RESEARCH ARTICLE

ECONOMIC IMPACT OF AGRICULTURAL MECHANIZATION IN RICE FARMING IN SHIVASATAKSHI MUNICIPALITY OF JHAPA DISTRICT, NEPAL

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ABSTRACT

A study was conducted in Shivasatakshi municipality of Jhapa district to assess the economic impact of agricultural mechanization in rice farming in 2020. Altogether, 40 rice farmers were selected randomly and surveyed using a semi-structured interview schedule. Based on the use of machinery, farmers were categorized into mechanized and non-mechanized farmers. Cost and revenue were calculated among both categories. T-test was used to compare the mean cost and revenue between mechanized and non-mechanized rice farmers. The average cost of production of rice was NRs.87,215.50/ha. The cost of human labor was found higher in both categories (more than 40%). The average total cost of production was lower in mechanized farms (NRs.67,191.74/ha) as compared to non-mechanized farms (NRs. 1, 07,239.27/ha). The contribution of rice grain and straw to the overall revenue was 98.53% and 1.46% respectively. The average revenue from production was calculated to be NRs.1, 21,879.25/ha. The average gross revenue was greater in mechanized farms (NRs.1,26,042.90/ha) than non-mechanized farms (NRs. 1, 22,067.00/ha). The benefit-cost ratio was observed higher in the mechanized rice farms (1.898) than non-mechanized farms (1.143). The findings of the study showed that mechanized rice farming reduced the cost of production by lowering down human labor cost and increased the profitability of the enterprise. Therefore, it is recommended to adopt machinery for rice cultivation in Shivasatakshi municipality, Jhapa.

KEYWORDS

Rice, mechanization, B: C ratio, labor, machinery

1. INTRODUCTION

Agriculture is central to the livelihood of Nepalese people. It is the main source of Nepal's Gross Domestic Product (GDP) and Nepali's income and employment opportunities (Shrestha, 2012). It contributes 27.6% to the national GDP. 80% of the total cultivated land in Nepal is used to grow cereal crops (ADS, 2015). Rice dominates the country's crop sector accounting for over 42.5% (168047 ha) of the total area under food grains and shares 51.6% in total food grain production (MoAD, 2017). It is a predominant staple food crop of Nepal which supplies about 40% of the food calorie intake and contributes nearly 20% to the Agricultural Gross Domestic Product (AGDP) and almost 7% to GDP (CDD, 2017). It is grown in a wide range of agro-ecological zones under varying climates, altitudes, and topography ranging from 60 meters in Terai (Kanchankawal, Jhapa) to 3,050 meters above sea level in Chumchaur, Jumla in Nepal (Bhujel, 2004; Bista, 2004). Jhapa district is the leading producer of rice in Nepal with the production of 3, 32,933 metric ton and productivity of 4.020 tons per hectare under the area of 82,826 hectares (MoALD, 2017/18). It has been selected as a super zone for rice production under the Prime Minister Agriculture Modernization Project (PMAMP).

In recent years, the rice self-sufficiency ratio is below 100, which means domestic rice production is not sufficient to meet domestic consumption. While Nepal was a marginal exporter of rice before 1980, it has now turned a rice-importing country due to the combined effects of slow growth in yield and rapid growth of population (Tripathi et al., 2019). Nepal now imports huge quantities of milled rice every year, draining fiscal resources and adversely impacting development efforts (Nepal and

IRRI, 2019). The total amount of paddy imported in the year 2016/17 is 1, 63,302 Mt and 3, 93,918 Mt respectively creating a huge trade deficit (MoALMC, 2018).

In addition to this, labor scarcity is an emerging constraint in Nepal. Farm wage rates increased more than four folds in the last one decade. The average farm labor wage rate increased from NRs.30 per day in 1993/94 to NRs. 350 per day in 2013/14 (Bhandari, 2014). This has increased the production cost and has reduced farm profitability. As rice is most labor intensive among cereal crops, rising labor costs will reduce its comparative advantage and encourage farmers to shift from rice to non-rice crops unless labour costs are reduced. With reduction in cost of different farming operations such as; land preparation, transplanting, harvesting etc. mechanization can be an appropriate option in Nepal where labor shortage and high cost of production are major problem of farmers (Updety, 2011). This study compares the cost and returns of rice production of mechanized and non-mechanized rice farms and motivates farmers to adopt machinery for rice cultivation.

2. MATERIALS AND METHODS

2.1 Study Site

Shivasatakshi municipality of Jhapa district was purposively selected for the study as the area was noted for its high rice production potential. The study site is located at latitude of 26.61258°N and longitude of 87.83528°E. The mean annual precipitation, maximum and minimum temperature of the study site are 250-300 cm, 42°C and 10°C respectively

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2.2 Selection of Rice farmers

A list of registered rice farmers was obtained from Agriculture Development Farm, Chandradangi Jhapa. Forty rice farmers (20 mechanized and 20 non-mechanized) were selected using simple random technique. Farmers were categorized into two categories based on the use of machineries as follows:

- Mechanized farmers (farmers who use tractor for land preparation, combine harvester/ reaper for harvesting and thresher for threshing)
- Non mechanized farmers (farmers who do not use any machines for performing farm operation and completely depend on human labour and bullock labour)

2.3 Data Collection and Analysis

Primary data were collected using semi-structured interview schedule and the data were validated through focus group discussion with farmers, local leaders and other concerned stakeholders. Secondary data were collected from various articles, reports and books published by different institutions and organizations like District Agriculture Development Office (DADO), Central Bureau of Statistics (CBS), Market Research and Statistics Management Program (MRSMP), and Agriculture Development Farm. The raw data obtained were coded, tabulated and entered into the computer. The local measurements were converted into standard units and final analysis was done using Microsoft Excel and Statistical Package for Social Sciences (IBM SPSS version 25). Descriptive statistics such as mean, frequency and percentage were used to analyse socioeconomic characteristics of farmers.

2.4 Cost of production

For analyzing the cost of production, variable costs and fixed costs were considered. The variable costs included expenditure on seed, FYM and chemical fertilizers, irrigation, machine and bullock hiring cost for farm operations like tillage, puddling and leveling, harvesting and threshing, and human labor cost for agronomic operations. The fixed costs included land tax and maintenance costs. The land tax in the study area was NRs.430 per hectare.

Total Cost= Fixed Costs + Variable Costs

2.5 Gross revenue

Gross Revenue is the total revenue obtained from grains and straw.
Gross Revenue= Revenue from grains+ Revenue from straw

2.6 Net Profit

Net Profit is the economic incentive to the farmers and is an important motivating factor to the farmers to increase the paddy yield.
Net profit = Gross Revenue - Total cost

2.7 Benefit Cost Analysis

The B: C ratio was calculated using the following formula:
B/C ratio= (Gross revenue/Total cost)

2.8 Henry Garrett ranking technique

To evaluate the most significant reasons for using machinery in rice cultivation and constraints of mechanization, Henry Garrett's (1969) ranking technique was used. In this method, farmers were asked to rank the reasons and constraints according to the magnitude. The orders of merits given by the respondents were converted into score values by using the following formula.

Percentage position = $100 (R_{ij} - 0.5) / N_{ij}$
Where,

R_{ij} = Rank given for i th variable j th respondents

N_j = Number of variable ranked by j th respondents

The percentage position of each rank thus obtained was converted into scores by referring to the table given by Henry Garrett. Then for each factor, the scores of the individual were added together and the total value of scores and mean value of score was calculated. The factor having highest mean value was considered to be the most important factor.

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics of the farmers

Table 1 shows the socio-economic variables (gender, age, education and total landholding) in the survey region. 85% of household heads were male while 15% were female which implies that rice farming community is dominated by males. A majority (80%) of the rice farmers were between the ages of 15 to 59 years. 22.5% of the household heads were illiterate while only 12.5% had gained higher secondary education. Nwele reported that education can influence the decision-making process such as the adoption of farm innovation like machineries (Nwele, 2016). 67.5% of the farmers had medium landholding (0.28 to 1.60 ha).

Table 1: Socio-Economic Characteristics of the farmers Shivasatakshi and Jhapa, 2020

Parameters	Frequency	Percent
Gender		
Male	34	85
Female	6	15
Age		
15 to 59	32	80
Above 59	8	20
Education		
Illiterate (0 years of schooling)	9	22.5
Primary (up to 5 years of schooling)	10	25
Secondary (up to 10 years of schooling)	16	40
Higher secondary and above (above 10 years of schooling)	5	12.5
Land holding		
Small (less than 0.28 Ha)	5	12.5
Medium (0.28 to 1.60 Ha)	27	67.5
Large (more than 1.60 Ha)	8	20

3.2 Source of information on mechanization in rice farming

The study revealed that the majority (62.5%) of the respondents gained information about the use of machinery in rice farming from Agriculture Development Farm, Chandradangi, Jhapa followed by progressive farmers and media (27.5%) and cooperatives (10%) as shown in Table 2.

Table 2: Source of information about mechanization in rice farming in Shivasatakshi, Jhapa, 2020

Source	Frequency
Government farm (ADF, Chandradangi)	25 (62.5)
Cooperatives	4 (10)
Progressive farmers and Media	11 (27.5)
Total	40 (100)

Note: Figures in parentheses indicate the percentage

3.3 Training related to agricultural mechanization

Table 3 revealed that only 7.5% of the respondents had previously received training related to agricultural mechanization.

Table 3: Training status of the respondents Shivasatakshi and Jhapa, 2020

Training	Frequency (N=40)
Yes	3 (7.5)
No	37 (92.5)
Total	40 (100)

Note: Figures in parentheses indicate the percentage

3.4 Reasons behind using machinery

Table 4 shows that the major reason behind using machinery as realized by the farmers was it made farm work faster followed by lack of human labor and animal power, reduce cost, reduce drudgery and increase production.

Table 4: Reasons behind using machinery by the respondents Shivasatakshi, Jhapa, 2020		
Reasons behind using machinery	Mean value	Rank
Makes farm work faster	61.625	1
Lack of human labour and animal power	59	2
Reduce cost	58.875	3
Reduce drudgery	40.875	4
Increase production	29.625	5

3.5 Constraints of mechanization

Table 5 revealed that less availability of machinery at the study area was the major constraint in mechanization followed by small landholding, high cost of machineries, lack of training on use of machineries and lack of awareness about the use of machineries.

Table 5: Constraints of mechanization in Shivasatakshi, Jhapa, 2020		
Constraints of mechanization	Mean value	Rank
Less availability of machineries	65.45	1
Small land holding	60.375	2
High cost of Machineries	54.025	3
Lack of training on use of machineries	49.275	4
Lack of awareness about the use of machineries for rice cultivation	36.1	5

3.6 Cost of Production

Table 6: Cost of production of rice per hectare in Shivasatakshi, Jhapa, 2020				
Particulars	Mechanized farmer (N=20)	Non mechanized farmer (N=20)	Overall (N=40)	t-value
A. Variable costs	66454.74 (98.90)	106767.28 (99.57)	86611.00(99.31)	-9.028*
a. Seed	2829.24 (4.21)	3250.82 (3.03)	3040.03 (3.49)	-2.108*
b. Farm Yard Manure and chemical fertilizers	13960.47 (20.78)	12617.52 (11.77)	13288.99 (15.24)	0.527
c. Irrigation	597.18 (0.89)	610.28 (0.57)	603.73 (0.69)	-0.376
d. Nursery bed preparation	816.59 (1.22)	1759.35 (1.64)	1287.97 (1.48)	-11.290*
e. Tillage	3984.90 (5.93)	10567.20 (9.85)	7276.05 (8.34)	-15.201*
f. Puddling and levelling	5035.70 (7.49)	13593.80 (12.68)	9314.75 (10.68)	-16.628*
g. Harvesting and Threshing	11081.50 (16.49)	14616.48 (13.63)	12848.99 (14.73)	-11.294*
h. Human labour cost (NRs/ha)	28149.16 (41.89)	49751.83 (46.39)	38950.49 (44.66)	-16.868*
B. Fixed costs	737.00 (1.10)	472.00 (0.44)	604.50 (0.69)	6.066*
Total Cost	67191.74 (100)	107239.27 (100)	87215.50 (100)	-15.222*

Figures in parentheses indicate the percentage of their respective column. * indicate significant at 5% level of significance

The overall total average cost of production of rice was NRs. 87,215.50/ha. The average total cost of production of mechanized rice farms (NRs. 67,191.74/ha) was significantly lower as compared to non-mechanized rice farms (NRs. 1, 07,239.27/ha) and the difference was statistically significant at a 5% level. The average variable cost of production was significantly lower in mechanized rice farms (NRs. 66,454.74/ha) as compared to non-mechanized rice farms (NRs. 1, 06,767.28/ha). MoALD (2018/19) conducted a similar case study on the Impact of Mechanization in Rice Farming in Nepal in three districts namely Jhapa, Sunsari, and Morang, and reported that variable cost incurred on all operation in rice cultivation were more on traditional farming (NRs. 1,13,475/ha) as compared to mechanized farming (NRs. 95,050/ha). From the table, it can be seen that human labor cost accounts for the maximum part of the total cost in both mechanized (41.89%) and non-mechanized rice farms (46.39%). The average human labor cost was higher in non-mechanized farms (NRs. 49,751.83/ha) as compared to mechanized farms (NRs. 28,149.16/ha) and the difference was statistically significant at 5% level. MoALD (2018/19) reported that with the introduction of machinery into farming operations, there is a large displacement of human labor in terms of cost by almost 40%.

3.7 Revenue from production

Table 7: Revenue from rice production per hectare in Shivasatakshi, Jhapa, 2020				
Particulars	Mechanized farmer (N=20)	Non-mechanized farmer (N=20)	Overall (N=40)	t-value
1.Revenue from Rice	124370.60 (98.67)	120172.85 (98.45)	120096.03 (98.53)	3.470*
2.Revenue from Straw	1672.30 (1.32)	1894.15 (1.55)	1783.22 (1.46)	-2.733
Gross Revenue	126042.90 (100)	122067.00 (100)	121879.25 (100)	3.306*

Figures in parentheses indicate the percentage of their respective column. * indicate significant at 5% level of significance

From the above table7, it is observed that the major contribution for revenue from rice was from grains i.e. 98.53%. Straw contributed only 1.46% to the gross revenue in overall. The gross revenue of mechanized

farms (NRs. 1, 26,042.90/ha) was significantly higher than non-mechanized rice farms (NRs. 1, 22,067.00/ha).

3.8 Net profit and B: C Ratio

Table 8: Net profit and B: C Ratio of rice farming in Shivasatakshi, Jhapa, 2020

Particulars	Mechanized farmer (N=20)	Non-mechanized farmer (N=20)	Overall (N=40)	t-value
1. Net Profit	58851.15	14822.70	36836.93	18.224*
2. B:C Ratio	1.898	1.143	1.521	16.830*

* indicate significant at 5% level of significance

Table 8 shows the benefit-cost ratio as influenced by the presence and absence of mechanization in rice farming. The Net profit was positive and B: C ratio was greater than unity (1), which shows rice cultivation is considered profitable in the study area. However, the net profit was significantly higher in mechanized farms (NRs. 58,851.15/ha) as compared to non-mechanized rice farms (NRs. 14,822.70/ha). This difference is mainly due to the lower cost of production in mechanized rice farms. Mechanizing farm operations in rice cultivation reduces the labor requirement in rice cultivation and reduces the cost of production (Singh, et al., 2011). Uprety reported that the farmers who have introduced mechanization into their rice farming have found that they can reduce production costs by 27% and increase their profit per hectare by 36% (Uprety, 2011). The average B: C ratio of rice production in the study area was 1.521. The B: C ratio was significantly greater in mechanized rice farms (1.898) as compared to non-mechanized rice farms (1.143).

4. CONCLUSION

The study depicts that rice farming was found solvent in both mechanized and non-mechanized rice farms. However, the B: C ratio was greater in mechanized farms (1.898) as compared to non-mechanized farms (1.143). The average total cost of rice production per hectare was significantly higher in non-mechanized farms (NRs. 1, 07,239.27) as compared to mechanized farms (NRs. 67,191.74). The human labor cost covers the maximum percentage of total cost in both farms with the average human labor cost per hectare significantly lower in mechanized farms (NRs 28,149.16) than non-mechanized farms (NRs. 49,751.83). So, it is recommended to adopt machinery for rice cultivation as it reduces human labor costs and increases profitability.

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