climate change is a major global concern due to its potentially profound impacts on human societies (UNFCCC, 2009). Numerous studies have indicated that climate change, if left unaddressed, poses a substantial threat to agricultural productivity and food security. Research suggests that

while climate change generally has a negative impact on agriculture, the implementation of suitable adaptation measures can help minimise these effects (Bahinipati & Venkatachalam, 2016) and the knowledge help in combating it (Ghanghas et al., 2015). India, with its vast geographical diversity and dependence on climate-sensitive sectors like agriculture, water, forestry, and fisheries, is particularly vulnerable to the impacts of climate change. Over recent decades, the country has witnessed a rise in average temperatures, erratic rainfall patterns, increased frequency of extreme weather events such as heatwaves, floods, cyclones, and droughts, all of which have

serious implications for livelihoods, food security, and the overall economy (MoEFCC, 2023). These changes have already affected agricultural productivity, particularly in rainfed areas, which comprise nearly 60% of India's net sown area. Crops such as wheat, rice, and maize have shown signs of yield reduction in several regions due to increased temperature and water stress (ICAR, 2021). In India, agriculture is still considered as an integral part of the economy as it makes up around 22% of the GDP, provides 58% of employment, fulfills the food and nutritional needs of the nation, produces raw materials, and contributes to around 14% of the exports (Swain, 2014) as per the projected climate change scenarios. Odisha is among the most climate-vulnerable states in India, facing increasing risks from cyclones, coastal erosion, sea level rise, floods, and droughts due to climate change. Among the key determinants of how effectively the farming community responds to these challenges is their adaptive capacity—a concept that refers to the ability of individuals or systems to adjust to potential damage, take advantage of opportunities, or respond to consequences (IPCC, 2014). Adaptive capacity is not uniform across regions or farming communities; it is shaped by a complex interplay of factors such as access to information, technology, education, extension services, institutional support, income level, landholding size, social networks, and perception of climate risk. Farmers with higher adaptive capacity are better equipped to modify agricultural practices, adopt resilient technologies, diversify income sources, and engage with climate-smart interventions. Understanding these disparities is crucial for equitable adaptation planning. Therefore, understanding the determinants of adaptive capacity and identifying region-specific gaps is essential for designing inclusive, effective, and targeted adaptation strategies. By assessing socio-economic attributes, level of adaptive capacity and access to different dimensions of adaptive capacity, this research seeks to provide insights that can inform policy recommendations for enhancing resilience and sustainability in India's agrarian economy.

METHODOLOGY

The study was conducted in Kendrapara district of Odisha, a coastal region situated in the eastern part Odisha. The district is known for its agrarian economy, with a majority of the population dependent on agriculture and allied activities for their livelihood. Kendrapara district was selected purposively, and three blocks namely Kendrapara, Derabish, and Rajnagar were chosen for the investigation randomly. From each block, two villages were selected randomly, namely Pandiri and Kantabada from Kendrapada block, Gulasingh and Basupur from Derabish block, and Jarimula and Nagada from Rajnagar block, resulting in a total of six villages. From each selected village, 20 farmers were chosen as respondents using a simple random sampling method, making a total of 120 respondents for the present study. An interview schedule was carefully developed to collect data after proper pre-testing with 5% of the non-respondents in alignment with the objectives of the study. It included detailed sections covering the socio-economic profile of the respondents, communicational profile, psychological profile which were likely to influence the level of adaptive capacity of farmers towards climate change. The total score of an individual was computed and the respondents were categorized into 3 groups by computing the mean and standard deviation. The three groups

are- low ($< \text{Mean} - \text{SD}$), medium (Between $\text{Mean} \pm \text{SD}$) and high ($> \text{Mean} \pm \text{SD}$). From the past studies and literature, 5 dimensions were taken into consideration for measurement of adaptive capacity i.e., social capital, physical capital, economic capital, human capital and management capital which were believed to influence the adaptive capacity. In terms of climate change impacts, adaptive capacity is often defined as “the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences” (IPCC, 2007). The 5 dimensions are operationalised as follows. Social capital includes networks, group memberships, and trust in relationships, essential for achieving livelihood objectives (Chepkoech et al., 2020). Physical capital represents the basic infrastructural facilities and tools required for carrying out agricultural activities (Nawrotzki et al., 2012). The availability and accessibility of financial resources that contribute to the wealth essential for agricultural activities are referred to as economic capital (Williges et al., 2017). Human capital refers to the knowledge, skills, working capacity, and good health condition that are required to meet livelihood objectives (DFID, 1999). Management capital comprises of the knowledge, skills, and decision-making competencies that enable farmers to effectively plan, implement, and adapt their agricultural practices in response to climate variability and other challenges. Under each dimension of adaptive capacity, 12 statements were taken for response from the respondents in Likert 5-point continuum i.e., strongly disagree, disagree, undecided, agree and strongly agree making it a total of 60. On the basis of mean and S.D, the respondents were divided into three (High, Medium and Low) categories of their level of adaptive capacity. Data were analysed with the help of Pearson's correlation and regression analysis.

RESULTS

Adaptive capacity of farmers

Adaptive capacity is defined as a latent property of an individual, community, or social-ecological system, which is activated in response to a crisis or opportunity (Engle, 2011). After calculating the mean and S.D the respondents were categorized as low, medium and high. Majority 71.6% of the farmers had a medium level of adaptive capacity whereas, 16.67% and 11.67% of the respondents had low and high level of adaptive capacity towards climate change.

Level of adaptive capacity and relationship with the selected independent variables

Correlation analysis was carried out to determine the association between the selected independent variables and the

Table 1. Distribution of respondents according to their level of adaptive capacity

Category of Adaptive Capacity	Percentage	Mean	SD
Low (< 176.02)	16.67	199.68	23.66
Medium ($176.02-223.34$)	71.66		
High (> 223.34)	11.67		
Total	100.000		

Table 2. Correlation analysis of selected independent variables with the adaptive capacity of the farmers to climate change

Independent variables	Correlation Coefficient (r)
Age (X ₁)	-.156
Education (X ₂)	.365**
Family type (X ₃)	.246*
Family size (X ₄)	.116
Farming experience (X ₅)	.261*
Ownership of land (X ₆)	.153
Land holding (X ₇)	.018
Occupation (X ₈)	.152
Annual income (X ₉)	.255*
Information source utilization (X ₁₀)	.198*
Social participation (X ₁₁)	.329**
Extension participation (X ₁₂)	.194*
Risk preference (X ₁₃)	.203*
Scientific orientation (X ₁₄)	.277**
Economic motivation (X ₁₅)	-.114

**Correlation is significant at the 0.01 level

*Correlation is significant at the 0.05 level

adaptive capacity of farmers towards climate change. Table 2 presents the correlation analysis between selected independent variables and the adaptive capacity of farmers in response to climate change. Among all the socio-economic factors analyzed, education (X₂) exhibited the strongest positive and highly significant correlation with adaptive capacity. Similarly, social participation (X₁₁) and scientific orientation (X₁₄) also showed a strong and significant influence on adaptive capacity. On the contrary, age (X₁) and economic motivation (X₁₅) were found to have negative correlations with adaptive capacity, though these were not statistically significant. Additionally, variables such as family size (X₄), ownership of land (X₆), area of land (X₇), and occupation (X₈) did not show any significant correlation. Overall, the analysis highlights the critical role of education, experience, social connectivity, scientific mindset, and income level in shaping the adaptive capacity of farmers facing the challenges of climate change.

Table 3. Multiple regression analysis of selected independent variables with the adaptive capacity of the farmers to climate change

Variables	Beta	t	Sig	R square
Age (X ₁)	-.332	-2.871	.005	0.650
Education (X ₂)	-.242	-2.113	.037	
Family type (X ₃)	-.303	-3.046	.003	
Family size (X ₄)	.005	.055	.956	
Farming experience (X ₅)	.055	3.266	.001	
Ownership of land (X ₆)	.189	2.062	.042	
Land holding (X ₇)	-.148	-1.530	.129	
Occupation (X ₈)	.126	1.208	.230	
Annual income (X ₉)	.071	2.711	.014	
Information source utilization (X ₁₀)	-.048	-2.354	.026	
Social participation (X ₁₁)	.238	2.674	.009	
Extension participation (X ₁₂)	.243	2.456	.016	
Risk preference (X ₁₃)	.179	2.107	.037	
Scientific orientation (X ₁₄)	-.097	-2.549	.031	
Economic motivation (X ₁₅)	-.223	-2.373	.019	

Multiple regression analysis between socio economic variables with adaptive capacity of the farmers to climate change

A multiple regression analysis was conducted to determine the influence of selected socio-economic variables on the adaptive capacity of farmers to climate change. The results, as presented in the above table revealed several significant predictors of adaptive capacity.

The model was statistically significant with an R value of 0.806, indicating a strong correlation between the independent variables and the dependent variable (adaptive capacity). The R² value of 0.650 suggests that approximately 65% of the variance in adaptive capacity can be explained by the set of independent variables included in the model. The adjusted R² value of 0.601 further confirms the model's robustness, accounting for the number of predictors used. Age (X₁) had a significant negative influence whereas, education (X₂) had a positive and significant influence on adaptive capacity. Family Type (X₃) was negatively associated with adaptive capacity. Farming Experience (X₅), ownership of land (X₆), and annual income (X₉) all had positive and significant effects. Participation in extension activities (X₁₂), social participation (X₁₁), and risk preference (X₁₃) also significantly contributed to farmers' adaptive behavior. Interestingly, scientific orientation (X₁₄), Information sources utilization (X₁₀) and economic motivation (X₁₅) had significant negative influences. Other variables like family size (X₄), occupation (X₈), and area of land (X₇) were not statistically significant, suggesting limited or no direct influence on adaptive capacity in the study context

DISCUSSION

The results revealed that education exhibiting the strongest positive and highly significant correlation with adaptive capacity suggested, farmers with higher educational attainment are more likely to adopt adaptive strategies to cope with the adverse effects of climate change. Higher levels of education increase farming households' adaptive capacity (Elahi et al., 2015). Similarly, social participation and scientific orientation also showed a strong and significant influence on adaptive capacity, indicating the importance of social networks and a progressive mindset in climate resilience. The findings also indicated that experienced farmers with greater economic stability, access to information, involvement in extension programs, and a higher risk-bearing capacity are more likely to adopt effective climate adaptation strategies. Risk taking is a significant factor in the adoption of Climate Smart Agriculture (Jatav, 2024). Improving farmers' knowledge and enhancing their economic capacity could substantially increase CSA adoption, thereby strengthening climate resilience (Mishra et al, 2025). Farmers must adopt PCAPs in order to capitalize on their promise for sustainable food production with a reduced environmental effect (Shitu & Nain, 2025). Additionally, variables such as family size, ownership of land, area of land, and occupation did not show any significant correlation, suggesting their limited direct influence on adaptive behaviour in this study context. Overall, the analysis highlights the critical role of education, experience, social connectivity, scientific mindset, and income level in shaping the adaptive capacity of farmers facing the challenges of climate change.

Byrne (2014) in his study on household adaptive capacity revealed that at household or community level, adaptive capacity is strongly influenced by factors such as the knowledge base, which enables anticipation of environmental change and identification of new or revised livelihood opportunities. The model was statistically significant with an R value of 0.806, indicating a strong correlation between the independent variables and the dependent variable (adaptive capacity). Age having a significant negative influence suggesting that younger farmers tend to be more adaptive. Family type was negatively associated with adaptive capacity, implying that certain family structures may hinder adaptability. Scientific orientation and economic motivation had significant negative influences, suggesting a complex relationship where economic or scientific drivers alone may not always foster adaptiveness. Information source showed a negative influence, which may indicate an issue with the quality or relevance of information accessed. The majority of the paddy farmers had experienced the effects of climate change, especially irregular rainfall and temperature fluctuations. However, few farmers remain unaware of adaptation measures due to limited access to information and a lack of communication with the extension agency (Pradhan et al., 2025). Socio-demographic variables such as gender, age, education, income, and ethnicity significantly influence individuals' awareness, attitudes, risk perceptions, and knowledge regarding climate change according to Masud et al. (2017). The intensity and probability of adoption of climate smart agriculture practices (CSAPs) were affected by numerous factors, such as demographic characteristics, access to market, farm plot features, climate risks, socio-economic, access to extension services and training (Aryal et al., 2018).

CONCLUSION

Farmers largely exhibited medium levels of information use, social participation, risk preference, scientific orientation, and economic motivation. Participation in peer learning, self help groups, and extension activities such as Field Days and Krishi Melas played a vital role in enhancing awareness and preparedness. Their adaptive capacity was shaped by strong community ties, practical knowledge, and a long-term perspective rooted in sustainability. Statistical analyses confirmed that education, farming experience, land ownership and annual income significantly and positively influenced adaptive capacity. Factors such as age, family type, scientific orientation, and economic motivation had negative associations with the adaptive capacity of farmers. The findings underscore the need for multi-dimensional strategy to strengthen farmers' adaptive capacity, integrating targeted education, responsive extension systems, institutional facilitation, and community-based knowledge-sharing. Building climate resilience ultimately depends on empowering farmers with the right tools, information, and supportive policies to make informed and forward-looking decisions in an increasingly unpredictable climate.

DECLARATIONS

Ethics approval and informed consent: Informed consent was sought from the respondents regarding the study during the course of the data collection.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The authors declare that during the preparation of this work, they thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

Publisher's note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organisation, or those of the publisher, the editors, and the reviewers. Any product/process or technology that may be evaluated in this article, or a claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

REFERENCES

- Aryal, J. P., Jat, M. L., Sapkota, T. B., Khatri-Chhetri, A., Kassie, M., Rahut, D. B., & Maharjan, S. (2018). Adoption of multiple climate-smart agricultural practices in the Gangetic plains of Bihar, India. *International Journal of Climate Change Strategies and Management*, 10(3), 407-427.
- Bahinipati, C. S., & Venkatachalam, L. (2016). Role of climate risks and socio-economic factors in influencing the impact of climatic extremes: a normalisation study in the context of Odisha, India. *Regional Environmental Change*, 16(1), 177-188.
- Byrne, T. R. (2014). *Household adaptive capacity and current vulnerability to future climate change in rural Nicaragua*. University of Lethbridge (Canada).
- Chepkoech, W., Mungai, N. W., Stöber, S., & Lotze-Campen, H. (2020). Understanding adaptive capacity of smallholder African indigenous vegetable farmers to climate change in Kenya. *Climate Risk Management*, 27, 100204.
- DFID, D. (1999). Sustainable Livelihoods Guidance Sheets: Framework Introduction Vulnerability Transforming. Context 26.
- Elahi, E., Zhang, L., Abid, M., Altangerel, O., Bakhsh, K., Uyanga, B., Ahmed, & Xinru, H. (2015). Impact of balance use of fertilizers on wheat efficiency in cotton wheat cropping system of Pakistan. *International Journal of Agriculture Innovations and Research*, 3, 1369-1373.
- Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Journal of Environment Change*, 21(2), 647-656. doi: 10.1016/j.gloenvcha.2011.01.019
- Ghanghas, B. S., Shehrawat, P. S., & Nain, M. S. (2015). Knowledge of extension professionals regarding impact of climate change in agriculture. *Indian Journal of Extension Education*, 51(3&4), 125-129.
- ICAR. (2021). *Climate Resilient Agriculture in India: Status and Strategy*. Indian Council of Agricultural Research.
- IPCC. (2007). Summary for policymakers. Climate Change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press
- IPCC. (2014). *Fifth Assessment Report: Impacts, Adaptation, and Vulnerability*. Intergovernmental Panel on Climate Change.
- Jatav, S. S. (2024). Factors Affecting Adoption of Climate-smart Agriculture Practices: Evidence from Uttar Pradesh, India. *Indian Journal of Extension Education*, 60(2), 27-32. <https://doi.org/10.48165/IJEE.2024.60205>

- Masud, M. M., Akhatr, R., Nasrin, S., & Adamu, I. M. (2017). Impact of socio-demographic factors on the mitigating actions for climate change: A path analysis with mediating effects of attitudinal variables. *Environmental Science and Pollution Research*, 24(26), 26462–26477.
- Mishra, J. S., Doharey, R. K., Meena, N. R., Sonu, K., & Deekshith, B. (2025). Adoption of climate-smart agriculture (CSA) in flood-affected regions of Darbhanga. *Indian Journal of Extension Education*, 61(3), 64-68. <https://doi.org/10.48165/IJEE.2025.61312>
- MoEFCC. (2023). *India's Third Biennial Update Report to the UNFCCC*. Ministry of Environment, Forest and Climate Change, Government of India.
- Nawrotzki, R., Hunter, L., & Dickinson, T. W. (2012). Natural resources and rural livelihoods: Differences between migrants and non-migrants in Madagascar. *Demographic Research*, 26, 661-700.
- Pradhan, S. K., Naik, A., Kumar, A., & Ray, S. (2025). Perception of paddy farmers on climate change in western Odisha: An ANN model integration. *Indian Journal of Extension Education*, 61(3),1-6. <https://doi.org/10.48165/IJEE.2025.61301>
- Shitu, A. G., & Nain, M. S. (2024). Benefits of precision conservation agriculture practices as perceived by Indo-Gangetic Plain (IGP) community for climate-smart agriculture, *SKUAST Journal of Research*, 26(2), 219-226. <https://doi.org/10.5958/2349-297X.2024.00029.2>
- Swain, M. (2014). Crop insurance for adaptation to climate change in India, Asia Research Centre working paper.
- UNFCCC. (2009). *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries*. United Nations Framework Convention on Climate Change.
- Williges, K., Mechler, R., Bowyer, P., & Balkovic, J. (2017). Towards an assessment of adaptive capacity of the European agricultural sector to droughts. *Climate Services*, 7, 47-63.