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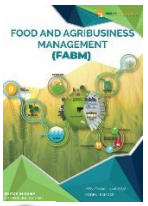

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RESEARCH ARTICLE

COMPARATIVE ECONOMIC ANALYSIS OF MAIZE GRAIN AND SEED PRODUCTION IN HETAUDA SUB- METROPOLITAN CITY, MAKWANPUR

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ABSTRACT

Maize is considered as second most important cereal crops in Nepal. In the hills of Nepal, such as Makwanpur, it dominates all other crop cultivation. Hence, a study was conducted for comparative assessment of socio-economic condition and to identify major problems of maize grain and seed production in Makwanpur. The data were obtained through the survey of 66 producers, 33 each of maize grain and seed producers, in March 2022. The data was then coded and imported into MS Excel, where it was analyzed using Excel and SPSS software. Benefit-cost ratio, Cobb-Douglas production function, mean t-test, and other descriptive statistics were calculated and compared between maize grain and seed producers. Socio-demographic characteristics of both the grain and seed producers were similar with exceptions in education, religion, etc. The inputs (FYM and labor) contributed 65% and 67% of the total cost incurred for grain and seed production respectively. The cost and return from seed production was higher than that of grain production. The B.C. ratio for grain and seed producers was 1.026 and 1.144 respectively. Nonetheless, seed producers sold only 34% of total output as seed, with the remaining portion being used as grain, however, marketing all of the potential seeds will result in higher benefits. Diseases and pest problems were ranked as most severe problem hindering efficient maize production in the study area.

KEYWORDS

seed, grain, maize, production, benefit-cost

1. INTRODUCTION

Nepal is an agrarian country with almost 66% of its population involved in agricultural activities. About 21% of total land is being cultivated in the country. Agriculture contributes to around 22.3% of the GDP of Nepal of which, the cereal sector contributes 49.4% of AGDP (CBS, 2018). Maize contributes around 9.5% in AGDP And 3.5% in GDP (MOALD, 2022).

Maize (Zea mays L.), is the third most significant crop in the world after rice and wheat. It is regarded as one of the most vital sources of food for humans (Zhao et al., 2017). It is grown in many countries for various purposes like for food for human, feed for animals, etc. Maize is the world's most commonly adaptable field crop. It is cultivated from latitude 58° N in Canada and Russia to latitude 40° S in New Zealand and South America (Badu-Apraku and Fakorede, 2017). It is one of the important sources of carbohydrate in the human diet in developing countries and animal feed in developed countries (Undie et al., 2012). Maize is cultivated in the tropical, subtropical and temperate climatic regions of the world. In Nepal, it is grown in diverse environment that varies from southern to northern parts of the country. Due to its great diversity, it is adaptive across different agro-ecological zones (Ferdu et al., 2001). The primary center of origin of maize is considered as Central America and Mexico. It was domesticated around 7000 years ago in Central Mexico. Maize belongs to the family poaceae and the tribe Maydea. *Zea mays* is the only species with the chromosome 2n=20 in the genus *Zea*. It is referred to as the "queen of cereals" since it has the highest yield potential among all cereals (Singh, 2002).

The per capita maize consumption in Nepal was 98g/person/per day (Ranum et al., 2014). About 86% of maize production in hills is used for human consumption while 80% in Terai is used for poultry and animal feed (Gurung et al., 2011). Its grain has high nutritive value containing 66.2% starch, 11.1% protein, 7.12% oil and 1.5% minerals (Chowdhury and Islam, 1999). The overall demand for maize will rise by 4 to 6% year as a result of the expanding livestock and poultry industries (Paudyal et al., 2001). Maize yield in Nepal is 3.06 t/ha compared to the possible yield of 5.7 t/ha (MOALD, 2022; K.C et al., 2015).

Seed is considered as principal element that governs the return of nearly all technological innovations based on agriculture, transferring genetic potential for the production of new crops. The timely availability of high-quality seeds has the potential to boost production, thereby reducing poverty (Subedi et al., 2017). Although there are some local seed suppliers, most of the market share is still dominated by foreign seed companies, with corn seed imports growing rapidly (MOAD, 2013). Every year Nepal import large quantity of maize seed. Nepal imported 15 million kg of seed worth NRs.10 billion in the fiscal year 2021/22 (DOC, 2022) .K.C, et al., (2015) concluded that the inherent issues with maize seed production and marketing in hills of Nepal include remoteness, inadequate infrastructures, labor constraints, limited volumes of seed at the producer level, and lack of private seed dealers. Similarly, poor producer negotiating power, low production volume, ineffective middlemen, inadequate marketing infrastructure, and price fluctuation are all identified as marketing issues in the production of maize seed (Sapkota, 2017). Low yield potential of existing genotype, limited and irregular access to improved varieties along with declining soil fertility, unavailability of

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fertilizer and emergence of new pest species are the main hindrances for maize production in Nepal (NMRP, 2017).

Makwanpur district lies in Bagmati province with district headquarter Hetauda. It covers an area of 2,426 sq. km. The elevation of Makwanpur varies from 166 masl in the southern side to 3,000 masl in the northern part. Out of the total area, only 61,489 ha area is suitable for farming. Distinctly three types of climate: tropical, warm temperate and temperate is found in this district. Agriculture is the main occupation of this district. Maize is cultivated in an area of 24224 ha with a production of 78335 mt and productivity of 3.23 t/ha (MOALD, 2022).

2. METHODOLOGY

The survey was done in Makwanpur district which is located in Bagmati province. Makwanpur was chosen as a PMAMP block for maize production, while Hetauda sub- metropolitan city was one among the places evaluated. Thus, Hetauda sub- metropolitan city was purposively selected for the study. The research area included two wards; 12 and 13 of Hetuada sub-metropolitan city. Both seed and grain producers of ward 12 and 13 were included in the sampling frame. By stratified random sampling technique, a total of 66 respondents were selected (33 from maize grain and 33 from seed producers).

Primary data was collected by conducting household survey, focus group discussion (FGD), key informant interview (KII) and recording socio-demographic and farm characters.

The semi-structured questionnaire was used to gather information from both producers type. The questionnaire covered socio-demographics, production economics, and major production problems. Focus group discussion that included progressive farmers, local representatives and local traders was conducted to verify the information collected from survey.

Secondary data was collected from various published materials like Journals, research articles, annual reports and booklets, MOALD, various NGOs and INGOs.

Both the primary and secondary information collected was coded, tabulated and analyzed by using SPSS and MS excel. The data were analyzed employing instruments such as independent sample t-tests, chi-square tests, frequency distribution, descriptive statistics, etc. Tables, figures, bar graphs, and other visual aids are used to describe and illustrate the results.

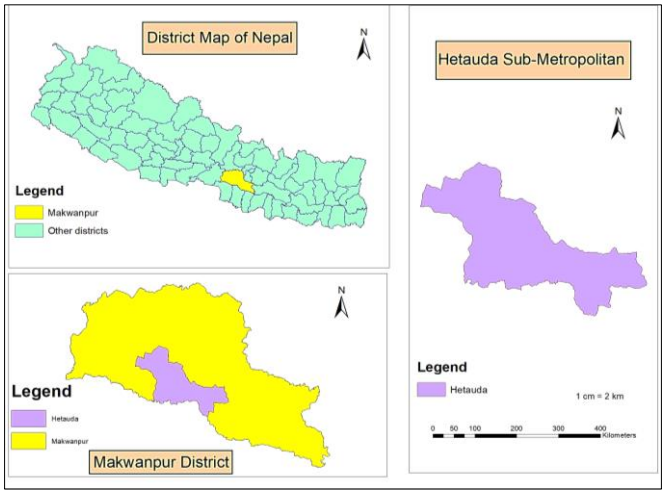

Figure 1: Study area map showing Hetauda Sub-metropolitan

3. PARAMETER STUDIED

3.1 Socio-Demographic Variables

Socio-demographic variables like age, gender, education level, land holdings and category of farmers were analyzed by using descriptive statistics like frequency, percentage, mean, standard deviation etc.

3.2 Economic Variable

Different economic variables were analyzed to find the profitability of maize farming. The production cost was analyzed by considering every variable cost. The variable cost included seed cost, fertilizer cost, manure cost, other chemicals cost, land preparation cost, cost for human resource used, bagging and transportation cost. Similarly, gross income for maize seed producers was obtained from maize seed as well as maize grain. The gross income for maize grain producers was obtained from maize grain only.

3.3 Benefit Cost Ratio

Benefit cost (B.C.) ratio is the ratio of gross income and total cost of production. It was calculated by using formula which was also employed by (Sapkota et al., 2018).

Benefit cost ratio = Gross income / Total variable cost of production

Where, Gross income = per kg price of maize × quantity of maize produced

3.4 Problem Ranking

Major issues with maize farming were identified and included in the interview schedule based on observations made in the field and discussions with AKC officers.

Forced ranking scales were used for scaling by giving a score of 6 to the most severe problem while the less serious issues received a lower score. Both maize grain and seed producing farmers were asked to rank the six predefined problems as the most serious in the study area. Based on the rank they 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;

$$I = \sum \frac{Sifi}{N}$$

Where,

I = index value

S_i = I^{th} scale value (I = 1, 0.83, 0.66, 0.5, 0.33, 0.16)

F_i = frequency of i^{th} importance given by the respondents

N = total number of respondents

The constraints with high index value were ranked as first, second, third and so on. The above formula was also applied to rank the problems related with production of maize seed in mid hill area of Nepal (Sapkota, 2017).The It has also applied the same scaling technique to identify the problems related with the maize production in Okhaldhunga, (Nepal Dulal et al., 2020).

3.5 Regression Analysis

Dummy regression technique in Cobb Douglas form was used to compute the efficiency of maize seed and maize grain farming in the study area. Following formula was used for the purpose:

ln Y= ln a + b1ln x1 + b2 ln x2 + b3 ln x3 + b4 ln x4 + b5 ln x5

Where,

Y=return;

X1 = Seed cost per ha;

X2 = FYM cost per ha;

X3 = Land preparation cost per ha;

X4 = Chemical fertilizer and insecticide cost per ha;

X5 = Labor cost per ha;

b_i = Regression coefficient of respective inputs.

This technique was also used to estimate efficiency of maize seed and maize grain farming in Rolpa (Pokhrel et al., 2018).

4. RESULT AND DISCUSSIONS

4.1 Household Characteristics

In the study area, most of the oldest members (above 50 years of age) were the heads in case of maize grain producers whereas the average age of head was 47.79 years in case of seed producers. However, these two values were found to be insignificant. The average family size in the study area was 5.09, which was higher than national average family size, 4.32 as per

the preliminary data of national census (CBS, 2021). The average family size of grain producers was 4.94, which was lower than that of maize seed producers i.e. 5.24.

The average number of economically active and dependent population in case of maize grain and seed producers were 3.15 and 1.79, 4.00 and 1.24 respectively. The dependency ratio (No. of dependent/ No. of economically active population) of maize grain producers was 0.76, while that of seed producers was 0.44. The dependency ratio was found to be significantly different at 10% level. The average maize cultivated area was also found to be statistically different at 10 percent level of significance as well.

Table 1: Household Characteristics

Variables	Producer Type		Mean difference	t-value	P value
	Maize Grain	Maize Seed			
Household head age (years)	51.03	47.79	3.24	1.034	0.305
Family size	4.94	5.24	-0.30	-0.738	0.463
No. of dependents	1.79	1.24	0.55	1.813	0.075*
No. of independents	3.15	4.00	-0.85	-2.47	0.016*
Dependency ratio	0.75	0.44	0.31	1.68	0.099*
Maize cultivated area (hectare)	0.21	0.34	-3.77	-2.58	0.012*

*indicates significant at 10% (Source: Field Survey 2022)

4.2 Education Level of Household Heads

Most of the heads of households (75.8%) in case of maize seed producers were illiterate while 66.7% of household heads were illiterate in case of maize seed producers. About 27.3% were literate in case of maize seed producers which was three times higher than that of maize grain producers.

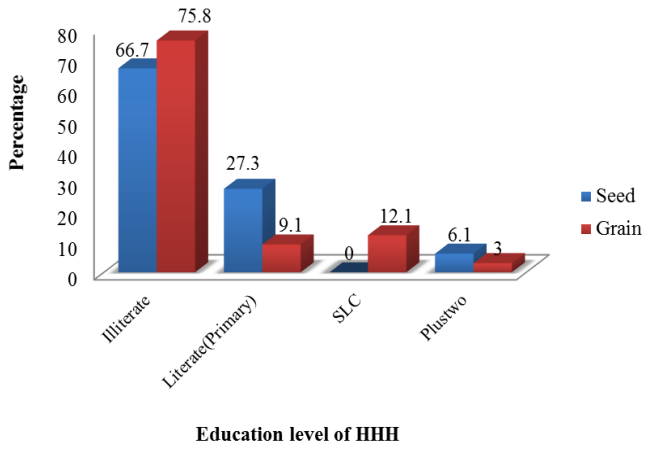

Figure 2: Education level of household head (Source: Field Survey 2022)

4.3 Gender Distribution as Labor Force

In spite of the fact that most of the households were headed by male in the study area majority of farm laborers were female. In an average male contributed only 25% and female contributed about 75% labor force in case of maize grain producers while it was 31% and 69% in case of maize seed producers. In a study carried out at Rolpa, it was found that an average female contribute as 60 percent of labor force in the farm whereas male contribute 40 percent of total labor force (Pokhrel et al., 2018).

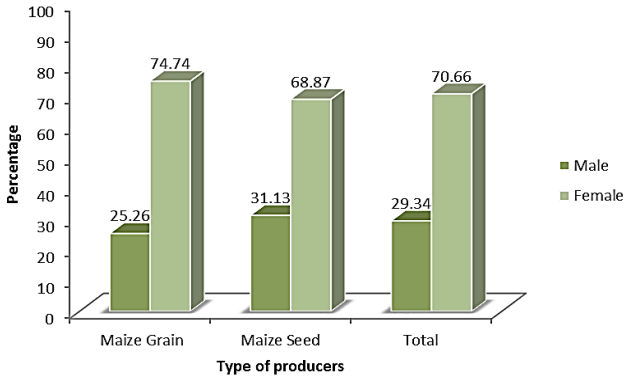

Figure 3: Labor distribution (Source: Field Survey 2022)

4.4 Comparative Cost of Production in Hectare

Out of the total cost, cost of FYM and labor cost constituted the majority of production cost, which was more than 65% in case of maize grain producer and it was more than 67% in case of maize seed producers. Similarly, cost of seed input was lower in case of seed producers than that of grain producers. However, the difference was found to be insignificant. Labor cost was found to be significantly higher in case of seed producers. The higher labor cost in case of maize seed producers is due to the extra activities like roughing, field inspection and post-harvest activities. Mathematically, the cost of production was higher in case of maize seed producers than maize grain producers but was statistically similar.

Inputs that are used in production were higher for the seed producer than the grain producers as well as the number of laborers was found to be significantly greater in production of seed because more laborers were required for the extra activities like rouging, field inspection and post harvest management (Dulal et al., 2020). Similarly, labor cost was also found to be significantly higher in seed production in Rolpa (Pokhrel et al., 2018).

Table 2: Comparative cost of production in NRs.

Variables	Grain producer	Percent share	Seed producer	Percent share	Mean difference	t-value	P-value
Seed	4646.73	6.88	4134.98	4.73	509.44	0.407	0.685
FYM	15913.16	23.59	23776.13	27.2	-7863	-1.508	0.136
Land Preparation	10532.99	15.59	9976.84	11.42	556.16	0.238	0.812
Chemical fertilizer and insecticides	8417.92	12.45	9665.29	11.06	1247.37	-0.867	0.389
Labor	28064.46	41.53	39845.05	45.59	-11781	-2.15	0.035**
Total cost	**67573.02**	**100**	**87398.34**	**100**	**-19825**	**-1.479**	**0.144**

**indicates significant at 5% (Source: Field Survey 2022)

4.5 Income Comparisons

The average income per hectare was NRs. 70196.52 in case of maize grain producer which was statistically lower than that of maize seed producers, NRs.99777.40. About 42% of total income was obtained from seed and remaining was from grain in case of seed producers whereas in case of grain producers the only source of income was grain sale.

Table 3: Comparison of Income Per Hectare							
Variable	**Maize grain**	**Percent share**	**Maize seed**	**Percent share**	**Mean difference**	**t value**	**p value**
Grain income	70196.52	100	56896.07	57.023	**-29580.88**	**-2.032**	**0.046****
Seed income	0	0	42881.33	42.977			
Total	**70196.52**	**100**	**99777.40**	**100**			

**indicates significant at 5% (Source: Field Survey 2022)

4.6 Estimation of Efficiency of Maize Grain Producers

Cobb-Douglas regression model to calculate the efficiency of maize grain producers is shown in the table below. To ascertain the impact of different inputs on the overall income of maize grain producers, the Cobb Douglas production function was taken into consideration. The F value was 215.528, which was significant at the 1% level, and the R square value was 0.976, implying that 97.6 percent of the variation in maize income was explained by the variables under consideration. Therefore, the model is compatible with the research.

Above analysis draws the conclusion that the costs of FYM, labor, and land preparation had a direct positive and statistically significant impact on the income. With 1 percent increase in cost of FYM, land preparation cost and labor cost, the income will increase by 1.254%, 0.753%, and 1.258% respectively. In a similar vein, the cost of chemical fertilizer and insecticides was positively related to income, whereas the cost of seeds was negatively related to income. However, both were statistically insignificant. Thus, we can say that as farmers were already using excess seed than needed, reducing the amount of seed would not diminish the profitability.

Table 4: Estimation of Efficiency of Maize Grain Producers				
Variables	**Coefficient**	**Standard Error**	**t value**	**p value**
Seed cost	-0.366	2.136	0.171	0.865
FYM cost	1.254	0.185	6.789***	0.000
Land preparation cost	0.753	0.386	1.954*	0.061
Chemical fertilizer and insecticide cost	0.667	0.681	0.980	0.336
Labor cost	1.258	0.221	5.697***	0.000
Constant	3072.422	3775.710	0.814	0.423

***indicates significant at 1%

**indicates significant at 5%

*indicates significant at 10%

(Source: Field Survey 2022)

4.7 Estimation of Efficiency of Maize Seed Producers

Cobb-Douglas regression model to calculate the efficiency of maize seed producers is shown in the table below. To ascertain the impact of different inputs on the overall income of maize seed producers, the Cobb Douglas production function was taken into consideration. The F value was 383.115, which was significant at the 1% level, and the R square value was 0.986, implying that 98.6 percent of the variation in maize income was explained by the variables under consideration.

Above analysis draws the conclusion that the costs of FYM, labor, and land preparation had a direct positive and statistically significant impact on the income. With 1 percent increase in each cost of FYM, chemical fertilizer and insecticide cost and labor cost, the income will increase by 0.942%, 0.979% and 1.455% respectively. Similarly, seed cost and land preparation cost showed a positive relation with the income. However, both were statistically insignificant. Thus, we can say that increasing them won't increase income.

Table 5: Estimation of Efficiency of Maize Seed Producers				
Variables	**Coefficient**	**Standard error**	**t value**	**p value**
Seed cost	0.360	0.218	1.648	0.111
FYM cost	0.942	0.139	6.787***	0.000
Land preparation cost	0.818	0.526	1.555	0.131
Chemical fertilizer and insecticide cost	0.979	0.412	2.377**	0.025
Labor cost	1.455	0.132	10.997***	0.000
Constant	281.101	2831.577	0.099	0.922

***indicates significant at 1%

**indicates significant at 5%

(Source: Field Survey 2022)

4.8 Profit Comparison Per Hectare

The profit obtained by seed producers was NRs.12379.06 which was significantly higher than that of maize grain producers, NRs.2623.50.

Table 6: Profit Comparison Per Hectare in NRs.					
Type	**Profit**	**Standard error mean**	**Mean difference**	**t value**	**p value**
Maize grain producer	2623.502	1896.74	-9755.54	-3.676	0.000***
Maize seed producer	12379.062	1855.73			

***indicates significant at 1% (Source: Field Survey 2022)

4.9 Benefit Cost Ratio

The B.C. ratio was higher than 1 in both producer type. It was found to be 1.03 and 1.14 in case of maize grain and seed producers respectively. The found out higher B.C. ratio for seed producer i.e. 1.31 in comparison with grain producer 1.05 in Okhaldhunga (Dulal et al., 2020). It a found out ratio B.C. of maize seed as 0.875 and grain production as 0.69 in Rolpa as a result the profit obtained by seed producer was higher by NRs. 9947 in comparison with non-seed producer (Pokhrel et al., 2018).

Table 7: BC Ratio Calculation				
Type	**Total cost**	**Income**	**Profit**	**BC ratio**
Grain producer	67573.81	70196.522	2623.502	1.026
Seed producer	87398.34	99777.402	12379.062	1.144

(Source: Field Survey 2022)

4.10 Percentage of Maize Used as Seed

Contrary to the fact that about two-thirds of the total kernels from a cob can be used as actual seed, only 34% is used as seed and the remaining 66% is used as food grain and animal feed. This number is much lower than the potential that the seed can be marketed and the profit could be increased.

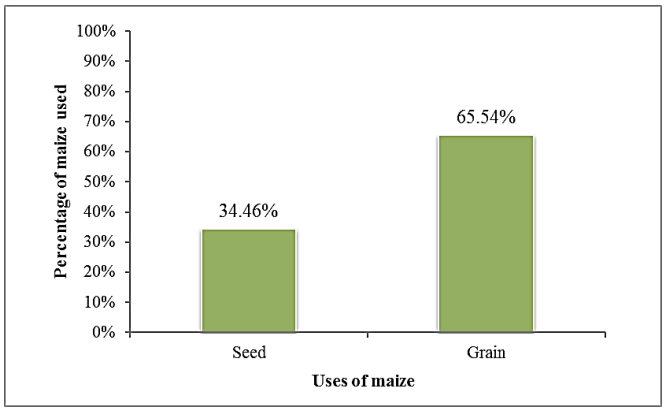

Figure 4: Amount of maize used as seed (Source: Field Survey 2022)

4. 11 Problem Ranking

Both maize grain and seed producers ranked diseases and pests problem as the most severe problem. Maize grain producing farmers ranked unavailability of inputs as 2nd whereas maize seed producers ranked it as 3rd most important problem. Similarly, lack of irrigation was ranked as 6th by grain producing farmers while it was ranked at 2nd position by seed producing farmers. Lack of technical knowledge was ranked at 3rd and 4th position by grain and seed producing farmers respectively. Lack of machineries and abiotic stresses like wind, rainfall, hailstorm, etc were respectively ranked as 4th and 5th by grain producers while they were ranked as 6th and 5th problems by seed producers. Scarce farm labor, infrastructure, input unavailability, lack of technical knowledge, diseases/pest problems and post-harvest storage problems were ranked as 1st , 2nd , 3rd , 4th,5th and 6th simultaneously in Okhaldhunga (Dulal, et al., 2020). Similarly, found out lack of technical assistance as most ranked problem in Arghakhacchi (Bajracharya et al., 2016). Lack of transportation got first rank in the study carried in Rolpa (Pokhrel, et al., 2018).

Table 8: Ranking of Major Problems

Problems	Maize Grain Producer			Maize Seed Producer		
	Weight	Index	Rank	Weight	Index	Rank
Unavailability of inputs like fertilizers	25.376	0.768	II	20.708	0.63	III
Disease and pests	30.843	0.93	I	30.519	0.92	I
Lack of technical knowledge	16.698	0.51	III	17.869	0.54	IV
Lack of machineries	16.2	0.5	IV	8.851	0.27	VI
Abiotic stresses like wind, rainfall, hailstorm, etc	16.197	0.49	V	9.349	0.28	V
Lack of irrigation	10.352	0.31	VI	23.358	0.71	II

(Source: Field Survey 2022)

5. Conclusion

Maize is one of the most potential crop of Makwanpur district. Agriculture was the main occupation of majority of respondents. Major portion of total land is being used for maize cultivation; yet, the production and productivity are very low as compared to district average. The study revealed average productivity of the study area was 2.33 t/ha in case of grain producers and 2.89 t/ha in case of seed producers.

Despite the fact that most of the household head were by male, majority of laborers were female in both types of producers. More than 70% of labor force was contributed by female in the study area. Farmers ranked disease and pest as a major problem hindering efficient maize production. Both maize grain and seed producers were obtaining profit from their farming. Despite low profit from their farming, they were adopting this practice as key determinants of production costs, labor and FYM, were available in the household and were not included in the economics of production.

Labor was the major input for both maize grain and seed producers and the labor requirement was higher for seed production. Seed growers were benefitted more than grain growers due to higher income from seed sales. Farmers in the study area have not yet exploited the full potential of maize seeds, if fully utilized as seeds, it will greatly increase farmers' earnings.

Conflict of Interest

The author here declares that there is no conflict of interest regarding the publication of this article.

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