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Gyan Shukla
Banaras Hindu University

Ratnesh Kumar Jha
Dr Rajendra Prasad Central Agricultural University Pusa

Shishir Kumar Gangwar
Rajendra Agricultural University

R P Singh
Krishi Vigyan Kendra, West Champaran-II of Dr Rajendra Prasad Central Agricultural …

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Gyan Shukla
Banaras Hindu University

Sudhanand Prasad Lal
Dr. Rajendra Prasad Central Agricultural University, Pusa

Ratnesh Kumar Jha
Dr Rajendra Prasad Central Agricultural University Pusa

Dhiru Tiwari
Dr Rajendra Prasad Central Agricultural University, Samastipur, India

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Predictive Attributes Influencing Adoption level of Farmers' apropos Climate Resilient Agriculture Technologies in Bihar

Gyan Shukla[1], Utpal Kant[1], Sudhanand Prasad Lal[2*], Ratnesh Kumar Jha[3], S.K. Gangwar[4], R.P. Singh[5] and Dhiru Kumar Tiwari[6]

[1]Senior Research Fellow, Climate Resilient Agriculture Programme

[2]Assistant Professor cum Scientist, Department of Extension Education, PG College of Agriculture

[3]Professor cum Principal Investigator of Climate Resilient Agriculture Programme and Nodel Officer of National Agriculture Disaster Management Plan, Climate Resilient Agriculture Programme, Dr. Rajendra Prasad Central Agriculture University, Pusa, Bihar, India

[4]Senior Scientist & Head, Krishi Vigyan Kendra, West Champaran-I; [5]Senior Scientist & Head, Krishi Vigyan Kendra, West Champaran-II; [6]Subject Matter Specialist, Krishi Vigyan Kendra, West Champaran-I

Corresponding author's e-mail: sudhanand.lal@rpcau.ac.in

ABSTRACT

Climate changes are the most threatening challenges to the farmers. The “Climate Resilience” is basically a concept of management of climatic risk. This study focused on extent of adoption level of climate resilient interventions and socioeconomic attributes influencing that of the farmers in West Champaran and Sheohar districts of Bihar under project called “Climate Resilient Agriculture Programme (CRAP) of RPCAU, Pusa funded by Government of Bihar and implemented since Rabi 2019 (although in selected districts it began after 1 year in Rabi 2020). A data of 120 randomly selected farmers were taken. The results explained that most of the respondents (54.17%) had partial level of adoption followed by farmers having full adoption level and non-adoption of CRA interventions. The variables *viz.*, number of schooling year, social participation and innovation propensity were found positively significant at a 10 per cent, 5 per cent and 1 per cent significance level having p-value 0.091, 0.036 and 0.000, respectively; with R Square value of 0.785. Findings concluding that these factors had significant influence on adoption level of climate resilient technologies. From this, researchers can conclude that if they want to promote climate resilient technology, the factors *viz.*, number of schooling years, social participation and innovation propensity of the farmers should be given added preference.

Keywords: Adoption, Bihar, Climate Resilient Agriculture, CRAP, Zero tillage.

INTRODUCTION

Global agriculture is seriously threatened by climate change. There is now widespread acceptance of extreme weather occurrences like cyclones, droughts, floods, and desertification as having a negative influence on agricultural productivity, sustainability, and livelihood security. Due to extreme flood in Kosi River of Bihar (India) in 2008, officially stated as “National Calamity” by the honorable Prime Minister of India (SAARC report, 2008), livelihood security of was hugely hampered and the livelihood security index reveled that most of the affected farmers had very poor livelihood creation (Lal *et al.* 2021). Following years (2009, 2010 and 2013) that placewasobserved dry periods, and proclaimed drought-affected regions of Bihar state (Lal *et al.* 2015). Such kind of uncertainty in meteorological phenomenon is threatening sustainable planning of cropping system. Moreover, the adverse effects due to continuous change climatic conditions causing, ground water depletion, soil fertility degradation, runoff, negative environmental effects (Pingali, 2012). Though the climate change is a global threat but the countries like India, more vulnerable because more than 50 per cent of the rural peoples of India still employed primarily agriculture and its allied sectors (FAO, 2022; PIB, 2021). Our country is expected to suffer major negative consequences from medium-term climate change (2010-2039), which is expected to lower agricultural yields by 4.5 to 9 per cent, reliant on the severity and distribution of temperature rise. Given that agriculture accounts for around 16 percent of India's GDP, a 4.5 to 9 reduction in output indicates a cost of climate change of up to 1.5 per cent of GDP every year (NICRA, 2011). Therefore, it is the need of hour to bring the sustainability in agriculture by adopting strategic research and on-fam demonstration of Climate Resilient Technologies.

The “Climate Resilience” is basically a model of management of climatic risk. In this context, “Resilience refers to the ability of an agricultural system to anticipate and prepare for, as well as adapt to, absorb and recover from the impacts of changes in climate and extreme weather” (Alvar-Beltrán *et al.* 2021). Resilience can be increased through implementing short- and long-term climate adaptation and mitigation methods, as well as by encouraging transparent and inclusive participation of varied stakeholders in decision-making and management processes.

In Bihar, approximately 90 per cent of the population lives in rural regions, with agriculture employing roughly 80 per cent of the people. Being a major part of Indo-Gangetic Plains in Bihar, which is worlds' most fertile and productive agricultural area, thus in the region, it is very essential to rise production level of farm for safeguarding food security of the nation. However, climatic unpredictability drastically impairing agriculture in this region. North Bihar is usually a much vulnerable to floods, however, south Bihar is very prone to drought (BSDMA, 2022). The rainfall distribution in between July to September (almost 80% of the total rainfall per year) is the main source of floods in the northern regions of Bihar due to the flat landscape. Flood-prone areas cover over 74 per cent of Bihar's entire geographical area, accounting for around 17 per cent of India's total flood-prone areas.

Considering these, since Rabi 2019, RPCAU, Pusa commenced a project called “Climate Resilient Agriculture Programme (CRAP)” and implementing it in collaboration with BISA (Pusa), BAU (Sabour) and ICAR-ATARI Zone IV (Patna) throughout the Bihar (Lal *et al.* 2022). The project financially assisted by Government of Bihar. But, in West Champaran and Sheohar districts of Bihar it penetrated in Rabi 2020 through the respective KVKs. The basic aims of this project are promoting to strategic research, to bring a desirable change in farmers' behavior by adopting CRA technologies through and conducting field level CRA technological demonstration under close supervision of scientists, mechanization of agriculture and capacity building of farmers. Under the project different technologies being demonstrating at farmers' fields are timely sowing, climate resilient verities, direct seeding of paddy, zero tillage sowing in wheat, raised bed planting, intercropping, irrigation scheduling by alternate wetting and drying (AWD) pipes, nutrient management by leaf color chart (LCC), green seeker, soil testing, land leveling by laser land lever, community irrigation and so on. In any community, all the farmers are not adopting the innovations same time and same level due to variety of socio - personal and socio – economic characteristics. In light of this, the current study was executed with the objective: to analyze the socio-economic characteristics of farmers affecting the adoption level of CRA innovations. The outcome of the study may help the policy maker to increase the level of adoption.

METHODOLOGY

An ex-post facto study was conducted to explaining the relationship between socio-economic attributes of farmers and adoption level of CRA technologies. A combination of simple random sampling and purposive sampling were followed for sample selection. Being the CRA project site, two districts namely West Champaran and Sheohar of Bihar are selected purposively. Sheohar and West Champaran District, situated in the Agro Climatic Zone 1, in North Bihar andlies under the Middle Gangetic plain zone. From the project site, two villages namely Harnahi and Paharpur of Sheohar block were randomly selected under Sheohar district. Again, two villages namely Baikunthwa and Jhakhra of Nautan block were randomly selected under West Champaran district. For the grassroots inquiry, 30 respondents were also randomly chosen from each village. Thus, the sample comprising a total of 120 farmers with diverse farm and socioeconomic variables were selected. In the chosen villages, informal interviews and focused group discussions with 5-8 farmers were organized. Farmers were questioned informally about the factors affecting the adoption rate of the climate resilient interventions of the programme during the field investigation. Extent (level) of adoption of climate resilient technologies calculated by collecting data from respondents with the help of semi-structured interview schedule and it was later classified by mean and standard deviation approach. Independent variables were collected for measuring adoption level of the respondents. These explanatory variables include 11 variables viz., age, family size, years of schooling, social participation, experience in farming, occupation, annual family income, land-holding, mass media exposure, extension contact and innovation propensity. Additionally, respondents were asked to describe the measures they adopted to combat climate change using different climate resilient interventions. Thus, eleven variables were fitted in the multivariate regression model selected to explore the degree of association between these independent and dependent variables. The standardized regression coefficient (β value) is more suitable to employ (Nardi, 2006) for that. So, the standardized beta coefficients were used to compare the importance of each variable in predicting adoption level. β value conveys the direction (positive or inverse) and the weighting of the independent variable in relation to the other independent variables in order to explain the variance of the dependent variable (Shukla *et al.*, 2021; Lal *et al.*, 2016).

RESULTS AND DISCUSSION

Adoption level of CRA technologies: Table 1 depicts that, majority of farmers (54.17%) have partial adoption level of climate resilient technologies and 25% of selected farmers have fully adopted the different interventions provided by our project. Thus, it can be concluded that significant strategies are required to increase adoption of climate resilient technologies to face climate uncertainty and increase farm profitability.

Table 1
Adoption level of CRA technologies

Sl. No.	Adoption Level	Respondents (n=120)		
		Frequency	Percentage	
1	Non-Adopted (<8.94)	25	20.83	Mean = 13.45 SD = 4.51
2	Partially Adopted (8.94 – 17.96)	65	54.17	
3	Fully Adopted (>17.96)	30	25.00	

Range of Minimum to Maximum Adoption level could be from 0 to 20.

Robustness of the regression model

The significant F-value (35.825), measure standard error of the estimate and high R^2 value show that the overall fit of the model was satisfactory (Table 2 & 3). Table 2 revealed that multiple correlation (R) is 0.886 and the R square is 0.785, which means is 78.5 per cent of the variation in adoption level among therespondents is explained by this set of11 variables working together.

Table 2
Model Summary of dependent variable, i.e. adoption level of the respondents

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.886	0.785	0.763	2.194
a. Predictors: (Constant), age, family size, years of schooling, social participation, annual family income, occupation, experience in farming, land holding, mass media exposure, extension contact, innovation propensity				

Table 3

ANOVA value representing the suitability of regression model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1897.637	11	172.512	35.825	0.000[b]
	Residual	520.063	108	4.815		
	Total	2417.700	119			
a. Dependent Variable: Adoption Level						
b. Predictors: (Constant), age, family size, years of schooling, social participation, annual family income, occupation, experience in farming, land holding, mass media exposure, extension contact, innovation propensity						

Multivariate regression analysis of independent variables with ISB ofthe respondents through mobile:

The regression analysis fitted to the model and data analyzed the association of adoption level of CRA interventions with socioeconomic factors whose findings given in Table 4. In contrary to a priori expectation; age, family size, occupation, experience in farming, annual income, land holding, mass media exposure and extension contact were not found to have a significant influence on adoption level of climate resilient technologies. The variables which had significant influence on adoption level of climate resilient technologies explained following.

Table 4

Multivariate regression analysis of independent variables with ISB ofthe respondents through mobile

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	99.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5.667	1.822		3.110	0.002	0.888	10.445
	Age	-0.018	0.018	-0.045	-0.949	0.345	-0.066	0.031
	Family size	0.059	.147	0.019	0.402	0.689	-0.327	0.446
	Years of Schooling	0.077	0.045	0.079	1.703	0.091*	-0.041	0.195
	Social participation	0.151	0.071	0.188	2.123	0.036**	-0.035	0.337
	Occupation	-0.219	0.247	-0.048	-0.885	0.378	-0.867	0.429
	Experience in farming	0.001	0.025	0.002	0.027	0.978	-0.065	0.067
	Land holding	-0.638	0.522	-0.108	-1.223	0.224	-2.008	0.731
	Annual family Income	3.292E-7	0.000	0.009	0.115	0.909	0.000	0.000
	Mass media exposure	0.095	0.091	0.113	1.051	0.296	-0.142	0.333
	Extension contact	-0.125	.091	0-.105	-1.381	0.170	-0.363	0.112
	Innovation propensity	0.338	.057	0.710	5.883	0.000***	0.187	0.488
a. Dependent Variable: Adoption Level								
***, ** & *, depict value is significant at 1, 5 & 10% levels respectively (2-tailed).								

Year of Schooling: The variable was found to be statistically significant at 10 per cent level of significance as its p-value is 0.091. Its standardized beta value which is 0.079, this means education has positive effect on adoption level of respondents. So, it can be suggested thata greaternumber of schooling years or education level should be provided to farmers by adopting formal and non-formal (extension education) method of education. This improves the decision making of farmersand lead to increase in adoption of different climate resilient interventions (Table 4).

Social participation: The variable was found to be statistically significant at 5 per cent level with the p-value .036. Its standardized beta value is 0.188 which revels that an increment in level of social participation will positively increase the adoption level positively. So, it can be concluded that social participation aspect of the farmers should be emphasized for greater level of adoption on farmers' end (Table 4). Increased social participation by the farmers at different platforms like gosthi, training, kisan mela, field days, study tour group meetings with progressive farmers and so on may helpful in breaking farmers' orthodox perception and building the scientific understanding.

Innovation propensity: The variable was found to be statistically significant at 1 per cent level with the p-value .000. Its standardized beta value is 0.710. So, it can be deduced that farmers having higher level of innovation propensity will have higher adoption of different climate resilient technologies. Wide and appropriate innovation should be reached to farmers for more adoption (Table 4). Usually, small and marginal farmers suffer with low innovation propensity because the fear of technology failure. Such kind of fear may be addressed by free or low-cost input supply, frequent visit of scientists at field and rapport building with farmers, providing insurance or compensatory promises in case of technology failure.

CONCLUSIONS

This study assessed the factors determining the adoption level of climate resilient technologies in the CRA adopted village of West champaran and Sheohar district. Understanding Constraints and finding, suitable steps or conditions can promote farmers and accelerate their adoption level of climate resilient technologies. Farmers' socio-economic characteristics including age, years of schooling, social participation, landholding and annual family income, mass media exposure, extension contacts and innovation propensity are found to be some of the major factors affecting the adoption of the CRA technologies. This study reinforces that independent variable *viz.*, schooling, social participation and innovation propensity, should be given more emphasis if the level of adoption of CRA technologies of the respondent farmers has to be increased and sustained. It is concluded in present study that years of schooling, social participation and innovation propensity are positively significant at 10% 5% and 1% significance level respectively. This shows that these factors have immense opportunity for improving farmers' adoption level. These explained that farmers who have completed his schooling and have sufficient and more social participation and having more innovation propensity can smoothly and efficiently adopt the different CRAs technologies. These farmers know and understand the relevance of these technologies in the present era threatened by the climate change.

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