

## RESEARCH ARTICLE

## PROFITABILITY AND RESOURCE USE EFFICIENCY OF MAIZE PRODUCTION IN UDAYAPUR DISTRICT, NEPAL

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## ARTICLE DETAILS

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## ABSTRACT

The study entitled "Profitability and Resource Use Efficiency of Maize Production in Udayapur District, Nepal" analyzes the profitability and resource utilization efficiency of maize production in the region. Conducted in May 2023, it surveyed 80 farm households from Triyuga, Belaka, Katari, and Chaudhandigadhi municipalities. Data collection involved semi-structured questionnaires, Focus Group Discussions (FGD), and Key Informant Interviews (KII), using a clustered sampling technique. MS Excel and SPSS were used for analysis, with results presented through frequencies, percentages, and averages. Findings reveal that 77.5 percent of respondents primarily engage in agriculture. On average, 12.3 kattha of land is allocated to maize cultivation, yielding a net profit of 1780.0735 per kattha and a B/C ratio of 1.21. Costs of seed, fertilizer, and machinery significantly impact maize productivity at varying levels, with seed being the most influential factor. The study indicates a decreasing return to scale (0.881), suggesting inefficiency in resource allocation, particularly in labor. Efficiency ratios below 1 highlight excessive labor allocation, while resources like seed, machinery, and fertilizer are underutilized. To optimize resource allocation, reducing labor expenses by 74 percent while increasing expenditures on seed, fertilizer, and machinery by 98, 36, and 532 percent respectively is recommended. The prevalent practice of maize cultivation for self-consumption poses challenges in quantifying expenses, investments, and profits. Addressing these issues would contribute to enhancing the rural economy.

## KEYWORDS

Benefit Cost Ratio, Cobb-Douglas, SWOT analysis, Marketing channel, Production problem.

## 1. INTRODUCTION

Cereal grains, such as rice, wheat, maize, sorghum, and millets, have been a staple food for humans for thousands of years and have played a critical role in shaping human civilization. Cereals are the most important crops and the top three cereals like maize, rice and wheat together represent about 90% of all cereals produced in the world (FAO, 2017). Rice, wheat and maize are important food sources accounting for 94% of all cereal consumption (Ranum et al., 2014). According to World data Atlas in 2021, maize production for World was 1,210 million thousand ton. Its production increased from 308 million thousand ton in 1972 to 1,210 million thousand ton in 2021 growing at an average annual rate of 3.18%. Maize is primarily grown for grain and secondly for fodder and raw material for industrial processes. As of 2021, according to the Food and Agriculture Organization (FAO), the world area under maize cultivation was approximately 197 million hectares, with a total production of about 1.21 billion tonnes and an average productivity of 6.05 tonnes per hectare. The major maize producing countries in 2021 are United states of America, China, Brazil, Argentina and Ukraine (FAOSTAT, 2022). In 2020, maize yield for World was 58,786 hg per ha. According to World Data Atlas, maize yield of World increased from 26,867 hg per ha in 1972 to 58,786 tonnes per ha in 2021 Maize is a versatile crop with wide range of uses like it is a food for human beings and feed for livestock and used in various industries. Maize is a major source of animal feed for poultry,

cattle, pigs, and other livestock. It is used to produce a variety of food products, including maize meal, maize starch, maize oil, maize syrup, and snack foods such as pop-maize. It can be processed to produce biofuels, such as ethanol, which can be used as a fuel additive or as a standalone fuel. It is used in the production of various industrial products, such as adhesives and paints. Top 5 maize producing countries in Asia are China, India, Pakistan, Bangladesh and Nepal (FAO, 2021). According to FAO, Nepal was Ranked as the 5th top maize producing country in Asia with the production of 2,997,733 tonnes in 2021. It is reported that 80% of maize production in the Terai region is used for poultry and animal feed (Gurung et al., 2011). In contrast, in the hilly regions, more than 86% of maize production has been used for human consumption (Gurung et al., 2011). According to USDA, maize yield in Nepal was 3 tonnes per ha in 2020. The total production is accounted to be 43,714 mt in the cultivated area of 17,945 ha in Udayapur district (MOALD, 2020/2021). MOALD reports the average yield of Maize in Udayapur district is 2.44t/ha (In 2021, Maize imports for Nepal was 158,273 thousand US dollars. Maize imports of Nepal increased from 0 thousand US dollars in 1972 to 158,273 thousand US dollars in 2021 growing at an average annual rate of 331.27%(FAO,2021).

Top trading partners (import of "Maize (maize)") of Nepal in 2021:

- India with a share of 91% (144 million US\$)

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- Argentina with a share of 6.65% (10.5 million US\$)
- South Africa with a share of 1.11% (1.76 million US\$)
- Brazil - 610 thousand US\$
- USA - 413 thousand US\$
- Turkey - 251 thousand US\$
- Canada - 56 thousand US\$
- Thailand - 2.66 thousand US\$

- China - 770 US\$
- Colombia - 289 US\$

Source: Trend economy,2022

Nepal's export of maize (maize) in 2021 was valued at \$1.66 thousand. This is a relatively small amount, indicating that Nepal's maize exports are not a significant source of revenue for the country (2020/2021). Ministry of Commerce Trade and Supplies, 2021.

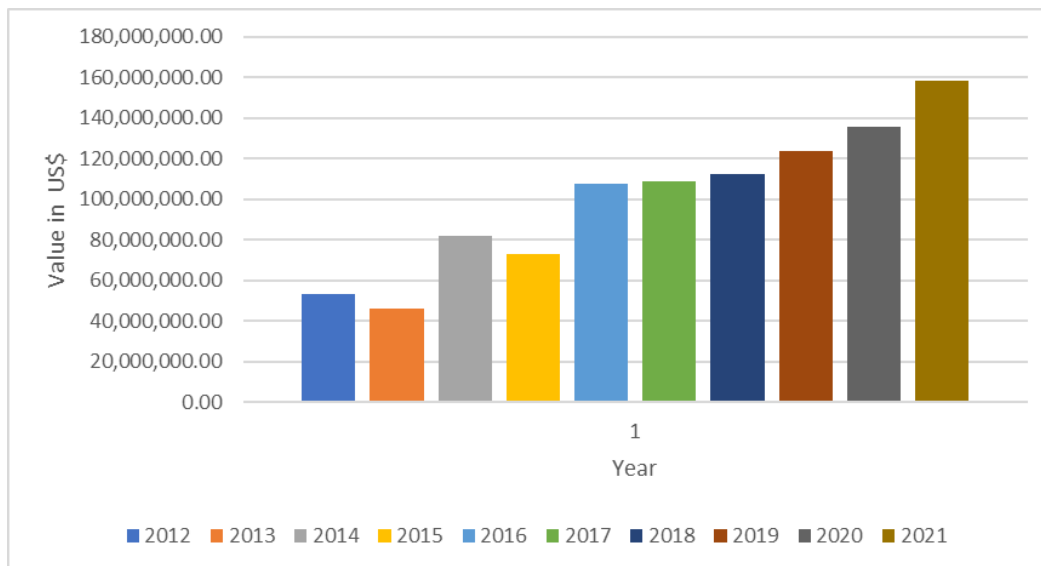


Figure 1: Import of maize in Nepal varied over different years (Source: Trend economy,2022)

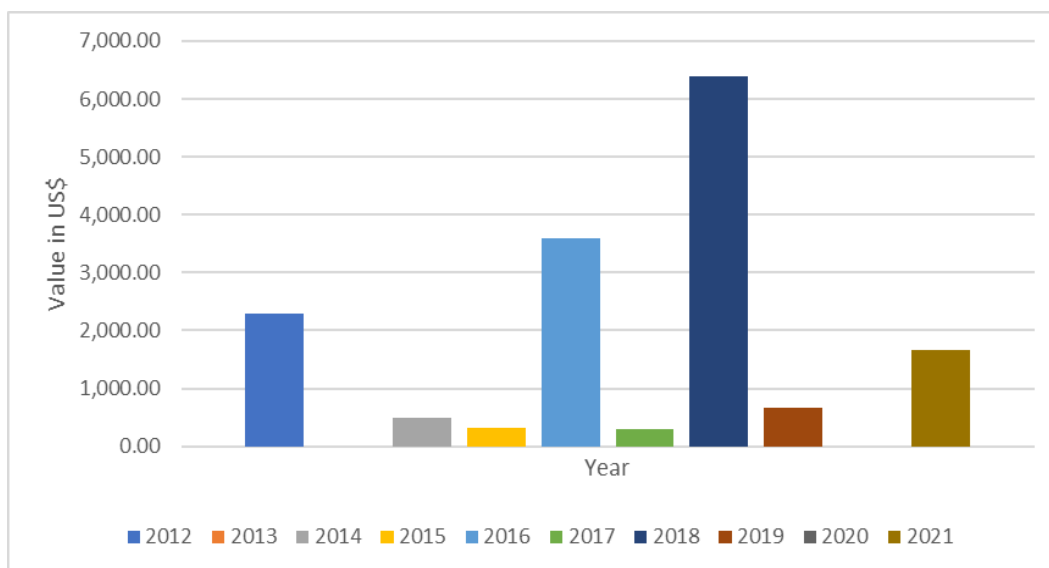


Figure 2: Export of maize from Nepal over different years (Source: Trend economy, 2022)

The production and productivity of maize have risen. According to data from the Food and Agriculture Organization (FAO), Nepal's maize production has been increasing over the years. In 2020, Nepal produced about 3.8 million tonnes of maize, which was a significant increase from the 3.1 million tonnes produced in 2010. Despite the increase in production, Nepal imports maize to meet the demand for poultry feed and other industrial uses. Nepal primarily produces maize for domestic consumption as it is an important staple food crop for many people in the country. Additionally, the country's agriculture sector is focused more on subsistence farming rather than commercial agriculture, which means that there is not a significant surplus of maize available for export. According to World data Atlas in 2020, Nepal exported about 700 thousand tonnes of maize. The data from the journal "Maize Research and Development 2015" published by the Ministry of Agriculture and Livestock Development suggests that the poultry industry in Nepal requires approximately 664,000 tonnes of feed annually, with maize being a major raw material for poultry feed production (Paudel, 2020). The

demand for maize in Nepal is increasing at a rate of 11% per year due to the growing demand for milk, meat, and meat products (Paudel, 2020). Nepal's domestic production of maize is generally enough to meet the country's total maize consumption. However, the demand for maize as a feed ingredient is not being fully met by domestic production, which has led to an increase in maize imports for animal feed.

## 2. STATEMENT OF PROBLEM

The production and productivity of maize have risen. According to data from the Food and Agriculture Organization (FAO), Nepal's maize production has been increasing over the years. In 2020, Nepal produced about 3.8 million tonnes of maize, which was a significant increase from the 3.1 million tonnes produced in 2010. Despite the increase in production, Nepal imports maize 2 to meet the demand for poultry feed and other industrial uses. Nepal primarily produces maize for domestic consumption as it is an important staple food crop for many people in the

country. Additionally, the country's agriculture sector is focused more on subsistence farming rather than commercial agriculture, which means that there is not a significant surplus of maize available for export. The data from the journal "Maize Research and Development 2015" published by the Ministry of Agriculture and Livestock Development suggests that the poultry industry in Nepal requires approximately 664,000 tonnes of feed annually, with maize being a major raw material for poultry feed production (Paudel, 2020). The demand for maize in Nepal is increasing at a rate of 11% per year due to the growing demand for milk, meat, and meat products (Paudel, 2020). Nepal's domestic production of maize is generally enough to meet the country's total maize consumption. However, the demand for maize as a feed ingredient is not being fully met by domestic production, which has led to an increase in maize imports for animal feed. Maize is a highly traded commodity, and its profitability depends on the ability of farmers to access markets and compete with other producers. The major hindrance in the marketing is the low seasonal price followed by lack of marketing knowledge whereas the unavailability of inputs and lack of technical knowledge were major constraints for the maize production (Dulal and Marahatta, 2020). Hence, this research aims to address the current information gaps in existing economics of maize and this research will explore the challenges faced by Maize industry. The study's findings can be utilized to enhance productivity, raise farmers' incomes, and encourage sustainable farming practices, with the ultimate aim of improving the livelihoods of Nepalese farmers who rely on maize cultivation for income.

### 3. OBJECTIVES

#### 3.1 General Objective

- The General Objective of this is to analyze profitability and resource use efficiency of Maize production in Udayapur district, Nepal.

#### 3.2 Specific Objectives

- To explore the socio-demographic characteristics of respondents.
- To study benefit cost ratio of maize.
- To analyze the resource use efficiency of maize production.
- To find out the marketing channels of maize.
- To carry out SWOT analysis and ranking of the problems related to production and marketing of maize.

### 4. METHODOLOGY

#### 4.1 Description of Study area

Udayapur District is one of 14 districts in Nepal's koshi province in the east. The district, with Triyuga as its district headquarters, covers an area of 2,063 km<sup>2</sup> (797 sq mi) and have overall population of 342,773 (CBS, 2021). Udayapur district is surrounded by Mahabharat hills from north and Shivalik from south, whereas both hills meet together by west which forms the region a valley of Udayapur. Udayapur valley is about 30 km (19 mi) long and from 2 to 4 km (1.2 to 2.5 mi) wide, it is drained by the Triyuga river flowing east to join the koshi river. Udayapur District is divided into total 8 local level bodies, 4 local level body categorized into Rular Municipality and 4 into Municipality.

#### 4.2 Site Selection

Four municipalities were chosen for the analysis and 3 wards were selected from each municipality as suitable sites for conducting the study. The site selection was based on the settlement patterns of farmers. Four Municipalities considered for the study on the basis of population are given below:

- Triyuga Municipality
- Chaudandigadhi Municipality
- Belaka Municipality
- Katari Municipality

#### 4.3 Sources of Data

##### 4.3.1 Primary Sources

Semi-Structured Questionnaire, In-depth interview with the farmers Focus Group Discussions (FGDs) and Key informant interview (KII).

##### 4.3.2 Secondary Sources

Books, journals, reports, online websites, and unpublished reports from various sources. Visited Various websites and collected publications from relevant organizations like AKC of Udayapur, Documents published by NARC, MOALD, CBS, HICAST, and CAIDMP. Latest information were taken from internet.

##### 4.3.3 Sample Size Determination

Total 80 samples were selected from 4 municipalities of Udayapur district. The sample size from each municipality was determined based on the population size.

size details for the study:

- Triyuga Municipality: **31**
- Katari Municipality: **18**
- Chaudhandhigadhi Municipality: **16**
- Belaka Municipality: **15**

Randomly chose 2 to 3 wards from each municipality, given that maize growers were distributed across various municipalities. Household survey was conducted among maize farmers using a personal interview schedule (PIS). Clustered sampling procedure was used to select respondents from the study area, encompassing quantitative aspects.

#### 4.4 Method and Technique of Data Analysis

The information obtained from the survey was coded and inputted into a computer. The available data was analyzed by inspecting, cleaning, transforming, and modeling it to discover valuable insights, support conclusions, and aid in decision-making. For the analysis, MS Excel and Statistical Package for Social Science (SPSS) version 21 were utilized, employing both descriptive and analytical tools. The analyzed data was subsequently presented using tables, graphs, and pie charts. The relationship between inputs and outputs in the production process was analyzed using the Cobb-Douglas production function, and resource use efficiency was calculated using the necessary formula.

##### 4.4.1 Variables

###### 4.4.1.1 Cost of production

Cost of production is the sum total of all the variables cost and fixed cost incurred during the production process (Ghimire et al., 2023).

Cost of production = Total Fixed Cost (TFC) + Total Variable Cost (TVC)

###### 4.4.1.2 Gross return

The total gross return was calculated by multiplying the quantity of maize produced (kg) with the average price of the maize. (Ghimire et al., 2023).

Gross return = Average production \* Average rate

###### 4.4.1.3 Net profit

Net profit, also called net earnings, net income is calculated by adding up a total expenses i.e. variable cost and fixed cost and subtracting that from its revenue.

Net profit = TR - (TFC + TVC)

Where,

TR = total revenue

TFC = total fixed cost

TVC = Total Variable Cost

###### 4.4.1.4 Gross margin

Gross margin was calculated by using the method as given by using following formula (Olukosi et al., 2006);

Gross Margin = Gross return - Total Variable cost

###### 4.4.1.5 B/C ratio

Benefit cost ratio is the ratio of gross income and total cost of production.

B/C ratio = Gross Return / Total Cost

The above mentioned equation for computing the Benefit-Cost Ratio (BCR) has been applied in the research conducted (Dhakal et al., 2015; Subedi et al., 2019)

#### 4.4.2 Production Function Analysis

The Cobb-Douglas production function was used in the study as it is mostly used in the agricultural research and is convenient for the comparison of the partial elasticity Coefficient. The following form of Cobb-Douglas production function was used to determine the contribution of different factors of production and to estimate the efficiency of the variable factors of production of Maize.

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}e^u \text{ (Yuan, 2011)}$$

Where,

Y=Gross income (Rs/Katha)

X1= Seed cost (Rs/Katha)

X2=Cost of fertilizer (Rs/Katha)

X3= Cost of labor (Rs/Katha)

X4=Cost of Machinery use (Rs/Katha)

U=Random Disturbance term and  $b_1, \dots, b_3$  are the coefficient to be estimated.

The Cobb-Douglas production function in the form expressed above was linearized in to a logarithmic function with a view of getting a form amenable to practical purposes as expresses below.

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + u$$

Where,

$\ln$ =Natural logarithm

a= constant

u=Error term

##### 4.4.2.1 Return to scale analysis

This is the measure of farm success in producing maximum output from a given set of inputs. For the calculation of return to scale from maize, Cobb-Douglas production function was used and calculated using formula;

$$RTS = \sum b_i$$

Where,

$b_i$ = regression coefficient of  $i$ th variables.

The sum of  $b_i$  from the Cobb-Douglas production function indicates the nature of return to scale.

Return to Scale decision rule;

RTS<1: Decreasing return to scale

RTS=1: Constant return to scale

RTS>1: Increasing return to scale

The regression coefficients, as estimated, were employed to determine the Marginal Value Product (MVP) and assess resource use efficiency ( $r$ ), as outlined in the equation provided by (Suresh and Reddy, 2006). The level of resource use efficiency was calculated using following formula:

$$r = MVP/MFC$$

Where,

$r$  = Efficiency ratio

MVP = Marginal Value Product; which is the value of incremental unit of output resulting from the additional unit of inputs.

MFC = Marginal Factor Cost which is equal to one since both dependent and explanatory variables are converted to monetary value; and is defined as the increase in the cost of inputs due to purchase of additional unit of inputs.

$$\text{Now, } MVP = b_i \cdot \bar{Y}_i / \bar{X}_i$$

Where,

$b_i$ = Estimated regression coefficient of input  $X_i$

$\bar{Y}_i$ = Geometric mean value of output.

$\bar{X}_i$ =Geometric mean value of  $i$ th resources used

Decision rule:

$r = 1$ ; Efficient use of resource

$r > 1$ ; Underused of the resource

$r < 1$ ; Overused of the resource

Finally, the relative percentage change in MVP was calculated using following way:

$$D = (1 - MFC/MVP) \times 100$$

$$\text{Or, } D = (1 - 1/r) \times 100$$

where, D= absolute value of percentage change in MVP of each resource (Mijindadi1980)

#### 4.4.3 Problem Ranking

Major production problem and marketing problem were identified and included in the interview schedule based on the field observation and discussion with AKC officer. These issues were then presented to the respondents, who were responsible for evaluating and ranking them according to the severity of the problem. Forced ranking scales were used for scaling by giving a score of 1 to 6 to the most severe and least severe problem. Based on the rank the respondent assigned to each problem, the weight of each problem was calculated and the index was finally obtained. Based on the index, ranking was done.

The formula used for indexing is given below:

$$I = \frac{\sum S_i F_i}{N}$$

Where,

I=index value;  $\Sigma$ =summation

$S_i$  =  $i$ th scale value ( $i = 1, 0.83, 0.66, 0.5, 0.33, 0.17$ ) for production problem

( $i = 1, 0.8, 0.6, 0.4, 0.2$ ) for marketing problem

$F_i$  =frequency of  $i$ th importance given by the respondents

N = total number of respondents

## 5. RESULTS AND DISCUSSIONS

### 5.1 Socio-demographic Characteristics

The sociodemographic features encompass the age composition, gender distribution, household size, ethnic diversity, educational attainment, and employment status of the participants, along with their land ownership and extent of maize cultivation. In the study area, both male and female respondent's involvement was found of which a larger proportion (61.25%) of household heads were male, while the remaining (38.75%) were female members. The study shows that majority of the respondent's were within age group of 31-40 years. The largest portion of participants (30%) fell within the range of 31 to 40 years old. A smaller fraction, 4% of respondents, were within the range of 21-30 years old. Approximately 32.5% of respondents reported family sizes of 1 to 4 members, with a majority (58.2%) having family sizes ranging from 5 to 8 members, and 8.75% falling within the 9 to 12 member. Average size of the family was 5. out of 80 respondents, 27.5 percent were illiterate, approximately 36.25 percent had primary level education, around 16.25 percent had secondary level education, about 12.5 percent had higher secondary level education, about 6.25 percent had bachelor's level education, and about 1.25 percent of the respondents had master's level. The respondents within the study area were observed to be involved in a diverse range of occupations. The survey findings unveiled that the majority of respondents relied on agriculture as their main source of livelihood. Within this group, agriculture accounted for 77.5%. Private and government employment contributed 9%, business activities constituted 6.25%, remittances made up 5%, and other miscellaneous endeavors contributed 2.25% to their overall livelihood. Education. This indicates that the majority of the maize farmers' families were educated. Among the 80 respondents surveyed, the Chettri ethnicity was the predominant group engaged in maize cultivation, with 30 respondents, followed by 28 Brahmins, 21 Janajatis and 1 Dalit.

An average of 12.3 katha of land is found to be under maize cultivation. Among them, it was found that 70 percent of the respondents have their own land and remaining 30 percent of the respondents practiced

sharecropping. Sharecropping is often referred to as "Batiya" or "Bataidar" system. In this system landowners provide land, seeds, and other inputs to laborers (Bataidars), and in return, a portion of the harvested crops is shared with the landowner. The study uncovered that the majority of the respondents relied entirely on rainwater for irrigation. Out of the 80 respondents, 51.25 percent depended on rainwater for irrigation. Approximately 27.5 percent of the respondents utilized surface water as their irrigation source, while 21.25 percent utilized underground irrigation methods like boring water sources. From the survey, it was found that the majority of the respondents use their own seeds. The findings indicated that 48.75% of respondents rely on their self-saved seeds, 30% acquire seeds from nearby neighbors, 17.5% make purchases from agricultural supply stores ("Agro-vet"), and the remaining 3.75% source seeds from cooperatives.

## 5.2 Cost of production of Maize

All the fixed costs and Variable cost were identified and combined to compute the total production expenditure accrued throughout the production process.

### 5.2.1 Fixed cost

Table 1: Fixed cost incurred in maize production		
S.N.	Fixed cost	Average cost (NRs/Katha)
1	Land tax	63.308
2	Water tax	26.422
3	Depreciation	272.91
	<b>Total fixed cost</b>	<b>362.64 NRs/Katha</b>

Source: Field survey, 2023

### 5.2.2 Variable cost

The different inputs that vary based on the scale of maize cultivation encompass seeds, fertilizers, labor, expenses for plant protection, and machinery usage. The mean cost associated with these variable inputs was calculated to be 17904.175 per unit of land area (katha).

Table 2: Variable cost incurred in maize production						
S.N.	Materials	Unit	Quantity	Per Unit Cost (RS)	Total cost	Percentage
<b>1</b>	<b>Variable cost items</b>					
1.1	Seed	KG	0.826	62.162	51.39	0.65
1.2	Fertilizer					
1.2.1	Animal manure	KG	324.445	4.381	1421.47	17.98
1.2.3	Poultry manure	KG	66.856	13.67	913.703	11.55
1.2.4	Urea	KG	4.1569	45.35	188.463	2.3
1.2.5	DAP	KG	2.145438121	55.3735849	118.8087	1.50
1.2.6	Potash					
1.7	Pesticides				100.1016	1.266
1.8	Machinery use					
1.8.1	Ploughing	HRS	0.55050813	1853.846154	1020.557	12.911
1.8.2	Transportation	lump-sum			300.7031	3.80
1.8.3	Pumpset /motor irrigation	lump-sum			12.72045	0.16
1.9	Bullock Labor					
1.9.1	Land preparation	Days	0.325203252	406.25	132.1138	1.67
1.9.2	Weeding	lump-sum			74.39024	0.94
1.10	Human Labor					
1.10.1	1st weeding	Man days	1.462398374	624.375	913.085	11.55
1.10.2	2nd weeding	Man days	1.193838254	625	746.1489	9.43
1.11	Irrigation cost	Man days	0.12195122	600	73.17073	0.92
1.12	Harvesting	Man days	1.010162602	607.5	613.6738	7.76
1.13	Repair and maintenance	RS			51.27033	0.64
1.14	Variable cost	Rs			6731.778	85
1.15	Interest on variable cost	Rs			801.661	10.14
1.16	Management cost	Rs			336.5889	4.27
1.17	Marketing cost	Rs			32.52033	0.41
	<b>Total variable cost</b>	<b>NRs/Katha</b>			<b>7904.175</b>	<b>100</b>

Source: Field survey, 2023

### 5.2.3 Total cost per Katha

$$\begin{aligned} \text{Total Cost} &= \text{Total Fixed Cost} + \text{Total Variable Cost} \\ &= 362.6414 + 7904.175 \\ &= 8266.816 \end{aligned}$$

Therefore, the total cost of maize production in the study area was found to be Rs 8266.816 per katha.

## 5.3 Return from the maize cultivation

The total production of respondents in the area was calculated to be 162434 kg of total. The average Maize production was calculated to be 165.0752033 kg per katha of total household. The average per kg rate of

maize seed was found to be Rs60.862. Hence the average gross return was calculated to be NRs 10046.88.

Table 3: Gross return from maize cultivation			
Description	Quantity (Kg)	Rate (NRs/Kg)	Gross return
Average production per Katha	165.0752033	60.862	10046.88

## 5.4 Net profit and Benefit cost ratio from maize production

Net profit from maize production was found to be NRs 1780.073 per katha. Net profit was calculated using following formula,

Net profit = Total average revenue - Total cost of production

$$= 10046.88 - 8266.816$$

$$= \text{NRs } 1780.073$$

B/ C ratio was found to be 1.21

### 5.5 Gross margin

From the study, the average gross margin obtained was NRs 2142.7149 per katha.

Table 3: Gross margin obtained from maize cultivation in the study area		
Average variable cost (NRs/Katha)	Gross return (NRs/Katha)	Gross margin (NRs/Katha)
7904.17464	10046.88956	2142.7149

Table 4: Economic analysis of maize production in the study area		
Measuring criteria	Unit of measurement	Amount
Total cost	Rs/Katha	8266.816
Average production	Kg/katha	165.075
Average price	Rs/Katha	60.862
Gross return	Rs/katha	10046.88
Gross margin	Rs/Katha	2142.7149
Net profit	Rs/Katha	1780.073
Benefit cost ratio		1.21

Source: Field survey, 2023

### 5.6 Factors affecting production of maize; Production function analysis

Table 5: Factors affecting production of maize in Udayapur						
Model		Unstandardized Coefficients		Standardized Coefficients	t- value	P value
		B	Std. Error	Beta		
1	Constant	4.188	.720		5.817	.000
	Seed	.342*	.090	.405	3.788	.000
	Fertilizer cost	.268***	.110	.266	2.438	.017
	Labor	.113	.095	.103	1.188	.239
	Machinery cost	.158***	.086	.190	1.842	.069

R square= 0.807, Adjusted R square =0.797, F ratio =78.435 and returns to scale =0.881

\*,\*\* and \*\*\* indicates 1, 5 and 10 percent level of significance

Dependent variable: Income from maize

In the context of maize cultivation, the costs associated with seed, fertilizer, and machinery have a statistically significant impact on maize productivity at 1%, 5% and 10 % level. Table 12 indicates that among these factors, seed holds the utmost significance in determining maize production in Udayapur. Use of seed had positively and significantly impacted on maize production at 1% level of significance. It means that the cost of seed contributed to increase maize products output. The output elasticities of seed were 0.342 indicating that holding other explanatory variables constant, one percent change in seed contributed 0.342 percent increase in output. The R Square value, which represents the goodness of fit of the model, was found to be 0.807 and the summation of Coefficient is 0.881 which is less than 1 implied decreasing return to scale.

### 5.7 Estimation of Resource use efficiency of maize

Estimation of resource use efficiency using Cobb-douglas production function The Cobb-Douglas production function was employed to assess the effectiveness of resources utilized in the maize production process. In this analysis, the total yield of maize served as the dependent variable, while various factors and resources involved in the production process were considered as explanatory variables. In the study, it was determined that, with the exception of labor, all other resources were not fully utilized

Table 6: Estimation of MVP and resource use efficiency						
Variables	Coefficient	MVP	MFC	r	D-Value	Efficiency
Seed	0.342	70.330	1	70.33	98.57	Underused
Fertilizer	0.268	1.563	1	1.563	36.02	Underused
Labor	0.113	0.572	1	0.572	74.82	Overused
Machinery	0.158	1.321	1	1.321	532.911	Underused

### 5.8 Marketing channel

In the study area, the marketing of maize remains largely non-commercialized. The majority of consumers had direct connections with local maize producers. The prevalent practice involves producers selling their harvested maize directly to consumers, with a significant portion of these transactions occurring within the immediate neighborhood. Neighbors often emerge as the primary buyers of the produced maize. The survey revealed that a substantial portion of the maize was utilized either for personal household consumption or as animal feed for livestock. While studying marketing channels, two types of channels were considered, one

in the maize production process. The study revealed that the efficiency ratio less than 1 indicated an excessive allocation of labor in the study region. In contrast, seed, machinery and fertilizer were recognized as resources that were not maximally utilized. For optimal allocation of resources, it is advisable to decrease expenditures on labor by 74 percent and raise expenses for seed, fertilizer, and machinery by 98, 36, and 532 percent respectively.

A group researchers observed analogous findings, indicating a need to decrease labor costs for achieving optimal resource allocation (Ghimire and Dhakal, 2014; Sapkota et al., 2018). According to a study, enhancing access to seeds, chemical fertilizers, and other management inputs could lead to increased maize farming productivity (Sapkota et al., 2018). According to a group researchers labor, including both human and bullock labor, is excessively utilized due to its high cost relative to its marginal contribution to productivity (Khanal et al., 2020). Therefore, it is recommended to either reduce labor or optimize its utilization. Possible reasons for the underutilization of fertilizer, machinery, and seed include inadequate access, high costs, or insufficient awareness among farmers regarding the benefits and proper utilization of these resources in the agricultural production process.

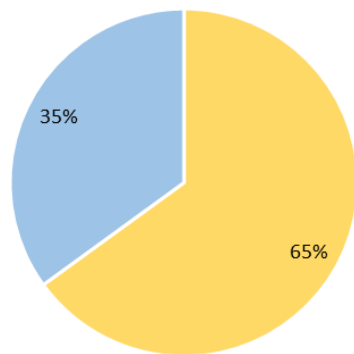
directly from producers to consumers and other through intermediaries. It was found that 65 % use direct selling channel and 35% of them sells their product through intermediaries.

The prevailing marketing channels were:

Channel 1: Producers → Consumer

Channel 2: Producers → miller → Wholesaler → Retailer → Consumer

Channel 3: Producer → miller → Wholesaler → Consumer



■ Direct channel ■ Indirect channel

**Figure 3:** Marketing channels

**5.9 Problems related to production of maize**

I identified various challenges encountered by the producers, listed them, and categorized them based on their severity. I incorporated these challenges into the interview questionnaire and asked farmers to prioritize and rank these issues according to their perceived importance. I used the forced ranking scales method, assigning a score of 1 to the most severe problem, while the relatively less severe problems received scores of 2, 3, 4, 5, and 6. I calculated the index value and conducted ranking based on the high index value. The major constraints in maize production are listed below:

- A. Disease and pest infestation
- B. Lack of irrigation facility
- C. Labor shortage
- D. Costly fertilizers and manures
- E. weather unpredictability
- F. Lack of technical knowledge

Most farmers indicated that the primary issue they encountered during maize production was pest and diseases, with the lack of irrigation facilities following closely as a significant concern. Costly fertilizers and manures, labor shortages, limited technical knowledge, and unpredictable weather conditions were subsequently ranked as the 3rd, 4th, 5th, and 6th most prominent problems, respectively.

Problems of production	Index value	Rank
Disease and pest infestation	0.85	I
Lack of irrigation facility	0.79	II
Costly fertilizers and manures	0.57	III
Labor shortage	0.42	IV
Lack of technical knowledge	0.35	V
Weather unpredictability	0.27	VI

**5.10 Problems related to marketing of maize**

Achieving a favorable return depends as much on effective marketing as it does on the production technology. The prioritized list of marketing problem are listed below:

- A. Low seasonal price
- B. Low volume of production
- C. Inadequate processing facility
- D. Limited financing option
- E. Lack of marketing Knowledge

I ranked marketing problems using the forced ranking scales method, prioritizing major issues based on their severity. In the study area, the problems of low seasonal prices, low volume of production, lack of marketing knowledge, inadequate processing facilities, and limited

financing options were ranked as 1st, 2nd, 3rd, 4th, and 5th, respectively, as shown in the table.

Problems of marketing	Index value	Rank
Low seasonal price	0.81	I
Lack of marketing knowledge	0.75	II
Low volume of production	0.72	III
Inadequate processing facility	0.39	IV
Limited financing option	0.32	V

**5.11 SWOT Analysis**

Strengths	Weakness
<ul style="list-style-type: none"> <li>• Appropriate soil conditions</li> <li>• Multipurpose crop</li> <li>• Short growing season</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of marketing expertise</li> <li>• Poor quality of seed</li> <li>• Lack of technical support from concerned authorities</li> <li>• High input cost of fertilizers and pesticides</li> <li>• Limited adoption to modern farming methods</li> <li>• No financial assistance or government subsidy</li> <li>• High pest infestation and diseases</li> <li>• Soil degradation due to heavy use of fertilizers</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Growing demand for animal feed</li> <li>• Emerging markets for processed products</li> <li>• Improved varieties available</li> </ul>	<ul style="list-style-type: none"> <li>• Climate change</li> <li>• Competition from other crop</li> <li>• Requires high labor cost</li> <li>• Increasing trend of import and competitors outside the country</li> </ul>

**6. DISCUSSIONS**

**6.1 Socio- Demographic characteristics**

It was found that majority of the respondents were male. It indicates that higher proportion of male may be attributed to traditional gender roles and societal norms that have historically favored men as primary breadwinners and decision-makers within households. Majority of the respondents were within age group of 31-40 years. The lower number of respondents in the 21-30 age group can be attributed to the out migration of Youths in the study area. Average family size of the respondents was 5. This indicates that majority of the family was nuclear family. Majority of the respondents were educated. According to Ghimire and Gyawali's article in 2023, Nepal's adult literacy rate in 2018 stood at 67.9%, marking a significant rise from 20.6% in 1981, with an average annual growth rate of 36.06% (as reported by Literacy Rate in 2022). As majority of the respondents main occupation was found to be Agriculture, One possible reason for agriculture being a prominent occupation in Nepal is suitable climates for a range of agricultural activities, making it a viable and historically significant livelihood option for many Nepalese.

An average of 12.3 katha of land was found under maize cultivation. This may reflect the optimal land size for efficient maize cultivation in the surveyed region, where farmers have determined that this amount of land is most productive and sustainable for their maize crops. Majority of the Farmers were dependent on rain water due to restricted access to alternative water sources such as rivers or groundwater and they had financial limitations hindering investments in irrigation infrastructure. As 48.74 % of the farmers use their self- saved seeds. This indicates that in Nepalese society, there is still a traditional- practices of saving their own seeds and may be to reduce the Cost of input.

**6.2 Cost of production**

The total production cost, which includes interest on variable costs and maintenance costs, was 8266.816 Rs/Katha. However, when these interest and maintenance costs are excluded, the total production cost becomes 7126.940 Rs/Katha. In similar research conducted by Dahal and Rijal in

2019, the total production cost was reported to be Rs 42423.3 Rs/ha. The benefit-cost ratio (B/C ratio) from maize in the study area was 1.21, indicating a positive economic outcome and the economic viability of maize farming. This means that for every one rupee invested in maize production in Udayapur, the expected return or benefit is 1.21 Rs.

In a separate investigation led by Dulal and Marahatta in 2020, they determined that the benefit-cost ratio (B/C ratio) for grain production stood at 1.13. Meanwhile, a study undertaken by Sapkota et al. in 2018 in Palpa reported B/C ratios below 1 for small-scale farmers. In Sindhuli, as documented by Dahal and Rijal in 2019, the B/C ratio for Marin Municipality was calculated to be 1.25.

To summarize, the B/C ratio is a crucial measure of economic effectiveness in farming operations. When it exceeds 1, it indicates a profitable venture. In the case of the maize study in Udayapur, the B/C ratio was 1.21, confirming the profitability of maize farming. Similar studies found varying B/C ratios for different crops and regions, highlighting the economic differences in agricultural practices.

### 6.3 Production Function Analysis

In the context of maize cultivation, the costs associated with seed, fertilizer, and machinery have a statistically significant impact on maize productivity at 1%, 5% and 10% level. The R-squared value was 80.7%, which indicates that 80.7% of the variation in income of maize was explained by the independent variables included in the model. Seed holds the utmost significance in determining maize production in Udayapur. Use of seed had positively and significantly impacted on maize production at 1% level of significance. It means that the cost of seed contributed to increase maize products output. The output elasticities of seed were 0.342 indicating that holding other explanatory variables constant, one percent change in seed contributed 0.342 percent increase in output. Use of fertilizer had positively and significantly impacted on maize production at 5% level of significance. The output elasticities of fertilizer were 0.268 indicating that holding other explanatory variables constant, one percent change in fertilizer contributed to 0.268 percent increase in output. Use of Machinery had positively and significantly impacted on maize production at 10% level of significance. The output elasticities of machinery were 0.158 indicating that one percent change in machinery contributed 0.158 percent increase in output. The summation of all the values of parameter was 0.881, which is less than 1 implied decreasing return to scale; 100% increase in all factor of production included in this model would result in 88.1% increase in farm income. Similar result was obtained in potato production in western hills of Nepal (Bajracharya and Sapkota, 2017).

### 6.4 Problems

Pest and Diseases infestation were identified as the primary concern, followed by the lack of irrigation facilities. In a study conducted by Dulal and Marahatta, scarce labor was the major production problem of maize (Dulal and Marahatta in 2020). Similarly, Ghimire and Gyawali's 2023 study also found that pest and diseases ranked as a major issue. The prevalence of pest and diseases in maize cultivation may be attributed to limited access to disease-resistant maize varieties, insufficient pest management practices, and a lack of knowledge and resources for effective control.

Furthermore, both Dulal and Marahatta's research and our study identified low seasonal maize prices as a significant marketing problem (Dulal and Marahatta's 2020). This issue can be attributed to various factors affecting supply and demand within the agricultural market. Often, a surplus maize harvest leads to an oversupply in the market, resulting in decreased prices due to the fundamental economic principle of supply and demand.

## 7. CONCLUSION

Maize stands as a fundamental dietary component for Nepalese individuals, and its necessity for both consumption and livestock feed is progressively expanding each year across local markets within the district, as well as in external markets beyond the district's borders. The BCR was found to be 1.21. This indicates a positive economic prospect for maize farming, emphasizing the opportunity for consistent financial benefits. As maize cultivation is found profitable business, farmers are suggested to persist maize cultivation. To combat pest and infestation issues, emphasize the adoption of integrated pest management, promote disease-resistant maize varieties, and provide farmers with essential training and resources for effective pest control. Efficient resource allocation is vital for economic efficiency and maximizing production. The study highlights that in the production process, excessive use of labor requires cost reduction

for optimal allocation. Conversely, underutilized seed fertilizer and machinery costs should be increased for optimal resource distribution. The importance of farmers having technical knowledge to use existing resources efficiently is underscored, emphasizing the need for wise resource utilization to maximize returns.

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