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Climate Change Perception of Farmers and Its Effect on the Technical Efficiency of Rice Production

Md. Motiur Rahman[1], Md. Toriqul Islam[1♥], Mst. Esrat Jahan[2]

[1]Economics Discipline, Khulna University, Khulna-9208, Bangladesh
[2]Department of Economics, Rabindra University, Bangladesh, Sirajganj-6770
♥Correspondence: toriqul@econ.ku.ac.bd

Abstract

Background: In recent times, Climate change poses increasingly significant difficulties to agriculture and farmers' perception of these can augment their adaptive strategies against these changes and thus ensure efficiency in crop production. **Aim:** The study aimed to analyze the impact of climate change perception of farmers on the technical efficiency of rice production in North-West Bangladesh. **Methods:** Cobb-Douglas stochastic frontier approach, including maximum likelihood estimation and technical efficiency estimation, was employed to determine the technical efficiency of Boro rice production in Nilphamari, Bangladesh. Required data were collected from 108 Boro rice-producing farmers of Domar Upazila under Nilphamari district, selected using a convenience sampling technique. In analyzing the data, farmer-specific technical efficiency scores were estimated using the Cobb-Douglas stochastic frontier approach, including maximum likelihood estimation and technical efficiency estimation. The weighted average index was used to measure the climate change perception of the farmers. **Results:** The study's findings revealed that the technical efficiency of Boro rice production in Domar Upazila under Nilphamari district is 87%. It is also found that education, access to non-farm income, access to credit, access to organic fertilizer and ownership of land, access to climate awareness training, access to the government subsidy, and all the factors of production are significant factors that affect the level of technical efficiency. The mean weighted climate change perception index is 19.25. **Conclusion:** The current technical efficiency indicates that Boro rice production in the study area has been operating below the maximum level of production frontier, and given the available technology, farmers can increase their production by 13% through improving their awareness related to attributes and by making optimal use of factors of production or inputs.

Keywords: climate change perception; rice production; stochastic frontier approach; technical efficiency

Introduction

The consumption of rice is vital for over half of the world population's food security (Mohidem et al., 2022). More than 21% of human calorie requirements and 76% of calorific intake of Southeast Asian inhabitants come from rice (Mohidem et al., 2022). However, climate-induced events for instance floods, droughts, heavy rains, storms, cyclones pose a detrimental impact not only on dams, buildings or other engineering constructions in developing countries (Kershaw et al., 2011; Zięba et al., 2020) but also on agricultural productivity in these countries (Hossain et al., 2022). Environmental change is strongly linked with rice production (Nguyen, 2002; Rezvi et al., 2023). Akram (2013) claimed that Climate change and agricultural productivity are negatively and significantly related. The severity of the negative effects of climate change depends on the economic condition of any country, so the areas that are dependent on agriculture (Abdul-Razak & Kruse, 2017) and are already vulnerable to undernourishment and hunger are at high risk due to climate change (Wheeler & Von Braun, 2013). Thathsarani & Gunaratne (2018) identified that poor people who possess low resources are subject to risk caused by climate change, irrespective of location. In most agrarian communities, there are nowadays reduced yields, increased food prices, increased pest infestations, changed land use, and increased difficulty in farm management, which are negative effects of climate change (Lungarska & Chakir, 2018; Mu et al., 2017). Hence, climate change can interrupt the global target of attaining zero hunger (Wheeler & Von Braun, 2013). With the rise of increased climatic issues, agriculture should be transformed in a more sustainable way because climate change causes severe threats to food security and agriculture (IPCC, 2014).

Bangladesh has recently been ranked as the third largest rice producer after China and India, and the production volume is 3.6 crore tonnes (Al Mamun et al., 2021). However, the country is placed in the list of economies that are exceedingly vulnerable to climate change (IPCC, 2014). The country faces challenges in achieving Sustainable Development Goals (SDGs) and food security due to climate change risk (Afroz et al., 2018). The problematic terrestrial position, plane, and lowland environments, together with its social and economic circumstances, make Bangladesh severely susceptible to the negative impacts of Climate change (Ayers & Huq, 2007; M. A. B. Siddique et al., 2014). Almost every year, different natural calamities visit Bangladesh (M. A. Siddique et al., 2014). The Study contributes to the advancement of a number of SDGs through addressing the association between agricultural productivity and climate change awareness. Specifically, SDG 1, SDG 2, SDG 12, and SDG 13 can be addressed through the present study. The goal of no poverty and zero hunger will be achieved by increased agricultural productivity and income levels of small-scale farmers. Sustainable and efficient management and usage of resources ensures responsible consumption and production of SDG goal 12. Building and strengthening adaptive capacity and resilience to climate hazards will advance to the attainment of SDG 13. Mottaleb et al. (2014) identified that in Bangladesh, production loss of rice arises due to drought and technical inefficiency due to floods. In this instance, farmers need to adopt adaptation practices to fight against climate change. Several studies found that the implementation of adaptation practices reduces the negative impacts climate change poses on agriculture (Di Falco et al., 2011, 2012; Finger et al., 2011). However, farmers' decision to adapt to climate change is closely related to what they perceive about climate change and how they place significance on this issue. However, the existing literature has either focused on farmers' perception regarding climate change or on technical efficiency; to the best of our knowledge, no study has focused on how technical efficiency can be influenced by farmers' perception regarding climate change. The present study is trying to fill the gap by focusing on how farmers' knowledge and perception regarding climate change can influence the technical efficiency of Boro rice production in Bangladesh.

Asia accounts for nearly ninety percent of the world's rice production and consumption (Rezvi et al., 2023). When compared with the first world and developed countries, developing countries face more vulnerability to climate change (CC) and its unpredictability (Ankrah Twumasi & Jiang, 2021). Lack of adoption of adequate adaptation measures against climatic events placed countries in South Asia and Southern Africa at risk from climate vulnerabilities (Lobell et al., 2008; Rahman & Anik, 2020). In these developing countries, more than 60% of the population is dependent on agriculture, and climate change severely influences their livelihood and food security (Khanal et al., 2018). Along with the impact of climate change, low productivity of staple crops in these developing countries is also the result of the nature of agriculture in these countries for instance subsistence means of agricultural production, insufficient irrigation facilities, low access to agricultural credit, and land degradation (Ojo et al., 2019; Ojo & Baiyegunhi, 2020). Non-industrialized and low-income countries are disproportionately affected by climate-related disasters due to their low adaptive capacity and lack of sufficient resources (Eckstein et al., 2021; Fahad et al., 2020). Rising climatic risk and expected climate change seriously challenge agriculture in these countries (Hossain et al., 2022).

With regard to the literature on technical efficiency, Bäckman et al. (2011) presented maximum likelihood estimates of the quadratic stochastic frontier production function and the Cobb-Douglas frontier production function and revealed that the technical efficiency is significantly influenced by farm households, including the age and educational attainment of the household heads, the availability of off-farm incomes, the fragmentation of land, the availability of microfinance, extension visits, and regional variation. According to Mohapatra (2013) , the average technical efficiency of paddy production in Odisha was 97.04. It was also discovered that education and farming experience both improve technical efficiency. Shantha et al. (2013) looked into the technical efficiency of rice farming in Sri Lanka; the average technical efficiency of a subset of farmers is 72.80. According to Tijani (2006) the technical efficiency of rice farms in Osun State, Nigeria, ranges from 29.4 to 98.2, with an average efficiency of 86.6. (Khan et al., 2010) conducted a study on the technical efficiency of rice production in Jamalpur district, Bangladesh, and found that the technical efficiency of Boro rice and Aman rice was 95% and 91% respectively. Farmers' age and farming experiences were found to be significant factors of technical efficiency.

Throughout the literature, we can see that there is consistent evidence that the number of studies showing the technical efficiency of agricultural producers is large. Once technical efficiency is obtained, most studies mainly focus on farmers' characteristics including human capital (such as age, education, household size), physical capital (such as household asset, farm size), institutional capital (such as access to information, training, credit), technical knowledge (such as experience) etc. to find out their impact on efficiency. To the best of our knowledge, no study has yet focused on how farmers' knowledge and perception regarding climate change can influence the technical efficiency of agricultural production. The present study attempts to contribute to the existing literature by focusing on this gap. Given the background, the specific objectives of the present study are:

i) To investigate the technical efficiency of Boro rice production in the study area.
ii) To explore farmers' perceptions regarding climate change and adaptation to it.
iii) To find out the determinants of technical efficiency of Boro rice production.
iv) To explore whether farmers' perception regarding climate change has any significant impact on technical efficiency or not.

The contribution of the present study is to explore the degree of perception-based climate change and other significant variables, which will support significant policy formulation to enhance technical efficiency.

Methods

1. Study area and data

The study area selected for this study is Domar Upazila under the Nilphamari district. This upazila covers an area of 250.84 square kilometers. The Domar upazila is traversed by three rivers: the Buri Tista, Shalki, and Deonai, 19 kilometers to the north of Nilphamari Sadar. Males make up 125,338 of the 249,429 residents in the area, while females make up 124,091. Farming is the primary activity of the population. In the working population, 45.28% of people are farmers, 27.11% are agricultural laborers, 3.42% are daily workers, 8.65% are entrepreneurs, 6.07% are government and non-government employers, and 8.7 have other vocations (BBS, 2019).

This study employs a convenient sampling technique to select samples. The majority of the population in the region is engaged in rice production. The rice-producing farmers are the study's sample unit. A total of 108 rice farmers have been chosen from the Domar upazila of the Nilphamari district. The sampling unions and the selected number in each union are shown in the following Table 1. The survey is conducted between August to September 2023. However, there are some limitations of self-reported data, such as social desirability bias or misunderstanding of questions: these limitations have been addressed by carefully designing of questionnaire and ensuring a consistency check.

Table 1. Distribution of the Sample

Name of the District	Name of the Upazila	Name of Union	Sample Size
Nilphamari	Domar	Domar	27
		Horinchara	27
		Motukpur	27
		Boragari	27
Total	01	04	108

Source: Author's compilation, 2023

2. Model specification

The technical efficiency of a farm is the ratio of the farm's actual output to the output that is technically possible given the quantity of resources (Battese & Coelli, 1995). In technical efficiency analysis, the Cobb-Douglas, Constant Elasticity of Substitution (CES), and Trans log production functions are the most prevalent functional forms (Haider et al., 2011). Most studies used the stochastic frontier production function approach to assess technical efficiency (Ajibefun et al., 2006). Consequently, the present study develops a stochastic parametric model to assess the technical efficiency of Boro rice production in the study area. This study explores the functional form of the stochastic production function (Eq. 1) by following Afrin et al. (2017), Abedullah et al. (2007), Battese and Coelli (1995), and to assess the technical efficacy of the rice farmers:

$$Y_i = f(X_i; \beta)e^{\varepsilon} \text{.............................}(1)$$

Where Yi, Xi, and β indicate the amount of output, vectors of input, and unknown parameters of the vectors of inputs, respectively. The Cobb-Douglas production function's logarithm expression is given in Eq. (2):

$$InY_i = \beta_0 + \sum_{j=1}^{n} \beta_j \, Inx_{ij} + \varepsilon_i \text{.............................}(2)$$

Where, i=1, 2, 3… … …, n and j= 1, 2, 3, … … …, m are the number of rice farmers and vector of input, respectively. Yi = Rice production (Mound), Xij = Vector of factor of production of the ith farmer, β = unknown parameters of the vectors of inputs, and ln = logarithm. The symbol ε represents the composed error term, which is the sum or difference of ωι and uι. The rationale for choosing the Cobb-Douglas production function over the Translog function is that it is simpler, easier to estimate, and relatively more interpretable. Its log-linear construction allows straightforward computation of output elasticities. Unlike the Translog function, it avoids issues such as overfitting or multicollinearity, which makes it practical and theoretically consistent for use in empirical studies. Even after that, the reliability of the estimates has been assessed by standard diagnostic checks. Multicollinearity has been examined by the variance-inflating factor (VIF) and heteroscedasticity by White's test.

The parameters of the stochastic frontier model have been estimated using the Maximum Likelihood Estimation (MLE) procedure using Eq. (2), where the likelihood function is presented in terms of the variance parameter in Eq. (5) (Ajibefun et al., 2006):

$$\sigma^2 s = \sigma^2 \omega + \sigma^2 u; \gamma = \frac{\sigma^2 u}{\sigma^2 s} \; and \; 0 \leq \gamma \geq 1 \ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

Where, the $\sigma^2 s$ symbolizes the variation of output due to changes in random shocks and inefficiency. The value of γ lies between 0 and 1, indicating whether the value γ = 1, there is complete inefficiency if γ = 0, there is no technical efficiency. Technical efficiency refers to how the farmers can produce the maximum feasible output with the given inputs (Coelli et al., 2002). Farrell (1957) analyzed farm efficiency, using both output and input approaches to increase efficiency and productivity. One concern shows that much production can be increased with given inputs, and another considers how much input can be reduced, without changing the production, respectively (Hasan et al., 2016). Likewise, the previous study conducted by (Rahman & Barmon, 2019), we have used a large number of explanatory variables; we first chose the Cobb-Douglas instead of the Trans log production function. Kopp and Smith (1980) claimed that there is no significant variation in the efficiency score in the choice of functional form. The logarithm expression of the Cobb-Douglas production function is as follows in Eq. (6):

$$InY_i = \beta_0 + \beta_1 InX_{1i} + \beta_2 InX_{2i} + \beta_3 InX_{3i} + \beta_4 InX_{4i} + \beta_5 InX_{5i} + \beta_6 InX_{6i} + \beta_7 InX_{7i} + \beta_8 InX_{8i} + \varepsilon_i$$

Where, Y_i = Rice production (Mound) of the ith rice farmer. The description of other variables is presented in Table 2. The Farmers' Perception-Based Climate Change Index (PCCI) has been developed by the following equation:

$$PCCI_i = \sum_{j=1}^{7} wiP_j$$

Where, $PCCI_i$= The perceptions-based climate change index of the ith farmer/farm. Here, wi = weights, (i = 0.2,0.4,0.6,0.8,1), higher weights mean the higher intensity of the climate change condition. P_j = Perception-based indicators (j = 1……7) such as P_1= decreasing rainfall, P_2= sudden rainfall, P_3= increasing temperature, P_4= problem of flood, P_5= drought problem, P_6= frequency of storm, P_7= decreasing rate of water layer. These seven indicators have been measured by using a Likert Scale, which generates values on a 1 to 5 scale. For each recognized climate change indicator, the farmers (respondents) choose the best option on a five-point Likert Scale. For instance, when a farmer chooses point 4 for the 'water layer problem', this implies that he/she is experiencing a high extent of the water layer problem. Accordingly, the Likert Scale would then evaluate the opinion by assigning a respective weight of 0.8. The main task of this exercise is to find numerical values of the perception-based climate change indicators.

Table 2. Description of variables

Name of Variables	Definition and unit of measurement
Rice production	Mound (1 mound = 40 Kg)
Land size	Bigha
Labor Cost	in BDT
Seed Cost	in BDT
Fertilizer Cost	in BDT
Tilling Cost	in BDT
Pesticide Cost	in BDT
Harvesting Cost	in BDT
Irrigation Cost	in BDT
Age of the farmer	in Years
Income	in BDT
Family size	Number of family members
Education	Years of schooling
Experience	in Years
Extensions Service	Dummy (Yes=1, No=0)
Access to microcredit	Dummy (Yes=1, No=0)
Take subsidies	Dummy (Yes=1, No=0)
Training	Dummy (Yes=1, No=0)

Source: Author's compilation, 2023

Results and Discussion

1. Summary statistics of the farmers

Table 3 displays the summary statistics of the output, inputs used for the cultivation of rice, the Climate Change Perception Index (PCCI), access to training and other institutional capitals, socio-demographic characteristics, and technical efficiency of the respondent farmers. From the table, we can see that the mean output is 140.712 maunds per hectare, with a minimum of 17.99 maunds and a maximum of 439.71 maunds per hectare. The land used for cultivating Boro rice is on average 0.858 hectares, with the other commonly used inputs such as seed, tilling, irrigation, pesticide, fertilizer, and labor, the cost for which, on average, are BDT 3512.483, BDT 8686.826, BDT 10718.81, BDT 7722.652, BDT 21875.293, and BDT 32290.601, respectively.

The average PCCI of the farmers is 19.011, with its minimum of 10.2 and a maximum of 28.2. In case of their socio-demographic characteristics, we can see that the mean years of schooling of the sample respondents is 8.843 with a minimum and maximum of 0 and 16 years, respectively. The average age of the farmers is about 46 years, with a minimum and maximum age of 25 and 69 years, respectively. Similarly, the average years of farming experience of the farmers is 26.815 years, with a minimum and maximum of 2 and 52 years, respectively. The table also demonstrates that about 25% of the farmers have access to non-farm income. The dependency ratio in the family is, on average, 2.489 persons per earning person.

In case of access to training and institutional capitals, we can see that about 52% of the sample respondents have access to rice cultivation training, with only 28% farmers having access to the agriculture extension service. Whereas, the farmers having access to credit and organic fertilizers are 27% and 68% respectively. Farmers having access to training regarding climate awareness is only 17% and having access to government subsidies is again very low, only 21%. However, among the rice-producing farmers, about 93% farmers have land ownership, which is a good sign indeed. The analysis also indicates that, the highest number (71%) and (79%) of Boro rice farmer did not receive any services of agricultural extension and subsidies,57% of Boro rice farmers faced seed and capital related problem, some farmer faced water layer and swamp problem where all farmers faced increasing rate of rice diseases problem. By solving these problems, farmers can increase their production and efficiency. Hence, the government and non-governmental organizations should focus on those problems.

Table 3. Descriptive Statistics

Variable	Unit of measurement	Mean	Std. Dev.	Min	Max
Output	Maunds/ha	140.712	91.952	17.99	439.71
Seed cost	BDT	3512.483	2470.1	499.67	11992.04
Tilling cost	BDT	8686.826	5875.506	1199.2	27981.42
Irrigation cost	BDT	10718.81	6825.329	1499	37475.121
Pesticide cost	BDT	7722.652	5533.184	699.54	35976.121
Fertilizer cost	BDT	21875.293	14700.356	2498.34	59960.199
Labour cost	BDT	32290.601	23190.581	4097.28	113924.37
Land	Hectares	.858	.559	.13	2.68
Climate change (PCCI)	Composite index	19.011	4.048	10.2	28.2
Education	Years	8.843	3.61	0	16
Age	Years	46.185	10.523	25	69
Experience	Years	26.815	11.843	2	52
Access to non-farm income	Yes=1, No=0	.25	.435	0	1
Dependency ratio	The ratio of dependent to earning member	2.489	1.111	.5	5
Access to rice cultivation training	Yes=1, No=0	.528	.502	0	1
Access to agriculture extension services	Yes=1, No=0	.287	.454	0	1
Access to credit	Yes=1, No=0	.278	.45	0	1
Access to organic fertilizer	Yes=1, No=0	.685	.467	0	1
Ownership of land	Own=1, lease=0	.935	.247	0	1
Access to climate awareness training	Yes=1, No=0	.176	.383	0	1
Access to govt. subsidy	Yes=1, No=0	.213	.411	0	1
Technical efficiency of farmers	Percentage (%)	.871	.088	.645	1

Source: Authors' compilation from the field survey, 2023

Finally, the average technical efficiency of Boro rice producing farmers is 87% with a minimum of 64% and a maximum of 100%. This result means that the Boro rice farmers in the study area have been operating below the maximum level of the production frontier. Given the available technology, farmers can increase their production by 13%.

2. Distribution of the technical efficiency

The distribution of technical efficiency of the Boro rice farmers has been demonstrated in the following Table 4. In the present study, farmers' technical efficiency of Boro rice farming has been classified into five categories ranging from 64 to 100. The estimated findings reveal that the most significant number of farmers (38.89%) have technical efficiency in Boro rice farming, which lies between 0.8≤TE<0.9 and 0.9≤TE. Another significant group of farmers (18.52%) have technical efficiency between 0.7≤TE<0.8, and only 3.7% farmers' technical efficiency lies between 0.6≤TE<0.7.

Table 4. Distribution of the technical efficiency of the rice farmers

Technical efficiency (TE)	No. of farmers	Percentage
TE<0.6	0	0
0.6≤TE<0.7	4	3.7
0.7≤TE<0.8	20	18.52
0.8≤TE<0.9	42	38.89
0.9≤TE	42	38.89

Source: Authors' compilation from the field survey

3. Results of the Cobb-Douglas stochastic frontier model

The parameters of the Cobb-Douglas production function and the jointly estimated model of stochastic frontier and efficiency model are presented in the 2nd and last columns of Table 5. The estimation of the Cobb-Douglas (OLS) production function reveals that there is a positive relationship between land and the production of Boro rice, and the variable 'ln land' is significant at 1% level. The result indicates that for 1% increase in land, output increases by 1.097.

The variable 'ln fertilizer' cost is significant at the 10% level and has a positive relationship with Boro rice production, which indicates that with increased cost of fertilizer, output also increases. The result shows that, for 1% increase in fertilizer cost, output increases by 0.075. 'Ln tilling cost' is significant at 5% level and has a negative relationship with output or production, which indicates that output decreases with increased tilling. For 1% increase in tilling cost, output decreases by 0.173.

The jointly estimated SFA model demonstrates that land, labor cost, fertilizer cost, pesticide cost, irrigation cost, and seed cost are significant at 1% level and the positive coefficients point out that for 1% increase in the use of these inputs Boro rice production increases by 0.912, 0.065, 0.014, 0.009, 0.076 and 0.05 respectively. The tilling cost variable is significant at 1% level, and the negative coefficient indicates that increased tilling cost reduces production by 0.12. The findings are supported by other studies in a similar field (Bäckman et al., 2011; Khan et al., 2010; Narala & Zala, 2010). The farmers may increase the production level by increasing the use of these inputs.

The lower panel of Table 5 exhibits the determinants of technical efficiency of Boro rice production. The significant and negative coefficient of the education variable indicates that the farmers who are educated are 0.1% more efficient than those who are not educated. Similarly, the significant negative coefficients of the variables of access to credit, land ownership, climate awareness training, and govt. subsidy indicates that the farmers who have access to these particulars are technically more efficient than those who do not have access. This result might indicate that harvesting costs are being used at high doses by the farmers in the study area, and therefore, they should use these inputs with appropriate doses. However, the variables access to non-farm income and access to organic agriculture are positively associated with technical inefficiency.

Table 5. OLS and MLE of the Cobb-Douglas stochastic frontier model

Variables	**Ordinary Least Squares (OLS)**	**Maximum Likelihood Estimation (MLE)**
Ln land	1.097***	0.912***
	(0.206)	(4.34)
Ln labour cost	-0.0252	0.0653***
	(0.110)	(2.81)
Ln fertilizer cost	0.0754*	0.0140***
	(0.0450)	(9.44)
Ln pesticide cost	0.0257	0.00931***
	(0.0388)	(4.74)
Ln irrigation cost	0.0197	0.0769***
	(0.0593)	(1.48)
Ln tilling cost	-0.173**	-0.120***
	(0.0821)	(1.66)
Ln seed cost	0.00865	0.0503***
	(0.0389)	(3.24)
Constant	5.702***	4.284***
	(2.006)	(0.000449)
	Efficiency model	
Climate change (PCCI)		0.0229
		(0.0305)
Education		-0.100***
		(0.00843)
Age		0.0344
		(0.0417)
Experience		-0.00824
		(0.0292)
Access to non-farm income		0.530***
		(0.141)
Dependency ratio		0.0867
		(0.0832)
Access to rice cultivation training		-0.212
		(0.323)
Access to agriculture extension services		0.682
		(0.567)
Access to credit		-0.555***
		(0.125)

Access to organic fertilizer	0.682***
	(0.140)
Ownership of land	-0.639***
	(0.111)
Access to climate awareness training	-0.0834***
	(0.0106)
Access to govt. subsidy	-0.642***
	(0.148)
Constant	-2.219***
	(0.509)
Observations	108

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Authors' compilation from the field survey, 2023

The variable climate change perception index (PCCI) was expected to have a significant and negative relationship with technical inefficiency, although no such relationship has been found. The reason behind this may be a small sample size or farmers' lower level of climate literacy.

Although the PCCI is insignificant in influencing technical efficiency, the finding can be aligned with the theory of Climate Change Adaptation. This can mainly be reflected in terms of gaps in perception-action linkage, farmers' adaptive capacity, or barriers to behavioral responses resulting from their low climate literacy. Farmers' low climate literacy intensifies the gap between awareness or perception and effective action, thus the limited understanding hinders the adoption of effective practices. Thus, it can be acknowledged that perception is not enough; rather, its combination with resources and institutional support can result in improved technical efficiency. Thus, based on the findings of the present study, it can be suggested that the government and nongovernment organizations operating in the study area should make the farmers aware of the proper use of inputs of Boro rice production and provide the opportunity of climate literacy among them to increase the level of technical efficiency in this study area.

Conclusion

The technical efficiency of Boro rice production plays a vital role in warranting optimal and sustainable yields in the agricultural sector. It is evident from examining important elements like input usage and management techniques that increasing technical efficiency can result in more effective resource allocation, lower costs, and higher productivity. Again, improving rice production's technical efficiency is essential for both economic expansion and food security in the face of global issues like population growth and climate change. The present study aimed to analyze the technical efficiency of Boro rice farmers by relating their climate change perception into analysis. The main limitation of the study is its' limited number of sample. Future research could be conducted in the same field, incorporating a large sample size. However, according to the research findings, policies to increase productivity and efficiency can be recommended, such as establishing training programs and extension services to educate farmers about modern and efficient farming practices. The government and concerned authorities should take the initiative to solve the increasing rate of rice disease problems in this study area, which will help to increase production and efficiency. The government and NGO should provide short-term loan facilities with a low interest rate to farmers to engage in rice production. The government and agricultural organizations should implement policies to provide farmers with easier access to modern and efficient farming equipment, such as tractors, combine harvesters, and rice transplanters. This can be achieved through subsidies, low-interest loans, or equipment-sharing programs. The government and development organizations should provide financial support to farmers through subsidies, insurance schemes, and risk mitigation strategies. This can help farmers manage the financial risks associated with agricultural production and encourage them to adopt more advanced and efficient practices.

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