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ECONOMIC ANALYSIS OF POTATO PRODUCTION IN SINDHUPALCHOK DISTRICT

Bhim Prasad Acharya* and Arun GC
Himalayan College of Agricultural Sciences and Technology (HICAST), Kirtipur
Corresponding author: creativebhimsamir@gmail.com

ABSTRACT

Potato (Solanum tuberosum L.) is a major food crop which has a high contribution on food security as well as acts as a major source of income of Nepali farmers. It is also a major cash crop of Sindhupalchok district. To assess and analyze the economics of potato production in Sindhupalchok district, this study was conducted in two municipalities (Chautarasangachokgadi and Balephi RM) of Sindhupalchok, Nepal, where most of the farmers were involved in potato farming. Total 150 potato farmers were selected using simple random sampling technique. A semi-structured questionnaire was administered to collect the primary data. The result shows that the average production per household was 3,951Kg and 7,738.3Kg of Balephi and Chautarasangachokgadi Municipality, respectively. Moreover, the average productivity of potato was found to be 13,546.96 Kg/Ha with a statically significant yield gap between Chautarasangachokgadi (19,355.62 Kg/Ha) and Balephi Rural municipality (7,738.30 Kg/Ha). The average gross margin of potato was NRs. 12,737.8/ropani and the average benefit cost ratio was 1.68. The highest farm gate price was reported to be NRs. 23/Kg and highest selling price of retailer was reported to be NRs.35/Kg, where the average marketing margin was NRs.11/Kg. The study showed a statistical significant difference in variable costs between municipalities because of different level of input usage, particularly in the utilization of labor and fertilizer. According to the Cobb Douglas model, the coefficient of labor was negative while the coefficients for tractors, tubers, fertilizers, and manures were positive. The return to the scale was found to be 1.03, which means there was growing returns to scale. Findings revealed that timely unavailability of fertilizer, lack of irrigation facilities, pest problems and fragmented land holding were the major problems for the production of potato and access to national market , variation in climatic condition, fertile land and improving infrastructure were the major strength for potato production in study area.

Key words: Potato production, Productivity, BC ratio, Gross margin

INTRODUCTION

Potato is one of the important vegetable crops which is considered as major food crop in more than 100 countries and grown in more than 125 countries in the world (IYP,2008). The potato is native to the Peruvian-Bolivian Andes and is one of the world's main food crops. Potatoes are frequently served whole or mashed as a cooked vegetable and are also ground into potato flour, used in baking and as a thickener for sauces. The tubers are highly digestible and supply vitamin C, protein, thiamin, and niacin. After major cereals having global average per capita consumption of 33 kilograms per year; China and India being leading producer and consumer (IYP, 2008). In Nepal potato has been cultivated since 18th century (Ojha, Hidalgo, & Lama, 2001). The potato remained a relatively minor and unrecognized crop in Nepal for over 150 years, until the first official attempt to improve potato production in Nepal occurred in 1962 under a program sponsored jointly by Nepal and India. It is a noticeable food security and cash crop of high hills in Nepal, currently fourth to rice, wheat and Maize in importance as the largest consumed staple in the country (Timsina,Kafle & Sapkota, 2011). Though potato productivity has increased rapidly (by 43%) over the past 35 years in Nepal, it is still among the lowest in the world (ABPSD, 2008/2009).Potato cultivation is popular among smallholder farmers due to its wider adaptability, high yield potential and high demand and act as major source of food, income and employment to Nepalese and contributes about 6.57 and 2.17% in AGDP and GDP, respectively (MoALD, 2015).

Over the past few decades, potato has become the fastest growing staple crop in Nepal. It is considered as the major staple food crops and source of income for smallholder farmers in high mountain regions of Nepal (Timsina et al., 2011). Climatic diversity of the country permits year-round cropping of potato from plains (60 masl) to the mountains (4400 masl) (Timsina et al., 2011). By agro ecological region, out of the total area under potato crop, around 19% lies in the high hills/mountains, 43% in the mid-hills and remaining 38% in the Terai and Bhabar, occupies the fifth position in area coverage, second in total production and first in productivity among the food crops grown in the country (ABSPD, 2014). The larger share of its production is traded and consumed in major market centers in the cities such as Kathmandu, Chitwan, Biratnagar and Pokhara. Hills has fairly large share in total potato production (Timsina et al., 2011). According to (MoALD, 2019), important potato cultivation areas are Dolakha, Jhapa, Bara, Kavre, Morang, Ilam, and Jhapa districts and which were responsible for 40% of the total output.

In Nepal, potato production was ranked fifth in area (198788 Ha), second in production (3325231 Mt) and first in productivity (16.73 Mt/Ha) among the food crops grown in Nepal (MoALD, 2020). And according to latest data the average national productivity of potato of 2021 is (17.20 Mt/Ha) which is increased by 0.5 Mt/Ha (MoALD, 2021). In Sindhupalchok, the amount of potato production in 2020 was 55980 Mt in an area of 3,345 Ha with the productivity of 16.74 Mt/Ha (MoALD, 2021) and in 2021 the potato production was increased to 58,055 Mt in 3,415 Ha of land with the productivity of 17Mt/Ha which is less than the national average productivity. This study was conducted to assess the existing production practices, production, productivity, cost, income and benefit of potato production Sindhupalchok district.

METHODOLOGY

The study was carried out in the two municipalities of Sindhupalchok (Chautarasangachokgadi and Balephi RM) which were purposively selected. A total 150 potato farming households listed in Agriculture Knowledge Center were selected by sample random sampling method. The pre-tested interview schedule was administered to the respondent to collect the primary data on socio-demographic information, prevailing production practices, cost and return of production and others by carrying out the household survey. Similarly, to get the more information regarding the various aspects of potato production face to face interviews and Key Informant's Interviews (KII) with AKC officers, traders, input suppliers, consumers and financial service providers were conducted.

Two comprehensive Focus Group Discussions (FGDs) were conducted at each municipality/RM of the study area after completing the field survey with help of the checklist to verify the results obtained from household surveys. The secondary data were collected from various books, national reports, publications, reports of different INGOs, web, published articles, etc. The statistical packages for social science (SPSS) and Microsoft Excel were used for necessary qualitative and quantitative data analysis.

The benefit cost ratio, production, productivity, gross margin were calculated and analyzed. Similarly, Cobb-Douglas Production Function regression was carried out to find out the technological relationship between the factors used and gross revenue generated from potato production of study area. Gross margin of the producer for a particular enterprise is the difference between the gross revenue

earned and the total variable cost incurred (Gujrati, 2003). The gross margin was calculated by using following formula:

$$GM = \Sigma P_i Q_i - \Sigma C_j X_j$$

Where,

GM = Gross Margin, P_i = Unit price of product i, Q_i =Quantity produced of product i, C_j = per unit variable cost of input j, X_j = quantity of input used, $\Sigma P_i Q_i$ = Gross Return, $\Sigma C_j X_j$ = Variable cost

BCR ratio is the ratio of the benefits of a project or proposal, relative to its costs, both expressed in monetary terms (Hayes, 2020). Total variable cost of production and gross return from potato was used for benefit cost analysis as below:

$$B/C = \frac{Grossreturn}{Totalvariablecost}$$

The Cobb-Douglas production function is used for analyzing the resource used efficiency on potato cultivation. It is the most widely used model for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillon, 1969). It is a homogeneous function that provides a scale factor enabling one to measure the return to scale and to interpret the elasticity coefficients with relative ease (Beattie et al., 1985).The production function to be used is presented as:

$$Y = \alpha X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} X_4^{\beta 4} X_5^{\beta 5} X_6^{\beta 6} X_7^{\beta 7} X_8^{\beta 8} X_9^{\beta 9} e^{\mu}$$

The production function was converted to logarithmic form so that it could be solved by Ordinary Least Square (OLS) method i.e.

$$\ln Y = \ln \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \mu$$

Where,

Y = production ofpotato (Rs/Ha), X_1 = cost of seed tuber used (Rs/Ha), X_2 = Cost of land (Rs/Ha), X_3 = FYM cost (Rs/Ha), X_4 = NPK cost (Rs/Ha), X_5 = Pesticides cost (Rs/Ha), X_6 = Labour cost (Rs/Ha), μ = error term, α and β_1,…….β_6 = parameter to be estimated

For identifying major problems of production index was prepared based on response frequencies. Indexing is a technique to analyze respondent's perceptions

by using the scaling technique (Subedi et al., 2019). Production problems were ranked by using five point level of influence comprising most serious,serious, moderate, low and very low or no problem at all using scores of 1.00, 0.80, 0.60, 0.40 and 0.20 respectively. The formula given below was used to find the index for intesity of production problems faced by the producers. The priority index for ech variable was calculated by weighted average mean in order to draw valid conclusion and making responsible decision.

Index of influence is calculated by using following formula:

$$I_{inf} = \sum \frac{s_i f_i}{N}$$

Where,

I_{inf} = index of influence, Σ = summation, s_i =scale value, f_i = frequency of influence given by respondents, N = total number of respondent

Return to scale indicates the response of output for the proportional change in inputs of any production activity. It was obtained by summing up the regression coefficients of respective inputs from CPDF regression analysis.

1 Decision rule:

2 Return to scale >1: Increasing return to scale

3 Return to scale =1: Constant return to scale

4 Return to scale<1: Decreasing return to scale

RESULTS AND DISCUSSSION

Socio-demographic characteristics of the respondents

The study depicted the average age of respondents was 37.65 yrs. and among them 54.7 % were male and 45.3 % were female. Agriculture activity was the respondents' primary source of income of both municipalities' people. Among 150 respondents 47.3 % respondents have joint family and 52.7 % respondents were living in nuclear family. Most of the respondents 73.4 % of both municipalities have cemented house and 21.5 % of respondents have mud house. Among total respondents 68.7 % were literate and remaining 31.3 % were illiterate, which was less than the national literacy 71.14 % of Nepal (CBS, 2021). Majority of the

respondents were from Brahmin/Chhetri caste which is 61.3 % followed by Janajati 34 % and remaining 4.7 % were from Dalit community. In both municipalities household head were male headed 80.7 % and 19.3 % household were female headed. The average family size of each family was 5.59 in which 3.09 were active population and 2.33 people of family were involved in agriculture.

Social Capital

Majority of the respondent family income was from agriculture; 84 percent, 5.3 percent family income from government service, 4 percent family income from business, 2.7 percent family income from foreign income and remaining 4 percent family income was from labour work or other occupations.

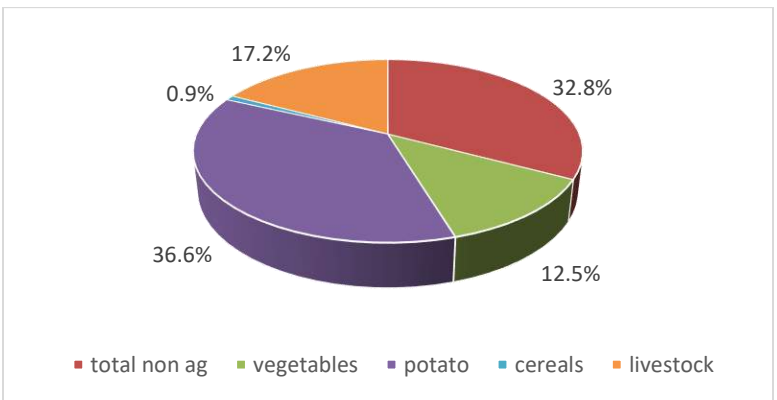

Figure 1. Distribution of household income of the study area

The average land holding of each family was 7.54 ropani (0.37 Ha.) and average area of land under potato cultivation was 4.93 ropani (0.25 Ha). The experience of growing potato of farmers on an average was 12.37 years. In study area most of the people were engaged in cooperatives/groups. During the study it was found that on average 70.7 % people were involve in cooperatives/groups in which from Balephi 44 % farmers were involve and from Chautarasangachokgadi 62 % farmers were involve. Among 150 farmers on an average 27 % borrow loan for potato cultivation in which 21% of Balephi and 33 % of Chautarasangachokgadi borrow loan. Overall the interest rate from institutional organization was 15.25% and non-institutional rate was 19.87 % in average in both municipalities.

Economics of Potato

Seed tubers, FYM, manure, chemical fertilizers, pesticides and labour were the major inputs used in potato production by the potato growers in study area. The quantity of different inputs used is significantly different between two municipalities. The result revealed that the average total cost of potato production was NRs. 329,637.27 /Ha. The average total cost of potato production in Balephi was significantly lower than in Chautarasangachokgadi and mean difference for average total cost between two municipalities were highly significant at 1% level of significance. Also, it was evident that the seed tuber cost was NRs. 83,379.60 in case of Chautarasangachokgadi and it was NRs. 74,538.17/Ha in case of Balephi. The cost for seed tubers was assigned as per the market price of potato as the farmers retained their own seed tubers for next season of cultivation while in case of Chautarasangachokgadi some farmers usually bought tubers from market. The mean difference of cost incurred in seed tuber was also highly significant between two municipalities. From the table it can be concluded that the major cost was incurred in labour wage in both municipalities. The labour cost was followed by manure cost, transportation cost, chemical fertilizers cost and land preparation respectively in Balephi while in Chautarasangachokgadi labour cost was followed by pesticides cost, FYM cost, NPK cost, transportation cost, land preparation and seed tubers respectively. Also, the mean differences of all categories of costs were highly significant between two municipalities. Due more amount of investment in Chaurasangachokgadi the cost was increased highly in comparison to Balephi. Hence the cost of inputs used was more in Chautarasangachokgadi. The comparative cost of potato production with location is shown below in Table 1.

The relative contribution of eight categories of cost incurred in potato cultivation was shown diagrammatically and it was found that labour cost have highest share in total cost accounting 29% of total average cost. This means huge amount of money was spent in labour. Similarly, about 24% cost was incurred for seed tuber, 13% in FYM, 11% in transportation of inputs and sold potatoes, 10% in pesticides, 9 % in NPK (chemical fertilizers), 3% in land preparation, and remaining 1% in other purpose. It was revealed that overall average production of potato was found to be 5,767.75 Kg/household. The average yield of potato was 951 Kg/ household of for Balephi which was significantly lower (at 1%) than that of Chautarasangachokgadi which was 6,384.5 Kg per household.Similarly, the yield (Kg potato tuber per Ha) was found 13546.96 Kg/Ha which was lower than national average productivity (17,204 Kg/Ha) of potato (MoALD, 2023).

Table 1. Cost components of potato production with location (NRs. per hectare) (2021)

Cost Components	Location			Mean Difference	t value	P value
	Overall	Chautara	Balephi			
Seed tuber	78958.89 (19332.3)	83379.60	74538.17	-8841.43***	-3.31	.001
Land preparation	10149.9 (9527.04)	15984.94	4314.86	11670.07***	10.95	.00
FYM	43915.41 (22429.74)	55874.68	31956.15	23918.53***	8.90	.00
Chemical fertilizer	27685.67 (23240.58)	45842.4	9528.93	36313.46***	17.73	.00
Pesticides	33436.98 (38629.37)	66873.97	0.00	66873.97***	24.57	.00
Labour	94408.40 (38749.59)	127296.19	61520.61	65775.58***	22.79	.00
Transportation	36973.69 (22818.02)	42361.6	31585.78	10775.82***	3.43	.00
Others	4108.33 (15385.31)	8016.67	200.00	7816.67***	3.71	.00
Total cost excluding HH labour	278383.37 (114040.82)	379142.45	177624.29	201518.15***	26.85	.00
Total cost including HH labour	329637.27 (120040.2)	436788.6	222485.94	214302.66***	28.21	.00

Note: Figures in parentheses indicates standard deviation. *** indicates the significant at 1% level.

The yield of potato in Balephi was 7,738.30Kg/Ha which is 44.97 percent less than national average while in Chautarasangachokgadi the yield was 19,355.62 Kg/Ha, 1.12 percent higher than national productivity. The mean difference of productivity between two municipalities was highly significant at 1% level.

Table 2. Production and yield of potato with location (2021)

Particulars	Location			Mean difference	t value	P value
	overall	Chautara	Balephi			
Production at HH level (Kg)	5167.75 (4082.16)	6384.50	3951	2433.50***	4.40	.00
Yield (kg/ha)	13546.96 (7141.52)	19355.62	7738.3	11617.32***	19.82	.00

The estimated values of coefficient and related statistics of Cobb-Douglas production function have been presented in table 3.The coefficient of NPK cost and pesticide cost were positive and significant at 1% level. The co-efficient tuber cost was negative and significant at 10% level and the coefficient of labour cost was also negative and significant at 1% level. Cost of manure application and land preparation had positive impact on the income of potato but the effects were not significant at desired level of significance.

The study revealed that an increase in 10% cost of NPK and chemical pesticides remaining other factors constant would increase the gross return of potato by 0.45% and 0.83% respectively (Haque, Miah, Hossain, & Rahman, 2012) also found positive and significant effect (1%) of NPK used in gross return of potato where the result showed that 10% increase in cost of NPK used increase the gross return of potato by 3.86%. Similarly, an increase in 10% cost of seed tuber and hired labour would decrease the gross return of potato by 1.4% and 0.28% respectively. The value of the co-efficient of multiple determination (R^2) of the model was 0.82 indicating about 82.1 percent of the variation in gross return of potato production were explained by the explanatory variables included in the model. The overall F value was 143.82 and it was statistically highly significant at 1% level of significant. This indicates that the explanatory variable included in the model were important for the explanation of variations in gross returns of potato. Similarly, on an average benefit cost ratio (B: C) from the potato was 1.68. The B:C ratio of potato obtained from this research was slightly lower than the B:C ratio (2.9) obtained by Timsina, Kafle and Sapkota (2011) in Taplejung district while the result was higher than the B:C ratio (1.44) obtained by Bajracharya and Sapkota (2017) in Baglung district. B: C ratio was found highest in Chautarasangachokgadi (1.89) followed by Balephi (1.46). The high B:C ratio in Chautarasanghachokgadi was accounted to high fertilizers, periodic pesticide application for pest control and proper crop management leading to high production per unit area in low cost.

Table 3. Estimated coefficients and their related statistics of production function for potato (2021)

Variables	Coefficients	Std. Error	T	P>|t|	Collinearity Statistics	
					Tolerance	VIF
LN cost of land preparation	0.08	0.05	1.64	0.10	0.34	2.96
LN tuber cost	-0.14*	0.08	-1.83	0.07	0.87	1.14
LN FYM cost	0.01	0.01	0.03	0.73	0.92	1.09
LN NPK cost	0.05***	0.01	5.3	0.00	0.66	1.52
LN pesticide cost	0.08***	0.01	12.37	0.00	0.25	4.05
LN labour cost	-0.03***	0.01	-4.91	0.00	0.72	1.39
(Constant)	13.31***	1.13	11.77	0.00		

Number of observations = 150
F (6, 188) = 143.82
Prob> F = 0.00
R- Squared = 0.82
Adj R- Squared = 0.82
Root MSE = 0.26
Return to scale: 1.03

Note: ***, ** and * indicate significant at 1%, 5% and 10% level, respectively.
From the above table we can develop the cobb Douglas model for potatoes as:

$$\ln Y = 13.34 + 0.084 \ln \text{cost of land preparation} - 0.148 \ln \textit{tuber cost} + 0.005 \ln \text{FYM} + 0.045 \ln \text{NPK cost} + 0.083 \ln \text{Pesticides} - 0.028 \ln \text{labour cost} + \mu$$

The return to scale of potato cultivation in study area was found to be 1.032 which signifies the increasing return to scale in production of potato in the study area. It means with increase in variables such as fertilizers, irrigation and human labor can increase the production and can get more return by utilizing optimum resources. The return to scale of potato in Saptari district of Nepal was found 1.85 (Mahatha, 2012), 0.82 in Baglung district (Bajracharya & Sapkota, 2017) and 0.32 in Nuwakot district (Dahal and Rijal , 2019).

In this study the average marketing margin and producer share of potato was calculated. Produce's share in consumer price was found higher that is 66.67 percent. And the average marketing margin was found Rs.11/Kg. In study area**,** the lack of chemical fertilizer was the main problems in the production of potato in study area and ranked I whereas the least problems among was problems of disease and insect pests. Altogether, five marketing channels were operated for marketing of potato throughout the study area had been identified. Those channels

have been presented hereunder which are found during the survey of the study area and market. Multiple handling up to five different handlers were found from the farm to the final consumers which affected the prices and quality of potatoes of study area. Most of the farmers in study area used Channel IV (Producers⇒Collectors⇒Wholesalers⇒ Retailers⇒Consumers) (70.2%) which was more costly and lengthy.

CONCLUSION

Economically, potato cultivation was found to be a profitable business to undertaken in Sindhupalchok. From the obtained benefit cost ratio, it can be concluded that it is more profitable to cultivate potato in large scale as compared to small scale. Gross margin showed that potato cultivation was profitable and best option for potato growing farmers. During the course of survey, it was observed that the farmers were facing many constraints which ultimately affected the cultivation of the potato production. Expensive labor has drastically increased the cost of production of potato in the Sindhupalchok district. Similarly, unavailability of fertilizers in timely, the insects like Potato tuber moth, red ant, white grub and the disease like late blight were prominent and caused huge loss in production. Due to the difficult land topography along with fragmented and small land holding of farmers had caused higher production cost. Mechanization in potato farming could help bring down the associated costs and increase benefits. Apart from this, ensure year-round irrigation, developing higher yielding varieties, supply farm inputs and quality seeds at required times can dramatically boost up the profits from potato farming in the district. It is concluded from the result of this study that potato is still a most profitable crop, which is helpful in income and employment generation and offering the food and nutritional security to the country. The constraints prevailing in the study area needs to be managed by Government, Department of Agriculture, local government and farming community itself, in order to offer a prominent place to the crop in the cropping pattern.

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