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Resource productivity analysis of maize production in Arghakhanchi District, Nepal

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Abstract
Mere availability of resources does not decide profitability of any enterprise but using them in judicious manner does. Increasing use of those resources that have significant effect on production and lowering the other with less contribution is the secret of success in production business. If profit is not attainable in any combination of resource management in particular socio-economic and bio-physical condition, it is always wise to move for next possible profitable enterprise. There is always a need of a study to reveal whether the factors of production are used in an economic way and to investigate whether the enterprise is profitable. This study was carried out to identify the profitability and productivity of maize production in Arghakhanchi district of Nepal. A total of 120 farmers, 60 each from two villages namely Wangla and Bhagwati, were randomly selected and interviewed using pre-tested, semi-structured interview schedule. Collected data was analyzed using descriptive statistics and Cobb-Douglas production function. The production function revealed that manual labor cost had significant effect on gross returns with magnitude of regression coefficient 0.823 whereas seed cost, nutrient cost and animal labor were found to be statistically non-significant. Sum of regression coefficient also revealed that production function exhibited decreasing returns to scale by 0.89. So, providing market information, training and extension services would increase resource productivity of maize production. Farmers can be motivated to shift from grain production to seed production for increasing profitability.

Keywords: return to scale, regression coefficient, Cobb-Douglas production function, benefit cost ratio

Introduction
Agriculture is considered as the most important component of Nepalese economy as it contributes 28.79% of Gross Domestic product (GDP) of the country. Above 65% of the population are involved in agriculture and 33.32% of the country's area is used for cultivation (AICC, 2016) [1]. However, there is still a trade deficit of NRs. 39,009,610 in cereal crop only (MOAD, 2015/16) [12]. Maize is the second most important crop of Nepal after rice in terms of both production and area under cultivation. The area under cultivation and total production of Maize is 891,583 hectare and 2,231,517 metric ton with productivity 2.503 tons per hectare (MOAD, 2015/16) [12].

The area under cultivation and total production of maize in Arghakhanchi district is 16,500 hectare and 49,335 metric ton which covers 2.21% and 1.85% of total production and area under cultivation of the country. Productivity of maize in Arghakhanchi district (2.99 ton per hectare) is greater than national average (2.503) (DADO, 2015/16) [7]. Agriculture of Nepal is mostly dependent upon seasonal monsoon rain, subsistence and mixed farming and majority of the farmers have small land holding (MOAD, Features of Nepalese Agriculture, 2015) [11]. In Nepal around 2,641,000 hectare of land is cultivable whereas only 1,392,177 hectare is irrigated so it is clear that almost half of its good land depends upon seasonal rain (MOAD, Statistical Information on Nepalese Agriculture, 2015/16) [11].

Use of improved variety increases cost of production at initial stage because of higher seed cost of improved seed and need of more fertilizer, irrigation, other inputs and care as compared to traditional variety but at the end because of high yield of improved variety, unit cost of production decreases (Anupama, Singh, & Kumar, 2005) [4]. Thus, seed type has significant effect on economic efficiency (Hasan, 2008) [10]. Well trained and genuine extension workers can have great contribution for enhancing production (Ali & Byerlee, 1991) [3] and agriculture training has been identified as a factor that has a positive impact on technical efficiency (Hasan, 2008) [10]. Accessible information, better extension service, education status, women involvement and facilitation of farmers to get credit would make the farming system technically more efficient (Bozoglu & Ceyhan, 2007) [6]. Organizing farmers through cooperatives and farmer groups could help farmers to get loans at minimum interest, buy inputs in bulk at cheaper price and reduce the transaction cost (Oladejo, A., ADETUNJI, &

M.O, 2012) [13]. Extension of modern technologies with adjustment on resource use should be encouraged to increase productivity and profit (Dhakal, Regmi, Thapa, Sah, & Khatri-Chhetri, 2015) [8].

Materials and Method

Study area and sampling design

Maize is the most important crop of mid-hills in terms of area and production as compared to other cereal crop. Arghakhanchi district is one of the major maize producing districts of the country so it was selected for the study. Two VDCs namely Wangla and Bhagawati were selected randomly. A total of 120 households, 60 households from each VDC, were selected by simple random sampling technique for the study.

Data Collection and Analysis

Primary data collection was done by household survey with farmers using semi-structured, pre-tested interview schedule. The collected information was supplemented and verified byfocus group discussions, key informant interviews and direct field observation. Different reports, books, journals and research articles were used for secondary data collection. The data was coded, entered and analyzed by using SPSS and MS-Excel software. The data was analyzed to gather relevant information by using descriptive statistics and Cobb-Douglas production function.

Cost and Return Analysis

Cost on seed, Cost on plant nutrients like organic manure and chemical fertilizer, animal labor costs and human labor costs were the variable costs of maize production taken into account in this study. Maize growers in the study area do not have access to irrigation and plant protection techniques so these costs are not considered in this study. Total variable cost was calculated by adding all these variable costs.

Total variable cost = $C_{seed} + C_{nutrient} + C_{animal\_labor} + C_{human\_labor}$

Where, C_{seed}= total cost on seed (NRs./ha), $C_{nutrient}$= cost on organic manure and chemical fertilizer(NRs./ha),C_{animal_labor} = cost on total animal labor(NRs./ha), C_{human_labor}= cost on human labor(NRs./ha).

And, a gross return was calculated by using following formula:

Gross returns = Total maize grain produce in kilogram × price of wheat grain per kilogram + equivalent amount of stover and cone of maize

Undiscounted benefit-cost ratio (BCR) was computed by following method as used by Sapkota *et al* (2017) [15].

$$\text{Benefit cost ratio (BCR)} = \frac{GrossReturns}{TotalVariableCost}$$

Gross margin was calculated by using formula as used by Olukosi, Isitor, & Ode (2006) [14]:

Gross Margin (NRs./ha) = Gross return (NRs./ha) – Total variable cost(NRs./ha)

Resource productivity analysis

Contribution and efficiency of different inputs on production can be clearly defined by Cobb-Douglas production function. Cobb-Douglas production function of following form was used to examine the resource productivity of different variable inputs.

$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}e^u$

Where, Y = Gross returns (NRs/ha, X_1 = Cost on seed (NRs./ha), X_2 = cost on plant nutrients (NRs./ha), X_3 = Cost on human labor (NRs./ha), X_4 = Cost on Animal labor (NRs./ha), e = base of natural logarithm, u = random disturbance term, a = constant, and b1, b2, b3 and b4 are coefficients of respective variables.

Results and Discussion

Cost of production

The average cost of maize production in the study area is presented in the Table I and Figure I given below. About 58.54% of the total variable cost, which wasestimated about NRs. 44,291.13 per hectare, was found to be contributed by human labor and it was the largest part of the maize production cost similar to Dhakal *et al* (2015) [8]. Sowing, harrowing, manure application, fertilizer application, weeding, earthingup, harvesting and threshing weremajor activities which required human labor. This indicates that maize production in the study area is labor intensive. The cost per hectare on animal labor was estimated to be NRs. 15,020 which accounted about 19.85% of the total variable cost. Animals are used for plowing as there is no availability of modern tillageequipment for farm mechanization in the study area. Cost on Nutrient per hectare was found to be NRs. 14,129.95 which represented 18.68% of the variable cost. Nutrient comprised of FYM, goat manure and some chemical fertilizers like urea, DAP and MOP while other micro nutrients used were almost nil. The cost per hectare on seed was NRs. 2,217.51 which accounted about 2.93% of total variable cost. The cost for irrigation and plant protection was nil in the study area as the farming system was rainfed and maize growers do not use any plant protection measures at all.

Table 1: Average Cost of Maize Production (NRs. /ha)

Parameters	Mean	Percentage
Seed	2217.51	2.93
Nutrient	14129.95	18.68
Animal Labour	15020	19.85
Human Labour	44291.13	58.54
Total	75658.59	100

Source: Field Survey, 2017

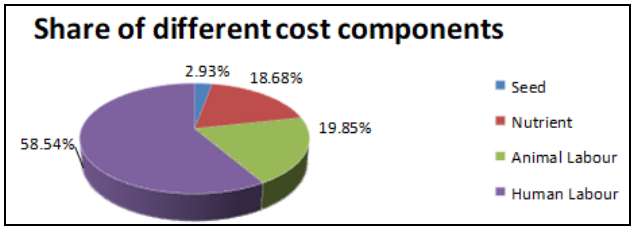

Fig 1: Share of different cost components to total variable cost

Returns from maize production

The average farm size under maize production was quite small. It was estimated about 0.26 hectares with average productivity of about 2.11 ton per hectare. The gate price of maize was NRs. 30 per kilogram. Gross return and total variable cost were estimated about NRs. 69,339.15 per hectare and NRs. 75,658.59 per hectare respectively. Gross margin of maize production was calculated at about NRs. – 6,319.44 per hectare. In gross returns, value of stovers and cones of maize were also taken in account as they have also economic value as these were being used for animal feed. The overall undiscounted benefit cost ratio considering total variable cost was 0.94.It indicates that the maize production is not profitable in the study area. The economics of maize production in the study area is presented in the table II:

Table 2: Economic statement of maize production in the study area

Measuring Criteria	Average Value
Area (ha)	0.26
Productivity (metric ton/ha)	2.11
Gate Price (NRs./kg)	30
Gross Returns (NRs./ha)	69,339.15
Total Variable Cost (NRs./ha)	75,658.59
Gross Margin (NRs./ha)	-6319.44
Benefit Cost Ratio	0.94

Source: Field Survey, 2017

Resource productivity analysis

The estimated values of coefficients and related statistics of Cobb-Douglas production function are shown in table III.

Table 3: Estimated value of coefficients and related statistics of Cobb-Douglas production function of maize production

Factors	Coefficient	Standard Error	t-value	p-value
Constant	1.697*	0.93	1.82	0.070
Seed Cost	0.018	0.051	0.36	0.722
Nutrient cost	-0.002	0.008	-0.26	0.795
Human labor cost	0.823***	0.079	10.33	0.000
Animal labor cost	-0.051	0.082	0.63	0.530
F-value	38.58			
R square	0.5730			
Adjusted R-square	0.5582			
Return to scale	0.89			

Source: Field Survey, 2017

Four different independent variables like seed cost, nutrient cost, human labor cost and animal labor cost were included in the regression analysis of which only human labor cost was found to be highly significant at 1% level of significance while other inputs were found non-significant similar to Anupama, Singh and Kumar (2005) [4] and Fasai (2006) [9]. The regression coefficient of human labor cost was estimated to be 0.823 which indicates that unit increase in human labor cost could increase gross returns by 0.823. The sum of regression coefficients of all the inputs taken into account turned out to be 0.89. It indicates that the production function exhibited in a decreasing return to scale. This implies that if all the inputs specified in the production function are increased by unity, the gross returns will increase by about 0.89.

Conclusion

The undiscounted benefit cost ratio 0.94 clearly shows maize production in Arghakhanchi district is not a profitable business. 58.54% of the total variable cost is contributed by human labor and 19.85% by animal labor which indicates maize production in the study area is labor intensive. Among seed cost, nutrient cost, human labor cost and animal labor cost only human labor cost was found statistically significant. Use of pesticides was nil and chemical fertilizer like urea, MOP and DAP was also negligible. Farmers should consider shifting from maize grain production to seed production as it is more profitable business (Sapkota, Joshi, & Bajracharya, 2017) [15]. Use of appropriate inputs(like plant protection measures and chemical fertilizers), effective participatory extension facility and more efforts from research institutions is recommended to get maximum results from the available resources (Akighir & Shabu, 2011).Mechanization in maize production would reduce production costs and drudgery in farm activities ultimately increasing resource productivity and profitability of maize production.

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