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Resource Efficiency of Winter Paddy Cultivation by the Tenant Farmers in the Brahmaputra Valley of Assam

Runu Jyoti Devi and Niranjan Roy*

Department of Economics, Assam University, Silchar, India

E-mail/Orcid Id:

RJV, runujyoti306@gmail.com, https://orcid.org/0009-0008-1042-9368; *NR* roy_niranjan@yahoo.com, https://orcid.org/0000-0001-5434-6611

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Abstract: As a predominantly agricultural state, Assam's economy heavily relies on agriculture. Paddy cultivation is one major crop produced in Assam and Brahmaputra Valley in particular. The region's unique agroecological conditions and the prevalence of tenant farming methods have been considered, along with a comprehensive understanding of resource utilisation and productivity status. The Cobb Douglas production function has been applied to determine resource use efficiency. The information of sample data for the present research study has been gathered from a total of 225 tenant farmers, considering the tenant farmer's availability in the villages concerned. Analysis has been conducted on the efficiency of resources, such as seeds, fertilisers, machine use, plant protection and human labour. It is observed from the findings that, except for human labour and machine use, the input resources such as seed, fertilisers and plant protection were being under-used by tenant farmers for paddy cultivation.

Introduction

The state of Assam has been broadly divided into three geographical divisions, viz, Brahmaputra Valley, the largest in size, followed by Barak Valley and the hill range. In Brahmaputra Valley, 98.5% of the geographical area is constituted by rural areas supporting 86.9% of the valley's population (Deka et al., 2011). The agricultural farmlands are cultivated by either the landowners themselves or the tenants' farmers. Many landowners do not cultivate all of their cultivable farmlands due to a lack of family labour and other resource constraints and, hence, lease them out to the tenants. Two primary types of tenurial arrangements are predominantly prevalent in the state of Assam, such as (i) Fixed produce or fixed rent where the gross produce is shared as per the pre-agreed quantity (ii) Share of produce or sharecropping indicates that the produce is shared as per the proportion of final output (Goswami and Bezbaruah, 2013; Goswami, 2015, Roy and Bezbaruah, 2002).

The degree of efficiency of resources under different types of tenure has been studied for both theoretical and empirical analysis by economists of both Marshallian and non-Marshallian traditions. Various studies (Johnson, 1950; Pant,1980; Shetty, 1988; Chattopadhyay and Sengupta, 2001; Gogoi et al., 2023; Saikia et al., 2024) have made several attempts to explain possible inefficiencies in tenant cultivation in developing economies. Tenant cultivation, in general, is believed to be inefficient because of adverse effects relating to the disincentive consequence of output sharing on work effort and the adverse effect of tenurial insecurity on long-term investments (Nasrin and Uddin, 2011). In their paper, Mukhamedov and Pomfret (2019) highlight that the tenurial arrangements have not yet succeeded in achieving efficiency in productivity, even in high-income countries. Moreover, the nature of the tenurial arrangements (sharecropping and fixed-rent tenancy) makes no difference in farm efficiency as per the study by Paltasingh et al. (2022). In the present study, an

***Corresponding Author:** roy_niranjan@yahoo.com

attempt has been made to evaluate the effectiveness of resources used in winter paddy cultivation by tenant cultivators in the Brahmaputra valley of Assam. Understanding the efficiency of resources used in crop production can help tenant farmers attain the highest possible benefit. Farm income largely depends on how effectively farmers utilise essential input resources such as seeds, human labour, fertilisers and machinery tools, etc, in their crop cultivation.

The main objective of the present study is to analyse the efficiency of resources used in paddy cultivation by the tenant farmers in the Brahmaputra valley of Assam.

Materials and Methods

The present study uses a multi-stage sample technique to select agro-climatic zones, districts, ADO circles, and villages in the Brahmaputra valley of Assam. The field study was carried out during the period 2020 and 2021. Assam has six agro-climatic zones, and the Brahmaputa Valley covers four agro-climatic zones. In the first step of sampling, from the available four Agro-climatic zones of the Brahmaputra Valley, four districts from each were chosen randomly, namely Golaghat from Upper Brahmaputra Valley zone, Biswanath Chariali from North Bank Plain zone, Hojai from Central Brahmaputra Valley Zone and Nalbari from Lower Brahmaputra Valley Zone. From each selected district, one agricultural sub-division has been selected, then from each agricultural sub-division of the selected districts, two Agricultural Development Office (ADO) circles have been selected at random for the field study. Lastly, one village from each ADO circle was selected based on the availability of tenant farmers. Total 8 villages have been selected in the present study. 225 tenant farmers were selected and interviewed for the study with a pre-tested interview schedule. The procedure for selecting the sample size is shown in Table 1.

Descriptive and Econometric Method of Analysis

In the present study, descriptive analysis was employed to understand the socio-demographic characteristics of tenant cultivators. As such, the collected data was tabulated and represented diagrammatically. Software tools such as SPSS have been employed to analyse the data effectively. The efficiency analysis of resources was attained by applying production function analysis. This method applied the Cobb-Douglas production function to measure the relationship between output and input variables. As such, the estimated regression coefficient values of input variables were applied to estimate the marginal value product of the inputs. This approach was adopted by various researchers in their studies (Mijindadi,1980; Majumder et al., 2009; Adhikari, 2013; Anitha et al., 2013; Lamichhane and Sharma, 2019; Singh et al., 2020; Dung et al., 2022).

To assess the level of efficiency analysis of resources in agricultural production, the ratio of MVP (Marginal Value Product) to MFC (Marginal Factor Cost) needs to be determined, and then the ratio is denoted as ‘r’.

For the estimation of r, the following formula was used.

MVP/MFC= r ………………………………… (3)

The profit maximisation principle states that a farm reaches its profit maximum as long as it keeps its operation at the level where the marginal cost (MC) is equal to marginal revenue (MR) , the effectiveness of resources used is optimal. This principle is true for farms that use multi-input factors such as in agriculture, and these are used in the present study. Therefore, the economic effectiveness of a firm's resources reaches its optimal point under perfect competition when the MVP equates to MFC. Thus, the economic efficiency parameter is calculated using the ratio of MVP of inputs to the MFC. Under this method, the decision rules are:

If MVP/MFC i.e.r < 1, it means overutilization or overuse

Table 1. Selection Process of Tenant Farmers.

	Brahmaputra Valley			
Agro-climatic Zone	**Upper Brahmaputra Valley zone**	**North Bank Plain zone**	**Central Brahmaputra Valley Zone**	**Lower Brahmaputra Valley Zone**
Districts	Golaghat	Biswanath Chariali	Hojai	Nalbari
Agricultural Sub-Division	Bokakhat	Biswanath	Hojai	Nalbari
ADO Circle	ADO 1	ADO 1	ADO 1	ADO 1
	ADO 2	ADO 2	ADO 2	ADO 2
Village	Village 1	Village 1	Village 1	Village 1
	Village 2	Village 2	Village 2	Village 2
Tenant Farmers	24+ 30 =54	32+26=58	32+31= 63	28+22= 50

of resources and profit can be increased only if the quantity of resources decreases.

If MVP/MFC i.e.r > 1, it means underutilization or underuse of resources and profit can be increased with more use of resources used.

If MVP/MFC i.e.r =1 means efficient resource use and a perfect balance between inputs and output in production function.

The MVP of each input was worked out from the corresponding geometric means and the estimated regression coefficients. The MVP value, therefore, was computed with the estimated regression coefficients as follows:

$$MVP = bi \frac{\bar{Y}}{\bar{X}i}$$

Where, $\bar{Y}$= Geometric mean of yield Y,

$\bar{X}i$= Geometric mean of inputs Xi

b_i = Production elasticities of Xi

By summing up all production elasticities of $X_{i,}$ the nature of a return to scale can be identified. The returns to scale are said to be increasing, constant, or decreasing, depending on whether the proportionate simultaneous increase of input factors results in an increase in output by a greater or, same or small proportion. The returns to scale are reported to be increasing, constant or decreasing when it is greater than unity (1), equal to unity (1) or less than unity(1) respectively. In other words, If, $\sum bi = 1$, then it is constant returns to scale, $\sum bi > 1$, then it is increasing returns to scale and $\sum bi < 1$, then it is decreasing returns to scale.

It is to be noted that each input's MVP was estimated and then compared to its MFC. Here, the MFC is taken to be one rupee if the MVP was expressed in monetary terms. On the other hand, the cost of one unit of input would be the MFC if the MVP was addressed in terms of the physical amount.

Specification of the Model

The functional analysis for the efficiency of the resources used and the linear and Cobb-Douglas production function was used.

The model specified for the current study is as follows

$$Y= A\ X_1^{b1}\ X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}U \quad \ldots\ldots\ldots\ldots (1)$$

Where, Y= Total yield of paddy per hectare produced by tenant farmers

U= Error term, A = Intercept of the model

bi = Elasticity coefficients of i^{th} inputs

X_1= Machinery (cost per hectare)

X_2= Hired labour (mandays per hectare in value terms)

X_3= family labour (mandays per hectare in value terms)

X_4= Fertiliser (cost per hectare)

X_5= Seed (cost per hectare)

X_6= Plant Protection (cost per hectare)

The above-mentioned model was evaluated using logarithmic transformation as follows:

$$\ln Y= \ln A + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + U_i \ldots\ldots\ldots.(2)$$

Specification of Variables

Table 2 presents the definition of independent variables used in the production function analysis along with their dependent variables.

Table 2. Specification of Variables.

Particulars	Definition of Variables
Dependent Variable	
Output	This variable includes the total yield of paddy produced by tenant farmers, measured in rupee terms per hectare.
Independent variables	
Machinery	This input variable includes the cost of the machine used in land preparation, measured in rupees per hectare.
Hired labour	This input variable includes hired labour used in transplanting and harvesting in man-days measured in rupees per hectare.
Family labour	This input variable includes the imputed value of family labour used in transplanting and harvesting in man-days measured in rupees per hectare.
Fertiliser	This input variable includes the cost of NPK fertiliser, which is measured in rupees per hectare.
Seed	This input variable includes the cost of seed used, which is measured in rupees per hectare.
Plant Protection	This input variable includes the cost incurred in plant protection per hectare, which consists of the weedicide and pesticides, measured in rupees per hectare.

Results and Discussions

Socio-demographic Characteristics of Sample Tenant Farmers

Farm size: The farm size in the Agricultural Census Report is categorised into five classifications, viz, large, medium, semi-medium, marginal and small, which reflects the fragmented nature of land ownership. This categorisation has important implications for agricultural productivity, socio-economic status, and rural development. This study presents the land leased-in for paddy cultivation by Tenant sample farmers as farm size. As such, farm size are segregated into three categories, viz Marginal farm (below 1 hectare), Small (1-2 hectare) and large (2 hectare and above). It is important to note here that due to fewer observations from the field survey, the semi-medium (2-4 ha), medium (4-10 ha), and large (>10 ha) farm size categories, we have consolidated all these categories into a single large farm size (2 hectare and above) classification. The figure1 shows the percentage distribution of land leased in for paddy cultivation by sample tenant farmers.

Figure 1 shows that most tenant farmers' farm size constitutes the category of Marginal farm which has 63.33 percent share of total farm size, whereas 29.33 percent share of total farm size goes to small farm size, followed by large farms, i.e., only 7.1 percent.

Age: The age distribution of tenant farmers is a critical factor in paddy cultivation due to its influence on various agricultural practices. The relationship between age and productivity has often been observed in terms of an inverted U-curve (Daveri and Maliranta, 2007; Skirbekk, 2008). According to this hypothesis, productivity

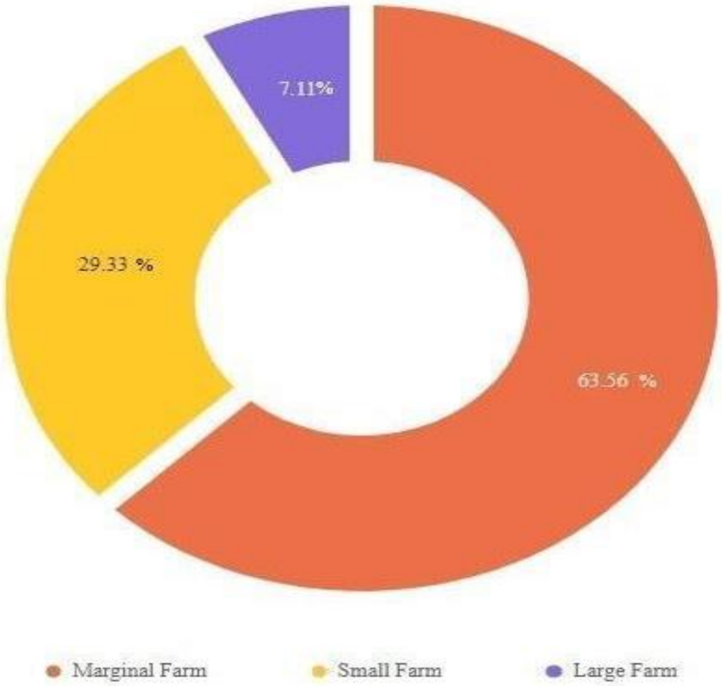

Figure 1. Percentage distribution of land leased for paddy cultivation by sample Tenant Farmers [Source: Field survey data].

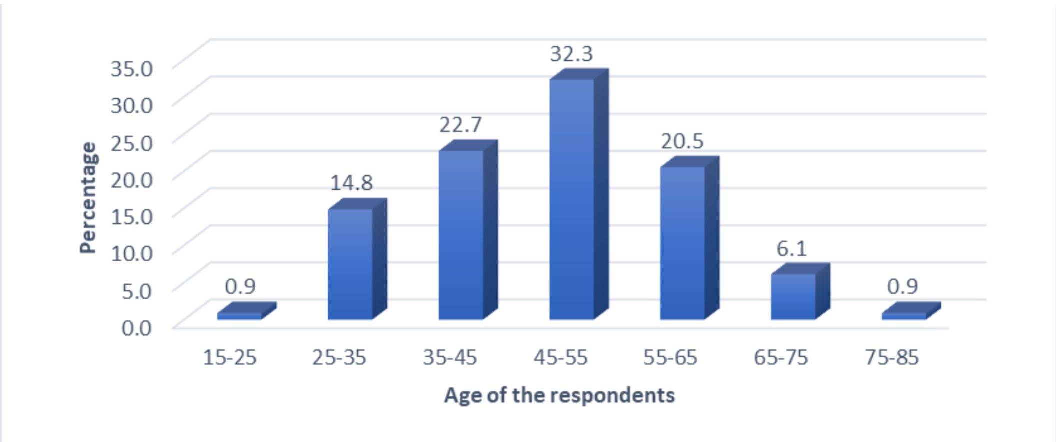

Figure 2. Percentage distribution of age of the sample Tenant Farmers [Source: Field Survey Data].

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increases with age up to a certain point due to experience and knowledge accumulation, then decreases after reaching a peak as physical abilities decline and adaptability to new techniques or technologies diminishes. To understand the demographic characteristics of the tenant farmer, age was segmented into seven groups, viz. 15-25, 25-35, 35-45, 45-55, 55-65, 65-75 and 75-85 in the present study of the paper. Figure 2 represents the percentage distribution of age of the sample tenant farmers.

The Figure 2 reveals that the majority of the tenant farmers are between 35 and 55 years old. This age group constitutes a significant portion of the sample, with 32.3% and 22.7% falling within the 35-45 and 45-55 age categories, respectively. There is a smaller percentage of younger and older tenant farmers. The 15-25 and 25-35 age groups each account for only 0.9% of the sample, while the 55-65, 65-75, and 75-85 age groups account for 20.5%, 6.1%, and 0.9%, respectively. Most tenant farmers in the sample are middle-aged, with a smaller proportion being younger or older.

Farming Experience

Farming experience encompasses a farmer's accumulated knowledge, skills, decision-making abilities, and adaptation strategies over time. It plays a pivotal role in enhancing agricultural productivity, but its impact varies based on factors such as farm size, access to resources, education, and technology adoption. For understanding, the socio-demographic characteristics of tenant farmer's farming experience have been segregated into seven groups. 0-10, 10-20, 20-30, 20-40, 40-50, and 50-70. Accordingly, figure 3 shows the percentage distribution of farming experience of sample tenant cultivators in the study area.

Figure 3 reveals that the majority of the tenant farmers have 20-30 years of farming experience. This group accounts for the largest percentage of the total sample, with 29.3% of the respondents falling into this category. A significant proportion of tenant farmers have 10-30 years of experience. The 10-20 and 20-30-year experience groups together account for over 50% of the sample. A smaller percentage of tenant farmers have less than 10 years or more than 30 years of experience. The 0-10, 30-40, 40-50, 50-60, and 60–70 year experience groups each account for a relatively small percentage of the sample.

Family Size: In the context of paddy cultivation by tenant farmers, family size plays a critical role in shaping agricultural productivity, labour availability, resource management, and household well-being. Family size has been segmented into four categories viz., (1-3). (4-6), (7-9) and (10 & above) in the present study. Figure 4 shows percentage distribution of family sizes among a sample of tenant farmers. The figure reveals that the majority of tenant farmers have families with 4-6 members. This family size category accounts for the largest percentage of the sample with around 70 % of the respondents falling into this group. A smaller percentage of tenant farmers have families with (1-3 members), (7-9 members), or (10 and above members) group. These family size categories encompass relatively small percentages of the sample, 13.8%, 11.1%, and 4%, respectively. Overall, the figure suggests that among the tenant farmers, the most common family size in the sample is 4-6 members, with a smaller proportion having larger or smaller families.

Education Level: Tenant farmers typically do not own the land they cultivate but are leased in from a landowner, which puts them in a vulnerable economic

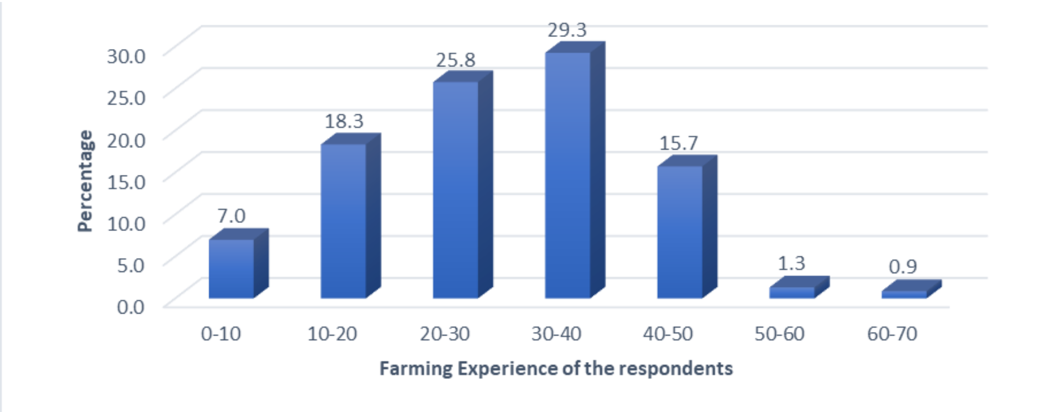

Figure 3. Percentage distribution of farming experience of the sample Tenant farmers [Source: Field survey data].

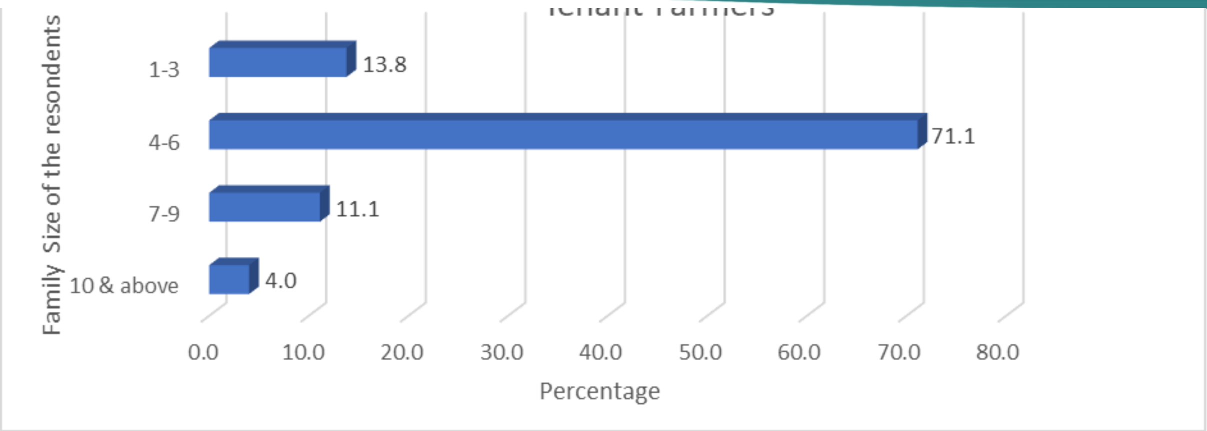

Figure 4. Percentage distribution of family size of the sample Tenant farmers [Source: Field survey data].

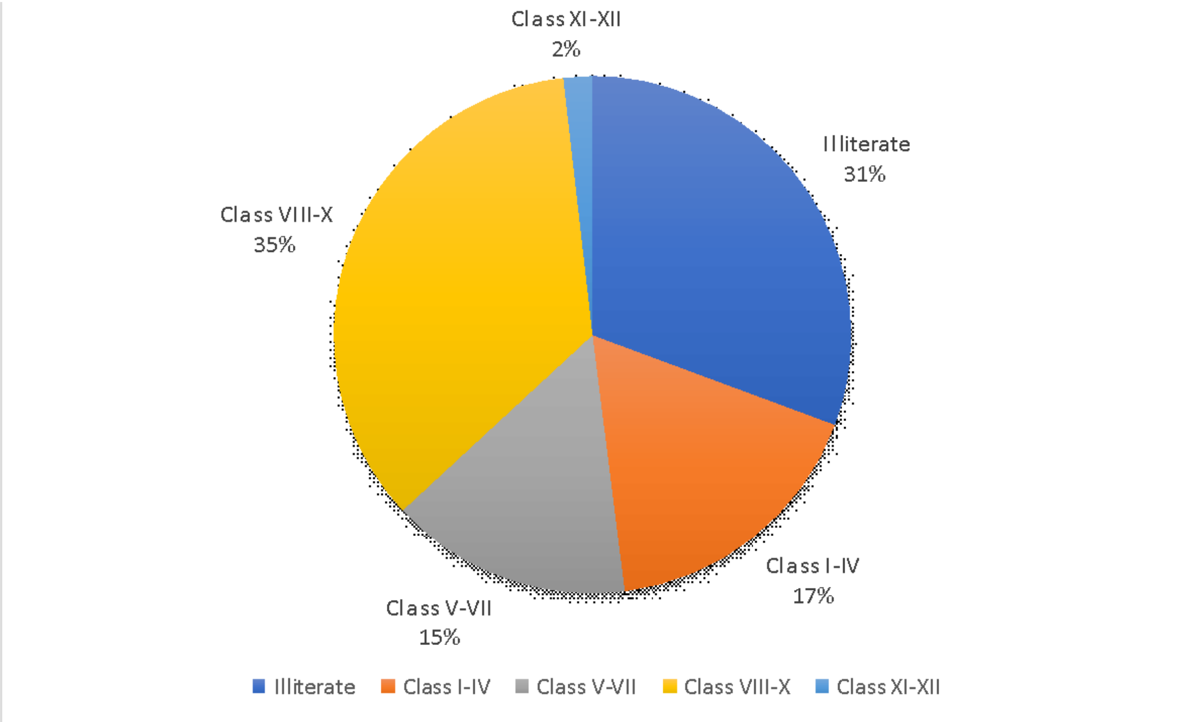

Figure 5. Pie diagram of percentage distribution of education level of sample Tenant farmers [Source: Field survey].

position. The education level of tenant farmers can considerably affect how they handle these challenges and opportunities. In this present study, the education level of tenant farmers has been segregated into five groups' viz., Illiterate, Class I-IV, Class V-VII, Class VIII-X, Class X-XII. Figure 5 represent the percentage distribution of the education level of sample tenant farmers.

The different segments of the pie chart represent different education levels, while the percentage values indicate the proportion of respondents in each category. The largest segment is "Illiterate," accounting for 31% of the sample. This indicates that a significant section of the tenant cultivators in the sample

have not completed any formal schooling of education. The second largest segment is "Class VIII-X," accounting for 35% of the sample. This suggests that many tenant farmers are having primary and middle school education. On the other hand, smaller segments represent "Class V-VII" (15%), "Class I-IV" (17%), and "Class XI-XII" (2%).

Occupation Level

The occupation level of tenant farmers refers to their involvement in agriculture, whether full-time or part-time, and whether they engage in other off-farm activities to supplement their income. This characteristic is crucial in understanding their socio-economic status, agricultural productivity and income diversification. Figure 6 represents the percentage distribution of occupation level of sample tenant farmers.

It is revealed that the majority of the tenant farmers have diversified their income sources beyond cultivation. 67.6% of the total tenant farmer respondents are Cultivator and Wage earners, followed by Only Cultivator having 20.4% of the total respondents. A smaller percentage share of total tenant farmers also engage in other additional activities, viz, Cultivator and Farm Activities (4%), Cultivator and Non-Farm Activities (5.8%), Cultivator and Salaried/Retired (1.3%) and Cultivator, Wage Earner and Farm Activities (0.9%). Thus, it is found that though cultivation constitutes the primary occupation of most of the tenant farmers in the sample farms, a significant portion of them also engage in other activities to supplement their income.

Estimation of Regression Coefficient from Cobb Douglass Production Function

The estimates of their respective co-efficiencies, presented in Table 3, show the individual contribution of key inputs to tenant farmers' paddy cultivation. The table shows seven variables (X1 to X6) with their regression coefficients, standard errors and P-values, including their intercept. Moreover, the return to scale was calculated using regression co-efficiencies.

Note: *** significant at 1% percent level, ** significant at 5% percent level, *significant at 10% percent level, NS -Non-Significant.

The variables under consideration include the logarithm of Machinery (X1), Hired labour (X2), Family labour (X3), Fertiliser (X4), Seed (X5) and Plant Protection (X6) used by tenant farmers. Table 3 reveals that all independent variables except family labour and plant protection are statistically significant. Hired labour and Seed are found to be significant with p-value < 0.001. Seed has the largest positive influence on paddy yield compared with other variables with a coefficient of 0.723, indicating a 1% increase in seed results in a 0.723% increase in paddy yield, holding other factors constant. Similarly, variable hired labour positively influences paddy yield with 0.026 coefficient value, meaning 1% increase in hired labour results in 0.026 % increase in paddy yield. The regression coefficient for machinery is

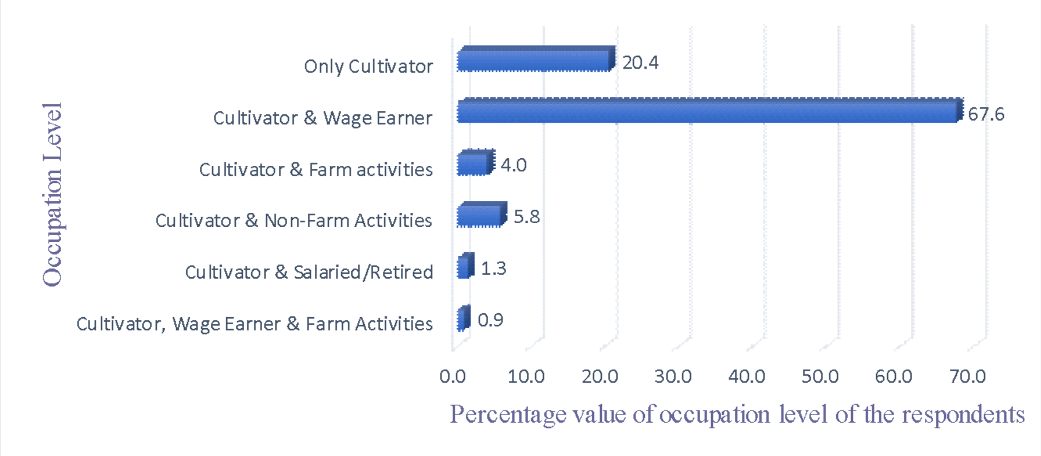

Figure 6. Percentage distribution of the Occupation level of the sample Tenant farmers [Source: Field survey].

Table 3. Regression Co-efficient from the Cobb-Douglass Production Function.

Sl No	Parameters	Particulars	Regression co-efficient	Standard Error (SE)	P-value
1	Y	Ln (Total Yield of Paddy)			
2	A	Intercept	5.83***	2.47	0.000
3	X1	Ln (Machinery)	0.025**	0.011	0.018
4	X2	Ln (Hired labour)	0.026***	0.007	0.000
5	X3	Ln (family labour)	-0.020^{NS}	0.020	0.330
6	X4	Ln (Fertiliser)	0.016**	0.008	0.049
7	X5	Ln (Seed)	0.723***	0.036	0.000
8	X6	Ln (Plant Protection)	0.003^{NS}	0.008	0.675
10	$\sum b_i$ (Return to Scale)		0.774		
11	R Square Value		.76		
13	Number of observations		225		

Source: Field survey data

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Table 4. Efficiency of Resources used in Winter Paddy Cultivation by the Tenant Farmers.

Particulars	GM Value of inputs	Regression coefficient	MVP	MFC	r value	Decision Rule
Y	36393.32					
X1	3110.98	0.025	0.295	1.00	0.29	Overuse
X2	1620.18	0.026	0.582	1.00	0.58	Overuse
X3	6312.23	-0.020	-0.114	1.00	-0.11	Overuse
X4	251.27	0.016	2.288	1.00	2.29	Underuse
X5	413.93	0.723	63.583	1.00	63.58	Underuse
X6	13.95	0.003	9.007	1.00	9.01	Underuse

Source: Researcher's Calculation from field survey data
Note: GM: Geometric Mean, MVP: Marginal Value of Product, MFC: Marginal Factor Cost

0.025 with p-value < 0.05, meaning that a 1% increase in machinery use is associated with a 0.025% increase in paddy yield. The coefficient for fertilizer is 0.016 with p-value <0.05, suggesting a 1% increase in fertilizer use leads to a 0.016% increase in yield. Although the effect of size is relatively small in the case of machinery and fertiliser use, both inputs contribute positively to paddy yield. Conversely, Family labour and plant protection have not displayed statistically significant effects, suggesting these inputs may not play a pivotal role in influencing productivity. The family labour input had a diminishing effect on the yield, as indicated by the negative coefficient (-0.02), though it was statistically insignificant, suggesting the over-utilisation of family labour. The excessive use of family labour in agriculture often results in diminishing marginal productivity, whereby each additional labour unit yields progressively less output due to untrained workers and lack of skills, etc. This reflects the similarity to the notion of Marshallian inefficiency, where resources are not optimally allocated, causing reduced overall productivity. As labour inputs increase beyond an efficient level, the cost of added labour outweighs its benefits, resulting in inefficiencies where more labour does not lead to proportional increases in output.

The R-squared value of 0.76 in Table 3 suggests that the explanatory variables explain approximately 76% of the variation in paddy crop yield observed among tenant farmers.

Return to Scale (∑bi)

The sum of the regression coefficients (∑bi) is 0.774, which is less than 1. This indicates decreasing returns to scale, suggesting that a proportional increase in all inputs could lead to a less than proportional increase in paddy crop yield for tenant farmers. This potentially reflects that the input resources were over-utilized by tenant farmers. Similar results were reported in the findings of Phuge, et.al (2020) in their studies but the contrasting result were reported in the findings of Bey et al. (2021) in their study of paddy cultivation by tenant farmers in the Karbi Anglong district of Assam

Resource use efficiency

The results of the Cobb-Douglas production function analysis were used to evaluate the resource used efficiency of inputs and are presented in Table 4. An analysis of tenant sample farmers' resource use efficiency in winter paddy production has been made. The ratio value (r), calculated as the MVP divided by the MFC of each input, to assess efficiency for various inputs was presented in Table 4.

The input variables, Fertiliser (X4), Seed (X5) and Plant Protection (X6), all exhibited efficiency ratios (r) greater than 1. The respective values are (+) 2.29, (+) 63.58 and (+) 9.01, respectively, suggesting under-utilisation or under use of these resources by tenant farmers for paddy cultivation. Similar results were reported in the findings of Parasar et al. (2016) in rice cultivation under SRI method in Assam, India. Another similar outcome was obtained in the previous findings of Suresh and Reddy (2006) in the case of fertiliser input and plant protection input; however, the results were inconsistent with those of seed input. Another result by Bey et al. (2021) which supports X6 input variable (seed cost per hectare), but it contradicts with the results of the input variable X4 i.e., fertiliser cost per hectare. The under-utilisation of fertiliser in the present study was similar to the finding outcomes of Lone, et al. (2021) but contradictory results in fertiliser input in tenant farmer's rice cultivation in Bey et al. (2021) findings. The result of the Plant Protection input of present study was found to contrast with the findings of Singh et al. (2023) but in line with the finding outcomes of Singh and Bera (2016) and Nitin et al. (2023), Suresh and Reddy (2006).

Conversely, the efficiency ratios (r) for Hired Labour (X2), Family Labour (X3) and Machinery (X1) were found to be less than 1, at 0.58, (-) 0.11 and 0.29, respectively. This indicates tenant farmers' over-utilisation or overuse of these inputs in the current practices. The results of over use of family labour and hired labour in the present study are in conformity with the findings of Gyan et al. (2014), Makadia et al. (2014), Lone et al. (2021) and Singh et al. (2023), but inconsistent results with the previous study of Singh and Bera (2016) and Nitin et al. (2023). As for the input variable, machinery use, the outcomes of Suresh & Reddy (2006) reported over-utilisation of machinery use, but in contrast with the outcomes of Singh & Bera (2016)

Conclusion and Policy Implications

It is apparent from the study findings that tenant cultivation is inefficient. Inefficiencies in resource allocation among tenant farmers represent the opportunities for reorganization of input resources to materialise significant improvement in paddy crop cultivation. The present study analysed the pattern of allocation of input resources by tenant cultivators to cultivate the paddy. The field surveys of the study have disclosed that almost all sample tenant farmers do not possess any formal lease agreements or legal proof of their tenancy status. Additionally, it is to be noted that most tenant cultivators do not have access to government agricultural schemes and extension services because they are unaware of them or do not show importance to the governmental agricultural schemes. However, only a small segment of tenant cultivators who interact with extension advisors know and have access to the benefits offered by governmental schemes. While contributing significantly to agricultural production, tenant farmers often encounter challenges that hinder their ability to utilise resources efficiently in paddy cultivation. Some of the important challenges faced by tenant cultivators that have been observed from the analysis of the present study include the following: First, the tenant farmers were not rational in their behaviour of their input variable use in terms of their usage and proportions. Secondly, the management practices adopted by the tenant farmers were not effective enough, or they were not aware of how the resources were to be utilised. Thirdly, observations from the field study area show that nearly all tenant farmers use the same agricultural technologies and tools for crop cultivation in their respective fields in a locality, influencing their adoption behaviour of more advanced agricultural technologies and other innovative methods. Fourthly, the existing tenurial arrangements have an adverse effect on the efficiency of tenant farming. The land lease duration, concerning most tenant farmers, is uncertain beyond three years. The landowners do not want to lease land beyond three years as the tenants will be eligible to become occupancy tenants, permitting the possession of the farmland. Similar situations regarding tenant farming have been observed in the case of Brahmaputra and Barak Valley region of Assam in earlier studies in which more than 60% of tenancy contracts were for less than two years and tenancy arrangements are informal (Goswami and Bezbaruah, 2013; Bezbaruah and Roy, 2002). Such uncertainty in land tenure arrangements discourages tenant farmers from adopting technologies and investing further in input resources. Fifthly, since tenant farmers are producing crops on other's farms, they have no full control of input decisions, leading to suboptimal resource allocation. Last but not least, the tenant farmers faced difficulty in managing the resources used in paddy crop cultivation due to a lack of proper advice from the extension agents.

Based on the findings mentioned above, it is advisable that tenant farmers might be more inclined to invest in resources if farmland can be leased for an extended period. Therefore, the government of Assam needs to take measures to amend the existing Tenant legislation to address the issues related to tenant farmers. In addition, strengthening government- and NGO-driven agricultural extension services by focusing on tenant farmers is crucial. Some other recommendations for enhancing tenant farmers' resource management skills include: First, by offering suitable guidance and training through government and NGO-driven agricultural extension services to tenant farmers about the efficient use of resources such as proper use of fertiliser, quantity or quality of seeds, and irrigation methods that can help them to optimise input resources used in crop cultivation. Second, digital-based advisories like mobile applications on input usage, sensor networks, etc, enabling farmers to collect real-time data on soil moisture, temperature, humidity, and crop growth could be harnessed, further strengthening resource management capabilities. Third, capacity building hands-on workshops may be organized for sustainable modern agricultural farming techniques. Fourthly, financial literacy programmes and awareness campaigns can greatly help tenant farmers make better financial decisions and effectively assist them in analysing resource management decisions.

Conflict of Interests

The writers of this paper proclaim that they have no personal or financial conflicts of interest that could influence the content presented in this research paper.

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