**Original Research Article**

# Factors Influencing the Adoption of Climate Resilient Technologies in Semi-Arid Regions: Insights from NICRA in Samba District, Jammu and Kashmir in the Shivalik Hills, India


## Abstract

Climate-induced temperature increases and reduced rainfall haveseverely threatened the agricultural productivity and food security of the Indian state of Jammu and Kashmir. National Innovations Climate Resilient Agriculture (NICRA) interventions like crop rotation, soil management and help farmers adapt the technology to reduceclimate change risk. Therefore, this paper examines the impact of NICRA interventions on crop yield and income of farmers in a vulnerable and semi-arid region of the Samba district of Jammu and Kashmir. The study surveyed 120 farmers inthe Sambadistrict of Jammu and Kashmir. The ordinary least square method has been used to analyze the data. The results show that attendance at the training, having a Kissan credit card, and farmers' experience have significantly influenced the adaptation of NICRA interventions. The study sheds light on the positive relation with farm income due to the adaptation of NICRA interventions. Our study proposed policy-related recommendations to encourage farmers to adopt climate-smart agriculture through NICRA interventions. This includes raising awareness among farmers through high-quality information and training and developing climate action for the small and marginal farmers of the Samba district of Jammu and Kashmir. This study provides a foundation for understanding the role of NICRA interventions in increasing farm productivity and income in semi-arid regions.



**Keywords**: Adaptation, Climate change, Climate Smart Agriculture,Mitigation,Productivity, Sustainable Agriculture

JEL Codes: Q54, Q5

## INTRODUCTION

The change in climate affects food security and productivity through rising temperatures and variable rainfall across the world. This has resultedin food insecurity, changes in livelihood, land degradation, ecosystems, and emissions of greenhouse gases (IPCC, 2019). Due to changesin the patterns of rainfall, there is an outbreak of pests that poses a significant threat to productivity and food security (Dinesh et. al,2018). The IPCC (2022) reported that greenhouse gas concentrations in the air have reached an exceptional level for the last decade. It has been predicted that global temperature can rise to 1.1 to 3.7 degree Celsius (Urban et. al, 2023).Climate-smart interventions are a strategy to build against climate change(Kayusi et al., 2024). Climate resilient technologies are enhancing agricultural productivity and reducing the impact of greenhouse emissions gases (Aafaw and Maggio, 2016). Climate-smart agriculture has three pillars: increase productivity, enhance resilience and reduce emissions. There should be integration of policies and adoption levelsfor sustainable agriculture (Lipper et al.,2014). There havebeen studies thatexplore the adoption of climate-smart practices in South Asia, focusing on perceived benefits and climate risk. The emphasis on the need for awareness and risk management strategies for resilient agriculture is very important (Arya et al., 2018). The empirical studies identify factors such as credit, education, credit access, and extension servicesthat play an important role in enhancing the adoption level of resilient agriculture practices (Tanjea et al., 2018). There should be integration of adaptation and mitigation strategies in agricultural practices to increase productivity. There are many case studies and empirical evidenceto support the benefits of climate-resilient technologies in improving the yield of crops and reducing vulnerability among farmers in India's diverse agro-climatic zones (Reddy and Syme, 2015). Given the context of Himachal Pradesh (Sharma and Singh, 2017), they explore the adoption behavior and identify the factors like access to information and institutional support that influence the farmers to take up climate-smart practices. The role of the policy framework helped the farmers to adopt the interventions and promote sustainable agriculture(Habowa et al., 2024). The CSA practices in Rajasthan havebeen influenced by socio-economic factors and perceived benefits. The policy support in semi-arid regions aims to build resilience against climate change while ensuring sustainable agriculture (Kumar and Kumar, 2020). The CSA is recognized as an important tool for managing the impact of climate change and climate-responsive technologies have been adopted (Rao and Mohan, 2018).

The events of extreme weather have increased in Jammu and Kashmir. The agriculture sector has been enormously damaged by the variation in the weather. The Government of India through ICAR and state universities has been increasing the flow of information on climate-smart agriculture (CSA). The National Innovations of Climate Resilience Agriculture (NICRA) is one of the steps by ICAR to protect farmers from variable weather conditions. NICRA has been working towards improved crop yield(Kayusi, et al., 2024), soil management, improved seed varieties, water management, and institutional capacity building. These key NICRA interventions helped the farmers enhancetheir resilience in agriculture and mitigate the adverse effect of climate change on crop production. In Jammu and Kashmir due to adverse climate change the NICRA Interventions have been promoted by the Government of India. The key factors that influence the adoption of climate resilience technologies are govt. Support, relevant information, and training (Singh, 2013). In Himachal Pradesh, key CSA practices include the adoption of drought-resistant varieties, improved irrigation systems, and soil and water conservation measures (Sharma and Singh, 2017). The present paper contributes to the literature on households' adoption level of climate resilience agriculture in the Samba district of Jammu and Kashmir. The OLS particularly looks at the factors which affect the adoption of NICRA interventions. Adoption is a long-run process that requiresnot only initial adoption but also the maintenance of the interventions so that farmers will mitigate the adverse effectsof climate change. The findings of this study will help the policymakers to develop an action plan for the farmers to disseminate and promote information on climate resilience technologies.

## METHODOLOGY

### Sources of data

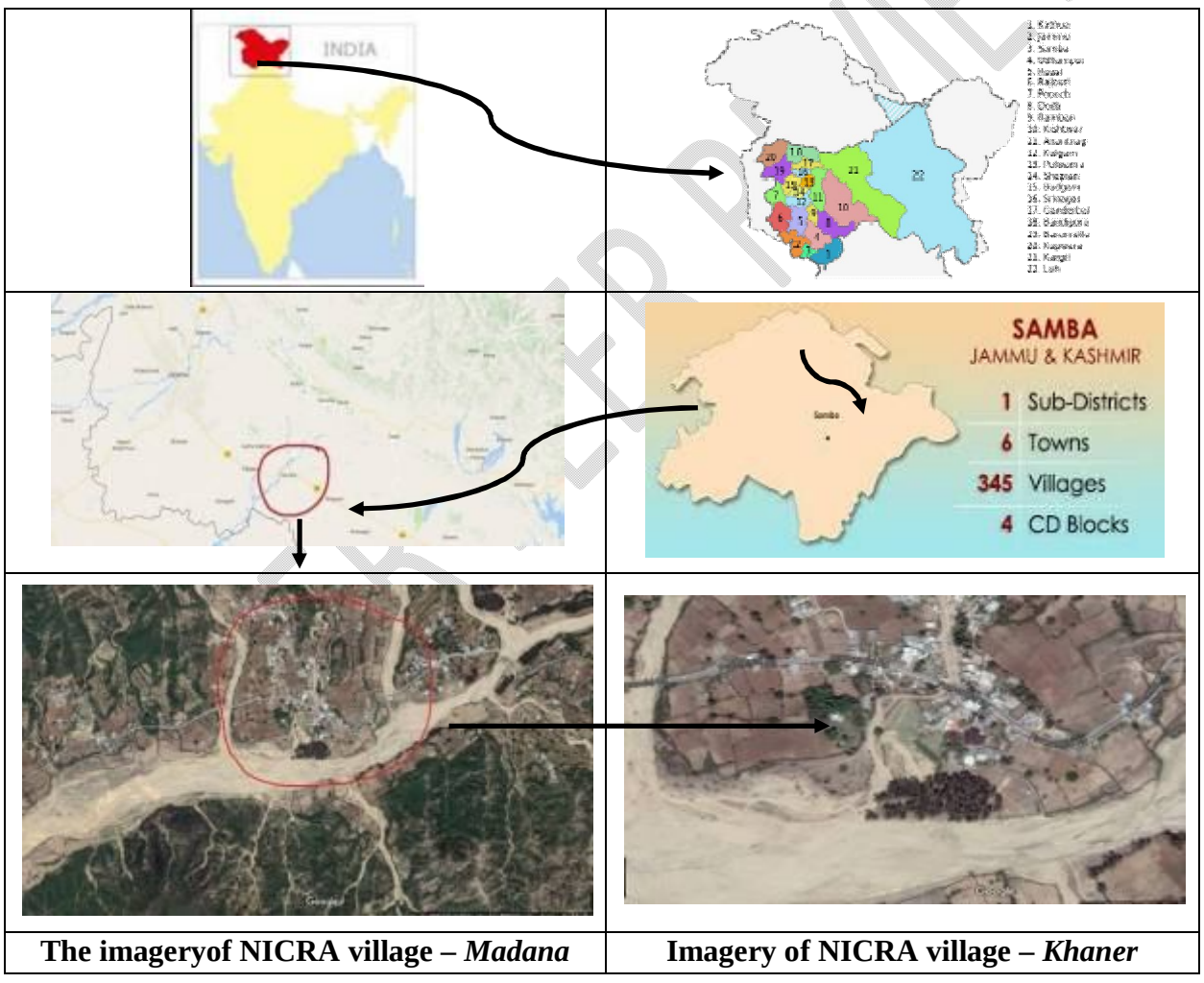
The primary survey has been conducted in the Samba district of Jammu and Kashmir. A total sample of 120 farmers has been collected from the three NICRA villages namely Khaner, Khada, and Madana in the Samba district of Jammu and Kashmir using a purposive sampling technique. The villages were selected for implementation oftheNational Initiative on Climate Resilient Agriculture (NICRA) Project.The village is situated at a latitude of 32° 39" North and longitude of 74° 53" East at an elevation of 335 meters above the mean sea level and it represents the true

*kandi*belt of Samba plain areas and parts of Jammu, Kathua and Udhampur districts of Jammu and at a distance of about 15 km from DLRSS RakhDhiansar..The village is under KharaMadana Gram Panchayat under the Block Purmundal, teh&distt. Samba, J&K.

**NICRA Site**:

The village '***Khaner***' is situated about 15 km away from Block: Purmundal and about 40 km away from teh&distt. Samba HQ. The othertwo villages namely Madana and Khadaare adjacent to Khaner village.

**Figure 1: Image of NICRA Villages:Khaner and Madana – Climate Resilient Agriculture Practices in Action**




| The imageryof NICRA village – *Madana* | Imagery of NICRA village – *Khaner* |
|---|---|

Table 1: Characteristics of the NICRA Farmers of Samba District of Jammu and Kashmir

| **Characteristics** | **Adopter** | |
|---|---|---|
| | **Number** | **Percentage (%)** |
| **Sex** | | |
| Male | 110 | 91.66% |
| Female | 10 | 8.33% |
| Total | 120 | |
| Age | | |
| Mean | 49.26 | |
| Civil Status | | |
| Married | 97 | 83% |
| Unmarried | 23 | 19.16% |
| Total | 120 | |
| Education Qualification | | |
| No. of years of Schooling (Mean) | 9.04 | |
| Illiterate | 0 | 0 |
| Primary | 17 | 14.16% |
| High School | 96 | 80% |
| Graduation and above | 7 | 5.83% |
| Total | 120 | |



**Ordinary Least Square Regression**

The adoption of NICRA interventions is measured by several variables like age, experience, social participation, Personal characteristics, and demographics measures.

$DC_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_k X_{ki} + e_i$

Where $DC_i$is the dependent variable adoption of NICRA interventions by $i^{th}$farmer in the data,

$\beta_0$ is intercept, $\beta_1$, $\beta_2$ ……$\beta_k$ are regression coefficients, $X_1$, $X_2$.....$X_k$are independent variables and

$e_i$is the error term.

## RESULTS AND DISCUSSION

The OLS model has been used to identify the significant factors affecting the adoption of NICRA interventions. Several independent variables affectthe adaptation of NICRA interventions which help farmers for climate-smart Agriculture. The model has adjusted $R^2$ 0.64 i.e. 64% the independent variables can collectively explain the variation in the dependent variable. The factors that significantly and positively explained the adoption level of NICRA interventions are training, Farmer Experience, TV as a source of information, income, and ownership of land (at a 1% significance level each), and Agricultural Extension as the source of information, KCC, Number of crops (at 5% significance level each).

Thus, attending training programmeswas likely to increase the adoption level of climate-resilient agricultural practices. The positive role of the extension officers also brought anincrease in the level of adoption. TV as a source of information plays an important role in spreading the awareness of NICRA interventions. TV is the main source of disseminating information to the mass population. Thus, farmers were becoming aware of climate-smart agricultural practices through television. In addition, farm income also plays an important role in adopting climate-resilient technologies. The Kissan Credit Card (KCC) is also an important factor that influences farmers to adopt climate-resilient interventions. Growing more than one crop also increases the adoption as the farmers are more aware of crop diversification which is less risky than growing one crop at a time. The farmers are looking for new technologies so that they can increase their yield and income. The technological interventions have been improving the awareness, knowledge, and skills of the farmers. Our results are consistent with the previousstudies that have been conducted earlier. Adaptation to climate change has significantly increased farm income practices like varietal change of seeds, and water management havea positive and significant impact on net farm incomes (Di Falco et al., 2011). The farmers' perceptions regarding climate change are being influenced by access to information. Services like extension, credit, and information regarding climate change increased climate resilience (Bryan et al., 2013). The positive attitude towards the adoption of CSA practices is significant for the farmers of Ghana (Atta-Aidoo et al., 2022). Crop diversification also increases the adoption of CSA practices which corresponds to the results (Franke et.al, 2018) which shows how crop diversification through the rotation of crops enhances soil fertility and increases the resilience towards climate variability in Sub-Saharan Africa.

Table 2: OLS Regression Results: Adoption of NICRA Interventions

| **Variables** | **Coefficients** | **p> Ƶ** |
|---|---|---|
| **Constant** | **-2.316** | **0.262** |
| **Farmers** | | |
| Sex | 0.231 | 0.563 |
| Age | 0.023 | 0.511 |
| Education | 0.033 | 0.710 |
| Experience | 1.19 | 0.005*** |
| Training | 2.871 | 0.0051*** |
| TV as a source of information | 1.017 | 0.000*** |
| Fellow farmersas a source of information | 0.726 | 0.267 |
| Agriculture Extension as a source of information | 1.467 | 0.028** |
| Internet | 0.234 | 0.540 |
| Income | 1.135 | 0.0037*** |
| KCC | 2.34 | 0.005** |
| **Farm** | | |
| Farm Size | 0.087 | 0.367 |
| Ownership | 1.089 | 0.0071*** |
| Hired Labour | 0.283 | 0.358 |
| Number of crops | 2.271 | 0.000** |
| **Institutional** | | |
| Social Access | -0.367 | 0.687 |
| Institutional Credit Access | 0.547 | 0.261 |
| **No. of observation = 120** | **F(16,103)= 6.730** | **Prob>p= 0.000** |
| **$R^2$ = 0.67** | **Adj. $R^2$ =0.64** | **Root MSE= 2.258** |

***Significant at 10%, **Significant at 5% and ***Significant at 1%**

The training has been consistent and plays a crucial role in the adoption of climate-smart interventions (Arslan et. al, 2020).Government attention should focus on providing tools, information, training, andfinancing to smallholder farmers in the Samba district of Jammu and Kashmir. Thus, it is essential to raise awareness among farmers to protect their food security and sovereignty. The most important thing is to implement agricultural practices based on adaptation capacity, which requires, firstly, increased investments to optimize resources; increase productivity; improve quality; reduce costs; preserve the environment, and add value to products.

## CONCLUSION

The study focused on the farmers' adoption level of climate resilience technologies which helps them to enhance their crop yield and income in the villages of Samba district of Jammu and Kashmir. There are several factors that positively and significantly affect the adoption of NICRA interventions. The training and information to the farmers played an important role in the initial adoption of climate resilient practices. The role of the Extension officers also has a significant effect on farmers' adoption of practices that help them to increase the productivity of the crops. The study highlights the importance of quality and quantity of information at the right time to the farmers. Extension activities play a significant role in promoting new technologies and interventions forfarmers. The climate-resilientinterventions upgraded the knowledge skills and speeded the process of adoption level among farmers. The Government can utilize the power of mass media like TV, newspapers, or posters to create awareness among farmers regarding climate-resilientinterventions. The KCCprovides timely and adequate credit to the farmers which ensures the flexibility for the purchase of agricultural inputs like seeds, fertilizers, etc. Finally, the adoption of interventions is location-specific, thus the govt. Should give more attention tothe policy, research, and practice of new climate-resilient interventions which will encourage the farmers to adopt them.

**Conflict of Interests**

The authors declare that there is no conflict of interest**.**

**Data availability statement**

The data is available from the corresponding author upon reasonable request**.**

**Disclaimer**

The content, opinions, and views expressed in the research communication published in the journal namely These views are of the authors and do not necessarily reflect the views of the organization they belong to.

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