Archives of Agriculture and Environmental Science 7(3): 425-431 (2022)
https://doi.org/10.26832/24566632.2022.0703017

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

Analysis of profitability and effect of factors of production in paddy cultivation in Morang, Nepal

Bibhusha Basnet[1]*, Gaurab Luitel[2], Ashok Sah[1], Smriti Baral[1] and Madan Ghimire[1]

[1]G.P. Koirala College of Agriculture and Research Center, Morang, NEPAL,
[2]Institute of Agriculture and Animal Science (IAAS), Department of Agriculture Economics, NEPAL
*Corresponding author's E-mail: basnetbibhusha14@gmail.com

ARTICLE HISTORY

Received: 24 July 2022
Revised received: 21 August 2022
Accepted: 22 September 2022

Keywords

BC ratio
Cobb-Douglas Production Function
Productivity

ABSTRACT

Paddy is one of the principal food crops in Nepal. Most of the Nepalese farmers are currently utilizing inputs in an unscientific manner due to lack of information about the most efficient use of resources, resulting in low yield and efficiency. This study was conducted for the analysis of profitability and effect of factors of production in paddy cultivation in Morang district of Nepal. A sample of 120 paddy growers were selected from 4350 paddy farmers registered in PMAMP, Rice zone, Morang using Simple Random Sampling Technique. Primary and secondary data were collected using face-to-face interview schedule and reviewing different articles and journals. Data collected were entered, tabulated and analyzed using MS-Excel and Statistical Package for the Social Sciences (SPSS). Descriptive statistics such as mean, frequency, and percentage were used to study farmer's socio-economic characteristics while inferential statistics was used in analysing the influence of production factors using Cobb-Douglas production function. The total cost of paddy production, gross income, and net income per hectare was found to be Rs.70,082.65, Rs.1,11,171.23 and Rs.41,088.57 respectively whereas productivity of paddy was found to be 4.32 MT/ha. The BC ratio 1.66 indicates that it is a profitable enterprise. The labor cost contributed most to the variable cost with 45.48%. Moreover, independent variables such as seed, labor and mechanical power contributed significantly to the yield. Therefore, paddy farming should be encouraged among farmers by increasing the availability and affordability of inputs while also improving food security.

Citation of this article: Basnet, B., Luitel, G., Sah, A., Baral, S., & Ghimire, M. (2022). Analysis of profitability and effect of factors of production in paddy cultivation in Morang, Nepal. *Archives of Agriculture and Environmental Science*, 7(3), 425-431, https://dx.doi.org/10.26832/24566632.2022.0703017

INTRODUCTION

The most extensively cultivated rice, *Oryza sativa* L., a member of Poaceae family, is the essential diet of an estimated 3.5 billion people globally. It may be grown in a variety of environmental situations (Odoemenem and Inakwu, 2011). About 10,000–14,000 years ago, *Oryza sativa* was cultivated from the wild grass *Oryza rufipogon*. According to archeological findings, the center Yangtze and top Huai rivers in China are conceptualized to be the two oldest places of *O. sativa* production within the country. Over the next 2,000 years, cultivation extended along these rivers (Almanac, 2013). Rice is the world's second utmost substantial crop after wheat, with Asia being the key producer and consumer (Yusop *et al.*, 2021). Rice is indeed the primary source of income and employment over a billion households in Asia, Africa, and the Americas. Agriculture is the backbone of the Nepalese economy. It was found that despite its diversity, Nepalese agriculture is dominated by three primary cereal crops: rice, wheat, and maize, which together contribute for 30.92 percent of the country's agricultural GDP (Magar, 2020). Altogether cereal crops contribute the most to agricultural sector (47.10 percent), while rice accounts for 16.33

percent of the AGDP. The Nepalese diet is cereal-based and rice-dominated (Bhandari *et al.*, 2017). Rice satisfies the majority of dietary requirements, particularly carbohydrates. Rice is the most significant staple food crop, and it is cultivated in a broad range of agro-ecological zones with diverse temperatures, elevations, and terrain varying from 60 meters above sea level in Terai to 3050 meters in Chumchure, Jumla (Joshi *et al.*, 2011). Rice can be produced in the Terai plains two to three times each year, depending on irrigation availability (Navaya, 2017). The overall production of cereal crops in Nepal is 10,935,664 MT out of which the production of paddy is 5,550,878 MT. The production of paddy in Province no.1 is 1,245,545 MT of which 367,070 MT is produced in Morang district alone (MoALD, 2021).

Rice productivity in Nepal is low (3.8 MT/ha) when compared to the worldwide average (4 MT/ha) due to a lack of investment in research and development. The present overall production is insufficient to fulfill the rising demand of the country's population while ensuring food security (Gairhe *et al.*, 2021). The study was conducted in Morang district, one of the leading districts for paddy production in the eastern part of Nepal. Despite the fact that significant attention has been placed in recent decades on growing and nurturing the paddy sector at a higher pace, the achievements in the paddy sector remain unsatisfactory. Nepal, which used to be a paddy exporter, is now a net importer. The study was conducted to analyse the profitability of paddy production, effects of factors of paddy production and to identify the socio-economic constraints in the production of paddy. Like other parts of the country, paddy is the staple food of the people in the study area. Inorder to know the problems related to paddy production in the study area, the economics of production was studied which can be the basis for further research as well. Since, paddy production has been declining recently and there is lack of specific research, this research will be helpful for the study of problems and the factors that affect the productivity of paddy.

MATERIALS AND METHODS

Selection of site

Ratuwamai Municipality of Morang district was purposively chosen for the study as it was one of the key paddies growing area in Eastern Nepal. It also comes under the command area of Prime Minister Agriculture Modernization Project (PMAMP, 2076).

Study Area

Morang is a district in Province no.1, Nepal and is located at latitude 26°37′43.32″ North and 87°26′09.96″ East longitude. It is one of the Outer Terai districts. It is bounded on the south by Bihar, India, on the east by Jhapa, on the north by Dhankuta and Panchthar, and on the west by Sunsari. Morang has an area of 1,855 km^2 (716 sq mi). The lowest position is 60 meters while the highest is 2410 meters above sea level. Morang District had a population of 965,370 as per Nepal Census 2011. People with diverse caste and religion live here. Ratuwamai is a municipality in Morang district of Nepal, located in the southern Terai. In March 2017, this municipality was formed by the amalgamation of six village development committees i.e., Sijuwa, Jhurkiya, Mahadev, Itahara, Govindapur (Ward No. 1, 3, 4 and 7) and Baradanga (Ward No. 1, 4, 5 and 7). The average annual rainfall is 2623mm while the temperature ranges from 170 to 310°C. This region has total population of 55,380 people and has the total area of 142.15 km^2.

Sampling technique

Sample of 120 paddy growers were selected among 4,350 paddy farmers registered in PMAMP, Rice zone, Morang using Simple Random Sampling Technique.

Data collection and analysis

Primary data were obtained in May-June, 2021 utilizing well-structured interview schedule and face-to-face interview technique. The raw data was coded and input for data analysis. The data was analyzed using Microsoft Excel 2019 and Statistical Package for Social Sciences (SPSS Version 26). The secondary data was gathered via reviewing different articles, journals, books and other publications most of which were published by organizations like FAO, MOALD and other relevant organizations.

Cost of production

The overall production cost was computed by adding costs of all the variable inputs and fixed cost. Seed, farmyard manure (FYM), fertilizer, human labor, machinery, irrigation and transportation were all included in variable costs. Fixed cost included expenses for land rent and use of own implements.

$$\text{Total Cost} = \text{Total Variable Cost} + \text{Total Fixed Cost} \quad (1)$$

Benefit-cost analysis

The benefit-cost ratio (BCR) was used to compare the discounted value of cash inflows to the discounted value of all cash out flows. Benefit-cost analysis was carried out using following formula:

$$\text{B: C Ratio} = \frac{\text{Gross Return}}{\text{Total Variable Cost}} \quad (2)$$

If B/C>1, The investment is profitable.
If B/C<1, The investment is not profitable.
If B/C=1, Indifferent.

Gross margin

Gross margin is the value of output by producer, which is computed at the return minus the total variable cost. Gross Margin was determined using following formula:

$$\text{Gross Margin} = \text{Gross Income} - \text{Total Variable Cost} \quad (3)$$

Where,

$$\text{Gross Income} = \text{Price Per Unit} \times \text{Total Paddy Production} \quad (4)$$

$$\text{Total Variable Cost} = \text{Summation of cost incurred in all variable items} \quad (5)$$

$$\text{Total Fixed Cost} = \text{Land Tax} + \text{Depriciation Cost} \quad (6)$$

Similarly,

$$\text{Net Income} = \text{Gross Income} - \text{Total Cost} \quad (7)$$

Productivity

The general formula for the calculation of productivity is mentioned below:

$$\text{Productivity} = \frac{\text{Total Production}}{\text{Total Cultivated Area}} \quad (8)$$

Scaling technique/ indexing

The respondents were asked to compare and rank their issues they encountered during paddy farming according to their perception. These problems were ranked by using scaling technique/indexing.

$$I = \sum S_i \times F_i / N \quad (9)$$

Where,

∑= Summation

I= Index (0<I<1)

S_i= Scale value of i^{th} intensity

F_1= Frequency of i^{th} intensity

N= Total number of respondents

Cobb- Douglas production function

The Cobb-Douglas production function depicts the relationship between two or more inputs - typically physical capital and labor - and the amount of outputs that maybe produced. Cobb-Douglas production function was used to determine the variables affecting the paddy production. It was used to calculate the effects of various inputs on production. Cobb-Douglas production function was used in the study as it is suitable in the analysis. The basic form of Cobb-Douglas production function can be specified as:

$$Q = B_1 \times L_i^{B_2} \times K_i^{B_3} \quad (10)$$

Where,

Q= Total production

L= Labor input

K= Capital input

B_1= Constant term

The output elasticity of labor and capital are B_2 and B_3 are respectively.

The natural log of both sides was then used to transform this form into a linear model:

$$\ln Q_i = \ln B_1 + B_2 \ln L_i + B_3 \ln K_i \quad (11)$$

The seed, labor, machinery and manure were the inputs (independent variables) included in the analysis. The following production function can be used to estimate yield of paddy:

$$\ln Y = \ln B_1 + B_2 \ln X_1 + B_3 \ln X_2 + B_4 \ln X_3 + B_5 \ln X_4 + \text{Error term} \quad (12)$$

Where,

Y= Yield of Paddy (Kg)

X1= Quantity of seeds (kg)

X2=Amount of labor (man-day)

X3= Time taken by machinery (hour)

X4=Amount of manure (Kg)

Hypothesis

Hypothesis testing was done to perform statistical test. It evaluates whether the null hypothesis should be accepted or rejected using sample data. The null hypothesis says that the sample means do not vary. If the null hypothesis is accepted, the result is said to be insignificant. The alternative hypothesis asserts that the sample means differ significantly. The findings of the study are considered to be significant if the alternative hypothesis is accepted. The hypothesis for the study was as follows:

H_0=Inputs have no significant impact on output.

H_1=Inputs have significant impact on output.

RESULTS AND DISCUSSION

Socio-economic characteristics

The number of male respondents was 73 and female was 47 representing 60.83% and 39.17% respectively as illustrated in the Table 1 , indicating that the paddy farming is dominated by males in Ratuwamai Municipality. The adult i.e., 16-59 age group of respondents were actively involved (i.e., 75.83%) in paddy cultivation. Similarly, respondents over the age of 59 were least active, accounting for 24.17% of total. According to (Thapa *et al.*, 2021), 67.5% of the respondents were found to be male and 32.5% were found to be female whereas the average age of 54 were found to be most active in the same area. Majority of the respondents were Brahmins with 49.17% followed by Chettri with 35.83% and Janjati with 13.33%, with Dalit accounting for just 1.67%. The respondents receiving primary education were found to be highest (i.e., 37.5%). Paddy is the major food crop in most part of the world. The produced paddy is used for home consumption as well as for marketing. Out of total production of paddy in the study area, 32.13% of the paddy were used for home consumption and 67.87% were marketed as illustrated in the Table 1 .

Cost and return of paddy farming

In the study area, labor costs contribute most to the total variable costs with 45.48% followed by mechanical power (28.29%), chemical fertilizers (8.09%), seed cost (7.84%), irrigation cost (3.28%), organic manure (3.26%), disease and pest management (2.22%) and transportation cost (1.55%). The average variable cost and fixed cost per hectare was found to be Rs. 66,899.47 and Rs. 3,183.18, respectively. Therefore, the average total cost was found to be Rs. 70,082.65. As per (Khatiwada *et al.*,

Table 1. Socioeconomic characteristics of respondents.

Categories	Frequency	Percentage
Gender		
Male	73	60.83%
Female	47	39.17%
Age		
16-59	91	75.83%
59 and above	29	24.17%
Ethnicity		
Brahmin	59	49.17%
Chhetri	43	35.83%
Dalit	2	1.67%
Janjati	16	13.33%
Education Level		
Informal	10	8.33%
Primary Education	45	37.50%
Lower Secondary Education	6	5%
Secondary Education	26	21.67%
Higher Secondary Education	21	17.50%
University	7	5.83%
Illiterate	5	4.17%

Source: Field Survey, 2021

Table 2. Cost of paddy cultivation per hectare.

S.N.	Particulars	Mean	Standard deviation
1.	Variable Cost		
A.	Labor Cost	30421.61	164
B.	Seed	5241.24	26.37
C.	Organic Manure	2180.78	26.79
D.	Chemical Fertilizers	5410.36	34.12
E.	Disease and Pest Management	1482.58	11.54
F.	Mechanical Power	18922.08	111.83
G.	Irrigation Cost	2193.75	15.44
H.	Transportation Cost	1047.07	10.04
	Total Variable cost	66,899.47	330.19
2.	Fixed Cost		
A.	Depreciation Cost	2802.96	16.28
B.	Land Tax	380.22	0
	Total Fixed Cost	3,183.18	16.28
	Total Cost of Production	70,082.65	337.38
3.	Output		
A.	Paddy Production	1,02,758.52	597.68
B.	Straw	8412.71	53.57
	Total Return	1,11,171.23	643.59

Source: Field Survey, 2021

2021), the total average cost of paddy cultivation was reported to be Rs. 87,215.50 per hectare in Jhapa district which is more than the study area due to the high cost of human labor. From the study, it was found that 4,326.909 kg of paddy was produced per hectare on an average and the price per kg of paddy was Rs.23.59. The return from paddy produced was Rs.1,02,758.52. The average production of straw was found to be 3,044.85 kg per hectare whereas price per kg of straw was Rs. 2.76. The return from straw was Rs. 8,412.71. Therefore, the average total return per hectare from the output of paddy cultivation was found to be Rs.1,11,171.23. The cost of production and returns of paddy and its byproduct is presented in the Table 2. The gross income or return from paddy cultivation was found to be Rs.1,11,171.23 per hectare. Similarly, gross margin was calculated by deducting the variable cost from average gross return and found to be Rs. 44,271.74. The net profit per hectare was calculated by subtracting the total cost of production from gross income and found to be Rs. 41,088.57 on an average. Benefit Cost Ratio was a measure which was used to compare the benefits with that of the cost and investments. It is the major that illustrates the relationship between costs and benefits of the project. The benefit cost ratio was found out to be 1.66 in this study. From the previous study (Pandit *et al.*, 2020), it was reported that the benefit cost ratio of production of rice in Morang district was found to be 1.26 which is profitable but not enough to maintain higher profit margin. The total production of paddy per ha was found to be 4.32 MT/ha as illustrated in table below:

Table 3. Economics of paddy cultivation per hectare.

Particulars	Mean	Standard deviation
Production per hectare	4326.909kg	24.69
Average price of paddy	Rs. 23.59	2.49
Gross Income	Rs.1,11,171.23	643.59
Gross Margin	Rs. 44,271.74	419.39
Net Income	Rs. 41,088.57	416.73
Benefit-Cost Ratio	1.66	0.53
Productivity	MT/ha	1.43

Table 4. Model summary of regression analysis.

Model Summary[b]			
R	R Square	Adjusted R Square	Std. Error of the Estimate
.882[a]	.778	.771	.29472

a. Predictors: (Constant), LnTotalManure, LnSeed, LnMachinery, LnLaborQuan
b. Dependent Variable: LnOutput

Table 5. Coefficient of regression.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Significant
	B	Std. Error	Beta		
(Constant)	4.719	.246		19.160	.000
LnSeed	.460	.090	.460	5.137	.000
LnLabor	.264	.097	.238	2.721	.008
LnMachinery	.173	.072	.200	2.419	.017
LnTotalManure	.039	.027	.071	1.427	.156

Factor influencing production of paddy

To determine the factors influencing the paddy production, regression analysis was done using Cobb- Douglas production function. Paddy yield was taken as dependent variables as it depends on the inputs used whereas input variables such as seed, labor, machinery and manure were taken as independent variables. It is used for determining the effect of these independent variables on paddy yield.

Goodness of model fit

R square, a statistical measure, also known as coefficient of determination was used to analyze the goodness of model fit. The Table 4 shows that R square is 0.778 indicating 78.1% of the variation in dependent variable is explained by independent variables. Therefore, 78.1% data fits the model.

Coefficient of Regression

The analysis showed that unstandardized coefficient for seed, labor, machinery and manure was found to be 0.460, 0.264, 0.173 and 0.39, respectively. It means that if quantity of seed is increased by 1 unit the output is increased by 0.460 kg remaining other variable constant; increase in 1 unit of labor, machinery and total manure increases the output by 0.264, 0.173 and 0.39 kg, respectively. The production of paddy can be estimated by the following Cobb-Douglas equation:

$$Y = 4.719 \times \text{Seed}^{(0.460)} \times \text{Manure}^{(0.39)} \times \text{Labor}^{(0.264)} \times \text{Machinery}^{(0.713)} + \text{Error}$$

Correlation between seed and paddy yield

The scatter plot of the relationship between seed and yield is illustrated in Figure 1. The scatter dots were near to the regression line. The correlation coefficient of seed and paddy yield was found to be 0.460 and significant at 99% confidence level as presented in Figure 1. Therefore, seed and paddy yield were found to be positively correlated. It means the increase in one unit of seed will lead to increase in the yield by 0.460 unit provided all other variables remain constant.

Correlation between labor and paddy yield

The scatter plot of the relationship between labor and paddy yield is illustrated in Figure 2. The scatter dots were near to the regression line. The correlation coefficient of labor and paddy yield was found to be 0.264 and significant at 99% confidence level as presented in Figure 2. It means the increase in one unit of manpower will result in increase of the yield by 0.264 units provided all other variables remain constant. Therefore, labor and paddy yield were found to be positively correlated.

Correlation between machine power and paddy yield

The scatter plot of the relationship between seed and paddy yield is illustrated in Figure 3. The scatter dots were near to the regression line. The correlation coefficient of machine use and paddy yield was found to be 0.173 and significant at 95% confidence level as presented in Figure 3. Therefore, machine use and paddy yield were found to be positively correlated. It means the increase in one unit of machine power will lead to increase in yield by 0.173 units, provided all other variables remain constant.

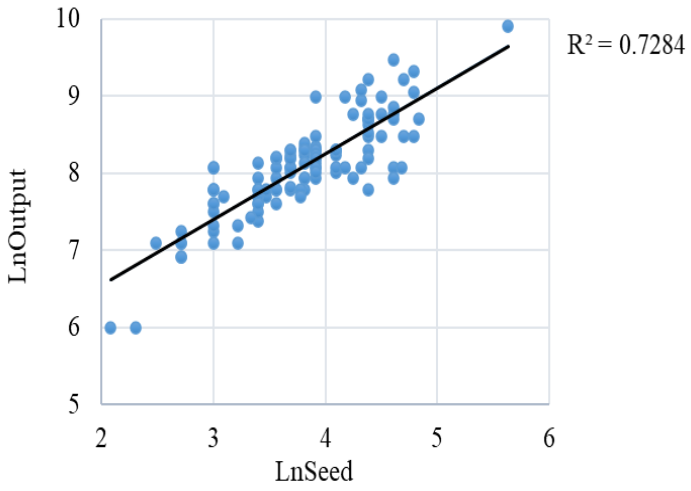

Figure 1. *Scatter plot showing the relationship between seed and paddy yield.*

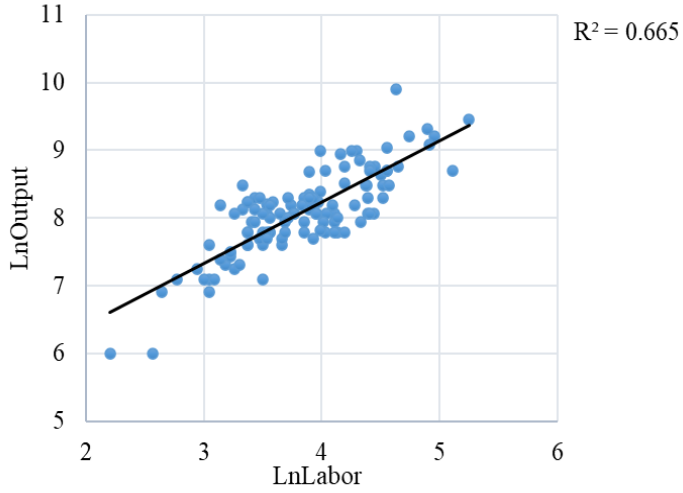

Figure 2. *Scatter plot showing the relationship between labor and paddy yield.*

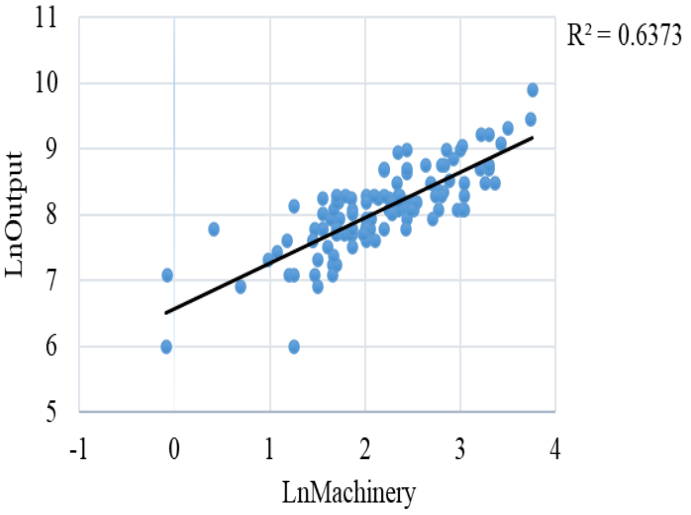

Figure 3. *Scatter plot showing the relationship between machine power and paddy yield.*

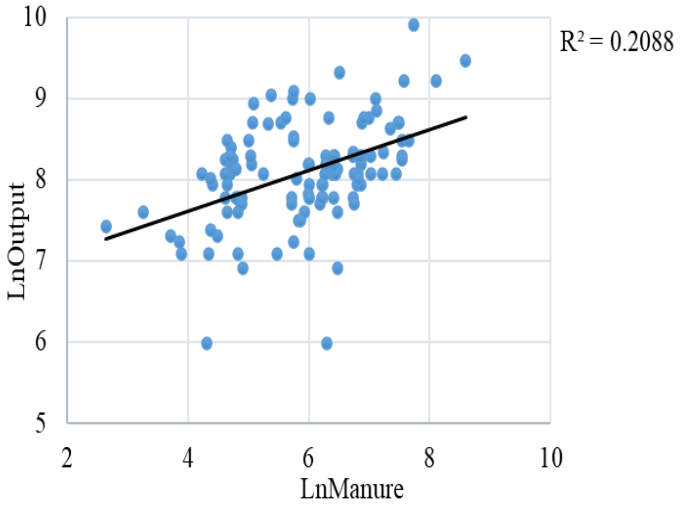

Figure 4. *Scatter plot showing the relationship between manure and paddy yield.*

Correlation between Manure and paddy yield

The scatter plot of the relationship between manure and paddy yield is shown in Figure 4. The scatter dots were not near the regression line. The correlation coefficient of manure and paddy yield was found to be 0.039. However, in Figure 4 the value is not significant even at a confidence level of 95%.

Conclusion

The field level survey was conducted in Morang district for the analysis of profitability and effect of factors of production. The positive BC ratio (1.66), gross income or return from paddy cultivation of Rs.1,11,171.23 per hectare suggests that paddy farming is fundamental and profitable crop in the study area. Due to the high contribution of labor costs to the variable cost, there is increase in cost of cultivation of paddy. Therefore, various new machineries and technologies should be adopted to reduce the cost of cultivation. The productivity was found to be 4.32 MT/ha in the study area which is higher than the productivity of fiscal year 2019/20 in Morang district i.e., 4.1 MT/ha. Hence, it is an important crop and profitable enterprise in the study area that should be supported among farmers inorder to increase its availability and affordability as well as to improve food security. The independent variables such as seed, labor and machinery were found to be statistically significant and had positive effects on paddy production. With the increase in production income, livelihood and nutritional status of farmers would have been improved as well.

ACKNOWLEDGEMENT

We are really thankful to Prime Minister Agriculture Modernization Project (PMAMP), Rice/Fish Zone, Morang, Nepal and G.P. Koirala College of Agriculture and Research Center (GPCAR) for providing fund to carry out the project and continuous encouragement.

REFERENCES

Almanac, R. (2013). *Rice almanac, 4th edition*. Los Baños (Philippines): GRiSP (Global Rice Science Partnership).

Bhandari, D. R., Sanjel, P. K., & Adhikari, S. (2017). Policy Review of Paddy Production in Nepal. *Rice Science and Technology in Nepal*. Retrieved from https://d1wqtxts1xzle7.cloudfront.net/61920008/Bhandari_Sanjel_Adhikari-_Policy_review_of_Paddy_production_in_Nepal20200128-50703-13d5u9w.pdf?1580227864=&response-content-disposition=inline%3B+filename%3DPolicy_review_of_Paddy_production_in_Nep.pdf&Expire

Gairhe, S., Gauchan, D., & Timsina, K. P. (2021). Temporal dynamics of rice production and import in Nepal. *Journal of Nepal Agricultural Research Council*, 97-108, https://doi.org/10.3126/jnarc.v7i1.36932

Joshi, N. P., Piya, L., & Maharjan, K. (2011). Production Economics of Rice in Different Development Regions in Nepal. *Journal of International Development and Cooperation*, *17*(1), 103-112.

Khatiwada, D., Dutta, P. J., Shrestha, K., Adhikari, G., & Paudel, H. (2021). *Economic Impact of Agricultural Mechanization in Rice Farming in Shivasatakshi Municipality of Jhapa District,Nepal* (Vol. 1). Food and Agri Economics Review. http://doi.org/10.26480/faer.01.2021.41.45

Magar, U. R. (2020). Identifying the Role of Paddy in the Economic Development of Nepal. *The Journal of Economic Concerns*, *11*(1). Retrieved from http://necs.org.np/wp-content/uploads/2021/04/7.pdf

MoALD, M. o. (2021). Statistical Information on Nepalese Agriculture 2076/77 (2019/20).

Navaya, J. L. (2017). Monsoonal Rainfall and its Impact on Rice Production in Nepal. *Rice Science and Technology in Nepal*.

Odoemenem, I. U., & Inakwu, J. A. (2011). Economic analysis of rice production in Cross River State, Nigeria. *Journal of Development and Agricultural Economics*, *3*(9), 469-474. Retrieved from https://academicjournals.org/journal/JDAE/article-full-text-pdf/8AAB7B68454

Pandit , R., Devkota, D., Devkota, N. R., Bhattarai, P. C., & Shrestha, H. K. (2020). Dynamics of Rice SSub-sector in Nepal: Research Investment, Production and Suply Chain. *Agricultural Science and Technology*, *12*(2), 178-188. https://doi.org/10.15547/ast.2020.02.030

PMAMP. (2076). *Annual Progress Report (2074/75 & 2075/76)*. Project Management Unit (PMU).

Thapa, K., Adhikari, P., Poudel, M., Adhikari, P., Baral, S., & Paneru, N. (2021). *An Assessment of Farm Mechanization Status of Rice Cultivation in Ratuwamai Municipality, Morang District, Nepal*. Tropical Agrobiodiversity. http://doi.org/10.26480/trab.01.2021.22.29

Yusop, Z., Aziz, A. S., Saili, A. R., Nor, R. M., & Sahmat, S. S. (2021). Constraints of Paddy production Among Smallholder Farmers. *International Journal of Service Management and Sustainability*, *6*(1), 107-119, https://doi.org/10.24191/ijsms.v6i1.12881