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Research Article

Comparative economics of maize grain and seed production in Okhaldhunga district, Nepal

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ABSTRACT

Maize cultivation is the one the major farm activities among Nepalese farmers. Basically, in the rural hills of Nepal like Okhaldhunga, it dominates any other crop production. The study was conducted for comparative assessment of economics, marketing and identification of major problems of maize seed and grain production in the hilly eastern district, Okhaldhunga during June of 2017. The data were obtained through the interview of 66 producers (33 each of maize grain and seed producers) with a pre-tested semi-structured questionnaire. Descriptive statistics and parametric tests (x^2-test, t-test) were applied. Both the grain and the seed producers were similar in terms of socio-demographic characteristics, marketing accessibilities but the seed producers were significantly benefited from the training, the extension services, credit facilities despite having 0.14 ha lesser landholding than grain producers. The inputs (manures, fertilizers and the seed) contributed 48% and 50% of the total cost incurred for grain and seed production respectively and the pre-sowing and sowing activities contributed more than 77% of cost in both cases. Despite higher cost for seed production (NRs. 24,969 more than grain production), the benefit-cost ratio of seed production was found higher (1.31) than grain production (1.05). Only 24% of the total harvest was processed and marketed as seed and using optimum quantity (66% middle portion of the cob) for seed production could further increase the income by 23.35%, the improved B:C ratio being 1.51 . The major production problems were scarce farm labor followed by lack of infrastructures while low seasonal price followed by low volume of production ranked the first and second most important marketing related problems.

Keywords: Maize seed, Economics, Problems, Okhaldhunga

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INTRODUCTION

Maize (*Zea mays* L.) is the second main crop after rice in Nepal in term of area and production(MoALD, 2018). Out of the total maize area, maize is cultivated 17.34% of Terai region, 72.85% of mid hills and 9.81% of high hills of Nepal. Two third of the maize produced in hills of Nepal is consumed directly by the farmers. However, maize can be used for multi purposes. The recipe of baby corn and other variety of corns (sweet corn, flint corn, flour corn, popcorn, dent corn, pod corn d waxy corn) is yet to be explored in the local level for increasing the maize enterprise establishment as the variety of maize products can be prepared by using different maize types. Despite the large area coverage (900288ha), the productivity of maize is limited to 2.62 t/ha (MoALD, 2018). The reason behind this is that 80% of the maize grown land is rainfed, unavailability of improved and hybrid seed as well and lower seed replacement rate (11.30%) (NMRP, 2017). Consequently, Nepalese agriculture failed to meet the increasing maize demand (11% per annum) and Nepal has turned into an import driven country importing 45% of maize from India (NMRP, 2019). Maize is the principal food crops of the majority of the hill people particularly among poor and disadvantaged groups and is the prime source of animal feed for growing livestock industries in Terai of Nepal (MoAD, 2017.

Seed is the genetic material, which is the first link in the food chain, source of life and even source of culture (Baniya et al., 2000) and use of improved seed can increase the yield by 20-30% (SQCC, 2013). About 94% of improved seed and 6% of local seed has been cultivated for maize production in the hills (MoALD, 2018) yet the seeds quality are mostly unchecked. In Nepal, improved maize seed covers 850 thousands hectares of land in the hill with the productivity 2.62t ha^{-1}, the total production is 2231 thousand tons in contrast use of local seed covers 49868 hectares of land, 68696 tons of production and productivity is 1.38 t ha^{-1} (MoALD, 2018)

Maize cultivation is the way of life in Okhaldhunga district, eastern midhills of Nepal. People rely on maize for food, feed and fodder. In Okaldhunga District, maize is cultivated in 12400 ha area with the production of 24800 tons (DADO, 2017). The major varieties of maize produced in the region are Manakamana-1, Manakamana-3, Ganesh-1, Ganesh-2, Poshilo Makai-1, Manakamana-4, Deuti, Arun-2, Khumal Yellow, Rampur composite, Sarlahi White, Sitala, Kakani Yellow etc. during rainy season. Maize being staple crop of the district, the increment in the production of maize can fill the food deficit of 2,157 tons per annum (DADO, 2017). The 10 tons seed deficit in the district (DADO, 2017) also indicates the need of maize production in Okaldhunga district.

Maize production in the district has been supported by many NGOs, INGOs aiming to create a significant impact to increase the maize productivity of the district. Traditionally, farmers used to produce maize for home consumption and for the feed to their livestock but now they have realized the economic value of commercial maize production. Despite the marginal profitability from maize enterprises in the previous years, the recent progressive results have shown that maize can be a profitable business in the district (DADO, 2017). Hence, the study is aimed at assessing and comparing the cost of cultivation, income and profit as well as making comparative remarks on the social status of the maize grain and seed producers of the Okhaldhunga district. In addition to this, the study is also focused to point out the major problems regarding the production and marketing of maize in the district.

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MATERIALS AND METHODS

The research was conducted in Okhaldhunga district eastern development region of Nepal. It lies between the range of lower tropical (1849 masl) - highest subtropical (3627 masl) with annual rainfall 144.40 mm and the average maximum and minimum temperature 22.6^{0}C and 8.75^{0}C respectively which is favorable for the maize cultivation. Rumjataar, of Siddhicharan municipality, of the district was selected as a block of maize seed and grain production block under PMAMP (Prime Minister Agriculture Modernization Project) and hence was purposively selected for the study. For the purpose, 33 each of maize grain and seed producers were selected. The grain producers were randomly selected whereas seed producers were selected from the seed producing group '*Majh Chandeswori Beeu Utpadan Samuha'* and the sample size was determined using Raosoft. The research was conducted based onpre-designed semi-structured questionnaire and the required information was collected with the face to face interview with the farmers.

The information obtained from the individual interview was validated by focus group discussion which included officers of DADO, Okhaldhunga, ward representatives, lead farmers, head of a cooperative, and the manager of the Local market '*Haat Bajaar'*. The Key informants' survey (KII) with the DADO officers and progressive farmers and local leaders was used to tally the response from farmers.

Secondary information was collected from various published journals, research articles and report from DADO, district profile, yearly agriculture development program and statistical book of DADO, Okhaldhunga, Reports from MoAD, Central Bureau of Statistics (CBS), VDCs, Cooperatives and publications from different district offices on maize.

Cost benefit analysis

The purpose of performing benefit cost analysis is to find if the investment made on the resources yields a reasonable return to the resources engaged. Benefit cost ratio (BCR) is assumed as a quick and one of the easiest method for evaluating the economic performance of any farm (Dhakal *et al*., 2015). For this study, the cost of production for both maize seed and grain producers was calculated by adding all the variable cost items such as seed, FYM, fertilizer, tillage, labor, intercultural operations, harvesting and post-harvest management and marketing was calculated separately for maize grain and seed producers. Likewise, the revenue obtained from the sale of maize grain and seed in addition of maize byproducts were also evaluated on monetary terms. And finally the benefit cost analysis was conducted using the formula as used by Sapkota et al. (2017);

Gross return = Total quantity of seed/grain produced (kg) × Price per unit of maize seed/grain (Rs.) + total quantity of byproducts (stover, nubbin, husk) produced (kg) ×Price per unit byproducts (Rs.)

Total variable cost = seed cost + Bullock cost + Labor cost + fertilizer and manure cost + machine cost+ post harvest cost +/ (marketing cost)

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Problem Ranking
The major problems were discussed and enlisted based on the FGD and KII and were presented to respondents, who ranked all these problems based on severity in their production system. The intensity of problems faced by the producers were identified by using seven point scaling techniques comparing most serious to no problems at all using score of 1.00, 0.83, 0.67, 0.50, 0.33, 0.17 and 0.00, respectively.
The index of the problem was calculated using the following formula:

$$I = \sum \left(\frac{SiFi}{N}\right)$$

Where
I=index value; Σ=summation
Si = ith scale value (i= 1, 0.83, 0.66,0.5,0.33,0.17,0.00)
F = frequency of ith importance given by the respondents
N = total number of respondents

Subedi *et al.* (2019a) used the scaling technique to identify the constraints associated with the potato production in Terai region of Nepal. This above formula was also applied by Shrestha and Shrestha (2017) to rank the problems associated with maize seed production. Subedi *et al.* (2019b) used this technique to explore the problems associated with wheat production.

Regression analysis
The regression technique was used to compute of effect of various factors of the production of maize grain and seed. The proposed equation of the multiple linear regression model is

$$Y_{income} = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(i)}$$

Where, Y_{income} = Household annual agriculture income (total income)
α = Intercept made of regression plane.
Where, X_1, X_2, X_3, X_4, X_5, X_7, X_8, X_9 and X_{10} represents the farmers' category, gender of household head, age of household head, education of household head, access to extension service, access to training, total land holding area, agro-input price along with price of machinery and labor price .
Similarly β_i represents the regression coefficients of the respective factors.

RESULTS

Socioeconomic and Demographic characteristics of sampled Households
In the study area, the average age of the household head of the grain growers and seed producers was 56.36 and 59.63 years respectively. Likewise, the average household size among the grain producers and seed producers was 6.42 and 6.30 respectively which is higher than the average national household size, 4.88 (MoALD, 2018). The male members were higher in case of the seed producers whereas the number of female members was higher in grain producers, however, the gender wise difference was not found to be statistically significant.

The family members that are in the age range of 15 to 59 years are considered economically active members and are directly involved in agricultural activities. The people of remaining

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age group are the dependent members. On this basis the economically active members among the grain producers were slightly higher (4.27) than that of the seed producers (4.18) and hence the dependency ratio of the seed producers was higher (0.75) than that of the grain producers (0.63).

Table 1: Characteristics of the sampled household

Variables	Farmer's category		Mean difference	t- value	p-value
	Grain producers	Seed producers			
Age of HH head	56.36 (13.55)	59.63 (14.42)	3.27	0.950 ^{ns}	0.346
HH size	6.42 (4.06)	6.30 (3.49)	-0.12	-0.130^{ns}	0.897
Economically active members	4.27 (2.45)	4.18 (2.54)	0.09	-0.148^{ns}	0.883
Dependency ratio[1]	0.63 (0.53)	0.75 (1.07)	0.11	0.506 ^{ns}	0.614
Total landholding (ha)	0.96 (0.22)	0.72 (0.14)	0.24	-0.871^{ns}	0.387
Total operational land (ha)	0.53 (0.07)	0.60 (0.11)	-0.07	0.595^{ns}	0.554
Livestock holding (LSU)[2]	4.66 (0.51)	4.40 (0.52)	0.26	-0.346^{ns}	0.730

Notes: Figures in parenthesis indicate standard deviation; p-values are the result of t-test
[1] Dependency ratio= Dependent members/Economically active members (CBS, 2014)
([2] LSU: 1.5(number of buffalo) +1(number of cow/bull) +0.6(number of swine/pig) +0.4(number of sheep and goat) +0.2(number of poultry) (Adhikari, 2000)

Land and livestock are the valuable assets of rural HH. The average landholding of the maize grain producers was 0.96 ha and that of the seed producers was found to be 0.72 ha. However, the average operational land of the grain and seed producers was found to be 0.53 ha and 0.60 ha respectively, which were not significantly different.

The farmers in the study area followed livestock integrated farming system. The majority of the farmers reared cow and goat and this livestock was the major source of FYM that is applied for maize production. The livestock holding (LSU) of the grain producers was 4.66 and that of the seed producers was 4.40 however the difference was found statistically non-significant as shown in the table above

Other social characteristics of HH

In the study area, 90% and 78.78% household head were male for grain producing and seed producing farmers respectively. The seed producers have more female headed houses as the migration has been more among the HH of seed producers (60.60%) than that of the grain producers (42.42%). The dominance of ethnic community (janajati) was seen on both the categories and the dominance of ethnic community among seed producers was statistically significant at 5% level. Though statistically non-significant, more grain producers (42.40%) have agriculture as a major occupation than that of seed producers (30.30%) and most the HH of both categories lived in the joint family.

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Table 2: Distribution of the socio-economic characteristics with farmer's category

Variables	Farmer's category		Chi-square value	p- value
	Grain producers	Seed producers		
Gender of the HH (Male)	30(90.00)	26(78.78)	1.886	0.170
Ethnicity				
(Brahmin/Chhetri)	15(45.50)	6(18.20)	5.67**	0.017
Janajati	18(54.50)	27(81.80)		
Occupation (Agriculture)	14(42.40)	10(30.30)	3.482 ns	0.481
Education status(Literate)	18(54.50)	19(57.6)	0.062ns	0.804
Family type(Joint)	19(57.60)	15(45.50)	0.971ns	0.325
Migration status (Migrated)	14(42.42)	20(60.60)	2.970*	0.085
Extension services	8(34.80)	15(45.50)	3.270*	0.071
Training	11(33.30)	21(63.60)	6.066**	0.014
Access to credit facilities				
Easy	11 (33.30)	10 (30.30)		
Satisfactory	12 (36.40)	4 (12.10)	11.879**	0.008
Hard	5 (15.20)	2 (6.10)		
Don't know	5 (15.20)	17 (51.50)		

Note: Figures in parenthesis indicate the percent. ***, ** and * indicate 1%, 5%, and 10% levels of significance, respectively.

The household head having agriculture as a major occupation is higher in grain producers (42.40%) than that of seed producers (30.30%). On average 19 of the grain producers and 15 of the seed producers had joint family. This study has found literacy rate higher among the HH of seed producing farmers than the grain producing farmers, which showed that literate household head tends to shift from grain to seed production. The extension services in the region include the field visit of DADO staffs, private organizations, INGOs/NGOs servicers, social facilitators and extension worker from different organizations. The major objective of the training is to enhance the knowledge level of the farmers and to promote the adoption of improved technology. Among the farmers in the study area, only 34.80% of the seed grain producers and 45.50% of the seed producers had access to extension services. Likewise, the training receiving members were higher among the seed producers (63.60%) than grain producers (33.30%) as shown in Table 2.

Membership in Community based organizations

Among the randomly sampled households, all the seed producing farmers were found to be involved in community based organizations but 15.20% of the grain producing respondents were found not involved in any social groups. The involvement of seed producers in the farmers group as well as in the cooperatives was higher (42.40%) than that of the grain producers (12.10%).The difference in the status of membership of the seed producers and the grain producers in these community based organizations was found significantly different at 1% level of significance. This shows a strong correlation between the involvement in social organization and maize seed production.

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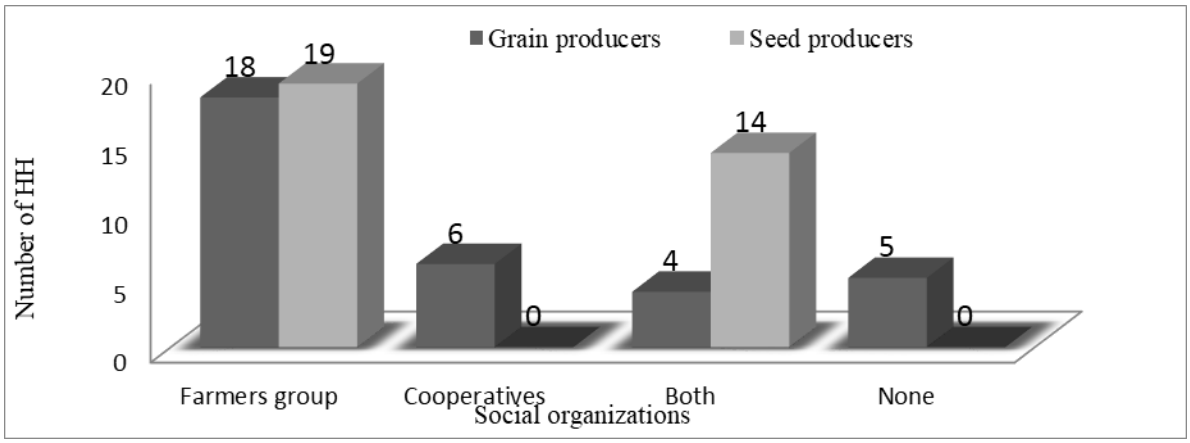

Figure 1: Membership of HH in Community based organizations

The facilities of extension services and the trainings have shifted the farmers from grain to seed production. The access to credit facilities was also significantly different among the seed than grain producers. Although the credit facility is way lower than excepted, it is highly appreciable that farmers are dedicated towards maize seed production.

Production economics for maize

Inputs used for maize cultivation*:*

The major inputs that are being used are the Farmyard manure, Chemical fertilizers (Urea, DAP, MOP) and labor. The seed is also another major input but the rate of seed applied by the farmers was similar i.e. 50.17 kg ha^{-1} on an average. All the inputs that had been used are more for the seed producers than the grain producers as indicated in table 3. The use of labors was significantly greater in seed production as more number of labors were required for the additional operations like rouging, field inspection, post-harvest management.

Table 5: Use of inputs with Farmer's category

Inputs	Farmer's category		t-value	p-value
	Grain growers	Seed growers		
Manures (kg ha^{-1})	519.28 (50.09)	631.20 (64.69)	1.368^{ns}	0.176
Urea (kg ha^{-1})	108.36 (10.77)	148.55 (26.30)	1.414^{ns}	0.162
DAP (kg ha^{-1})	70.26 (9.79)	71.69 (8.25)	0.112^{ns}	0.911
MOP (kg ha^{-1})	1.22 (0.82)	0.00 (0.00)	-1.490^{ns}	0.141
Labor (MD ha^{-1})	106.00 (7.88)	129.78 (7.99)	2.340^{**}	0.022
Machinery and non-labor	11228 (13)	13289(12)	1.384^{ns}	0.171

Note: MD, man days. Figures in parenthesis indicate the percent. ** indicates 5% level of significance.

Cost of production based on type of inputs:

The various inputs were categorized into machinery and non-labor, input, and labor as shown in Figure 2. The tillage operations like tillage by bullocks and tractors were included under machinery and non-labor category. Similarly, the basic inputs like seed, FYM, chemical fertilizers were included in inputs category and the total labor (in man days) required in maize seed and grain production was included under labor category. The average share in cost for tilling operation for grain and seed producers is 13.00% and 12.22% respectively. Likewise, the maximum share for production was contributed by inputs amounting Rs.40,492 (48%) and Rs.41,463 (50.50%) for grain producers and seed producers respectively which is

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shown in figure 2. The cost of labor was higher for seed producers as additional labors are required for thinning, rouging and seed selection. The difference in the cost of labor was significant at 5% level

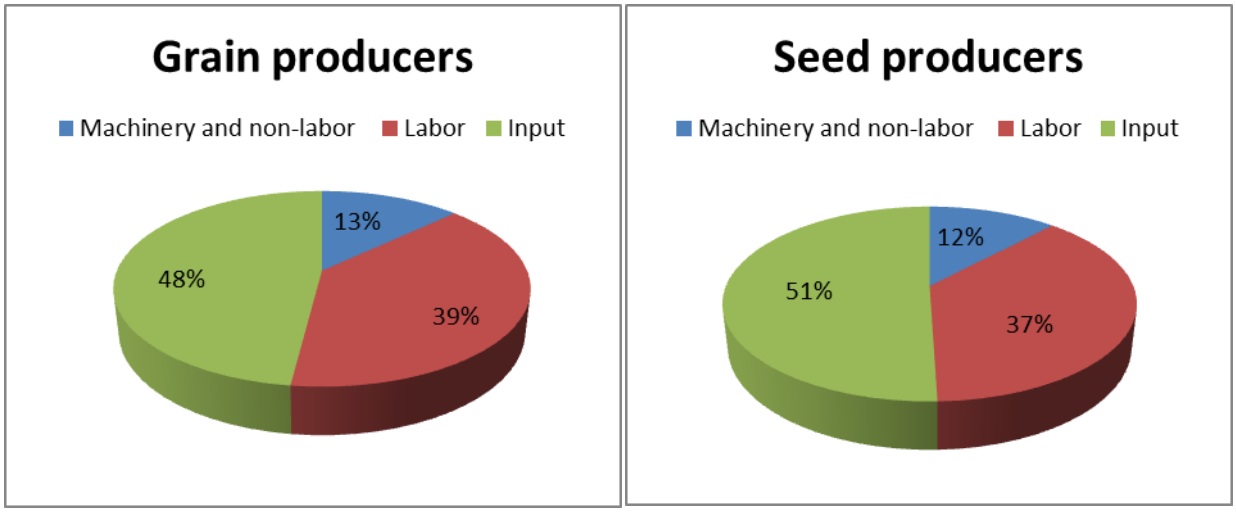

Figure 2: Comparison of cost of input used by maize grain and seed producers

Yield and cost benefit analysis*:*
The average yield of maize for the grain producers was 2591 kg ha^{-1} and that of the seed producers was 2595 kg ha^{-1}. The yield of fresh Stover for grain producers was 12005 kg ha^{-1} and that of the seed producers was 17176.03 kg ha^{-1} as shown in table 6.

Table 7: Production and cost, benefit of maize and seed and their byproducts

Outputs	Farmer's category		t-value	P-value
	Grain growers	Seed growers		
Grain (kg ha^{-1})	2591.49 (228.84)	2595.79(373.14)	1.20	0.232
Stover-fresh (kg ha^{-1})	12005.41 (1130.65)	17176.03(2991.99)	1.62	0.111
Average Return of maize grain (NRs./ha)	81447 (7192)	101181 (14679)		
Average Return of maize seed (NRs./ha)	0	31181 (5338)		
Return of stover (NRs./ha)	9004 (848)	12882 (2244)		
Total return (NRs./ha)	90451 (7834)	145244 (21168)		
Total cost (NRs/ha.)	85562.21 (6645.09)	110620.69 (8419.84)	2.34	0.023
B:C ratio	1.05 (0.06)	1.31 (0.24)	1.59	0.118

Note: Figures in parenthesis indicate the standard error of mean. (The average price of the maize grains was Rs.31.42 and that of maize seed was Rs.50. According to consumer price index of Nepal Rastra Bank, the average price of fresh Stover is 75 paisa per kg)

The price of maize stover (straw, husk, nubbin) was also added along with the grains and the final return of the farmers was calculated. The total return for maize grain producers is NRs. 90,451 and that for maize seed producers is NRs. 145,224 on hectare basis. The benefit cost ratio (B:C) was computed as the ratio of gross returns to the total cost involved in maize production. The B:C ratio for grain producers was 1.05 and that of seed producers was 1.31 however the difference was statistically non-significant as indicated in table 7. The higher

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B: C ratio indicates that the seed producers were more benefited than grain producers and this could encourage the grain producers to shift toward seed production.

Marketing status

Market for maize grain and seed

The marketing of maize is not that tedious despite the topographical remoteness. Despite the topographical remoteness, the marketing of maize seed and grains is not that tedious in Okhaldhunga district. The seed producers sold the produced maize seed directly to DADO and hence they had no problem of market. The grain producers had various options for selling their grains. *Haat bazaar*/local people were the major market for the majority of the respondent without involvement of any middle-men i.e. 63.60% whereas 28.80% of the farmers do not sell maize at all. The other markets were retailors and agro-vets.

The major market for the most of the farmers in Okhaldhunga district is the local *Haat bazaar* which is held every Friday. The average distance to market for grain producers is 24.70 minute walk whereas that for the seed producers is 8.21 minute walk. The difference might be due to the fact that the seed producers are confined in an area near to the place where *Haat bazaar* is held. The distance isolation for seed production is another fact that has confined the seed producers and on the other hand the grain producers are scattered and are relatively far from the area where *haat bazaar* is conducted.

Determinants of annual income by maize production using linear regression model

The income obtained from maize (maize grains, maize seeds, and stover) was regressed with the important socioeconomic explanatory variable. The R^2 of the model was 0.44 for income from maize cultivation. It indicates that about 44% of variation in the income was explained by the explanatory variables in the model. The adjusted R^2 was found 0.34. It indicates that when the degree of freedom is taken into account, the variation in the dependent variable (income) is explained by explanatory variables by 34% in the model. There were total 10 explanatory variables in the model. Among them, 4 variables were found significant whether at 1% and 10% level as shown in table 8.

Above regression shows that on shifting the farmers from grain producing to seed producing, the annual income from maize could be increased by Rs.26918.59 keeping other factors constant. On increasing unit area for maize production the income would increase by Rs.3.030 and this increment is significant at 10% level.

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Table 8: Factors affecting income from maize production

Variables	*Coefficients*	*Standard Error*	*t Stat*	*P-value*
Farmer's Category	26918.59	9905.28	2.72	0.01*
HH head gender	-14878.99	12370.66	-1.20	0.23
HH head age	91.19	410.95	0.22	0.83
HH head schooling year	7776.57	11050.12	0.70	0.48
Extension Service	-9064.23	11068.49	-0.82	0.42
Training	4529.21	11729.55	0.39	0.70
Area (ha)	3029.64	1589.04	1.91	0.06*
Input price	-0.52	0.84	-0.62	0.54
Machinery Price	5.50	3.15	1.74	0.09*
Labor price	3.26	1.82	1.79	0.08*
Intercept	-57823.90	52912.59	-1.09	0.28
R Square = 0.44298;	Adjusted R	Square = 0.341703;	Standard Error = 31973.252	

The negative coefficient in input price indicates that more than enough quantity of inputs had been used in the maize production and decrease in inputs doesn't affect the income at all and can increase the profit by reducing cost of production. All the other considered explanatory variables like gender of the household head, age of household head, trainings, household head schooling year, had positive impact on the annual income of the farmers but were statistically insignificant.

Optimization of seed production

At present condition out of total produced maize, on an average only 624 kg seed per ha was marketed and remaining 1794 kg seed per ha was marketed as grain. If two third parts of the cobs would have been utilized for seed production then the marketed seed would be increased to 1968 kg ha^{-1} and the grain would be decreased to 869 kg ha^{-1}. The seed producers were receiving Rs.93028 from the marketed seeds at present time but if the optimum quantity of the cobs was utilized then the return from maize seed would be Rs.114,757 which is Rs.21,729 (23.35%) more than currently received price as shown in figure 3. So, it seems necessary that proper trainings should be provided for the farmers to increase their knowledge regarding maize seed production.

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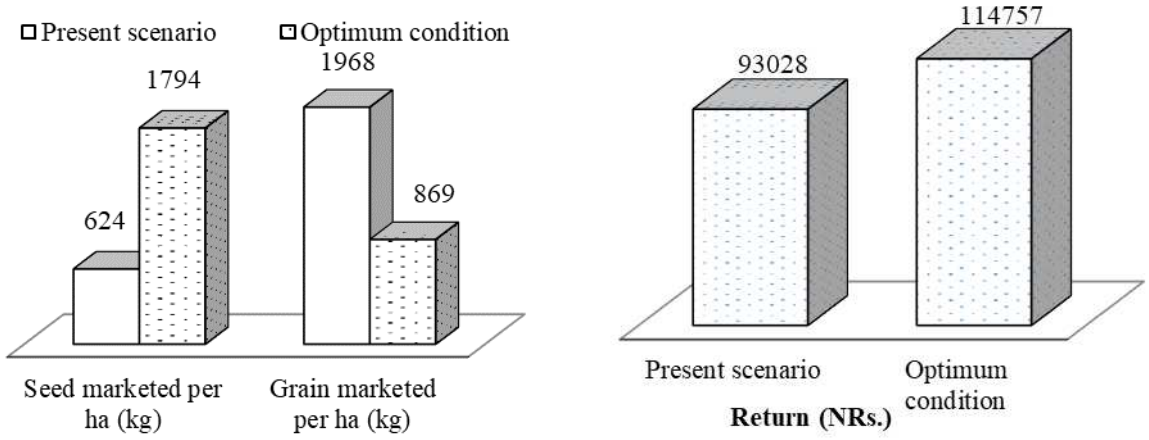

Figure 3: Optimization of seed production

Problems related to production and marketing

Based on the direct field observation and discussions with DADO officers, major problems associated with maize production in the district were identified and included in the interview schedule. The farmers were asked to rank these problems. Forced ranking scales were used for scaling by giving score of 6 to the most severe problem and descend the score on less severe problems. The index value was obtained and ranking was done based on high index value. The majority of the farmers responded that the unavailability of the labor during peak working season was the major problems for them. As already discussed, 39% of total cost of production for grain producers and 37.50% for seed producers were shared by labor and this major input if not available in sufficient amount then farmers are forced to pay higher for those labor and hence the cost of production would further increase. The problems like lack of infrastructures/irrigation, inputs unavailability, lack of technical knowledge, problems of disease/insect/pest and post-harvest/storage were ranked 2nd, 3rd, 4th, 5th and 6th problems respectively. Likewise, on behalf of the market related problems, low seasonal price, low volume of production, lack of marketing problems, lack of bargaining power, distant market and inefficient middle man were ranked 1st, 2nd, 3rd, 4th, 5th and 6th problems respectively in the study area as shown below in table 9.

Table 9: Ranking of the problems related to maize production and marketing

Problems of production	Index value	Rank	Problems of marketing	Index value	Rank
Input unavailability	0.56	III	Low seasonal Price	0.540	I
Technical knowledge	0.48	IV	Lack of Marketing knowledge	0.144	III
Scarce farm Labor	0.83	I	Lack of bargaining power	0.088	IV
Disease/Insect/Pests	0.46	V	Low volume of production	0.265	II
Infrastructures	0.67	II	Distant market	0.083	V
Post-harvest/Storage	0.37	VI	Inefficient middle man	0.030	VI

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DISCUSSION

The decision makers of HH of Okhaldhunga, the rural Nepal were the old aged males who were also the household heads as is also stated by Sapkota et al. (2017) while assessing the

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technical efficiency of maize growers in Papla district The average size of the family was larger in the hilly regions of Nepal than the national average ie.4.88 (MoALD, 2018). The farming in the Okhaldhunga was livestock integrated farming system where people reared some cattle, buffaloes, goats and some hens to satisfy their family needs and get some economic benefits which depict the scenario of farming system in Nepal (FAO, 2017). In addition to this the main asset of the rural farmers was the land that they hold and seed producers were more efficient in using their assets despite having lesser land holdings and livestock. The livestock they reared were the main source of FYM that are applied in the land they possess. Most of the seed producers were the indigenous and so called marginalized ones (*Janajatis and Dalits)*. The majority of the people of Okhaldhunga district lived in joint family. The migrated members of the HH of seed producers were more than that of the grain producers and it was the exposure to the foreign land which has encouraged the farmers of Okhaldhunga to be involved in more economic agriculture i. e. seed production (Sapkota & Pokhrel, 2010). Community based organizations like farmers' group, cooperatives were the assets of the community that strengthen the unity among the farmers and provide economic and social helps. The farmers of Okhaldhunga district started producing seed due to more accessible the extension facilities, trainings, credit facilities and assured market facilities (Seyoum et al.,1998).The involvement of farmers in the social groups helped them to acquire knowledge and discuss and share the problems and skills among each other(Paudyal et al., 2016).

The major inputs require for the maize production were the manures and fertilizers, seed, and labor. The inputs (manures and labors) required for seed production was higher than grain production. The larger labor required for this was due to the more intercultural operations like rouging, weeding and more post-harvest operations as well and hence the seed production requires more inputs than grain production (Pal et al.,, 2016) . Based on the type of inputs, the maximum cost is shared by the inputs and labor cost was also at the range of 37% to 39% for maize production which is in accordance to (Mohiuddin et al., 2007) also found about 50% of cost of human labor in maize production in an area of Bangladesh. The average yield of maize in the Okhaldhunga was 2.5 t/ha and which is similar to the average yield of Nepal and is more than that of the Okhaldhunga district (MOALD, 2018). The benefit from the seed production is higher because of the higher price of the seed than gain. The B: C ratio was higher for the seed producers than that of the grain producers in the study area which is in accordance to (Pokhrel et al., 2018). The markets for the rural area was the local *Haat bajar* where all the agricultural goods along with maize grains were sold whereas the governmental organizations like DADOs, CBOs, CSB were the market for the maize seed in Okhaldhunga district. The periodical markets were mostly common when we move from west to east of Nepal where agricultural products and livestock are sold are common in eastern Nepal. The producers and consumers traded several agricultural and livestock products among themselves (Paudyal et al., 2016).

CONCLUSION

The seed producers were technically more benefited by receiving the more number of trainings and extension services and hence have better market penetration and market information. The major input for both the seed and grain producers was labor and the more number of labors were required for the seed production. Maximum share on the cost of production was on the pre-sowing and sowing activities for both the seed and grain

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producers. The seed producers were more benefited than grain producers due to higher income form the seed sale. Farmers on the study area did not exploit the full potential of the maize seed, if full utilized as the seed production, would significantly increase the income of the farmers and aid in meeting the seed demand of the district. The market was comparatively far for the grain producers but the seed producers were near to the market due to the confinement of seed producing field in the market area. The major hindrance in the marketing was the low seasonal price followed by lack of marketing knowledge whereas the unavailability of inputs and lack of technical knowledge were major constrains for the maize production.

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Authors' contributions

S. Marahatta guided research and revised the article for the final approval of the version to be published. P.R.Dulal conducted the research and collected all the information, analyzed and wrote the final manuscript. R. Karna helped in collection and analysis of data.

Conflict of interest

The authors declare no conflicts of interest regarding publication of this manuscript.

REFERENCES

ABPSD. (2014). *Statistical Information in Nepalese Agriculture.* Government of Nepal, Agribusines Promotion and Statistic Division. Singha Durbar: MoAD. Kathmandu, Nepal.

ADDIN Mendeley Bibliography CSL_BIBLIOGRAPHY

Bajracharya, M., Sapkota, M., & Dhungana, S. M. (2016). Socio-economic analysis of maize seed production in Arghakhanchi district of Nepal. *Journal of Maize Research and Development*, *2*(1), 144–150. https://doi.org/10.3126/jmrd.v2i1.16227

Adhikari, J. (2000). *Decisions for survival:Farm management strategies in the midhills of nepal.* New Delhi: Adriot publishers.

Bajracharya, M., Sapkota, M., & Dhungana, S. M. (2016). Socio-economic analysis of maize seed production in Arghakhanchi district of Nepal. *Journal of Maize Research and Development*, *2*(1), 144–150. https://doi.org/10.3126/jmrd.v2i1.16227.

Baniya, B., Subedi, R., Poudel, R., & Rijal, D. (200). *Informal Rice seed supply system in midhills of nepal.* Nepal's contribution to global project.

CBS. (2015). *Economic Survey.* kathmandu: MOAD.

Chauhan, R., & Singh, J. (1998). Economic analusis of vegetable production and marketing inAzamgarh district of uttar pradesh. *Indian Journal Agriculture Economics*.

Journal of Agriculture and Natural Resources (2020) 3(1): 133-147
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v3i1.27111

DADO, O. (2073). *Annual Agriculture Development Program and Data Records.* okhladhunga: DADO,Okhaldhunga.

Dangol, B. (1991). *Factors affecting adoption of improved technology in paddy cultivation in chitwan district.* Udaipur, India.

Dhakal, S., Thapa, P., Sah, R., & Khatri-Chhetri, D. (2015). Productivity and Profitability of maize-pumpkin mix cropping in Chitwan, Nepal. *Journal Of Maize Research and Development*, *1*(1), 112-122.

FAO. (2017). Nepal at a Glance.

Hada, N. A. (2001). Private Sector on Domestic Seed Marketing and Distribution of Horticultural and Agricultural crops. Kathmandu.

IFPRI. (2010). *Ensuring Foody and Nutirtional Security in Nepal.* Kathmandu: International Food Policy research Institute.

Joshi, K. (2000). *Strengthening the farmers' seed system in Nepal.*

Khadka, R. (2005). Sociocultural Determinants of Wheat Variety Adoption and Seed Management a case study of Nagarkot VDC, Bhaktapur. *A Unpublished Dissertation Submitted to The Department of Sociology/Anthropology, Patan Multiple Campus*.

Mignouna, D.B., Manyong, V., Mutabazi, K., & Senkondo, E. (2011). *Determinants of adopting imazapyr-resistant maize tecchnologies and its impact in household income in western Kenya.*

MoAC ,WFP. (2015). *summer crop nepal.* kathmandu: MoAC.

MoAC. (2003). Application for the Technical Co-operation (Development Study) for Quality Seed development project in Nepal. Hariharbhawan, Lalitpur: Seed Quality Control Center.

MoAD. (2015). ADS (2015-2035).

MoAD. (2015). *Nepal Portfolio Performance Review.* Kathmandu: MoAD.

MoAD. (2073). *PMAMP*. Kathmandu: MoAD.

MoALD. (2018). *Krishi diary*. AITC, Harihar Bhawan, Lalitpur.

MoALD. (2018). *Krishi diary*. AITC, Harihar Bhawan, Lalitpur. Retrieved from www.aitc.gov.np

Pal, G., Radhika, C., Bhaskar, K., Ram, H., & Prasad, S. (2016). A Study on Comparative Economics of Grain and Seed Production of Groundnut in Karnataka, India. *Journal of Experimental Agriculture International*, *14*(5), 1–9. https://doi.org/10.9734/jeai/2016/29405

Pal, G., Radhika, C., Bhaskar, K., Ram, H., & Prasad, S. (2016). A Study on Comparative Economics of Grain and Seed Production of Groundnut in Karnataka, India. *Journal of Experimental Agriculture International*, *14*(5), 1–9. https://doi.org/10.9734/jeai/2016/29405

Paudyal, K. R., Ransom, J. K., Rajbhandari, N. P., Adhikari, K., Gerpacio, R. V., & Pingali, P. L. (2016). *Title : Maize in Nepal : production systems , constraints , and priorities for research*.

Paudyal, K. R., Ransom, J. K., Rajbhandari, N. P., Adhikari, K., Gerpacio, R. V., & Pingali, P. L. (2016). *Title : Maize in Nepal : production systems , constraints , and priorities for research*.

Pokhrel, S., Dhakal, S. C., & Pandey, S. (2018). *Economics of Maize Seed and Grain Production in Rolpa*. *2*(11), 43–50.

Pokhrel, S., Dhakal, S. C., & Pandey, S. (2018). *Economics of Maize Seed and Grain Production in Rolpa*. *2*(11), 43–50.

Journal of Agriculture and Natural Resources (2020) 3(1): 133-147
ISSN: 2661-6270 (Print), ISSN: 2661-6289 (Online)
DOI: https://doi.org/10.3126/janr.v3i1.27111

Prasad, R. (2004). *Text Book of Field Crop Producction.* New Delhi: ICAR.

R.Scheaffer. (1979). *Elementary survey sampling.* USA: duxbury press.

Rajbhandari, K. a. (1993). Some Innovative Aspects of Nepal's Seed Program. *Seed Research , Special volume No. 2*.

Sapkota D., & Pokhrel S. (2010). Community based maize seed production in the hills and mountains of Nepal: A review. *Agronomy Journal of Nepal*, *1*(107).

Sapkota, M. (2016). *Economic Analysis of Maize Seed Production in Palpa District of Nepal: Prospects of Improving Technical Efficiency.* Chitwan.

Sapkota, M., Joshi, N. P., Kattel, R. R., Bajracharya, M., Division, D., & Office, A. D. (2017). *Technical Efficiency and Its Determinants on Maize Seed Production in Palpa Scientist , Nepal Agricultural Research Council , Communication , Publication and Associate Professor , Ph . D ., Taoyako Program , Graduate School for International Development a*. (May). https://doi.org/10.20944/preprints201705.0067.v1

Seyoum, E. T., Battese, G. E., & Fleming, E. M. (1998). Technical efficiency and productivity ofmaize producers in eastern Ethiopia: a study of farmers within and outside the Sasakawa-Global 2000 project. Agricultural economics, 19(3), 341-348.

Shrestha, A., & Shrestha, J. (2017). Production, Problems and Decision Making Aspects of Maize Seed Producers in Banke District, Nepal. *Azarian Journal of Agriculture,* 4(6): 212-216.

SQCC. (2013). National Seed Vision 2013-2015,Seed Sector Development Strategy. Hariharbhawan ,Lalitpur: National Seed Board, MoAD..

Subedi, S., Ghimire, Y.N., Adhikari, S.P., Devkota, D., Shrestha, J., Poudel, H.K., & Sapkota, B.K. (2019b). Adoption of certain improved varieties of wheat (*Triticum aestivum* L.) in seven different provinces of Nepal. *Archives of Agriculture and Environmental Science*, *4*(4), 404-409

Subedi, S., Ghimire, Y.N., Gautam, S., Poudel, H.K., & Shrestha, J. (2019a). Economics of potato (*Solanum tuberosum* L.) production in terai region of Nepal. *Archives of Agriculture and Environmental Science, 4*(1), 57-62

Thapaliya, J. (2006). *Constraints and Approaches for developing market access and vertical linkage in high value crop.* KAthmandu: MoF.

Tripp, R. (2000). *Strategies for seed system development in Sub-Saharan Africa.* ICRISAT, Pantancheru, India.