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RESEARCH ARTICLE

AN ANALYSIS ON PRODUCTION ECONOMICS OF RICE IN THE RICE ZONE OF PARBAT DISTRICT OF NEPAL

Poojan Adhikari*, Kabita Bhat, Pawan Pyakurel, Saujan Acharya, Ganga Dulal, Kiran Thapa, Randhir Paudel, Keshab Rijal

Agriculture and Forestry University, Chitwan, Nepal.
****Corresponding Author Email: adhikaripoojan5174@gmail.com***

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ABSTRACT

This study, conducted in Parbat district, Nepal, aimed to comprehensively examine the economic aspects of rice production, involving an in-depth analysis of farmers' socioeconomic status, production factors, inputs, and challenges faced. The research employed pre-tested interview schedules, Focus Group Discussions (FGD), and Key Informant Surveys (KIS) for primary data collection, supplemented by secondary information from relevant publications. Using simple random sampling, data were gathered from 125 farmers, classified as small-scale and large-scale based on their average land holdings devoted to rice cultivation. Statistical tools including SPSS and Microsoft Excel were utilized for data analysis. The study revealed that the land area dedicated to rice cultivation averaged 6.08 ropani. Human labor was a predominant input, alongside seed, tillage, organic and chemical fertilizers, pesticides, and transportation, employed by both small and large farms. Production per household amounted to 1177.44 kg, with a productivity rate of 217.96 kg/ropani. Notably, there was a significant disparity in production per household, with small-scale farms yielding 971.2 kg and large-scale farms producing 1585 kg. The study estimated the total average cost, gross revenue, and gross margin per ropani as NPR. 12188.79, NPR. 18295.09, and NPR. 6106.29, respectively, resulting in an average benefit-cost ratio of 1.5. The Cobb Douglas production function analysis indicated that inputs such as human labor, tillage, organic manures, pesticides, and transportation positively influenced income, while chemical fertilizers costs had a negative impact. The computed return to scale value of 0.95 signified decreasing returns in rice production in Parbat district. Consequently, the study recommends addressing issues related to the quality of inputs and other challenges to maximize production and income in the region.

KEYWORDS

Rice Production, Land Holdings, Microsoft Excel, Chemical Fertilizers, Transportation Positively

1. INTRODUCTION

The backbone of the Nepalese economy is agriculture, which is actively practiced by 65.6% of the population, 60.2% of whom are men and 72.8% of whom are women (Central Bureau of Statistics, 2068). Agriculture and forestry also contribute about 27.10% of GDP to GDP and create employment opportunities (Central Bureau of Statistics, 2068). Cereals comprise around 49.41% of the total agricultural GDP. The most important cereal crop in Nepal is rice (*Oryza sativa L.*), which contributes 20% of the nation's agricultural GDP and 50% of all edible cereal production (Adhikari, 2013). Rice is a crop that enjoys heat, short days, and sunlight. The typical temperature range for a crop's life cycle is between 21 and 37 °C, with seed germination requiring a minimum temperature of 10 C and a higher temperature during the tillering stage. The required temperature ranges for flowering and ripening are 26.5-29.5 °C and 20-25°C, respectively. The best soil types and pH ranges for growing rice are clay or clay loam soils, which range from 5.5 to 6.5. Crop, however, may survive a variety of soil reactions (Bhattarai, 2017).

The most significant cereal crop in Nepal is rice, which ranks first among other key cereal crops like wheat, maize, barley, millet, and others. More people are fed directly by rice than by any other crop, making it one of the most significant crops for human nourishment in the world. The main crop in South Asia, including Nepal, is rice, which has a huge impact on both economic and agricultural development as well as poverty reduction. In terms of output and area, it is the most prevalent cereal. In Nepal, rice is grown in three agro-ecological regions: the Terai and Inner Terai, which is 67 to 900 meters above sea level; the Mid Hills, which is 1000 to 1500 meters above sea level; and the High Hills, which is 1500 to 3050 meters above sea level (lowland and upland) (Gadal et al., 2019).

It is a part of Gandaki Province and one of the seventy-seven districts of Nepal. The district, with Kusma as its district headquarters, covers an area of 494 km^2 (191 sq m). Parbat district has diversified geographical features. It extends from 280 00' 19" N to 280 23' 59" N latitude and 830 33' 40" E to 830 49' 30" E longitude. Rice zone in Parbat district consists of all wards of Kusma Municipality, ward number 5 and 6 of Modi Rural Municipality, all wards of Paiyun Rural Municipality, ward number 1, 2, 3, 4 and 6 of Bihadi Rural Municipality and ward number 4, 6, 10 and 11 of Falewas Municipality. Rice zone of Parbat covers about 1395.35 ha of land. Farmers mainly cultivate rice of varieties Lumle basmati, Khumal 4, Jetho Budho, Gudura, Ekle etc. The production of main season rice in Parbat is 23,481 mt, on an area of 7,225 hectares, with a productivity of 3.25 mt/ha whereas in case of spring rice, the area is 100 ha with production of 452 mt and a productivity of 4.52 mt/ha (MOALD, 2021).

2. MATERIALS AND METHODS

2.1 Site of social research

Kusma Municiplaity, Paiyun Rural Municipality and Bihadi Rural Municipality of Parbat district was purposively selected for the study.

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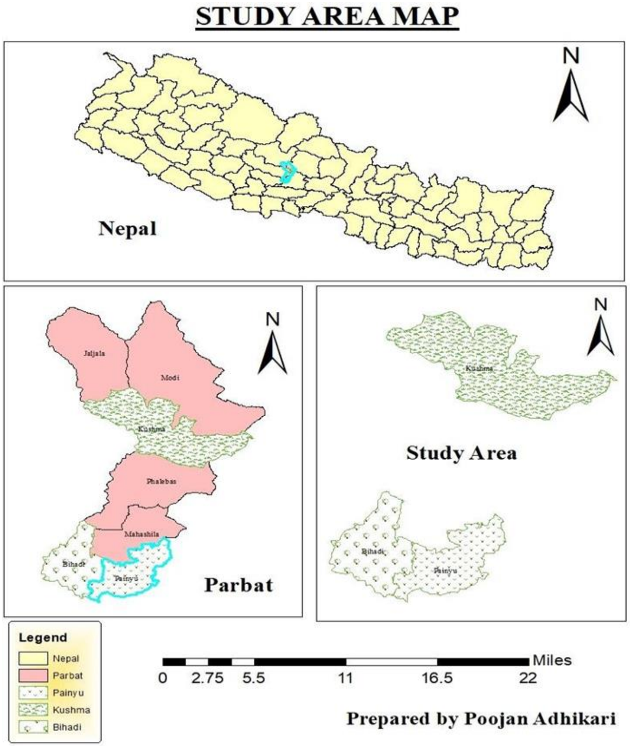

Figure 1: Map of study area

2.2 Preliminary survey

A preliminary study was conducted to acquire information on the feasibility of the research. The characteristics of the research site was evaluated by direct observation and informal encounters with farmers. It gave a comprehensive overview of the rice zone from a variety of angles, which was useful for creating a rapport with the farmers and other relevant staff members as well as for creating the questionnaire.

2.3 Pre- testing of interview schedule

By giving the designed interview schedule to 10 houses around the study region, the interview schedule was pre-tested. The recommendations found during the pre-testing was carefully considered when creating the final interview schedule.

2.4 Sample and sampling technique

Simple random sampling was done in empirical study to select the sample farmers. Leading rice farmers of Kusma Municipality, Paiyun Rural Municipality and Bihadi Rural Municipality was included in sampling frame. The PIU has recorded 2500 rice growing farmers in rice zone of Parbat. Simple Random sampling was done to select about 125 farmers for the survey. The sample size was obtained from the sampling frame using Yamane's formulae with 9% of margin of error.

Yamane's Formula for Sample Size Calculation,

$$n = \frac{N}{1 + (e^2)}$$

where, n= Sample Size, N= Population Size, e= Sampling error

Thus, total number of sample size was 125 and the respondents were categorized into small scale and large scale farm holders on the basis of average area under rice cultivation.

2.5 Research instrument

2.5.1 Pre pilot field visit

Pre-pilot field visits was conducted to gather preliminary information regarding the demographic, socio-cultural, topographical setting and marketing structures of the site. This information was used in preparing schedule and designing a sampling framework.

2.5.2 Questionnaire survey

The research team asked a series of open-ended and closed- ended questions to the target group, which includes rice farmers, agrovets, wholesalers, retailers, and consumers, in order to gather some useful information about the social dynamics, economic situation, production, marketing structure, technological advancement in production practices, and price in the region. Simple random method of sampling was utilized to select the sample population because the survey cannot include every member of the target group.

2.5.3 Focus group discussion (FGD)

To supplement the questionnaire survey with extra data, focus groups was conducted. In order to learn more about common production, technology usage, and marketing issues in the region and, if possible, to find decisive solutions to the identified issue, the concerned stakeholder involved with rice production economics will be brought together for a conversation. FGD engaged members of the zone running committee, agricultural cooperative members, and farmers group members.

2.5.4 Key informant interview (KII)

To develop further idea of the study site, informal discussion and interview with key informant was done. Key information interview was done to the progressive farmers, DADO and Agriculture related organization officer, and other beneficiaries to obtain key information

2.5.5 Observation and verification

Regular field observation and verification was done in the sites to understand the situation which was helpful to validate the information obtain from household survey and market survey.

2.6 Data and its type

2.6.1 Primary data

Both primary and secondary data was used in the study. Via a preliminary questionnaire survey, data were gathered to get broad information on the status of the production, the frame system, and other things. The sampled farmers were given the pre- tested interview schedule in order to get first-hand information for the study. These details were gathered via a household survey, in-person interviews, focus groups, and key informant interviews. Interviews were conducted to understand the current production system, cost of production, return, area covered, selling processes, and current production problems. Similarly, face-to-face interviews were conducted with traders to learn about the current marketing system, market price, marketing channels, and current marketing problems.

2.6.2 Secondary data

The Central Bureau of Statistics (CBS), Nepal Agriculture Research Council (NARC), Agro-Enterprise Center (AEC), Statistical Information on Nepalese Agriculture, Agriculture Knowledge Centre (AKC), Parbat, Department of Agriculture, Ministry of Agriculture Development (MoAD), Agribusiness Promotion and Market Development Directorate, Department of Agriculture and Ministry of Agriculture Development (MoAD) were reviewed for secondary information related to the research topic.

2.7 Data analysis

Prior to being imported into Excel/SPSS, the qualitative and quantitative data gathered from the field will be coded. Software programs like Microsoft Excel and the Statistical Package for Social Science (SPSS) will be used for data entry and analysis. The analyses listed below will be carried out. A scale was used to represent the severity of the problems, with values of 1 for the most serious, 0.8 for serious, 0.6 for moderate, 0.4 for slightly serious, and 0.2 for the least serious problems. The weighted index will be then calculated and will be ranked on the basis of the index value from following equation:

$$I_{imp} = \sum \frac{Sifi}{N}$$

Where, Iimp= index of importance, Si= ith scale value,

Fi= frequency of ith importance given by the N number of respondents

2.8 Gross margin analysis

Gross return, which is determined by deducting the total cost of cultivation from gross return, is different from gross margin. Analysis of any enterprise may be done quickly and simply using gross margin data. It will be calculated using the formula below:

Gross Margin= Gross return – Total Variable Cost

2.9 Cost of production

Cost of Production is summation of total fixed cost and total variable cost. It can be calculated by summing all the variables inputs as given below:

Total cost = ∑ of cost of all variable inputs

= cost of seed + cost of land preparation + cost of labour + Cost of Transplanting + other input costs

2.10 Benefit-cost ratio

The indication of an agricultural sector's economic viability is the benefit-cost ratio. It is the proportion of gross return to overall cost (Subedi, Ghimire, Kharel, Sharma, Shrestha & Sapkota, 2020). It will be calculated using the formula below:

B/C ratio= Gross Return/ Total cost

Rice is short duration crop so only variable cost is taken into the account (Adhikari, 2013).

2.11 Cobb-Douglas production function analysis

The Cobb Douglas production function was used to estimate and analyze the technological relationship among the different inputs of production and output produced i.e., total income. Cobb Douglas production function is a mathematical representation of the relationship between capital, labor, and output (Biddle, 2012). Cobb Douglas production function is one of the common and frequently used economic function (Bajracharya and Sapkota, 2017). The regression coefficients represent the elasticity of respective inputs, and its sum gives the return to scale value.

The form of CPDF used in this study is as follows:

$Y= aX1b1X2b2\ X3b3\ X4b4\ X5b5\ X6b6e\mu$

Where Y is the total income from rice production (NPR /ha), X1 cost of seed (NPR.

/ha), X2 cost of labor (NPR. /ha), X3 cost of tillage (NPR. /ha), X4 cost of FYM and chemical fertilizer and pesticides (NPR. /ha), X5 cost of irrigation (NPR. /ha), and X6 other cost (NPR. /ha), e base of natural logarithm and b1, b2, b3, b4, b5, b6 are the regression coefficients to be determined.

Above mentioned equation was linearized in a logarithmic function for convenience during computation, which was then expressed as,

$\text{Ln } Y = \ln a + b1 \ln X1 + b2 \ln X2 + b3 \ln X3 + b4 \ln X4 + b5 \ln X5 + b6 \ln X6 + \mu$ Where, ln = natural logarithm, a = constant and μ = error term/ random disturbance term.

Human labor cost was calculated by quantifying the total requirement of human labor from pre-cultivation to post cultivation activities of rice production namely seed bed preparation, field preparation, transplanting, weeding, fertilizer application, pesticide application, harvesting and threshing activities etc.

3. Results and Discussion

3.1 Socio-economic and farm characteristics

3.1.1 Age

The maximum age of the respondent was found to be 82 years here as minimum was found to be 23 years. Average age of small scale farmers was found to be 48.71 while mean of large scale farmers was found to be 50.38. Average age was found to be less than the previous study i.e. 59.8 years old (Malla et al., 2015).

Table 1: Age of respondents by farm category in the study area

Age of the respondents	Small scale	Large scale	Total
Mean	48.71	50.38	49.27
Standard Deviation	12.744	11.527	12.327

Source: Field Survey, 2023

3.1.2 Gender of the respondent

The study studies the gender distribution of respondents in a survey, with a total sample size of 125 participants. Of these, 60% were male, constituting 75 individuals, while the remaining 40% were female, totaling 50 respondents. It was found that the number of male and female respondents in small scale was 48 and 35 respectively whereas in large scale the number of male and female respondents was found to be 27 and 15 respectively.

Table 2: Distribution of sex of respondents by farm category in the study area

Sex of the respondents	Small scale	Large scale	Total
Male	48(57.8)	27(64.3)	75(60)
Female	35(42.2)	15(35.7)	50(40)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.1.3 Educational Status of the respondent

The provided data illustrates the educational status of individuals categorized into different levels of education and scale, specifically small scale and large scale. The table indicates the number of individuals falling into distinct educational backgrounds, ranging from illiterate to those with a Bachelor's degree and above. In the illiterate category, there are 22 individuals in the small scale group and 6 individuals in the large scale group, totaling 28 illiterate individuals. Moving on to the Primary Education level, 27 individuals in the small scale category and 17 in the large scale category make up a total of 44 individuals. Similarly, in the Secondary Education category, there were 21 individuals in the small scale group and 14 in the large scale group, summing up to 35 individuals. When it comes to Higher Education, 7 individuals belong to the small scale group, and 5 were in the large scale group, making a total of 12. Lastly, in the category of individuals with a Bachelor's Degree and Above, there were 6 individuals in the small scale group and no individual in the large scale group, totaling 6.

Table 3: Distribution of respondents by farm category on the basis of educational status in the study area

Educational status	Small scale	Large scale	Total
Illiterate	22(26.5)	6(14.3)	28(22.4)
Primary Education	27(32.5)	17(40.5)	44(35.2)
Secondary Education	21(25.3)	14(33.33)	35(28.0)
Higher Education	7(8.4)	5(11.9)	12(9.6)
Bachelor's Degree and Above	6(7.2)	0(0.0)	6(4.8)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.1.4 Occupation of the respondents

The studied revealed that majority of the respondents were engaged in agriculture (70.40%) with (68.8%) in small scale and (73.8%) in large scale followed by service (23.20%) with (25.3%) in small scale and (19.0%) in large scale. The study also found the occupation like Business (1.60%), Government job (1.60%) and foreign income (3.2%). It is not surprising that majn occupation of the respondent was found to be agriculture.

Table 4: Distribution of respondents by farm category on the basis of major occupation in the study area

Major occupation of the respondent	Small scale	Large scale	Total
Agriculture	57(68.7)	31(73.8)	88(70.4)
Business	2(2.4)	0(0)	2(1.6)
Service	21(25.3)	8(19.0)	29(23.2)
Foreign Income	1(1.2)	3(7.1)	4(3.2)
Government Job	2(2.4)	0(0)	2(1.6)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.1.5 Religion of the respondents

The table provides a concise overview of the religious demographics in both small and large-scale farmers. Among the Hindu population, there were 82 individuals in the small-scale group, constituting 98.9% of that community, and 42 individuals in the large- scale group, accounting for 100% representation. Altogether, Hindus made up 99.2% of the total population across both scales. On the other hand, there were a solitary individual identifying as Buddhist in the small-scale group, representing 1.1% of that community, and no representation in the large-scale group, making up 0.8% of the total population.

Table 5: Distribution of respondents by farm category on the basis of religion of respondents in the study area

Religion	Small scale	Large scale	Total
Hindu	82(98.8)	42(100)	124(99.2)
Budhhist	1(1.2)	0(0)	1(0.8)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.1.6 Ethnicity of the respondents

In the study area, the respondents were found to be belonging to four different ethnicities, namely Brahmin, Chhetri, Janjati and Dalits. Majority of the respondents were Brahmins (67.20%) with (62.2%) in small scale whereas (80%) were in large scale farmers, Followed by Chettries (13.60%), Janjati (12%) and Dalit (7.20%). From this we can conclude that major area of the study area was covered by Brahmin Society (Malla et al., 2015).

Table 6: Distribution of respondents by farm category on the basis of Castes/Ethnicity of respondents in the study area

Ethnicity	Small scale	Large scale	Total
Brahmin	52(62.7)	32(76.2)	84(67.2)
Chhetri	10(12.0)	7(16.7)	17(13.6)
Janjati	14(16.9)	1(2.4)	15(12.0)
Dalit	7(8.4)	2(4.8)	9(7.2)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.2 Land Holdings of the respondents

3.2.1 Total land holding of the respondents (ropani)

It is found that the maximum land holding was found to be 58 ropani and minimum land holding was found was found to be 2 ropani.

Table 7: Land holding status of the respondents in the study area

	N	Minimum	Maximum	Mean	Std. Deviation
Total Owned Land Area (Ropani)	125	2	58	8.51	9.075

Source: Field Survey, 2023

3.2.2 Rice cultivated land

It was found that, (66.4%) of the respondents had their area under rice in area less than (6.08 ropani) and remaining (33.6%) of the respondents had greater than (6.08 ropani) as their area under rice cultivation.

Table 8: Area under rice farming of the respondents in the study area

Area under rice farming	frequency
Small scale farming (<6.08 ropani)	83 (66.4%)
Large scale farming (>6.08 ropani)	42 (33.6%)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.3 Irrigation system used by respondents

The table outlines the irrigation systems employed in both small and large-scale agricultural practices. In the small-scale category, 30.1% of the farmers rely on rainfed agriculture, while 20.5% utilize river/dam irrigation, 9.6% use underground water sources, and 39.8% depend on canals. In the large-scale category, 16.7% practice rainfed agriculture, 45.2% employ river/dam irrigation, 9.5% use underground water sources, and 28.6% utilize canals. When considering the overall scenario, 25.6% of the total agricultural practices were rainfed, 28.8% employ river/dam irrigation, 9.6% used underground water, and 36.0% depended on canal irrigation. This data showcases a significant reliance on canal irrigation across both scales, highlighting its prevalence in agricultural irrigation systems (Paudel et al., 2021).

Table 8: Source of irrigation by farm category in the study area

Irrigation system used	Small scale	Large scale	Total
Rainfed	25(30.1)	7(16.7)	32(25.6)
River/Dam Irrigation	17(20.5)	19(45.2)	36(28.8)
Underground water	8(9.6)	4(9.5)	12(9.6)
Canal	33(39.8)	12(28.6)	45(36.0)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.4 Types of fertilizers and manures

The table outlines the types of fertilizers and manures used in both small and large- scale agricultural practices. Among small-scale farmers, 81.9% utilized FYM, Urea, and DAP (Di-Ammonium Phosphate), while 3.6% used FYM and Urea, and 8.4% use FYM and DAP. Additionally, 2.4% used only FYM and 3.6% used Urea and DAP without FYM. In the large-scale category, 71.4% used FYM, Urea, and DAP, 14.3% used FYM and Urea, 11.9% used Urea and DAP, and 2.4% used only FYM. When considering the total scenario, 78.4% of agricultural practices involved FYM, Urea, and DAP, reflecting a widespread use of these fertilizers and manures in both small and large-scale farming. This data underlines the importance of these specific combinations in contemporary agricultural practices. Farmers were highly satisfied to learn that incorporating organic fertilizers (FYM) in combination with a proper mix of Nitrogen (N) and Phosphorus, is essential for boosting crop production (Chapagain and Gurung, n.d.).

Table 9: Farm categorical classification of fertilizers and manures used by the respondents in the study area

Types of fertilizers and manures	Small scale	Large scale	Total
FYM	2(2.4)	1(2.4)	3(2.4)
FYM, Urea, DAP	68(81.9)	30(71.4)	98(78.4)
FYM, Urea	3(3.6)	6(14.3)	9(7.2)
Urea, DAP	3(3.6)	5(11.9)	8(6.4)
FYM, DAP	7(8.4)	0(0.0)	7(5.6)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.5 Source of agriculture inputs

Our research delved into the sources from which farmers obtain their essential agricultural inputs, offering valuable insights into their reliance on different channels. Remarkably, only a tiny fraction, 2 respondents (1.6%), reported sourcing their inputs directly from government channels where both of them came in small scale farmer. In stark contrast, the majority, comprising 101 individuals (80.8%), heavily depend on cooperatives. Additionally, 22 respondents (17.6%) acquired their inputs from agrovets, showcasing the importance of local agricultural supply stores.

Table 10: Source of agricultural inputs

Source of agriculture inputs	Small Scale	Large Scale	Frequency
Government	2(2.4)	0(0.0)	2(1.6)
Cooperatives	67(80.7)	34(81.0)	101(80.8)
Agrovets	14(16.9)	8(19.0)	22(17.6)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.6 Cost of production of the rice

Successful rice cultivation requires higher amount of different inputs along with proper care and management. It is labor-intensive enterprise. The foremost cost attributing items for the rice cultivation are manifold field preparation, improved seed, chemical fertilizers, pesticides, farmyard manure, and sufficient labor for several intercultural operations (Sapkota et al., 2018). The cost incurred by these items constitutes the total variable cost. The cost of production is the major factor that influenced the profitability of the enterprise and also shows the efficiency of the inputs used by the farmers.

In the study area, human labor was one of the major attributing items among all variable items and was computed in term of man per day. Human labor was required for performing different operations such as nursery bed preparation, land preparation, fertilizer application, pesticides application, transplantation, weeding, harvesting, threshing etc. Still, traditional way of farming is prevalent in the study area, which makes the rice production activity more labor intensive. Major types of organic manures and chemical fertilizers used in the study area, were farmyard manure, Urea, DAP and MOP. In addition, farmers used pesticides to control pest problem in severe cases only. Since, cost of production is major factor for profit maximization; the average cost of rice production per ropani was computed in the study area.

The study showed the total variable cost for rice production in one ropani land was calculated. 12188.79. In addition, the average cost of seed per ropani was calculated. 505.5 whereas the cost of farmyard manure was calculated 1145.01 whereas chemical fertilizer was calculated 341.03. Likewise, the average cost of tillage per ropani was 1309.78. Similarly, the average cost of labor was calculated. 8538.22. This showed major cost attributing item was labor in the rice production. The details of the average cost of rice production are shown in the table below:

Table 11: Average Cost of rice production per ropani

Materials	Average Cost (Rs)
Seed	505.5 ± 382.91
Labour Cost (Nursery bed preparation, transplanting, weeding, harvesting, threshing)	8538.22 ± 5123.35
Tillage Cost	1309.78 ± 1903.83
Organic Manure (FYM)	1145.012 ± 953.05
Chemical Fertilizers	341.03 ± 254.33
Transportation	349.06 ± 243.54
Pesticides	0.2 ± 1.57
Total Variable cost	12188.79

Source: Field Survey,2023

3.6.1 Item-wise cost of production

Labor cost occupied the major portion of the cost of production i.e. (70.05%) followed by tillage cost (10.739%) and FYM i.e. (9.394%), chemical fertilizer and pesticides cost (20.2%), seed cost (4.147%) as shown in the Table.

Table 12: Average cost of rice production per ropani

Seed Cost	Labour Cost	Tillage Cost	FYM Cost	Chemical Fertilizer Cost	Transportation	Pesticides
4.147%	70.050%	10.739%	9.394%	2.798%	2.864%	0.002%

Source: Field Survey,2023

The study showed that returns obtained from two product grains and straw. Total returns from rice production in one season per ropani was nearly 18295.09. Gross margin per ropani is calculated as the difference between Gross returns per ropani minus total variable cost per ropani.

Gross margin (Rs.per ropani) = Gross returns (per ropani) –Total variable cost (per ropani)

= 18295.09 – 12188.79

= 6106.3

The total gross returns and total variable cost per ropani was taken as average. Benefit Cost Ratio (BCR) = Gross returns/ Total cost

= 18295.09/12188.79

= 1.5

Gross margin is positive and the BCR is greater than one i.e., if we invest one rupee, we can get the returns of 1.5 from the business, which indicate that the investment is financially viable and business can run smoothly (Bhusal et al., 2020).

3.6.2 Cost of production of rice on farm size basis

Various cost components were analyzed, such as seed cost, labor cost, tillage cost, farmyard manure (FYM) cost, chemical fertilizers cost, transportation cost, and pesticide cost. In terms of seed cost, small scale farms spent significantly more, with a mean of 616.13 compared to 286.87 on large scale farms. Labor cost also varied significantly, where small scale farms invested an average of 10298.10, much higher than the 5060.34 spent by large scale farms. Tillage cost was higher for small scale farms as well, averaging 1580.04 compared to 775.69 for large scale farms. FYM cost was notably higher for small scale farms at 1446.42, compared to 549.38 for large scale farms. Chemical fertilizers cost was 430.50 for small scale farms and 164.19 for large scale farms, indicating a substantial difference. Transportation cost was also higher for small scale farms at 434.72, in contrast to 179.78 for large scale farms.

Pesticide cost was observed only for large scale farms, indicating a mean cost of 0.5952. When considering the total variable cost, small scale farms spent significantly more, averaging 14805.92, while large scale farms spent 7016.86. The mean difference between the two scales was 7789.06, indicating a substantial gap. According to labour cost has the highest contribution to the cost of rice production. Statistical analysis, represented by t-values, indicates significant differences in various cost components (Paudel et al., 2021). The t-values for seed cost, labor cost, FYM cost, chemical fertilizers cost, transportation cost, and pesticide cost were significant, indicating notable variations between small- and large-scale farms. Additionally, the mean differences highlighted the disparities in spending patterns, emphasizing the financial challenges faced by small scale farmers in comparison to their larger counterparts.

Table 13: Cost of production per ropani by farm category in the study area

Cost items	Small scale farm	Large scale farm	Mean	Mean difference	t-value
Seed cost	616.13	286.87	505.5	329.26	0.021**
	(415.31)	(157.22)			
Labor cost	10298.1	5060.34	8538.22	5237.75	3.656**
	(5387.7)	(1634.6)			
Tillage cost	1580.04	775.69	1309.78	804.34	.574*
	(2238.4)	(708.16)			
FYM Cost	1446.42	549.38	1145.01	897.04	3.195**
	(1029.8)	(280.58)			

Table 13 (Cont.): Cost of production per ropani by farm category in the study area					
Chemical Fertilizers Cost	430.5 (262.51)	164.19 (97.77)	341.03	266.3	2.396**
Transportation Cost	434.72 (253.45)	179.78 (253.45)	349.06	254.94	3.188**
Pesticide Cost	0 (0.0)	0.5952 (2.69)	0.2	-0.5952	.855*
Total variable cost	14805.9 (7016.9)	7016.86 (2129.6)	12188.8 (7120.11)	7789.06	0.756

Values in parentheses indicate standard deviation ; ** and * Significant at 5% and 10% levels respectively

Source: Field Survey, 2023

3.6.3 Production, productivity and benefit cost ratio analysis of rice

In this comparative analysis between small scale and large scale farms, several key differences emerge. Small scale farms produced 971.2 kg of goods per unit, significantly less than the 1585 kg produced by large scale farms. The yield per ropani followed a similar pattern, with small scale farms generating 246.62 kg compared to the 161.32 kg of large scale farms. Despite this, small scale farms outperformed in terms of gross revenue, making 21849.24 per ropani, while large scale farms make 11271.40. The gross revenue of small- scale farms was lower than that of large-scale farms in Pyuthan district, where the average total revenue from rice production was NPR. 143049.45 (Bhusal et al., 2020). However, this higher revenue for small scale farms is counterbalanced by higher total variable costs, totaling 14805.92 compared to 7016.86 for large scale farms. Consequently, small scale farms have a profit margin of 7043.32, while large scale farms have 4254.54. Lastly, the benefit cost ratio slightly favors large scale farms where small scale farms exhibit higher revenue but also higher costs.

Table 14: Production, productivity, profit and benefit cost ratio analysis of rice by farm category in the study area

Items	Small scale farm	Large scale farm	Total	Mean difference	t-value
Production (kg)	971.2 (473.501)	1585 (888.754)	1177.44 (702.97)	-613.795	-5.045**
Yield (kg/ropani)	246.62 (124.54)	161.32 (56.63)	217.96 (113.81)	85.3	4.217**
Gross revenue (NRs./ropani)	21849.24 (10297.59)	11271.40 (3282.70)	18295.09 (9942.39)	10577.83	6.481**
Total variable cost (NRs./ropani)	14805.92 (7332.20)	7016.86 (2129.62)	12188.79 (7120.11)	7789.06	6.730**
Gross margin (NRs./ropani)	7043.32 (5684.89)	4254.54 (2224.14)	6106.29 (4975.57)	2788.78	3.058*
Benefit cost ratio	1.45 (0.47)	1.55 (0.49)	1.5 (0.46)	-0.15	-1.51

Values in parentheses indicate standard deviation; * and ** Significant at 5% and 1% levels respectively

Source: Field Survey, 2023

3.7 Production function analysis

The analysis conducted on rice production in the study area utilized the Cobb Douglas Production Function (CDPF). The coefficient of multiple determinations (R^2) was found to be 0.78, indicating that 78% of the variations in the dependent variable could be explained by the included explanatory variables. However, a 100% rise in labor cost resulted in a 49% increase in total income from rice production, a statistically significant effect at the 1% level. Additionally, a 100% increase in tillage cost led to a 7% increase in total income, significant at the 5% level. Similarly, a 100% increase in the costs of farmyard manure (FYM) led to 0.9% increase in total income and whereas in chemical fertilizer it was reverse as 100% increase in chemical fertilizer resulted in 0.9% decrease in total income. Moreover, a 100% increase in transportation cost led to a 23% increase in total income, a statistically significant effect at the 1% level. A VIF value ranging from 5 to 10 suggests a moderate correlation, whereas values exceeding 10 indicate a high, unacceptable correlation among the predictors in the model (James et al., 2013).

Table 15: Production function analysis of rice Production

Explanatory variables	Coefficient	Standard error	t value	P value	Tolerance	VIF
Seed cost	0.076	0.043	1.744	0.084*	0.536	1.867
Labor cost	0.49	0.056	8.72	0.000***	0.435	2.297
Tillage cost	0.07	0.026	2.56	0.012**	0.606	1.651
FYM	0.009	0.009	0.988	0.325	0.641	4.561
Chemical Fertilizer	-0.009	0.018	-0.491	0.625	0.772	1.295
Pesticide Cost	0.078	0.028	2.729	0.007***	0.654	1.53
Transportation Cost	0.236	0.045	5.215	0.000***	0.582	1.718
Constant	3.447	0.339	10.156	0.000***		
R2	0.781					
Adjusted R2	0.767					
F-value	59.471					
Returns to scale	0.95					

Source: Field Survey, 2023

Note. *, ** and *** indicate significance at 10%, 5% and 1% level respectively

3.8 Return to scale analysis

From the regression analysis of Cobb Douglas Production Function (CDPF) the sum of coefficient was computed to be 0.95 which signifies the decreasing return to scale in production of rice in the study area. It was estimated that diminishing returns seem to prevail in predominantly paddy areas (Bardhan, 1973). This means if we double the cost of variable factors, income will be increased by less than doubled.

3.9 Marketing channels

The study delves into the intricate web of marketing channels employed in the agricultural sector, shedding light on the diverse pathways through which agricultural products reach consumers. Among the surveyed options, the most prevalent marketing channel identified was the "Producer-collector-mills-consumers" route, accounting for a substantial 33.6% of the total responses. Following closely behind, the "Producer-collector- wholesaler-mills-consumer" channel was chosen by 21.6% of the respondents. This pathway integrates wholesalers into the process, indicating a more complex yet common route to market. Additionally, a noteworthy 16.8% of the participants opted for the "Producer-local level collector-consumer" channel, highlighting the significance of local intermediaries in the marketing process.

Moreover, the "Producer-local level collector-mills-consumer" approach, chosen by 19.2% of respondents, showcases a blend of local intermediaries and mills in the marketing chain. This hybrid model suggests a nuanced strategy wherein producers utilize both local collectors and larger mills to reach the end consumers effectively. Furthermore, 8.8% of participants preferred the straightforward "Producer-consumer" channel, indicating a preference for direct sales without the involvement of intermediaries.

Table 16: Marketing channel in study area

Marketing Channels	Frequency
Producer-collector-mills-consumers	42 (33.6)
Producer-collector-wholesaler-mills-consumer	27 (21.6)
Producer-local level collector-consumer	21 (16.8)
Producer-local level collector-mills-consumer	24 (19.2)
Producer-consumer	11 (8.8)
Total	125 (100)

Figures in parentheses indicates percentage

Source: Field Survey, 2023

3.10 Production problems of rice grower

In the surveyed region, farmers encountered various challenges related to agricultural production. To understand these issues from the farmers' perspective, a ranking of problems was conducted. The results indicated that the most significant problem in production was the insufficient availability of fertilizers in the necessary quantity and at the right time. This was closely followed by the incidence of disease and pests and the unavailability of quality seed, among other issues, as illustrated in the table below.

Table 17: Problems of rice production

Problems	Index	Rank
Lack of availability of fertilizers	0.962	I
Incidence of disease and insects/pests	0.817	II
Lack of availability of quality seed	0.789	III
Lack of availability of labour	0.715	IV
Lack of proper irrigation and drainage	0.428	V

Source: Field Survey,2023

4. Summary

The research titled " AN ANALYSIS ON PRODUCTION ECONOMICS OF RICE IN THE RICE ZONE OF PARBAT DISTRICT OF NEPAL " was conducted to analyze the production methods and economic aspects associated with rice cultivation. The study focused on farmers in Kushma municipality, Paiyu rural municipality, and Bihadi rural municipality in Parbat district, sampling 125 farmers through a simple random sampling technique. Data was collected via household surveys, semi-structured questionnaires, Focused Group Discussions (FGDs), Key Informant Interviews (KII), and other secondary sources. The farmers were categorized into small and large-scale holders based on their average rice cultivation land. The study revealed that 60% of respondents were male and 40% were female, with agriculture being their primary occupation. The average age of respondents was 49.27 years, and they cultivated an average area of 6.08 ropani under rice. Most respondents were literate (78%), and irrigation sources included rainwater (25.6%), underground water (9.6%), rainfed (28.8%), and river/dam (28.8%). Common fertilizers used were FYM, urea, DAP, and potash. Labor, seed, tillage, FYM, chemical fertilizers, and pesticides were the major inputs for rice production. The total production cost was NPR 12,188.79 per ropani, with an average production of 1177.44 kg and productivity of 217.96 kg/ropani. Small-scale farms incurred a production cost of NPR 14,805.92 per ropani, and large-scale farms incurred NPR 7016.86 per ropani. Small farms generated NPR 21,849.24 per ropani, while large farms earned NPR 11,271.40 per ropani. The total gross margin per ropani was NPR 6106.29, with a significant difference between large and small-scale farms. The benefit-cost ratio was 1.5, indicating profitability. The Cobb Douglas production function analysis revealed that 78.1% of income variations could be explained by the included variables. There were positive significant relationships between total income and labor, tillage, pesticide, and transportation costs at different levels of significance. The study indicated a decreasing return to scale (0.95), suggesting potential for increased production and income if input management and production and marketing challenges are effectively addressed.

5. Conclusion

In conclusion, the research conducted in the rice zone of Parbat district, Nepal, sheds light on the production practices and economic aspects of rice cultivation. With a majority of the respondents engaged in agriculture, and a significant proportion being literate, the foundations for improved practices and knowledge dissemination are evident. The cost of production was found to be economically viable, with a benefit-cost ratio of 1.5, indicating the profitability of rice cultivation. The research also revealed that the total income from rice production was significantly related to various cost components, including labor, tillage, pesticides, and transportation. Major constraint of rice production was found to be the unavailability of the fertilizers followed by incidence of disease and insects with the least constraint of proper irrigation and drainage. Furthermore, the analysis of the production function demonstrated a decreasing return to scale (0.95), suggesting that increasing investment might not yield proportionate returns.

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