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RESEARCH ARTICLE

PROFITABILITY AND RESOURCE USE EFFICIENCY ANALYSIS OF POTATO CULTIVATION IN DOTI DISTRICT OF NEPAL

Bibek Gautam[a], Sushma Adhikari[b], Shreeja Acharya[c]

[a]Caritas Nepal
[b]Himalayan College of Agriculture Science and Technology, Kathmandu Nepal
[c]Agriculture and Forestry University, Chitwan Nepal
**Corresponding Author Email: gautam53.bg@gmail.com*

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ABSTRACT

A study entitled "Profitability and Resource use efficiency analysis of potato cultivation in Doti district of Nepal" was conducted on Bogtan and Jorayal RM of Doti on March April 2023 with an objective to access the profitability and resource use status in Potato production. 100 farming HH were randomly selected and interviewed using structured questionnaire. Data analysis was using SPSS and Microsoft excel to identify the BC ratio and resource use efficiency using Cobb Douglas production function. It was observed that potato production is Profitable in the study area with average yield of 446.02 Kg per kattha providing gross return of NRs. 13607.60 per kattha which statistically similar in both RM. Net return (NRs 2851.4) and BC ratio (1.25) by farmers of Jorayal is statistically par at 5% and 1% level of confidence in compared to Net return (NRs. 1875.59) and BC ratio (1.15) enjoyed by farmers of Bogtan. On production function analysis it was revealed that Cost of FYM in both Jorayal (0.24) and Bogtan (0.31) and Cost of total labor in Bogtan (0.39) was significant at 1% Confidence level. Similarly Cost of seed in Bogtan (0.33), Cost of Pesticide in Jorayal (0.12) and total cost of labor in Jorayal (0.20) was significant at 5% level of confidence, while Cost of seed (0.28) in Jorayal was significant at 10% level of Confidence. Efficiency ratios indicated that cost of seed in Bogtan (12.01) and Jorayal (10.61), Cost of FYM in Bogtan (11.33) and Jorayal (9.21), Cost of pesticide in Bogtan (1.98) and Jorayal (5.58), and labor in Bogtan (13.24) and Jorayal (7.20), while cost of land preparation and planting in Bogtan (4.46) were higher than 1 suggesting was underutilizing these resources while cost of land preparation and planting (-1.02) was overused in Jorayal. Therefore the findings suggests that number of factors, such as inadequate training and capacity building, traditional management techniques, a lack of investment in capital or technology, had led to underutilization of resources which must be addressed for optimal production and Income.

KEYWORDS

Profitability, Resource use Efficiency, Cobb Douglas, Production function

1. INTRODUCTION

Potato is the third most important food crop in the world after rice and wheat in terms of human consumption. Nepalese farmers have cultivated potatoes for 200 years and potato is one of the major food crops in the mid-and high-hills due to its highest dry matter per unit time and area (Timsina et al., 2011; Ojha et al., 2001). It is 5th most important crop in Nepal after rice, wheat, maize, and millet in terms of area and second in terms of production (MOALD, 2022). It is grown all over the country in the tropical climate of terai to high hills up to 4400 meters above sea level. In many places in hilly areas and high mountain areas, it is cultivated as the main crop and as a major vegetable crop in the Terai region (Khatri, 2016). In the year 2020/21 potato was cultivated in 198788 ha of an area that accounts for 6.43% of total agricultural land cultivated in Nepal. The total production of potatoes was 3325231 metric tons with a productivity of 16.72 metric tons per hectare (MOALD, 2022).

Since potato is one of the important crops to address food security and income of the farmers, potato production is subjected to many research questions on financial viability, cost attributes, resource allocation with the production, and so on. Although concerted efforts have been made to develop potatoes; still there are several constraints, such as lack of production and resource use-related research resulting in hindering the rapid expansion of production on a sustainable basis. (Phulara et al., 2021). Few research on economic analysis and the variables influencing the gross return of potato production in Nepal's Sudurpaschim province and Doti area. Lack of proper economic analysis results inability to adequately assess the financial sustainability of various crops and agricultural practices. This can result in low income levels, which can have far-reaching economic consequences. A more efficient use of resources and a reallocation of production options are required due to increasing pressure on water availability, commercialization of production, increased use of energy, and other bought inputs in agriculture (Rockström et al., 2003).

2. METHODOLOGY

2.1 Site Selection

The research was conducted on Doti district of western Nepal. Bogtan Phudsil Rural Municipality and Jorayal Rural Municipality of Doti were selected as the study area due to major potato production areas of Doti district. Climate of the study area is of subtropical nature favoring potato production once a year.

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2.2 Sample Size

50 potato producer farmers from each rural municipality are selected randomly. Altogether 100 households were taken randomly as sample. Face to Face interview was conducted using semi structured questionnaire in March 2023. Data on resources used and Cost incurred in potato production was collected during survey. Key informants interview was conducted with Agriculture Department of Rural Municipality to validate the information collected from survey. The secondary data was accessed through different textbook, article, annual report from agriculture office in Sudurpaschim province, Department of Agriculture (DOA)/Vegetable Development Division (VDD), Trade and Export Promotion Centre (TEPC), Agriculture Knowledge center Doti. Likewise, required data were also collected from Agriculture Enterprise Centre (AEC), and Nepal Agriculture Research Council (NARC).

2.3 Data Analysis

Collected information was coded and entered on Microsoft excel and SPSS. Data analysis was done through Microsoft excel and SPSS to make the comparisons and conclude the results.

2.3.1 Cost Of Production And Return

Total Variable cost incurred during production is assessed by summing all the variable cost associated with the potato production practice. Similarly gross return and Net return will be calculated using formula:

Total Revenue (Gross Return) =P x Qd

Where, p= price of good and service

Qd= number of unit sold

Net Revenue= Total Revenue – Total Expenses

2.3.2 Benefit Cost Ration Analysis

Benefit Cost Ratio was measured using the formula:

$$\text{BC Ratio} = \frac{\text{Total Gross Return}}{\text{Total Variable Cost}}$$

2.3.3 Cobb Douglas Production Function

The Cobb Douglas production function was used to analyze the effect of different inputs i.e. independent variables in the output or dependent variable i.e. total gross income. Following formula was used to calculate the resource use efficiency:

$Y=a\ X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}\ e^u$

Y= Gross Income from Potato per Kattha

a= Constant

X_1= Cost of Land Preparation and Planting

X_2= Cost of Seed tuber

X_3= Cost of FYM

X_4= Cost of Pesticides

X_5= Cost of Labor (Intercultural Operation, Pesticide Spray, Harvesting and Post-harvest operation)

e^u = error term

The above equation was then linearized

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

Where, ln= Natural Logarithm, a= Constant and μ= error term

The return of scale can be calculated on potato production, coefficient from linearized cobb-Douglas production function was used and calculated by summing coefficient of all explanatory variables.

The calculation of resource use efficiency can be calculated by the ratio of Marginal Value Product (MVP) and Marginal Factor Cost (MFC).

r = MVP/ MFC

where, r = efficiency ratio

MVP = Marginal Value Productivity

MFC = Marginal Factor Cost

The value of efficiency ratio can be interpreted as:

a) If R < 1, it means that resources are over utilized

b) If R > 1, it means that resources are underutilized.

c) If R = 1, it means that the resource was being efficiently utilized

3. Results and Discussion

3.1 Cost of Potato Production per Kattha

Table 1: Total average Cost of Potato Production in study area.

Mean Variable Cost of Production (NRs)	Jorayal	Bogtan	Overall	Mean difference	t value	p-value
Land Preparation and Planting Cost	1218.00	1315.8	1266.90	97.80	-1.50	0.06*
Seed tuber	2426.6	2417.76	2422.18	8.84	0.07	0.46
FYM	2360	2508.80	2434.40	148.80	-0.79	0.21
Labor in Intercultural Operation	1324	1312.40	1318.20	11.60	0.12	0.45
Pesticides	742	875.25	808.63	133.25	-1.67	0.04**
Labor Pesticide application	1870	1579.30	1724.65	290.70	1.59	0.05*
Harvesting and Post-Harvest Operations	1282	1256.30	1269.15	25.70	0.32	0.37
Total Cost of Production (NRs.)	11223	11265.6	11244.11	43.01	-0.08	0.46

***, ** and * indicates significance at 1%, 5% and 10% level of significance

The study revealed that farmers in the Doti District incurred an average cost of NRs 11,244.11 per kattha, or around NRs 244,882.2 per hectare in Potato cultivation which is similar to previous findings by (Sapkota et al., 2019; Shrestha et al., 2022). Additionally, it was found that Jorayal's farmers spend an average of NRs 11,223, which is NRs 43.01 less than Bogtan's farmers (NRs. 11265.6) but the difference is not statistically significant.

It was observed that Cost of land preparation and Planting, Cost of pesticide and Cost incurred on labor for pesticide application was statistically different in two study area on 10%, 5% and 10% level of significance respectively. The higher land preparation cost incurred by farmers in Bogtan (NRs. 1315.8) was due to factors such as difficult terrain and utilization of manual and animal power which is comparatively more time-consuming. Similarly, In case of cost of pesticide, farmers of Bogtan incurred a higher cost (NRs. 875.25) due to high average per unit cost of pesticide in Bogtan due to its distance from nearby large market but in contradict, labor cost incurred in pesticide application in Jorayal (NRs. 1870) was high in compared to Bogtan (NRs.1579.30) at a 10% level of

significance. The elevated pesticide usage quantity and high per unit labor cost led to higher costs for Jorayal' s farmers.

3.2 Return From Potato Enterprise

Economic Indicator of potato Cultivation	Jorayal	Bogtan	Overall	Mean difference	t value	p value
Average yield (Kg per Kattha)	454	438.04	446.02	15.96	0.64	0.26
Gross Return (NRs.)	14074	13141.2	13607.6	932.8	1.22	0.11
Net Return (NRs)	2851.4	1875.59	2363.49	975.81	2.31	0.01**
B:C Ratio	1.25	1.15	1.20	0.09	2.75	0.00***

***, ** and * indicates significance at 1%, 5% and 10% level of significance respectively

On Data analysis it was observed that potato production enterprise is Profitable in the study area. It was observed that an average yield on study area was 446.02 Kg per kattha (approx. 8920.40 kg per hector) which is similar to findings of providing gross return of NRs. 13607.60 per kattha which is slightly higher than findings of and lower than findings of (Bajracharya and Sapkota, 2017; Phulara et al., 2021; Subedi et al., 2019). In case of Gross Return Farmers in Bogtan enjoyed a gross return of NRs. 13141.2 per kattha, while farmers in Jorayal enjoyed NRs. 14074 per kattha, but the difference statistically non-significant. The high gross return in Jorayal was due to higher production quantity and higher per unit selling price of Potato in compared to Bogtan. In case of Net Return farmers of Jorayal earned NRs 2851.4 which is statistically par at 5% level of significance in compared to Net return enjoyed by farmers of Bogtan (NRs. 1875.59).

The overall mean Benefit Cost Ratio (B: C) for the study area was 1.20, which is consistent with the findings of previous studies of (Sapkota et al., 2019; Chauhan et al., 2022). This indicates that for every NRs. 1 spent on potato production, there is a return of NRs. 1.20 in gross revenue. The B: C ratio was found to be higher in Jorayal (1.25) than in Bogtan (1.15) at 1% level of significance, suggesting that potato cultivation is more economically beneficial in Jorayal than in Bogtan.

3.3 Production Function Analysis And Resource Use Efficiency

Variables	Jorayal			Bogtan		
	Coefficients	Standard Error	t Stat	Coefficients	Standard Error	t Stat
Constant	1.39***	0.4	3.5	0.07	0.55	0.12
Cost of Land Preparation and Planting	-0.02	0.09	-0.28	0.11	0.11	1.04
Cost of Seed	0.28*	0.14	1.97	0.33**	0.12	2.68
Cost of FYM	0.24***	0.08	2.93	0.31***	0.08	3.67
Cost of Pesticide	0.12**	0.05	2.66	0.05	0.06	0.82
Cost of Total Labor	0.20**	0.08	2.47	0.39***	0.11	3.42
R Square	0.87			0.63		
Adjusted R Square	0.86			0.58		
F value	59.87***			14.68***		
Returns to Scale	0.82			1.18		

***, ** and * indicates significance at 1%, 5% and 10% level of significance respectively

On analyzing the relation between costs of inputs applied and gross return at Jorayal and Bogtan it was observed that the regression equation was stable, with F-value of 59.87 and 14.68 respectively and significant at the 1% level of significance. Additionally, the coefficient of multiple determination, R-squared (R^2), was found to be 0.87 and 0.63 for Jorayal and Bogtan respectively, meaning that the explanatory variables included in the model could account for 87% and 63% of the variance in the gross income from potato production.

In Jorayal, four of the five factors had a statistically significant impact on the gross income from potato production. Cost of the pesticide and the total amount of labor used were significant at the 5% level of significance, the cost of farmyard manure (FYM) was determined to be significant at the 1% and cost of seed at 10% level of significance. This implies that per 10% increase in cost of seed will increase the gross revenue by 28%. Surprisingly, the investigation also showed that the expense of planting and preparing soil has a negative impact on the revenue from potato production. In an instance the gross revenue from potato cultivation declines by 2% for every 1% rise in land preparation costs. Similarly, In case of Bogtan, Cost of farmyard manure (FYM), cost of total labor utilized were both found to be significant at the 1% level, while cost of seed was also found to have a impact at the 5% level of significance. Similar results on relation of different production variables on gross income was observed by (Sujan et al., 2017; Dahal and Rijal, 2019).

Variables	Jorayal						Bogtan					
	GM	Coefficient	MVP	MFC	r	D value	GM	Coefficient	MVP	MFC	r	D value
Cost of Land Preparation	3.07	-0.02	-1.02	1	-1.02	198.37	3.1	0.11	4.46	1	4.46	77.56
Cost of Seed	3.37	0.28	10.61	1	10.61	90.58	3.37	0.33	12.01	1	12.01	91.68
Cost of FYM	3.31	0.24	9.21	1	9.21	89.14	3.37	0.31	11.33	1	11.33	91.17
Cost of Pesticide	2.79	0.12	5.58	1	5.58	82.07	2.88	0.05	1.98	1	1.98	49.56
Cost of Total Labor	3.62	0.2	7.2	1	7.2	86.12	3.6	0.39	13.24	1	13.24	92.45

GM= Geometric Mean, MVP= Marginal Value Product, MFC= Marginal Factor product,

The results on efficiency of input use in potato production indicated that efficiency ratios of cost of seed (10.61), FYM (9.21), pesticide (5.58), and labor (7.20), were higher than 1. This suggests that the production of potatoes was underutilizing these resources. The cost of land preparation and planting, had an efficiency ratio of -1.02, showing excessive use of this resource. The study suggests raising the price of labor, FYM, insecticide, and seed, respectively, by 90.58%, 89.14%, 81.07%, and 86.07%, can be enhanced up to recommended level and 198.37% reduction in the cost of land preparation to obtain optimal return. In case of Bogtan, all of the factors under study cost of preparing the ground for planting (4.46), cost of seed (12.01), cost of farmyard waste (9.21), cost of pesticide (1.98) and cost of labor (13.24) had efficiency ratios greater than 1. This suggests that

during the production process, these resources were not fully exploited. Similar results of resource use inefficiency was also reported (Sapkota, 2017; Phulara et al., 2021).

4. Conclusion and Recommendation

An analysis of total costs and benefits in potato production incurred in Doti district unveils that farmers incur an average cost of NRs 11,244.11 and average gross return of NRs. 13,607.60 per kattha at favorable benefit-cost ratio of 1.20. In spite of profitable enterprise, resource use in potato production are not optimally utilized i.e. underutilization are observed commonly. A number of factors, such as inadequate training and capacity building, traditional management techniques, a lack of investment in capital or technology, or adverse market circumstances had lead to underutilization of resources and hence lower the production and Income. Therefore appropriate strategy should be adopted to develop capacity of producers in terms of technology and resource management. The best part of study area was FYM have replaced the chemical fertilizers use but considerations should be made on quality maintenance of FYM to increase its effectiveness. Land fragmentation and geography have been one of challenges for mechanization in potato production. It was observed that Importance of improved seed have been clear among respondents but needs to make easy access to seed suppliers. There is high need to dissemination of appropriate technical knowledge about the effective management of diseases and to adopt disease- resistant seed varieties and recommended cultural practices which will also support to lower the total cost by cutting off cost on pesticide and associated labor for pesticide application.

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