(ORIGINAL RESEARCH ARTICLE)

Factors Affecting Farmers' Attitude Towards Climate Resilient Agricultural Technologies in Telangana, India

Abstract

Agriculture and climate change are interdependent processes on a global scale. To address the climatic risks in agriculture, adopting climate-resilient practices from the National Innovations on Climate Resilient Agriculture **(**NICRA) Project instead of traditional cropping methods is a strategy that not only enhances agricultural sustainability but also boosts farmers' income.Farmers' attitude is vital in the adoption of new technology. This paper examines the factors influencing farmers' attitude towards climate-resilient technologies under the NICRA project in the Suryapet and Khammam districts of Telangana, India. An *ex-post facto* research design was employed, with a sample of 200 respondents selected through a multistage simple random sampling technique.The profile characteristics *viz.,* education, annual income, landholding, economic motivation, and innovative proneness, demonstrated a positive and significant correlation with farmers' attitude, as indicated by the correlation coefficient. Additionally, occupation and the farming system showed a significant positive association with attitude through the chi-square test. Stepwise multiple regression analysis identified factors such as water resource availability, economic motivation, risk-taking ability, education, individual and mass media exposure, and landholding as having a significant effect on farmers' attitude.To enhance the adoption of climate-resilient technologies under the NICRA project, efforts should focus on improving farmers' education, economic motivation, and access to water resources. Additionally, leveraging individual and mass media exposure can further strengthen positive attitude towards these technologies, ultimately leading to greater agricultural sustainability and increased income for farmers.

Keywords: Attitude, Climate change, Climate-resilient practices, Food security, NICRA.

Introduction

Climate change and agriculture are interdependent processes on a global scale (Parry et al. 2007).The effects of climate change have begun to impact agriculture in India significantly (Chouksey et al., 2021**)**. Climate change significantly impacts the security of the global food supply(Naik et al., 2024). Agriculture serves as a source of livelihood for approximately 61.50 percent of the Indian population overall, and over 85 percent of the rural population in particular (Agricultural Census of India, 2011). Since the twentieth century, climate change has emerged as a significant concern, threatening the livelihoods of humans and other living organisms (Kowshika et al., 2021). Future climate change projections for India suggest a marked temperature increase and greater rainfall variability (Sandeep et al., 2018). Climate change affects agriculture in various ways, including reduced crop productivity, increased incidence of pests and diseases, and alterations in cropping patterns. As production declines, the availability of goods diminishes, disproportionately impacting the poor (Ashoka et al 2022).

Climate change affects agriculture by an estimated 4-9 percent annually. Given that agriculture contributes 15 percent to India's Gross Domestic Product (GDP), this impact likely results in a GDP loss of approximately 1.5 percent (Subhojit, 2017). The impact of climate change is especially evident in India's semi-arid regions, where geo-ecological fragility is characterized by low and erratic rainfall, poor soil fertility, and underlying socio-economic instabilities (Bantilan et al., 2006; Singh et al., 2012). Due to climate variability, the frequency and intensity of extreme weather events are escalating globally each year. As a result, climate variability has become an integral and unavoidable aspect of all global discussions and dialogues on sustainable development (Harikrishna et al., 2021). The agricultural sector is prioritized in most developing nations due to its vital contribution to economic growth. In addition to ensuring the sustainable and affordable provision of food and livelihoods, agriculture serves as a reliable support sector, providing economic stability during times of crisis (Das and Ansari, 2021). In February 2011, the Indian Council of Agricultural Research (ICAR) launched the National Innovations on Climate Resilient Agriculture (NICRA) project (Naik et al., 2024). The flagship project aims to conduct long-term strategic research focused on adapting crops, livestock, and natural resource management, as well as exploring institutional interventions to mitigate the impacts of climate change (NICRA, 2018).

Farmers' adoption of climate-resilient technologies largely depends on their perceptions of and responses to changes in the climate and environment. The study by (Joshi et al., 2018) emphasized that farmers' perceptions of climate change significantly influence their responses to climate-induced risks and uncertainties, guiding their adoption of specific adaptation measures to mitigate the adverse impacts on agriculture. Thus, insufficient awareness and knowledge about climate change and its impacts on agricultural production can adversely affect long-term sustainable agriculture in many developing countries (Kotei et al., 2007). Farmers' perceptions of climate change and climate-resilient practices involve a complex interplay of psychological factors, including knowledge, beliefs, attitudes, and concerns regarding the nature and extent of climate change (Whitmarsh and Capstick, 2018).Farmers' perceptions of climate change and coping mechanisms are complex due to their limited scope and the variability in individual perceptions over time. An individual's understanding of climate change may differ between past and present circumstances (Saarinen, 1976).Attitude refers to positive or negative feelings, while perception denotes an individual's understanding, which is shaped by personal characteristics, experiences, received information, and the cultural and geographic context in which one resides (Van and Hawkins, 2015; Ansari et al., 2018).

Generally, local short-term variations may be more prominent than long-term trends and can significantly influence the formation of perceptions about climate change (Lehner and Thomas, 2015).Life experiences can shape attitudes; individuals who have been directly affected by extreme climatic events often perceive a higher likelihood of such events recurring (Patt and Schroter, 2008; Carlos et al., 2019).Farmers' attitudeplays a crucial role in timely preparedness and the effective adoption of climate-resilient technologies. Against this backdrop, we conducted a study to assess the factors influencing farmers' attitude toward these technologies.

Methodology

The study utilized primary data collected from the Suryapet and Khammam districts of Telangana state, India. Bothdistrictswere purposively selected due to the implementation of the National Innovations on Climate Resilient Agriculture (NICRA) project since its inception. Boring Thanda, KothaThanda, and Nandyalagudem villages of Suryapet district,and Nacharam village of Khammam district,were selected purposively as NICRA had been implemented in these villages. From each selected village, 50 respondents were chosen using a multistagesimple random sampling technique, resulting in a total sample size of 200 respondents who were beneficiaries of NICRA.

The study employed an *ex post facto* research design. Primary data were collected using a structured and pre-tested interview schedule.A list of eleven independent variables with potentially influence farmers' attitudes toward climate-resilient technologies was prepared, including age, education, family size, annual income, farming experience, landholding, material possession, individual and mass media exposure,economic motivation,and innovativeness. Karl Pearson’s product movement correlation coefficientwas calculated to determine the degree of relationship between these variables and farmers' attitude.Chi-square analysis was employed on selected variables *viz.*, occupation and farming system which fall under nominal and ordinal levels of measurement. Along with this stepwise multiple regression analysis was conducted to determine the effect of independent variables on the dependent variable *viz*., attitude, and to identify the most significant contributors to the regression model.

Results and Discussion

Table 1. Correlation analysis of independent variables with an attitude of farmers of Suryapet and Khammam districts

S.No.	Independent Variable	Correlation (r) Values of Suryapet farmers	p value	Correlation (r) Values of Khammam farmers	p value
1	Age	0.101	0.218	0.020	0.407
2	Education	0.734**	0.000	0.886**	0.000
3	Family size	0.211	0.209	-0.199	0.166
4	Annual income	0.586**	0.000	0.770**	0.000
5	Farming experience	0.184	0.124	0.119	0.411
6	Landholding	0.616**	0.000	0.710**	0.000
7	Material possession	0.224	0.106	0.179	0.086
8	Individual and mass media exposure	0.332**	0.004	0.342*	0.015
9	Economic motivation	0.625**	0.000	0.834**	0.000
10	Risk-taking ability	0.456*	0.050	0.625**	0.000
11	Innovative proneness	0.575**	0.000	0.751**	0.000

**Significant at 0.01 level
*Significant at 0.05 level

Relationship between selected independent variables with the attitude of farmers

Data from Table 1 depicts that in Suryapet and Khammam, the variables education, annual income, landholding, economic motivation, and innovative proneness exhibit a positive and significant relationship with attitude at the 0.01 percent level of significance. Additionally, in Khammam, individual and mass media exposure show a positive relationship at the 0.05 percent level, whereas in Suryapet, this relationship is significant at the 0.01 percent level. The risk-taking ability in Suryapet is positively related at the 0.05 percent level, while in Khammam, it is significant at the 0.01 percent level. Material possession, although positively related to farmers' attitude, does not show statistical significance. These findings indicate that seven variables have a positive and significant correlation with attitude.

The findings from Table 1 indicate that farmers' literacy and individual and mass contact significantly influence attitude toward Climate-Resilient Agriculture (CRA) technologies. Large farmers with higher annual incomes demonstrate a positive attitude toward CRA technologies, likely due to their progressive nature. Additionally, farmers with higher levels of economic motivation, risk-taking ability, and innovative proneness tend to have a positive attitude toward CRA technologies, possibly because their willingness to take risks to secure stable income during drought conditions plays a crucial role.

Table 2.Chi-square analysis of selected independent variables with the attitude of farmers of Suryapet and Khammam districts

S.No.	Independent variable	Suryapet				Khammam			
		Pearson chi-square value	df	(2-sided)	Cramers value	Pearson chi-square value	Df	(2-sided)	Cramers value
1	Occupation	133.150[a]	12	0.000**	0.544	36.564[a]	6	0.000**	0.605
2	Farming system	147.609[a]	8	0.000**	0.701	23.289[a]	6	0.001**	0.483

**Significant at 0.01 level

Association between selected independent variables with the attitude of farmers

The results from Table 2 show that socio-personal variables such as occupation and farming system have a positive and significant relationship with attitude at the 0.01 percentsignificance level. The Cramer's V value of 0.544 and 0.605 suggests a strong association between the respondents' occupation and their attitude in both districts. Additionally, the Cramer's V value of 0.701 in the Suryapet district indicates a medium level of associationbetween the farming system and attitude. In contrast,Cramer’s V value of 0.483 in the Khammam district specifies a strong level of association betweenthe farming system and attitude.

Table 3 Extent ofeffect of independent variables on the attitude of overall farmers towards CRA technologies

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. An error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.592[a]	.351	.348	2.759	.351	106.989	1	198	.000
2	.673[b]	.453	.447	2.539	.102	36.787	1	197	.000

3	.797[c]	.635	.629	2.080	.182	97.440	1	196	.000
4	.815[d]	.664	.657	1.999	.030	17.223	1	195	.000
5	.824[e]	.680	.671	1.958	.015	9.379	1	194	.003
6	.829[f]	.687	.678	1.939	.008	4.782	1	193	.030
a. Predictors: (Constant), Availability of water resources									
b. Predictors: (Constant), Availability of water resources, Economic Motivation									
c. Predictors: (Constant), Availability of water resources, Economic motivation, Risk taking ability									
d. Predictors: (Constant), Availability of water resources, Economic motivation, Risk taking ability, Education									
e. Predictors: (Constant), Availability of water resources, Economic motivation, Risk taking ability, Education, Individual, and Mass media exposure									
f. Predictors: (Constant), Availability of water resources, Economic motivation, Risk taking ability, Education, Individual and Mass media exposure, Landholding									
g. Dependent Variable: Attitude									

Extent of effect of independent variables on the attitude of overall farmers

The results from Table 3 specify that the independent variables *viz.*,availability of water resources, economic motivation, risk-taking ability, education, individual and mass media exposure, and landholding have a significant effect on the dependent variables. Collectively, these six independent variables explain 68.70 percent of the total variance in the dependent variable.Specifically, the availability of water resources alone accounts for 35.10 percent of the variance. When combined with economic motivation, this contribution increases to 45.30 percent. The inclusion of risk-taking ability raises the explained variance to 63.50 percent. Further adding education to the model increases the explained variance to 66.40 percent, while the combined effect of availability of water resources, economic motivation, risk-taking ability, education, and individual and mass media exposure accounts for 68.00 percent of the variance.

Table 4.Extent ofeffect of independent variables on the attitude of Suryapet farmers towards CRA technologies

Model Summary									
					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. An error of the Estimate**	**R Square Change**	**F Change**	**df1**	**df2**	**Sig. F Change**
1	.625[a]	.390	.386	2.147	.390	94.640	1	148	.000
2	.658[b]	.433	.426	2.077	.043	11.205	1	147	.001
3	.680[c]	.462	.451	2.031	.029	7.731	1	146	.006

a. Predictors: (Constant), Economic Motivation
b. Predictors: (Constant), Economic motivation, Risk taking ability
c. Predictors: (Constant), Economic motivation, Risk taking ability, Landholding
d. Dependent Variable: Attitude

Extent of effect of independent variables on the attitude of Suryapet farmers

Findings from Table 4 reveal that the independent variables *viz.*, economic motivation, risk-taking ability, and landholding exert significant effects on the dependent variable. These three variables together account for 46.20 percent of the total variance in the dependent variable. Among them, economic motivation alone explains 39.00 percent of the variance, while the combination of economic motivation and risk-taking ability increases this contribution to 43.30 percent.

Table 5.Extent ofeffect of independent variables on the attitude of Khammam farmers towards CRA technologies

Model Summary									
					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. An error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.918[a]	.842	.839	1.131	.842	255.935	1	48	.000
2	.950[b]	.903	.899	.896	.061	29.442	1	47	.000
a. Predictors: (Constant), Education									
b. Predictors: (Constant), Education, Risk taking ability									
c. Dependent Variable: Attitude									

Extent of effect of independent variables on the attitude of Khammam farmers

Data from Table 5 reveals that the independent variables *viz.*, education and risk-taking ability have significant effects on the dependent variable. Together, these two variables account for 90.30 percent of the total variance in the dependent variable. Notably, education alone contributes 84.20 percent of the variance.

Conclusion and Policy Implications

The overall assessment revealed that among the eleven variables analyzed, education, annual income, landholding, economic motivation, and innovative proneness showed a positive and significant correlation with farmers' attitudes based on the correlation coefficient. Using the chi-square test, it was found that occupation and the farming system also exhibited a significant positive relationship with attitude. Stepwise multiple regression analysis demonstrated that in Suryapet, economic motivation, risk-taking ability, and landholding significantly influenced farmers' attitude. In Khammam, education and risk-taking ability were key determinants of farmers' attitude. Overall, factors such as availability of water resources, economic motivation, risk-taking ability, education, individual and mass media exposure, and landholding were found to have a significant effect on farmers' attitude.The findings highlight the key determinants directly influencing farmers' attitudes toward climate-resilient technologies. This underscores the necessity for an integrated extension approach aimed at fostering a positive attitude among farmers toward climate-resilient agriculture. Enhancing awareness through mass media and providing targeted training on climate-resilient technologies are crucial strategies. Implementing these recommendations may help to reduce the adoption gap of climate-resilient technologies within the farming community, particularly in the context of the NICRA project.

Disclaimer (Artificial intelligence)

The author(s) hereby declare that generative AI technologies, such as OpenAI ChatGPT version 4, have been used during the writing or editing of manuscripts for language improvement.

Acknowledgement

The authors express their gratitude to the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, for providing the necessary facilities to conduct this study. I extend my sincere thanks to the Ministry of Tribal Affairs for the financial support that enabled the timely completion of my research. I also acknowledge the scientists at ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, for providing valuable information during data collection. Additionally, I appreciate the assistance provided by the staff of Krishi Vigyan Kendra, Gaddipally, Suryapet, and Krishi Vigyan Kendra, Wyra, Khammam, in gathering data from farmers for this study. Finally, I thank all the farmers for their cooperation during data collection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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