



# **Analysis of Socio-economic Factors and Profitability of Hybrid Maize Production in Eastern Terai of Nepal**

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## **Authors' contributions**

*This work was carried out in collaboration between all authors. Author SPA designed the study, collected the data, performed statistical analysis and drafted manuscript. Author KPS managed literature searches and edited the paper. Author SRS collected the data and edited paper. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The study was conducted to analyze the socioeconomic factors and profitability of hybrid maize production in eastern Nepal. A household survey was conducted from March to April, 2017 in two districts Morang and Sunsari to collect information on socioeconomic characteristics and economics of maize production. The Structured questionnaire was administered to 98 randomly selected households from two districts i.e. 41 from Morang and 57 from Sunsari district. Descriptive and statistical tools including multiple regression model were used to analyze the data. The multiple regression model showed that larger the maize area, higher the education of household head and households who received maize farming related training were significant and positive towards maize output. Farmers of Morang district have higher maize production than Sunsari district. The benefit-cost ratio (1.7) indicates that hybrid maize farming was profitable with productivity of 6.9 ton per hectare. Despite the importance of maize crop to household income, many constraints were reported in its productivity including lack of irrigation, a high cost of inputs and the incidence of pests and diseases. Ensuring access to irrigation, training on maize farming, mechanization and efficient extension services were recommended to increase hybrid maize production in eastern Nepal.

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## 1. INTRODUCTION

Maize is the second most important cereal crop in Nepal, after rice and is also the staple food for hills people [1]. It is cultivated in 900,288 hectares of land, which is about 29% of the total cultivated area of 3.09 million ha. The total production of maize is about 2.3 million tonnes. Its average productivity is 2.5t/ha [1]. The productivity of maize in the country is almost stagnant, while the demand for maize is increasing in Nepal because of the emerging poultry industry [2]. It is reported that the demand for maize has been growing by 5 % over the last decade [3]. In order to meet the growing demand for maize resulting from increasing population and expansion of feed industries in Nepal, maize production has to be significantly improved, so suitable areas for production and new varieties or improved varieties are required to meet this demand. However, the average productivity of maize in Nepal is less compared to neighbouring countries [4]. To increase the maize production and productivity, cultivation of hybrid maize is one of the best alternatives. A current market requirement of maize grains is partly fulfilled by growing hybrids in winter at terai and inner terai [5]. Hybrid maize after rice is being popular among the farmers of eastern terai.

Various factors are responsible with the low productivity of maize crop in Nepal. The slow and limited adoption of production related to the application of a lower level of fertilizers, inappropriate seed rate, and lack of irrigation facilities [6]. Socioeconomic characteristics of farmers are important factors influencing maize production. The most important variables included in this category are age, education, household size, farm size, livestock number, membership, training and extension contact. The increased yield in maize production in Nigeria was associated with an expanded land area. Furthermore, the study reported that the net return from maize production increased by 2.1 percent for every 10 percent improvement in extension services [7]. A study in Nigeria found that a 10 percent increase in membership of social organization increased net earnings from maize farming by 10.4 percent [7]. A study found that education, family size and farm size significantly influenced the profitability of farm products [8]. Olujenyó in 2008 reported that positive relationship between the total output of maize production and age, education, labor, non-

labor input cost and type of season and inverse relationship between the output of maize and farm size, years of experience and sex of respondents [9]. The study found that Maize farming was profitable in the study area with gross margin and net returns of N2637.80 and N2141.00 respectively [9]. Awotide et al. [10] also found that farm size, labor input and seed input influenced maize production. Olwande et al. [11] in Kenya reported that age, education, credit, distant to fertilizer market significantly influenced maize production by smallholder farmers. The main objective of this study was to determine the significant relationship between farmers' socioeconomic characteristics and maize output. While making a production decision, farmers consider costs of production and yield which ultimately affect the rate of adoption and sustainability of any crop. So, the profitability study on hybrid maize farming gives valuable information regarding farm management. Identification of socioeconomic factors that influence maize production is very important for policy makers, researchers and extension agents so that they can make appropriate planning and strategy to increase the hybrid maize productivity in eastern Nepal. Thus, this study aims to identify the profitability and socioeconomic factors that influence hybrid maize production in eastern Nepal.

## 2. METHODOLOGY

The data used in this study was based on the farm level study of hybrid maize farmers in Morang and Sunsari district, province no.1 of Nepal. The main crops cultivated in these districts are; paddy, maize, wheat, sugarcane, vegetables and potato. Major population depend on agricultural activities whether they are cultivating their own land and share cropping. Peoples also depending on wage labor, business, service and foreign services. These districts are the major hybrid maize production district in eastern Nepal. The study areas were selected purposively based on hybrid maize production and with the consultation of District Agriculture offices. Random sampling was used to select the households from two districts. 41 households from Morang and 57 households from Sunsari were selected randomly from the list of hybrid maize growers in the selected villages. A total of 98 households were surveyed from March to April 2017 for the study. A comprehensive and structured questionnaire was

used to collect data from hybrid maize growers. The data collection involved a household survey, using a structured questionnaire. Face to face interviews were conducted with 98 farmers to collect information on socio-economic information, farming practices, cost of cultivation, return from the maize crop and problems associated with hybrid maize production. In addition, key informants and focus group discussions were conducted in each location. After the data collection, it was coded and entered in excel and analyzed in STATA 15. Collected data were analyzed with descriptive and quantitative methods.

### 2.1 Multiple Regression Model

We use the multiple regression model to estimate the socioeconomic factors that influence hybrid maize production.

$\text{LnY} = f(\text{LnMaize area, LnTotal landholding, Education, Age, Family size, Training, Membership, District dummy})$

$$\text{LnProduction} = \alpha_0 + \beta_i X_i + e_i$$

Where;

LnProduction = Hybrid maize production (in natural log form)  
 $\alpha_0$  = Constant  
 $\beta_i$  = Coefficient  
 $X_i$  = Explanatory variables  
 $e_i$  = Error term

### 2.2 Analysis of the Profitability of Hybrid Maize Production

Profitability (net income) was estimated by deducting total cost from gross income.

$$\text{Net Income} = \text{Gross Income} - \text{Total Cost}$$

The gross income was calculated by multiplying the average yield with the price of the given product.  $\text{Gross Income} = \text{Yield of the Product} * \text{Price of the Product}$

$\text{Total cost} = \text{Cost on Tractor for tillage} + \text{seed cost} + \text{Planting cost} + \text{Chemical fertilizers cost} + \text{Farm Yard Manure cost} + \text{Cost on weeding} + \text{Cost on Pesticides} + \text{Cost on irrigation} + \text{Harvesting cost} + \text{Threshing cost}$

Benefit-cost ratio is the ratio of gross return and total variable cost.

$$\text{B/C ratio} = \text{Gross return (NRs.)} / \text{Total variable cost (NRs.)}$$

## 3. RESULTS AND DISCUSSION

### 3.1 Descriptive Statistics of Hybrid Maize Farmers

Descriptive statistics for the surveyed farmers are presented in Table 1. The average maize output was 6899 kg/ha, in which the productivity of Morang district was two times higher than the Sunsari district, which is also significant at 1% level. The average education of household head was statistically higher in Morang as compared to Sunsari. The average farm size of sample farmers was 0.98 ha, and 0.62 ha is allocated to hybrid maize production on the average. Both farm size and total maize area were higher in Morang district as compared to Sunsari. About 21% of farmers received hybrid maize related training, whereas about 26% of farmers were the member in the agricultural related organization. About 44% of farmers received training in Morang district, whereas, in Sunsari only 5% of farmers received training.

### 3.2 Identification of Socioeconomic Factors Influencing Hybrid Maize Output

This analysis focused on the identification of factors that determine hybrid maize production in eastern Nepal. A multiple regression model was adopted for the analysis. To achieve normality and homogeneity of the error term, the dependent variable production and independent variables total landholdings and maize area were transformed to log form. Based on the analysis, the coefficient of determination ( $R^2$ ) was 75%. This shows that about 75% of the variance in the maize output was influenced by the explanatory variables included in the model. The F- statistics (32.78) shows the stability of the overall regression equation and significant at 1% level. The Breush-Pagan test for heteroscedasticity showed a constant variance of error and model has no heteroscedasticity. The mean Variance Inflation Factor (VIF) was 1.81 and none of the variables had VIF higher than 2. It indicates that there was no multicollinearity between independent variables.

The regression coefficient of the maize area was positive and statistically significant related to maize production. Cultivation of large farm sizes makes it more economical for farmers to apply inputs and more commercialization of farm. This is similar with Feder et al. [12] that says farmers

with bigger land holding size are assumed to have the ability to purchase improved technologies and the capacity to bear the risk if the technology fails. Similarly, Julius and Nmadu in Nigeria found that maize cultivated area was significant and positively related to maize output [13].

The total landholding was positively signed but not statistically significant. The coefficient of education of household head was positive and statistically significant at 10% level. This indicates that educated farmers have more skills and knowledge about hybrid maize farming as

compared to less educated farmers. Education enhances the ability of decision makers by enabling the farmers to think critically and use information sources efficiently. Farmers with more education should be aware of more sources of information, and more efficient in evaluating and interpreting information about innovations than those with less education [14]. Similarly, Urassa, J. K. [15] in Tanzania also found that education level had statistically impact on maize yield. Education may reflect greater awareness of good farming practices, e.g. application of fertilizers, pesticides.

**Table 1. Socioeconomic characteristics of maize farmers**

Continuous Variables	Total (N=98)	Morang (N=41)	Sunsari (N=57)	t-value
Production (Kg/ha)	6899.00	9683.00	4897.00	0.00***
Age of the household head (years)	47.43	45.73	48.6	0.24
Education of household head (Years)	6.31	7.58	5.40	0.00***
Family size (Number)	5.81	6.24	5.5	0.02**
Total land (ha)	0.98	1.53	0.60	0.00***
Total Maize area (ha)	0.62	0.84	0.46	0.00***
Categorical variables				Chi <sup>2</sup> - value
Training (Yes =1)	21 (21.43)	18 (43.90)	3 (5.26)	0.00***
Membership (Yes =1)	26 (26.53)	9 (21.95)	17(29.82))	0.38

Source: Field survey, 2017

Note: \* significant at 10% level, \*\* significant at 5% and \*\*\* significant at 1%

**Table 2. Regression result of socio-economic factors that influence maize production**

Variables	Coefficient	Standard error	p- value
Maize area (ha)	2.17*	1.25	0.09
Total land (ha)	-0.04	0.04	0.35
Education of HH (Years)	0.01*	0.00	0.09
Age of HH (Years)	-0.00	0.00	0.22
Family members (No.)	0.00	0.02	0.82
Training received (1=Yes)	0.19**	0.07	0.01
Membership (1=Yes)	0.01	0.06	0.93
District (1=Morang)	0.59***	0.06	0.00
Constant	8.46***	0.15	0.00

**Other statistics**

Number of observation	98
R-square	0.75
Adjusted R- square	0.72
F value (8,89)	32.78
Heteroscedasticity	chi <sup>2</sup> (1) =1.03 prob > chi <sup>2</sup> = 0.31 (constant variance)
Variance Inflation factor (VIF)	1.81 (mean vif) : no muticollinearity
Model has no omitted variable (ovtest): F (3, 86)= 1.20 prob >F = 0.31	

Note: \* significant at 10% level, \*\* significant at 5% and \*\*\* significant at 1%

Regarding household characteristics, there were no statistically significant of age, family size and membership on yields of maize production. The coefficient of the training was positive and statistically significant at 5% level of significance. This implies that there is a positive relationship between training received and maize output. The dummy variable district is significant at 1% level of significance. The result showed that Morang district farmers produced 58.6% more production than Sunsari farmers in one hectare of land. This may be the reason that Morang district farmers were more educated, they cultivated maize in a larger area and they also received more training related to maize production.

### 3.3 Profitability Estimation of Maize Production

#### 3.3.1 Cost of production

Farmers expensed highest resources in human labor for hybrid maize production. It was required for different farm operations such as land preparation, seed planting, fertilizer application, weeding, threshing, transportation, cleaning etc. The cost of human labor in the production of maize per hectare was estimated about Nepalese Rupee (NRs.) 27050. Human labor cost accounted for about 32.5% of the total variable cost in maize production. It indicates that hybrid maize production required more labor. To reduce labor cost, there should be focused on mechanization in maize farming. Farmers expensed about 15% in tillage cost. In the study area, all the farmers used tractor for tillage operation. Farmers performed 2 to 4 tillage operations for maize production. For the reduction in tillage cost, there should be focused on resource conservation agriculture.

Per hectare cost of seed was about NRs. 12244 which constituted about 15% of the total cost. All of the surveyed households adopting hybrid maize seed imported from India. To substitute the import from India, Nepal should focus on hybrid maize development and its extension. Almost all the farmers used chemical fertilizers such as Urea, DAP (Di-Ammonium Phosphate), Potash. Some of the farmers in Morang district also used micronutrients like calcium, boron and sulfur for production. Farmers expensed about 19% of total cost for inorganic fertilizers. Farmers also used FYM for maize production which constituted about 5% of total cost. Per hectare costs of irrigation was about NRs. 4800, which accounted for about 6% of total cost. Almost all of the farmers used thresher for threshing maize grain. The average threshing cost per hectare was about NRs. 5000. Similarly, few farmers applied pesticide to their crops, which constituted about 2% of the total variable cost of production.

#### 3.4 Returns from Hybrid Maize Production

The table revealed that the gross margin analysis from maize production in eastern Nepal. Farmers in the study area were involved in hybrid maize farming on an average of 0.62 ha of land with per hectare production as 6899 kg. The farm gate price of maize was NRs. 20 per kg. The average per hectare, price of maize by-product is NRs.2600. The average gross return and total cost of maize production were NRs. 140600 and NRs. 83301 respectively. Per hectare gross margin of maize production was about NRs. 57299. The benefit-cost ratio (BCR) was found to be 1.69. This implies that the hybrid maize farming was highly profitable, therefore it has a significant contribution to the income of the farmers.

**Table 3. Average cost of production**

Items of cost	Mean	Percent of total cost
Seed (NRs./ha.)	12,244	14.69
Tillage (NRs./ha.)	12,288	14.75
Chemical Fertilizers (NRs./ha.)	15,910	19.01
FYM (NRs./ha.)	3,892	4.67
Human labour (NRs./ha)	27050	32.47
Pesticide cost (NRs./ha.)	1,987	2.39
Irrigation (NRs./ha.)	4,875	5.85
Threshing (NRs./ha.)	5,055	6.09
<b>Total cost (NRs./ha.)</b>	<b>83301</b>	<b>100.00</b>

Source: Field survey, 2017

**Table 4. Average return in maize production**

Measuring Criteria	Average value
Main product value (NRs./ha)	138000
By-product value (NRs./ha)	2600
Gross return (NRs/ha)	140600
Total cost (NRs/ha)	83301
Gross Margin (NRs/ha)	57299
BCR	1.69

Source: Field survey, 2017

### 3.5 Major Problems in Hybrid Maize Farming

Table 5 presents the problems associated with hybrid maize farming. Although hybrid maize was observed to be a profitable crop, there exist many problems. Farmers perceived that lack of irrigation was the major problem followed by high seed cost. About 38% of farmers faced irrigation constraints in maize farming. Similarly, high input cost, high labor cost, market-related problem and infestation of disease and pest were third, fourth, fifth and sixth problems respectively. Farmers considered high seed, inputs and labor costs as compared to grain prices. Dawait et al. [16] in Ethiopia also found high input cost in maize farming.

**Table 5. Problems associated with hybrid maize farming**

Problems	Frequency	Percent
Lack of Irrigation	38	38.77
Seed - related (High cost)	19	19.38
High input cost	14	14.29
High labor cost	14	14.29
Marketing problem	7	7.14
Disease, Insect	6	6.12
<b>Total</b>	<b>98</b>	<b>100.0</b>

### 4. CONCLUSION

This study was conducted to identify the profitability and socioeconomic factors that influence hybrid maize production in eastern Nepal. The multiple regression model showed that maize area, education of household head and training were the socioeconomic factors that influenced maize output in the study area. Morang districts' farmers produced 58.6% more than Sunsari districts' farmers because farmers of Morang district were more educated and number of farmers involved in hybrid maize farming training than Sunsari. The maize farming in the study area was profitable with benefit- cost

ratio of 1.69. Farmers faced the lack of irrigation was the major problem followed by high seed cost.

The finding suggests that a higher level of education level and training on hybrid maize farming could help to better production. Higher yield could be achieved through the larger area of maize farming through commercialization. Farmers expensed more than 32% in labor cost. The government could promote mechanization in maize farming to reduce the cost of cultivation. All of the farmers used hybrid maize imported from India, they expensed more than 15% in the seed of total cost of production. Nepal government should focus on hybrid maize variety development and its extension to substitute the import.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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