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Do Socio-economic Conditions and Personal Behaviour Influence the Adoption of Climate Change Mitigating Measures

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ABSTRACT

This study aimed to identify the factors affecting farmers' perception of climate change and the adoption of Soil and Water Conservation (SWC) measures as a mitigation strategy for climate change. From the existing literature review, the study has identified the factors that potentially influence the adoption of climate mitigation and adaptation technologies. The binary logit model was employed using survey data collected from the Agra district of Uttar Pradesh during the year 2018-19. Results show that about 60 per cent of households had a clear perception of climate change, and age, education, membership of groups, mass media exposure, and extension agency contacts were key influencing factors in farmers' perception of climate change. Similarly, education, occupation, mass media exposure, awareness of climate change consequences, climate change perception, and attitude of farmers increase the probability of adopting soil and water conservation measures by the farmers in their fields. Therefore, the study results have significant implications for policies and campaigns promoting adopting climate-smart technologies to make the agricultural system more resilient to climate change.

INTRODUCTION

As global warming and climate change predictions become increasingly certain, there is mounting pressure to understand disaster risk better. Climate change is a significant contributing factor to the recent losses and damages to the agricultural sector (Greene et al., 2011; Meena et al., 2022). In Asia, crop yield is projected to be declined by 5-30 per cent by 2050 due to rising temperatures, and in India, it has been expected that a 2.7°C to 4.3°C rise in temperature by 2050 will lead to a reduction in yield of rice and wheat by 32-40 per cent and 41-52 per cent, respectively (Gupta & Pathak, 2016). In recent years, the projected adverse impact of climate change has attracted significant attention to adopting climate-smart agricultural (CSA) technologies to cope with the risk associated with climate change (Birthal et al., 2019; Mairura et al., 2021; Naik et al., 2023). An appropriate understanding of the determinants of farmers' perception of climate change is vital for making pro-farmer policies and adopting effective mitigation and adaptation strategies (Meena et al., 2022a). Most of the existing literature has reported the farmer's perception of climate change in terms of changes in temperatures, total rainfall, monsoon onsets and offsets, change in droughts frequency, lengths of summer and winter seasons, etc. (Banerjee, 2015; Ravikumar et al., 2015; Ghanghas et al., 2015; Guhathakurta et al., 2020; Meena et al., 2022b). The studies analysed the determinants of farmers' perception of climate change, assuming a farmer has the perception of climate change by considering any of the above-listed variables. However, this study used "clear perception" to integrate four variables, namely the perceived existence of climate change, change in temperature, rainfall, and drought, to identify the determinants of farmers' perception of climate change.

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In India, climate change threatens the sustainability of the agriculture sector by altering soil quality and the availability of irrigation water (Meena, 2022b). Policymakers and development practitioners are approaching farmers to adopt CSA technologies at the grass root level that help the sustainability of agricultural productivity, and adapt and make resilient agricultural systems. Farmers' perception of climate change and decision by farmers whether to adopt mitigation measures depends on various factors such as the magnitude of financial incentives likely to receive, socio-economic conditions of farmers, institutional variables, and personal behaviour. Several studies have identified different socio-economic factors such as age, education level, total income, primary occupation pattern, and family size; institutional information such as access to information, groups membership, and extension visits; personal attributes such as attitude, awareness, fatalism, perception, etc., that are important variables to influence adoption of mitigating measures either negatively or positively (Barman & Das, 2010; Pande et al., 2011; Mondal et al., 2013). Therefore, information on determinants of the adoption of CSA technologies enables policymakers to enact practicable strategies to encourage farmers to adopt. Soil and water conservation (SWC) has been considered one of the critical components of mitigation and adaptation strategies. Therefore, the objective of the study was to identify the determinants of a clear perception of climate change and the adoption of SWC measures.

METHODOLOGY

The study was conducted at ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Agra, during 2018-19. Primary data were collected from households using a semi-structured questionnaire using multiple-stage sampling. Agra district in the Semi-arid region of Uttar Pradesh state was selected purposively due to its high vulnerability to climate change. Within a district, three blocks were selected randomly, and one village from each block was randomly selected. A total of 120 households were selected randomly from the villages. Descriptive analysis was used to describe the independent variables, farmers' perceptions, and distribution of SWC adopted by farmers.

The study used the 'clear perception' and 'adoption of SWC measures' as dependent variables to identify the determinants of farmers' perception and adoption of SWC measures, respectively. A farmer is considered to have a "clear perception'' if all four conditions are satisfied below: 1. The farmer believes that climate change exists; 2. The farmer perceives an increase in the average temperature over the last 20 years; 3. The farmer perceives a change in total rainfall and rainfall pattern over the last 20 years; and 4. The farmer perceived an increase in the droughts frequency over the last 20 years. Thus, it allows the separation of farmers who clearly perceive climate change from those who do not (Roco et al., 2015). The rationale for the integration of three variables (temperature, rainfall, and drought) stems from the historical evidence that average temperatures have risen, average rainfall has declined, and droughts have become more prevalent in a consistent pattern (Sharma et al., 2018; Guhathakurta et al., 2020).

A farmer was considered an adopter of SWC measures if he implemented the measure at least in one of his farm plots. SWC measures include levelling, bunding, vegetative bund, broad bed furrow, summer ploughing, green manuring, farm pond, and recharge filters on farmers' plots. The study employed a binary logistic regression model to evaluate the determinants of farmers' perception of climate change and the adoption of SWC measures. The mathematical expression of the equation is given below:

$$ln\left|\frac{p}{1-p}\right| = \beta 0 + \beta 1x1 + \beta 2x2 \ldots\ldots + \beta jxj$$

Where p is the probability of perceiving climatic change or adopting SWC measures, and 1-p is the probability of not perceiving climate change or adopting an SWC measure. βo was the intercept, β1, β2 … βj were the regression coefficients of determinants, and X1, X2 … Xj represented the socio-economic, institutional, and personal psychological explanatory variables.

RESULTS AND DISCUSSION

Determinants of farmers' clear perception of climate change

The response of households to questions related to the clear perception of climate change variables is presented in Table 1. According to our definition of clear perception in this study, about 60 per cent of households had a clear perception of climate change. Results showed that a third-fourth of households reported increases in drought frequency and more thana third-fourth of households reported an increase in average temperature, and more than 80% of farmers reported a reduction in rainfall and existing of climate change in the last 20 years.

Table 1. Farmers' perceptions of climatic variability

Statement	Percentage of Farmers
Existence of climate change	85
Increase in the average temperature over the last 20 years	79
Reduction in the rainfall over the last 20 years	84
Increase in the occurrence of droughts over the last 20 years	75
A clear perception of climate change	60

The econometric estimates of the logit model indicate that age negatively affects perception (Table 2), indicating that younger farmers are more likely to perceive climate change than older ones. As expected, education positively impacts the perception that the likelihood of a farmer perceiving climate change increases by 3.1 per cent for each year of schooling completed. The model's parameters related to social participation were highly significant and positive. Access to information through mass media (press, television, agriculture exhibitions/fairs, and the internet) had a marginal effect of 24.1 per cent. At the same time, contact with extension agencies (Agriculture officer, Scientists, Gram Sevak/ VDO, NGOs) increased the likelihood of perceiving climate change by 35.5 per cent. The findings are similar to the results reported by Mandal et al., (2022).

Table 2. Determinants of farmers' clear perception of climate change

Variable	Coefficient	Robust standard error	Marginal effects
Age	-0.0189*	0.0201	-0.0035
Land Size	-0.0041	0.0171	-0.0007
Education	0.166*	0.085	0.0314
Income	0.0001	0.0001	0.0001
Social Participation	1.557**	0.744	0.2735
Mass Media Exposure	1.282**	0.618	0.2413
Extension contact	2.424***	0.730	0.3556
Constant	-1.251	1.157	
Log pseudo-likelihood	-48.011		
Pseudo R^2	0.457		
N	120		

Note: *, **, and *** indicate levels of significance at 10, 5, and 1 percent of probabilities, respectively

Determinants of SWC measures adoption

The details of SWC measures adopted by the farmers at their fields are presented in Table 3, and results showed that bunding, leveling, summer ploughing, and vegetative bund were the predominant SWC measures adopted by the farmers. The predominance of bunding and leveling in the study areas could be attributed to compatibility with local farming practices, availability of technical and financial support, improving yield by preventing soil runoff during heavy rainfall, reducing the loss of fertile topsoil, and capturing and retaining rainwater. Many previous studies have also reported that SWC fosters agriculture production and helps mitigate the adverse effect of climate change (Mondal et al., 2013; Meena et al., 2020 & 2021). Moreover, Meena et al., (2022a) conducted another study in the same area and reported that most farmers perceived SWC measures as the most effective strategies for mitigating the effects of climate change. Therefore, this study attempted to identify the determinants of adopting SWC measures as a mitigating strategy for climate change.

The estimate of determinants of SWC measures showed that awareness and perception are critical factors that affect the adoption of SWC measures. Farmers who are aware of the adverse impact of climate change on agriculture and perceive that SWC measures can reduce costs, increase yields, or mitigate the impacts of climate change are more likely to adopt SWC measures. Education positively influences farmers' adoption of SWC measures, i.e., the probability of adopting SWC measures increased by 1.5 per cent for each year completed schooling (Table 4). Similarly, as expected, occupation as agriculture, social participation, extension visits, and positive attitudes towards environments and climate change mitigating and adaption technologies increase the probability of adopting SWC measures significantly. At the same time, farmers' total income and fatalism behaviour negatively influenced their adoption of SWC measures at their farms. However, marginal effect coefficients showed that occupation, attitude, awareness and perception, and extension contacts are major key determinants of SWC measures adoption. Farmers who participate in the social network have likely more access to information related to various aspects of climate change and its mitigation measures by sharing knowledge and experience. Contact with extension agents facilitates access to technical information, resources, and inputs necessary for implementing SWC practices. Attitude plays a crucial role in the adoption of SWC measures. If farmers have a positive attitude toward the benefits of sustainable practices, they are more likely to adopt these measures. Attitude can be influenced by factors such as social norms, values, and beliefs, as well as previous experiences with these practices. Farmers who have a negative attitude or fatalistic behaviour are not ready to adopt SWC measures. Thus, it is essential to promote positive attitudes toward SWC measures among farmers to encourage adoption (Meena et al., 2022b). These findings have important implications for policymakers, extension workers, and other stakeholders seeking to promote sustainable agricultural practices. The awareness programs for adopting SWC measures must demonstrate the indirect benefits of SWC measures in monetary terms (Meena et al., 2022c). Policymakers should target enhancing farmers' awareness and positive attitudes toward adopting sustainable agricultural practices through increasing extension contacts, targeted education campaigns, and mass-level awareness programs.

Table 3. Adoption of SWC measures by the farmers at their farms

SWC Conservation measures	SWC adopted by farmers on farms (%)
Bunding	54.50
Levelling	35.09
Vegetative bund	22.73
Broad bed furrow	14.29
Summer Ploughing	25.76
Green manuring	19.05
Others	4.17
Overall adoption of SWC	66.67

Table 4. Determinants of SWC adoption under climate changing scenario

Variable	Coefficient	Robust standard error	Marginal effects
Age	0.0311	0.044	0.0018
Land Size	0.0424	0.049	0.0025
Education	0.2593**	0.130	0.0153
Occupation	2.692**	1.127	0.3492
Livestock	-0.330	0.206	-0.0195
Total income	-0.00001*	0.0006	-0.00007
Social Participation	2.080*	1.165	0.0980
Mass Media Exposure	1.623	1.147	0.0962
Extension contact	2.634**	1.148	0.1399
Awareness	2.036**	0.978	0.1440
Perception	1.567*	0.932	0.1036
Fatalism	-.2.780*	2.181	-0.1647
Knowledge	1.321	2.506	0.0782
Attitude	10.934**	4.320	0.6476
Constant	-9.7570***	3.298	
Log pseudo-likelihood	-23.69		
Pseudo R^2	0.659		
N	120		

Note: *, **, and *** indicate levels of significance at 10, 5, and 1 percent of probabilities, respectively

CONCLUSION

Results indicated that 60 per cent of farmers have a clear perception of climate change, and education, social participation as members of the organization, mass media exposure, and extension agency visit positively influenced the farmers' perception of climate change. SWC measures have been well acknowledged as a potent component of mitigation and adaptation strategies for climate change. The estimate of determinants of adopting SWC measures showed that education, attitude, awareness and perception of climate change, and extension visits are key factors for enhancing the adoption of SWC measures among the farmers. Based on the results, the study suggests that policymakers should focus on increasing awareness programs to change farmers' perceptions of climate change and attitudes towards climate-smart technologies through more extension visits and educational campaigns to make sustainable agricultural production and improve the agricultural system resilient to climate change.

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