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Profitability and Resource Use Efficiency of Rice Seed Production in Kailali Nepal

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Abstract

Rice crop plays a key role to maintain the food security in Nepal. However, inadequate knowledge on the economics of production hampers the level of production. Thus, this study seeks to analyze the profitability, resource use efficiency, and constraints faced in rice seed production in Kailali, Nepal. 158 households were selected using a simple random sampling technique. The primary data were collected from September to November 2021. The descriptive statistics, Benefit-Cost ratio, Cobb-Douglas production function, and scaling techniques were applied for data analysis using SPSS. Further, gross return NRs.115, 772/ha and benefit-cost ratio1.70 indicated that rice seed production was profitable with the productivity of 3.81 mt/ha. Estimation of resource use efficiency showed that the investment in seed and fertilizer needs to be increased by 53% and 63% respectively. The cost of tillage operations, labour, and agrochemicals should be decreased. The scaling technique resulted that pest in storage, inadequate capital and insufficient training were the major constraints. It is concluded that rice seed production is profitable with better yield, but the necessity was observed for the optimal allocation of inputs. The training, better storage facilities and credit access would be helpful to increase the income of farmers.
Keywords**:** Benefit-cost, cobb-douglas, farmers, income, input

Introduction

The rice (*Oryza sativa*) sub-sector contributes largely to the national food security of Nepal. The area and production of rice are 1,458,915 ha and 5,550,878 mt respectively in 2019//20 (MoALD, 2021). It covers more than 50% of the total agricultural area of the country (Pandit et al., 2020). Similarly, Kailali district has the highest rice production potential in Sudurpashchim Province; it alone holds 71,710 ha of area and produces 306,202 mt of rice with the productivity of 4.27

mt/ha (MoALD, 2021). In Tikapur and Janaki of Kailali, total of 13 seed entities provide farmers with marketing, inspection, and production services. Importantly, the national seed vision, 2013–2025 of Nepal has envisioned the availability of certified quality seed to farmers (NSV, 2013).

However, the production of rice is inadequate to meet the national demand because of the low level of productivity. The insufficient supply of quality seed from the formal sector has contributed to it. An inefficient marketing network and mechanism as well as an unorganized seed supply system have further weakened the sub-sector. Moreover, the seed replacement rate is significantly low where 90% of farmers showed reluctance to replace the improved seed in each succeeding year (Bhandari et al., 2021). As a result, it impacts to scale up the healthy seed and lowers the crop output. Hence, the availability of quality seed is essential (Sahu et al., 2021). It ultimately increases the crop yield; thereby promoting the agriculture commercialization. Along with this, the productivity gap is impaired by the inadequate skill of farmers in production economics. Also, limited knowledge of cost, benefit, and farm efficiency leads to wrong crop choice decisions (Kunwar & Maharjan, 2019). The ultimate goal of farm is to maximize the profit by reducing the cost of inputs. The inefficient use of inputs may lead to decrease in net profit (Bist et al., 2021). It confines the ability of small scale-farmers in production, which ultimately affects their agricultural income.

Hence, in order to make production viable option for farmers, it is necessary to assess the farm profitability. The profit and yield are basically dependent on the efficient use of inputs. It assists farmers to optimizethe farm resourcesin a sustainable manner (Yang et al., 2021). Additionally, the effective and efficient utilization of limited resources ensures the possibility of addressing food security challenges (Ishtiaque et al., 2017). It is, therefore, necessary to bridge the gap by examining the cost-benefit ratio and the operational efficiencies of rice farms. No study to date has been observed in Kailali about the profit level and resource use efficiency of rice seed production. Also, limited research has been conducted on paddy seed production. This study would help policymakers to take the necessary steps for the expansion of rice seed production area.

Thus, the objective of this study was i) to describe the socio-economic characteristics of the selected rice seed farmers ii) To analyze the profitability and resource use efficiency of farms and, iii) To identify the major production and marketing constraints associated with the rice seed production.

Conceptual Framework

The profitability measures the financial gain of the farm, which can be calculated through the Benefit-Cost (B: C) ratio value. The B: C ratio assesses the benefit to cost ratio for each unit of investment (Hwang, 2016). It assists to quantify the total expenses incurred in the production process and it returns in monetary value (Rathod & Gavali, 2021). The farm is in profit if the benefit exceeds the total cost. The revenue of farms could be increased with the proper utilization of inputs and a proficient cost structure (Sonwani et al., 2018). Similarly, Resource Use Efficiency is defined as the capacity to maximize the output in per-unit use of input. The efficiency implies that inputs are allocated in the farm according to the market price (Shrestha et al., 2021). The inputs such as fertilizer, labor, and irrigation were the important factors, which affect the level of income (Subedi et al., 2020). The cost of key resources like labor, seed, and agrochemical impact on the efficiency of production to a large extent (Shrestha et al., 2021).In addition to it, farm mechanization has a positive influence to enhance the farm performance of rice growers (Vortia et al., 2019). The study on resource use efficiency and its analysis demonstrates the rationale use of major inputs, for instance, human labor, seed, fertilizer, and irrigation (Sujan et al., 2017. Also, the farm size determines the gross return of cereal crops (Konja et al., 2019). The regression analysis using Cobb-Douglas production function estimation of the labor, tillage, fertilizer and irrigation illustrates the significant association with rice output (Yadav et al., 2021).

In this study, the B: C ratio was used as a decision-making tool centered on the value of profit.

To calculate the cost, the variable cost included the cost of seed, tillage operation (rental cost of tractor and power tiller), labor (family and hired), fertilizer (Farm Yard Manure and chemical fertilizer), and agrochemical (micro-nutrient, pesticide). The fixed cost was calculated by adding the cost of the depreciation, the opportunity cost of land, and irrigation tax. The total production cost was calculated by summing up all the variableand the fixed cost used in the production processes. In order to assess the efficiency of rice seed production, the Cobb-Douglas production function was applied in the study (Cobb & Douglas, 1928).The study hypothesized that the total return (output) is dependent on the explanatory variables such as cost of seed, tillage operation, labor, fertilizer, and agrochemicals.

Methods

Selection of the Study Area and Sample Size

Kailali district with the highest rice production area in Nepal was chosen for the study. Two municipalities, Tikapur and Janaki were taken purposefully, where seven agriculture cooperatives and six seed companies are engaged in cereal seed production and marketing. In addition, farmershave intensified and concentrated for the production of various types of rice seed. Out of that, 265 farmers of foundation and certified rice seed producers were identified as sampling frame (RJKIP, 2020) because these two types of seed play a major role to continue the seed project cycle. The sample size was calculated by the widely used software raosoft (Raosoft, 2021; Al-Balas et al., 2020). While using the software, 95% level of confidence with a margin of error of 10 % was fixed, and the sample size of 158 was calculated. Sample households were chosen from the sampling frame of 13 seed-producing entities using the simple random sampling method. It is considered a fair method because every member of the population has an equal opportunity of being selected (Sharma, 2017). A pre-test survey was organized and adjustment was made as per need. The primary data were collected through a household survey from September to November 2021. Two Focus Group Discussions and five key informant interviews were conducted for further validation of the data. The secondary data were gathered from the latest and relevant journals, and the reports of government and non-government organizations working in agriculture field.

Variables Selection and Data Analysis

The data were analyzed with descriptive statistics such as cross-tabulation to describe the samples. Benefit-Cost (B: C) ratio, Cobb-Douglas production function, and scaling techniques were analyzed using the Statistical Packages of Social Sciences (SPSS) software. The linear regression was run using the Cobb-Douglas production function to determine the resource use efficiency (Bajracharya & Sapkota, 2017). The description of the terms is given below:

Total Cost of Production

It is the sum of fixed cost and variable cost. The variable cost includes the cost incurred in the variable inputs such as seed, tillage operation, labor, fertilizer, and agrochemicals (NRs.). The fixed cost includes the cost from the rental value or opportunity cost of land, depreciation of farm machineries, and irrigation tax (NRs). The cost of tillage operations involves the cost of rental value of machinery, labor cost includes the hired and family labor used from planting, irrigating to harvesting. The family labor value was taken from the opportunity cost of total man-days. The cost of agrochemicals includes the cost of micro-nutrients, and pesticides.

Profit Loss Analysis

This method is widely used to calculatefarm profitability (Acharya et al., 2021). It was computed as $Netprofit/loss\ (NRs) = Total\ return - Totalcost$. The total return was obtained in this way: Total $return\ (NRs.) = (priceofmainproduct * quantity + priceofbyproduct * quantity)$. The positive value indicates the farm profitable while negative value shows the loss.

Benefit-Cost Analysis

The ratio of benefit-cost is used to assess the farm profit (Sapkota&Sapkota, 2019).

B: C ratio is calculated by using the following formula:

$$\text{B: C ratio} = \frac{\text{Total Return (NRs.)}}{\text{Total Cost (NRs.)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Decision rule:

B: C ratio =1, >1 or <1, farm is indifferent, profitable and loss respectively.

Econometric Model

The Cobb-Douglas production function was used to assess the efficiency of variable inputs in production (Sapkota & Bajracharya, 2018). The fixed cost was not included in the model because it was used to understand the relationship between the variable inputs and output in the production processes. The total return (output) was used as the dependent variable and the cost of variable inputs was used as the independent variables.

According to Cobb-Douglas, the production function formula is:

$$Y = a\ X_1^{b1} X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5} e^u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2)$$

By using the logarithm on both sides, the data is transformed to linear form for ease of computation.

Then, $\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + u$

Where,

Y = Total return from rice seed production (NRs./ha)

X1= Seed cost (NRs./ha)

X2= Tillage operation cost (NRs./ ha)

X3= Labor (NRs./ha)

X4= Fertilizer cost (NRs./ha)

X5= Agrochemical cost (NRs./ha)

u = Random disturbance term or error term

a = Intercept or constant term

e = Base of natural logarithm

ln = Natural logarithm

b_1, b_2, b_3, b_4 and b_5 = Coefficients of respective variables.

Resource Use Efficiency

The allocative efficiency was calculated using the ratio of Marginal Value Product (MVP) of variable input and the Marginal Factor Cost (MFC) for the input and considered for its equality to one. This method was used by Konja et al. (2019). The formula is expressed as

$$r = \frac{\mathrm{MVP}}{\mathrm{MFC}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Where, r = efficiency ratio, MVP=Marginal Value Product is the value of an incremental unit of output obtained from the additional unit of input use. MFC=Marginal Factor Cost is defined as the increase in the cost of inputs due to the expense made for an additional unit of inputs. This is equal to 1. Since both dependent and explanatory variables were converted to monetary value. MVP was calculated in the given formula below:

$$\mathrm{MVP} = \frac{bi * \bar{y}i}{\bar{x}i} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

b_iÖ Estimated regression coefficient of input X_i

$\bar{y}_{i\ddot{o}}$Geometric Mean (GM) value of output Y_i

$_{\bar{x}i\ \ddot{O}}$GM value of i^{th}resources used

Decision rule**:**

If r = 1,>1 or <1, or it indicates the efficient, underuse or overuse of resources respectively

Finally, the relative percentage change in MVP was calculated using the following way:

D= (1-MFC/MVP) × 100, or, D= (1-1/r) × 100, Where D= absolute value, which is taken from the change in value in MVP for each use of the resource.

Return to Scale Analysis (RTS)

The return to scale was computed by using the coefficients of explanatory variables obtained from the production function (Sujan et al., 2017).

The return to scale was calculated as follows:

RTS= $\sum bi$,

Decision rule:

If RTS=1,>1 or <1, it indicates constant, increasing, and decreasing return to scale respectively.

Indexing

The index value was calculated using the scaling techniques (Cooke & McDonald, 1987). It is used to rank the production and marketing constraints of rice seed production. The most serious, serious, moderate, a little bit serious, and least significant problems were assigned a scale value of 5,4,3,2, and 1 respectively. The given formula was used to compute the index value.

$$Iimp = \frac{\Sigma\,(Si\ Fi)}{N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.(5)$$

Where, Imp = Index of importance, $\sum$ = Summation, Si = i^{th} Scale value (1, 2, 3, 4 and 5)

Fi = Frequency of i^{th} importance given by the respondents, N = Total number of respondents

Results and Discussion

Descriptive Analysis

The descriptive analysis of the survey result is presented in Table 1. The findings show that the mean age of respondents was 44 and the majority (97%) were from Janajati (Tharu) community by caste. 58% of respondents were female, slightly higher than their male counterparts of 42%. But, 80% were from male-headed households. This is linked with the study on rice in Jhapa wherein 85% of households were male-headed (Khatiwada et al., 2021). This denotes the community of rice farmers is male-dominated. 72% of farmers had received an education at primary or above that level, as they can read and write. This is in line with Nwele (2016) education can play role in decision-making process of innovation of farmers. The study conducted in Nepal showed the positive impact of education on the use of quality seed (Bhandari et al., 2021).

As result depicted in Table 1, the average year of experience of farmers with rice seed production was 6.27. This indicates the rice seed producers in the study area are gaining better skills in seed production technology. A similar result was observed in the study in Nigeria, which reveals that experiences significantly contribute to increasing the rice seed yield (Adebayo et al., 2021). Another reason for the continuation of rice seed production is that seed companies are playing a vital role to provide a variety of services to farmers like storing, grading, and labeling. Apart from this, the mean size of the land was found to be 1.63 ha. Rice seed production is possible only if farmers have a large size of land. For example, a study of Mishra et al. (2016) reports a positive relationship between land size and paddy seed production. This means that the greater the size of farm land, the farmers are more likely to produce the paddy seed production.

Besides this, the majority (70%) of respondents had taken the membership in the cooperative. It is a positive sign to organize the seed producers into cooperatives. 86% of farmers had good irrigation facilities. The national pride project of Rani JamaraKulariya Irrigation Project (RJKIP) have been assisting the production of seed and irrigation facilities for seed growers. This could be taken as an opportunity for the expansion of rice seed production on a large scale in the study sites.

Table 1

Socio-Economic Characteristics of Households (N=158)

Continuous variables					
Variables	Mean value	Variables	Mean value	Variables	Mean value
Age	44±11.23	Experiences	6.27±3.80	Active members	5.12±1.58
Family size	6±1.92	Land size	1.63±.78	Farm gate price	30361±64
Categorical or dummy variables					
Variables		Frequency	Variables		Frequency
Gender	Male	66(42)	Education	Illiterate	44(27.9)
	Female	92(58)		Primary	68(43)
Caste	BCTN	5(3)		Secondary	36(22.8)
	Janajati	153(97)		College degree	10(6.3)
Gender of HHH	Male	126(80)	Variety	Sarju-52	129(82)
	Female	32(20)		Radha-4	23(14)

Training	Yes	90(57)		Sabitri	6 (4)
	No	68(43)	Irrigation	Yes	136(86)
Membership	Group	10 (6)		No	22(14)
	Cooperative	111(70)	Family type	Nuclear	90 (57)
	Both	31(20)		Joint	68 (43)
	None	6(4)			

(Source: Field Survey, 2021), Note: Value after "±" indicate standard deviation & figures in parentheses indicate percentage

Benefit-Cost Analysis

Inputs Used in Rice Cropping System

The major inputs used in rice seed production are seed, labor, Farm Yard Manure (FYM) and chemical fertilizer, tractors/power tiller for tillage, irrigation, and agro-chemical. The average amount of rice seed was found to be 49 Kg/ha and the purchase price varies from NRs.60 to NRs.62 per Kg. Total labor man-days/ha from planting to harvesting were 43, where the average wage rate for women was found to be NRs. 450/day and for man was NRs. 750/day. The use of FYM was 3900 Kg/ha on average. The time duration of the machine hours for tillage operation was found to be 30 hours/ha, and the average rate per hour was NRs.256.The availability of irrigation is year-round through the canal, for this, farmers pay an average NRs. 445/ha as irrigation tax. Nearly the same pattern was found in rice fields in a study performed by Dhakal et al. (2019), who reported that the average amount of seed and FYM of 52.55 Kg and 4411.60 Kg per ha respectively, but a contradictory result was found in labor rate, it was nearly double (76 man-days/ha) than this findings. Apart from this, Acharya et al. (2021) also reported the average machine-hours was 14 hours/ha, and labor was found to be 73 man-days/ha. This concludes that labor man-days could be reduced if there is more use of machines.

Furthermore, the overall practices for the use of inputs for the production of rice grain and rice seed are nearly the same, but seed production requires intensive care to maintain the genetic purity. The average farm-gate price of rice seed received by farmers is NRs.30/Kg, which is NRs.3/Kg higher than the grain rice.

Rice Seed Production Cost

The total cost containing the variable and fixed cost per ha incurred in the production of rice seed is illustrated in Table 2. The average total cost was found at NRs.68, 193/ha. Nearly the same pattern was found in the study of rice in Jhapa, reported the total cost of NRs.50, 901/ha. (Subedi et al., 2020), However, the production cost was found to be NRs 75,205/ha in rice farm in Morang (Pandit et al., 2020) and NRs.77,100/ha in Kapilvastu (Sapkota & Sapkota, 2019) which was higher than this survey findings. In addition, the variable cost occupied 79% of the total cost, whereas the fixed cost was 21% (Figure 1). This relates to the study in the Terai region of Nepal, wherein 84% of the total cost is covered by variable inputs including the managerial cost (Acharya et al., 2021). This indicates that rice seed production requires a substantialamount of variable inputs from planting to harvesting. The largest share of cost 35% was used for human labor, followed by fertilizer and tillage costs with 22% and 11% respectively, while the cost of seed and agrochemicals was low (Figure 1). Close to these findings Sahu et al. (2021) reported that 43% cost was shared for labor in paddy seed cultivation in India. On the contrary, the cost for FYM was found 45%, 24% used for seed, and 21% covered by labor costs in Baglung (Bajraycharya & Sapkota, 2017). However, the cost of input depends upon the context, crop, and region. From these results, it can be concluded the rice crop is labor-intensive and more amount of money is invested in the labor. But the total cost of production is lower than in other areas of Nepal. The use of machinery in tillage instead of bullocks might have contributed to reducing the cost to some extent.

Table 2

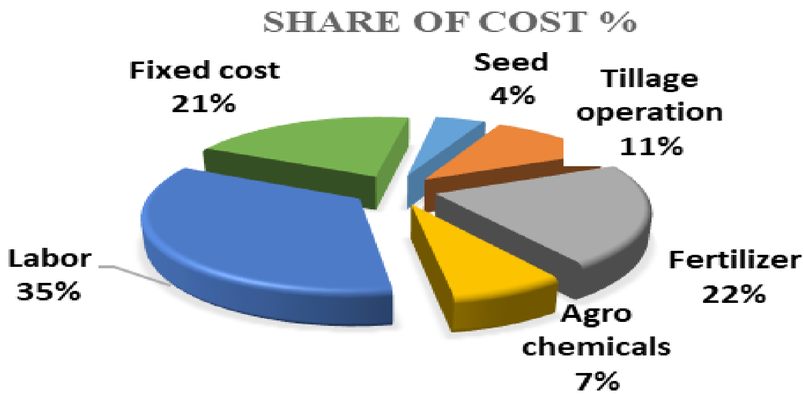
Average Cost of Production and Revenue (NRs./ha) (N=158)

Variable cost (NRs./ha)		Fixed cost(NRs./ha)	
Particulars	Average cost	Particulars	Average cost
Seed	3070	Irrigation cost	445
Tillage	7680	Depreciation	3604
Labor	23,632	Rental value of land for one season	10,000
Fertilizer	14,750	Total Fixed Cost (TFC)	14,049
Agro chemicals	5012		
Total Variable Cost (TVC)		Revenue	
(TVC)	54,144	Total revenue (NRs.)	115,772
Total cost (TVC+TFC)	68,193	Net benefit	47,579
B:C ratio	1.70	Gross margin	61,628

(Source: Field Survey, 2021)

Figure 1

Cost Sharing in Different Items in Rice Seed Production (%)



(Source: Field Survey, 2021)

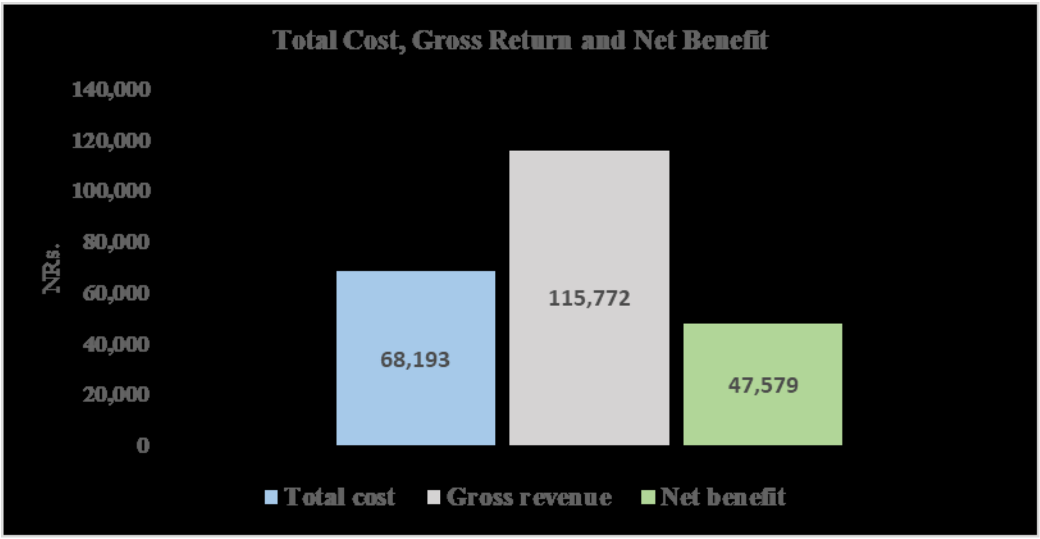
Yield and Profitability

The result of this study reveals the total return of NRs. 115,772/ha; it generated the net benefit of NRs. 47,579/ha with rice yield 3.81mt/ha. (Figure 2). A similar pattern of result was obtained in the study of rice in Chitwan by Dhakal et al. (2019), which reported the total return NRs.122,737/ha and net benefit NRs.41,435/ha. However, lower gross return and net benefit of NRs. 101,213/ha and NRs. 24,113/ha was obtained in the study of the Sawa variety of rice in Kapilvastu (Sapkota & Sapkota, 2019). The result of this study showed the B: C ratio of 1.70, which means if NRs 1 is invested, it will give NRs. 1.70 as a return. It implies the financial viability of rice seed production in the study area. This result relates to the findings in the research on rice in Jhapa, where they found B: C ratio of 1.9 with mechanized rice farms (Khatiwada et al., 2021). But the average B: C ratio of Kailali contradicts the lower BCR 1.11 of rice research in Rautahat Nepal (Sapkota et al., 2021). In brief, the yield of rice seed of 3.81 mt/ha in the study area was close to the national average of 3.80 mt/ha, but lower than the average yield of the Kailali district of 4.27 mt/ha (MoALD, 2021).

Further, as shown in Table 3, the yield of rice seed was found 3810 Kg/ha. The cost of production and margin price received by farmers was found to be NRs.17.9/Kg and NRs.12.1/Kg respectively. Thus, the result indicates that the Kailali district has the most favorable climate and fertile land for rice farming. The higher yield was associated with the available irrigation facilities in most of the field in the study sites.

Figure 2

Total Cost, Return and Net Benefit of Rice Seed Production (NRs.)



(Source: Field Survey, 2021)

Table 3

Gross Margin, Cost and Price per Unit

Variables	Average value
Volume of production (Kg./ha)	3810
Average selling price (NRs./Kg)	30
Cost of production(NRs./Kg)	17.9
Margin (NRs./Kg)	12.1

(Source: Field Survey, 2021),

Estimation of Resource Use Efficiency

Variance Inflation Factor (VIF) was checked to confirm the multicollinearity problem, where VIF was found to be from 1.04 to 1.09, at the acceptance level. The explanatory variables namely seed, tillage operation, labor, fertilizer, and agrochemical from the above equation (2) were transformed into linear log form to make it easier to compute (Table 4).

The efficiency ratio of the inputs such as seed (2.14) and fertilizer (2.72) were greater than 1 showing their underused. It implies that investing more in seed and fertilizer would give the higher yield. For instance, every extra rupee spent on seed and fertilizer results in the returns of NRs. 2.14 and NRs. 2.72 respectively.

The ratio of the MVP to MFC of the tillage (0.72), labor (-0.80), and agrochemicals (-2.74) was lesser than unity 1, which were overused. The negative efficiency ratio of labor and agrochemicals showed that the additional use of two inputs lead to below the economic advantage level. It gets no profit but loss. So, it indicates all the inputs were utilized inefficiently in the study area. For optimum allocation of resources, the cost of seed and fertilizer needs to be increased by 53% and 63% respectively, while investment in tillage, labor, and agrochemicals should be decreased by 39%, 225%, and 136% respectively (Table 4).

Table 4

Estimation of Resource Use Efficiency Using Cobb-Douglas Production Function

Variables	GM	Coefficient	MVP	MFC	r	Efficiency	D-value
LnSeed	2,995	0.065	2.142	1	2.14	Underused	53
LnTillage	7,330	0.054	0.723	1	0.72	Overused	39
LnLabor	22,656	-0.184	-0.801	1	-0.80	Overused	225
LnFertilizer	14,204	0.391	2.717	1	2.72	Underused	63
LnAgrochemicals	4,756	-0.132	-2.738	1	-2.74	Overused	136

(Source: Field Survey, 2021)

Related findings observed by Sapkota et al. (2018), reported the inadequate use of seed and fertilizer, overusing of labor, and tractor power in seed production in Palpa Nepal. This is in line with the findings of Amaechina and Ebhoh (2017), who concluded that the increase in the cost of seeds and fertilizers by 36% and 22.8% respectively, the cost of labor should be decreased by 41.7%.On the contrary, Sujan et al. (2017) disclosed the underused of labor and fertilizer in the research conducted in Bangladesh. Mix type of result was found by Bist et al. (2021), who suggested for increasing the cost of labor and seed.

The findings of this study reveal the adjustment of inputs is necessary for seed cost. It could be taken as an opportunity by purchasing the quality seed of high-yielding varieties. The fertilizer needs to be used in the recommended quantity in order to balance the required nutrients and enhance productivity. The labor and tillage cost could be reduced by increasing the use of farm tools and machinery. Also, the quantity of agrochemicals needs to be used as suggested by agriculture technicians. Besides this, the return to scale value of 0.194 (<1) indicated a decreasing return to scale. This result reflects similar results of Sapkota et al. (2018), who found a similar return to scale value of 0.861 in Palpa. Decreasing return to scale implies that an increase in output is lesser in proportion to change in inputs.

Constraints Faced by Rice Seed Farmers

The data presented in Table 5 points out the constraints faced by rice seed growers. Seven major problems were identified to explore the perception of farmers in each of the aspects. Respondents were asked to rank from 1 to 5 point Likert scale. The reliability test was performed to figure out the internal consistency of the Likert scale data. The value of Cronbach's alpha was found to be 0.665 at the acceptance range. The scaling techniques showed the pest problem in storage and inadequate capital ranked the most serious problem with an index value of 0.78, followed by inadequate training with an index value of 0.72.

The previous study reported that storage pest is the most serious problem as it deteriorates the quality of rice seed (Lamsal et al., 2018). Moreover, prior research informs that the rate of post-harvest losses was found from 15-30% in Nepal (Bhattarai et al., 2017). The direct packaging, not maintaining the moisture level, and poor storage facilities are major causal factors. The proper post-harvest management is linked with the quality product. So, seed quality is crucial for farmers since it determines the crop yield potential.Besides, inadequate capital (0.78) ranked as another most serious problem. Limited access to credit facilities is associated with stringent loan requirements for poor farmers. It might be one of the reason for scarce capital for the investment in various inputs. On the contrary, the opposite conclusion was found in the study in Nepal, where 94% of sampled households had access to credit facilities (Paudel et al., 2019). Access to capital helps the seed companies to offer advance payment to seed growers; again growers can purchase inputs in time (Choudhary et al., 2020). The study states that the accessible credit facility is positively associated with better farm performance.

A second most serious problem is inadequatetraining. Technical training plays a crucial role in adopting new technology and improving efficiency. It is very important for farmers to learn the seed production technology because intensive management with high skill is required for seed production. The variety should be pure and the farm needs to be certified by a certification agency to maintain the varietal purity. In the same line, Rahman et al. (2021) stated that the skills from the training had a positive impact on the adoption. As a result, we can be concluded that training is an important aspect to enhance the farmers' understanding.

Table 5

Constraints Faced by Rice Seed Farmers

Problems	Index	Rank
Pest problem in storage	0.78	I
Inadequate capital	0.78	I
Inadequate training	0.72	II
Insect pest problem	0.70	III
Insufficient technical skills	0.67	IV
Lack of marketing facility	0.47	V
Shortage of quality seed	0.39	VI

(Source: Field Survey, 2021)

Conclusion

The descriptive analysis reveals the majority of farmers were from the Tharu community with male-headed households. Years of experience, size of land, and the year-round irrigation system have contributed to the rice seed yield. The positive benefit-cost ratio implies the rice seed enterprises are financially viable. The total return (output) is reliant on the proper use of given inputs. However, the estimation of allocative efficiency demonstrates that the inputs have been utilized inefficiently, it is either overused or underused. Output could be maximized by re-organizing the farm inputs allocation. Furthermore, the pest problem in storage, inadequate capital, and limited training in rice seed production were the major constraints. It directly relates to the enhancement of the efficiency and productivity of rice. Therefore, it would be recommendable to enrich the farmers' knowledge in the economics of production and technology through trainings, by providing them with better storage facilities and easy access to credit. These factors offer a better prospect of increasing the income of rice seed producers in the study sites of Kailali.

Conflict of Interest

The author declares that there is no conflict of interest

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