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Comparative Advantages of Lentil (*Lens culinaris*) and Mustard (*Brassica nigra* L.) Production and their Profitability in a Selected District of Bangladesh

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Abstract

The present study was conducted to estimate the profitability, domestic resource cost (DRC) and comparative advantages of lentil and mustard production in Bangladesh. Primary data were used in this study, where a total of 100 randomly selected farm survey (Mustard 50 & Lentil 50) was conducted in Meherpur district using structured questionnaire. The study revealed that per hectare total cost and net profit of lentil production were about Tk. 78,442 and Tk. 86,590, respectively, whereas they were Tk. 62,527 and Tk. 38,718 for mustard production. The benefit cost ratios (BCR) of lentil and mustard production were 2.32 and 1.73, respectively, indicating that both lentil and mustard cultivation in Bangladesh are profitable. The domestic resource costs (DRC) of lentil and mustard production were 0.39 and 0.55, respectively which imply that Bangladesh has comparative advantage in producing both lentil and mustard. The Cobb-Douglas production function coefficients show that farm area, irrigation, pesticides, and chemical fertilizers (Gypsum, MP) were statistically significant factors affecting lentil production having increasing returns to scale. Farm area, irrigation and manure were statistically significant factors affecting mustard production with constant return to scale. In this study, production, technology and marketing problems have been listed down which will help the policy makers and the researchers to undertake proper steps for further improvement of lentil and mustard production in Bangladesh.

Keywords: Lentil and mustard production, Benefit-Cost Ratio (BCR), Profitability, Domestic Resource Cost (DRC), Cobb-Douglas Production Function.

1. Introduction

In Bangladesh, agriculture is the largest employment sector which employs 47% of the labor force and contributes to 14.8% of the country's' gross domestic product (GDP) (BBS, 2017). The performance of agriculture sector has a significant impact on poverty alleviation, food security, employment generation and poverty alleviation. Agriculture and nutrition are interlinked and agricultural products directly contribute to the family consumption of farming households.

Pulses are one of the vital ingredients in the diet list of the majority of the people in Bangladesh which contains about twice as much protein as cereals (Elias, 1986; Das, *et al*. 2016). Apart from this, pulses have the capability to fix nitrogen and adding organic matter to the soil as it is one of the essential factors in sustaining soil fertility (Senanayake *et al*., 1987). Lentil stands

1st in terms of area and consumers' preference in Bangladesh (Rahman, *et al.*, 2012). It is a popular edible crop among all pulses which contains 59% carbohydrate, 25% protein, and 0.7% fat (Afzal *et al.*, 1999).

On the other hand, supply and demand gap of edible oils is big that has been met through importing that incurs a lump sum amount of foreign exchange every year (Bangladesh Bank, 2012). Bangladesh is producing about 0.36 million tons of edible oil per year where the total amount of oil requirement is 1.4 million tons (Mallik, 2013). Import cost of mustard oil has increased from BDT 2.42 million in 2006 to BDT 50.59 million in 2014, which is extremely high (BBS, 2016). One of the key causes can be the replacement of high volume of palm oil import with mustard and soybean oils for consumption which is observed from 2006 to 2010 (BBS, 2014). In fact, mustard alone covers 80% of the total area under oilseed crops (Miah *et al.*, 2015). It attains first position among oilseed crops in terms of both area & cultivation. It is well known for its versatile uses. Oil-cake is used as both organic fertilizer and cattle feed and dry plant is also used as fuel (Hamjah, 2014).

In Bangladesh, the demand for edible oil and pulses are quite high. As to meet the domestic demand a huge amount of pulses, edible oils, and oilseeds have been imported from abroad spending a lot of foreign exchange. Bangladesh imported about 181,387 metric ton of lentil worth Tk. 1,133 crore and 2,539 metric ton of mustard worth Tk. 33 crore from abroad in 2014-2015 (BBS, 2015). So, it is very important to produce more pulses and oilseeds domestically rather than importing paying higher price. Bangladesh has favorable production environments such as weather condition, soil fertility, water availability and comparatively cheaper labor supply which can boost pulses and oilseeds production in Bangladesh.

Some research have conducted sporadically on the adoption practices and cultivation of oilseeds (Miah and Mondal, 2017; Hamjah, 2014) economic assessments such as profitability, gross margin (Salam and Kamruzzaman, 2015; Miah and Rashid, 2015; Miah *et al.*, 2015; Rahman *et al.*, 2012; Uddin *et al.* 2013; Dutta, 2016); Miah *et al.* 2004; Islam *et al.*, 2008; Shahabuddin, 2000), measurement of technical efficiency (Huq *et al.*, 2007; Dutta, 2016), constraints of production and marketing (Rahman *et al.*, 2012), rainfall variability and its impact (Kabir and Golder, 2017). However, the estimation of profitability, comparative advantages, and problems and prospects of lentil and mustard production in Bangladesh has been received less attention. Therefore, the present study estimates the financial, economic profitability and comparative advantage of lentil and mustard production. In addition, this study also explores the problems and prospects of lentil and mustard production in Bangladesh. Therefore, the findings of the study will help the policy makers and researchers to make appropriate policies and suggestions for the further development of lentil and mustard production in Bangladesh.

2. Methodology

2.1. Study area and data collection

Both primary and secondary data were used in this study. A total of 100 producers (of which 50 were lentil and 50 were mustard) were interviewed. A simple random sampling technique was applied to collect the information on socio-economic conditions of the selected households and input-output details of lentil and mustard using a comprehensive structured pretested questionnaire. A large number of farmers are involved in lentil and mustard cultivation in Meherpur district because the weather condition, soil and overall environment are favorable for lentil and mustard production in the area. This study was conducted in Meherpur district during April, 2017.

2.2. Analytical techniques

2.2.1. Analysis of profitability of lentil & mustard cultivation

Analysis of measurement of economic and financial profitability of lentil and mustard

cultivation are discussed in this section. The opportunity costs of cultivated land and family supplied labor were considered as fixed cost to estimate the total cost. Irrigation cost, pesticide cost, land preparation cost, seed and seedling cost, fertilizer cost and hired labor cost were calculated based on current market inputs price and were considered as variable cost. Total cost was estimated by adding variable cost and fixed cost. The output of lentil and mustard and their prices were taken into consideration in estimating gross return.

The below equations were used to estimate the costs of lentil and mustard cultivation.

$VC_{ij} = \sum_{i=1}^{n}(X_{ij}P_{ij})$ ..... (1)

$TVC_{ij} - VC_{ij} + IOC_{ij}$ ..... (2)

$TC_{ij} = TVC_{ij} + TFC_{ij}$ ..... (3)

Where,

$TC_{ij} = Total\ cost\ (Tk/ha) of\ j^{th} crop\ incurred\ by\ i^{th} farmer$

$TVC_{ij} = Total\ variable\ cost\ (Tk/ha) of\ j^{th} crop\ incurred\ by\ i^{th} farmer$

$TFC_{ij} = Total\ fixed\ cost\ (Tk/ha) of\ j^{th} crop\ incurred\ by\ i^{th} farmer$

$VC_{ij} = Variable\ cost\ (Tk/ha) of\ j^{th} crop\ incurred\ by\ i^{th} farmer$

$IOC_{ij} = Interest\ on\ operating\ capital\ (Tk/ha)\ of\ j^{th}\ crop\ incurred\ by\ i^{th}\ farmer$

$X_{ij} = Quantity\ of\ inputs\ used\ (kg/ha) of\ j^{th} crop\ by\ i^{th} farmer$

$P_{ij} = Price\ of\ inputs\ (Tk/kg)\ used\ for\ j^{th} crop\ by\ i^{th} farmer$

i = Number of farmers (1.2.3.....100)

j = Number of crops

The below equations (4-6) were used for estimating the profitability of lentil and mustard production.

$GP_{ij} = \sum Y_{ij}P_{ij}$ ..... (4)

$NR_{ij} = GR_{ij} - TC_{ij}$ ..... (5)

$GM_{ij} - GR_{ij} - VC_{ij}$ ..... (6)

$BCR_{ij} = \frac{GR_{ij}}{TC_{ij}}$ ..... (7)

Where,

$GR_{ij} = Gross\ return\ (Tk/ha)\ from\ j^{th} crop\ received\ by\ i^{th} farmer$

$NR_{ij} = Net\ return\ (Tk/ha)\ from\ j^{th} crop\ received\ by\ i^{th} farmer$

$GM_{ij} = Gross\ margin\ (Tk/ha)\ from\ j^{th} crop\ received\ by\ i^{th} farmer$

$P_{ij} = Price\ (Tk/kg)\ from\ j^{th} crop\ received\ by\ i^{th} farmer$

$Y_{ij} = Quantity\ of\ j^{th} crop\ (kg/ha)\ received\ by\ i^{th} farmer$

$BCR_{ij} = Benefit\ cost\ ratio\ of\ j^{th} crop\ for\ i^{th} farmer$

2.2.2. Benefit-Cost Ratio (BCR)

Benefit Cost Ratio (BCR) is an indicator to analyze the relationship between benefit and cost of any project in monetary terms. Higher BCR expresses higher return from the production and vice-versa. Usually total cost is used for calculating BCR. But we also used variable cost for calculating BCR.

For total cost,

$$BCR = \frac{TR}{TC}$$

For variable cost,

$$BCR = \frac{TR}{VC}$$

The project will be considered as a profitable investment if the BCR is higher than one and vice versa.

2.2.3. Domestic resource cost (DRC) estimation

Domestic resource cost (DRC) is the ratio of non-traded inputs (shadow price value) and cost of domestic resources of producing a good to net foreign exchange saved or earned by producing the commodity domestically. DRC is a measure which is used to evaluate the production efficiency of lentil and mustard with respect to comparative advantage. The following equation was used to estimate the domestic resource cost (DRC) of lentil and mustard production (Bruno, 1965; Krueger, 1966; Monake, 1981):

$$DRC = \frac{\sum D_{ij} V_i}{B_i - \sum T_{ik} V_k}$$

(j = 1----------m; k = 1----------n)

Where,

DRC = Domestic cost resource

D_{ij} = Quantity of j^{th} domestic resources and non-traded inputs used for producing **i** crop per metric ton

V_i = Price of j^{th} domestic resources and non-traded inputs (Tk/mt)

T_{ik} = Quantity of k^{th} tradable inputs for producing i crop per metric ton

V_k = Border price of tradable inputs k per unit metric ton

B_i = Border price of **i** crop (Tk./mt)

When DRC>1, it implies that the foreign exchange or savings is less than domestic costs which indicates that i crop should be imported instead of producing domestically as the economy faces loss of foreign exchange through crop production domestically. Contrariwise, DRC<1 means that domestic production of i crop helps economy to save foreign exchange either for import or export substitution as the foreign exchange saved or earned is greater than the opportunity cost of non-traded inputs and domestic resources used to produce i crop.

2.2.4. Cobb-Douglas production function estimation

The following Cobb-Douglas production function was used in order to estimate the contribution of factors that influence production of lentil and mustard in the study areas:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + \varepsilon_i$$

Where,

Y = Output from lentil & mustard (kg)

X_1 = Farm Area (acre)

X_2 = Irrigation (No. of application)

X_3 = Pesticides (No. of application)

X_4 = Seed (kg)

X_5 = Manure (kg)

X_6 = Urea (kg)

X_7 = TSP (kg)

X_8 = MP (kg)

X_9 = Gypsum (kg)

X_{10} = Labor (man-day)

β_0 is intercept and β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8,β_9, β_{10} are the coefficients of the regression to be estimated. u_i is the error term which is independently distributed with zero mean and constant variance. In addition, one sample t-test was used to find out the significance level of the variation of variables in the regression model.

3. Results and Discussions

3.1. Economic analysis of lentil and mustard production

The economic analysis of lentil and mustard production measures how better allocation of resources with minimum cost can maximize the output. The total cost of lentil and mustard production includes both fixed cost and variable cost. On the other hand, the profit or net return considers revenue from lentil and mustard production.

3.1.1. Variable cost
Variable cost considers the cost of seed, pesticides, irrigation, land preparation, hired labor, manure and fertilizers and interest on capital for lentil and mustard production in this study. The average variable cost of per hectare lentil production was estimated at about Tk. 47,127 and Tk. 32,288 for mustard production. Among the variable costs, hired labor had the highest cost covering about 21% and 14% of the total cost for lentil mustard production, respectively.

3.1.2. Fixed cost
Fixed cost is considered as the opportunity cost of own land, family supplied labor and inputs that the farmer used from their own house without any money outlay in this study. Family labor cost was measured by considering the daily wage of hired female and male labor in the current farm gate market price. The average fixed cost of per hectare lentil production was estimated at about Tk. 31,315 and Tk. 30,239 for mustard production. The land rent covered more or less one third of the total cost (as 25% and 32%) for lentil and mustard production, respectively.

3.1.3. Total cost
The average total cost of per hectare lentil production was estimated at about Tk. 78,442 and Tk. 62,527 for mustard production, respectively in the study area (Table 1). The average fixed cost covered about 40% and 48% of the total cost for lentil mustard production, respectively. On the other hand, the variable cost covered more or less three fourth of the total cost as 60% and 52% of the total cost for lentil and mustard production. The components of fixed and variable costs of per hectare lentil and mustard production were varied significantly within the producers (statistically significant at 1% level).

Table 1. Cost of per hectare lentil and mustard production in the study area

Particular	Lentil		Mustard	
	Tk./ha	%	Tk./ha	%
A. Variable cost (Tk.)	**47126.82*** **	60.1	**32288.36*** **	51.6
Seed	4242.07***	5.4	552.40***	0.9
Irrigation	3064.55***	3.0	3698.57***	6.8
Fertilizer	7756.12***	9.8	6966.08***	11.1
Manure	4058.78***	5.1	3386.46***	5.4
Pesticides	3961.73***	3.7	1563.57***	2.7
Land Preparation	7116.59***	9.0	7120.22***	11.4
Hired Labor	16575.82***	21.1	8760.66***	14.0
Interest on Capital	350.82***	0.4	240.36***	0.4
B. Fixed cost (Tk.)	**31315.14*** **	39.9	**30238.89*** **	48.4
Family Labor	11793.64***	15.0	9998.47***	16.0
Land Rent	19521.50***	24.8	20240.42***	32.3
C. Total cost (A+B)	**78441.96*** **	100	**62527.25*** **	100

Note: *** represents statistically significant at 1% level.

Table 2. Profitability of per hectare lentil & mustard production in the study area

Particular	Lentil	Mustard
1. Seed Yield (Kg/ha)	1723.01***	1860.249***
2. Price (Tk./kg)	95.98***	54.6***
3. Gross Return (Tk./ha)	165031.93***	101245.50***
4. Total Variable Cost (Tk./ha)	47126.82***	32288.36***
5. Total Cost (Tk./ha)	78441.96***	62527.25***
6. Gross Margin (Tk./ha) (3-4)	117905.11***	68957.14***
7. Net Return (Tk./ha) (3-5)	86589.97***	38718.25***
8. Rate of Return		
Over Variable Cost (3/4)	3.50	3.14
Over Total Cost (3/5)	2.10	1.62

Note: *** represents statistically significant at 1% level.

Table 3. Economic profitability and domestic resource cost of lentil and mustard production

Particular	Lentil (Tk./ha)	Mustard (Tk./ha)
(i) Cost of Traded Inputs	7756.12	6966.09
(ii) Cost of Non-traded Inputs & Domestic Resources	70334.67	55320.80
Irrigation	3064.55	3698.58
Seed	4242.07	552.40
Manure	4058.78	3386.47
Pesticides	3961.73	1563.57
Human Labor	28369.45	18759.13
Land Rent	19521.49	20240.42
Land Preparation (Tractor Cost)	7116.59	7120.23
(iii) Total Input Costs (i+ii)	78090.79	62286.89
(iv) Output Price	186085.31	107894.42
(v) Net Profit (iv-iii)	107994.52	45607.53
(vi) BCR (iv/iii)	2.38	1.73
(vii) Value Added (Tradable) (iv-i)	178329.18	100928.33
(viii) DRC (ii/vii)	0.39	0.55

3.1.4. Profitability of lentil and mustard production

On an average, the estimated gross return (GR), gross margin (GM), net return (NR)were about Tk. 165,032, Tk. 117,905 and Tk. 86,590 for per hectare lentil production and about Tk. 101,246, Tk. 68,957 and Tk. 38,718 for mustard production, respectively (Table 2).

The figures in Table 2 also shows that the rate of return was estimated at 2.1 over total cost and 3.5 over variable cost for lentil production while it was 1.62 over total cost and 3.14 over variable cost for mustard production. The rate of return of both lentil and mustard production indicates that both the crops are profitable enterprise in the study area. The gross return, total cost, gross margin, net return, and rate of return over

variable and total cost of lentil and mustard production were significantly varied (statistically significant at 1%) within the sampled producers in the study area. On an average, the seed yield (kg/ha) from lentil cultivation was around 1,723 kg and about 1,860 kg for mustard cultivation which was also significant at 1% level significantly.

3.1.5. Comparative advantage of lentil and mustard production

When a country produces a commodity at a lower cost than any other countries, it means that the country has comparative advantage over producing that commodity. This implies that the country should produce more of those commodities which have lower opportunity costs and be concerned about exporting those commodities if possible. On the other hand, the country should decrease production of those commodities which have higher opportunity costs producing domestically rather importing at a cheaper price from abroad. In this study the import prices were taken in terms of world prices and the domestic prices were taken in farm gate prices to measure the comparative advantage for both lentil and mustard production in the country.

Domestic resource cost (DRC) indicates the comparative advantage of lentil and mustard production. If domestic resource cost is greater than one, the country loses foreign exchange through domestic production and there are negative benefits of production. If domestic resource cost is less than one, the country can save foreign exchange and domestically produce the crop. The figures in the Table 3 show that the estimated DRC for lentil was 0.39 and 0.55 for mustard production which was less than one, indicating that Bangladesh has comparative advantage over both lentil and mustard production. Miah and Rashid (2015) conducted a research on profitability and comparative advantage of oilseed production in Bangladesh, where they used DRC method to evaluate the comparative advantage of oilseeds in Bangladesh. They also found that Bangladesh has comparative advantage of producing oilseeds. On an average, the BCR of lentil and mustard production was 2.38 and 1.73, respectively, indicating that both lentil and mustard are profitable crops in the study area.

3.2. Cobb- Douglas production function estimation

3.2.1. Definition of variables

The Cobb-Douglas production function signifies the relationship between inputs and the amount of outputs that can be produced in a production process. In this study, Cobb-Douglas production function has been used where output denotes as the dependent variable and farm area, irrigation, pesticides, seed, manure, urea, TSP, MP, gypsum, and labor are considered as the independent variables.

3.2.2. Summary statistics of the variables used in Cobb-Douglas production function

The descriptive statistics of independent and dependent variables which were used in this Cobb-Douglas production function is represented in table 4. The average amount of output was 448 kg ranging from 180 kg to 1200 kg with a standard deviation of 204.92 kg using average farm of 0.64 acre that lies between 0.33 acre and 1.32 acre with a standard deviation of 0.24 acre for lentil cultivation. On an average, the number of the application of irrigation was estimated at 1.34 ranging from 1 to 3 having a standard deviation of 0.52 and for pesticides, the average number of application was estimated at 1.54 that vary between 1 and 3 with standard deviation of 0.68. The average quantity of seed was measured at 11.61 kg which was varied between 4 kg and 28 kg with standard deviation of 5.04 kg. The amount of manure implied was 52.9 kg on an average ranging from 20 kg to 130 kg with a standard deviation of 23.59 kg, whereas the mean amount of urea was found to be 20.7 kg ranging from 8 kg to 42 kg with 7.65 kg standard deviation. The average quantity of TSP was found at 35 kg which ranging from 12 kg to 100 kg with standard deviation of 17.82 kg and the mean quantity of MP was 22.6 kg varying

between 8 kg to 84 kg having 14.02 kg of standard deviation. Gypsum was used 39.56 kg on an average with a standard deviation of 25.24 ranging from 12 kg to 135 kg. The mean labor (man-day) was estimated at 29.44 which lie between 15 and 62 with a standard deviation of 9.84. This table also showed the summary statistics of inputs used and output of mustard production. All the inputs used and output produced for both lentil and mustard were statistically significant which varied significantly (1%) among the lentil and mustard producers in Meherpur district.

Table 4. Descriptive statistics of independent & dependent variables in Cobb-Douglas production function.

Variables	Lentil				Mustard			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Output	448***	204.92	180	1200	484.8***	220.48	180	1380
Farm Area	0.64***	0.24	0.33	1.32	0.65***	0.28	0.33	1.65
Irrigation	1.34***	0.52	1	3	1.72***	0.70	1	3
Pesticide	1.54***	0.68	1	3	1.82***	0.66	1	3
Seed	11.61***	5.04	4	28	2.9***	1.66	0.5	10.5
Manure	52.9***	23.59	20	130	1758.8***	822.54	600	5200
Urea	20.7***	7.65	8	42	20.42***	9.85	8	60
TSP	35***	17.82	12	100	28.85***	12.85	12	80
MP	22.6***	14.02	8	84	19.61***	9.46	7	56
Gypsum	39.56***	25.24	12	135	41.66***	18.14	15	120
Labor	29.44***	9.84	15	62	19.28***	6.33	9	38

Source : Field Survey, 2017. Notes: *** indicates 1% significance level.

Table 5. Estimation of Cobb-Douglas production function for lentil & mustard production.

Explanatory Variables	Lentil			Mustard		
	Coefficients	SE	t-values	Coefficients	SE	t-values
Farm Area (lnX_1)	0.61***	0.17	3.65	0.53***	0.17	3.14
Irrigation (lnX_2)	0.18***	0.05	3.67	0.12***	0.04	3.33
Pesticides (lnX_3)	0.082**	0.04	2.06	-0.02	0.03	-0.6
Seed (lnX_4)	-0.08	0.13	-0.57	0.07	0.06	1.18
Manure (lnX_5)	0.01	0.15	0.08	0.36***	0.11	3.28
Urea (lnX_6)	0.07	0.11	0.6	0.02	0.14	0.17
TSP (lnX_7)	0.05	0.10	0.49	-0.02	0.15	-0.11
MP (lnX_8)	0.14*	0.08	1.7	0.04	0.12	0.34
Gypsum (lnX_9)	0.17**	0.08	2.02	0.03	0.12	0.22
Labor (lnX_{10})	-0.05	0.04	-1.34	-0.08	0.06	-1.32
Constant	5.17	0.60	8.57	3.58	1.03	3.49
Returns to Scale (RTS)	1.18			1.06		
R^2	0.97			0.98		
F- Value	121.60			250.16		

Source: Field Survey, 2017. Note: ***,** & * indicate 1%, 5% & 10% significance level, respectively.

3.2.3. Cobb-Douglas production function analysis

In this study, Cobb-Douglas production function was used to analyze the contribution of independent variables which were used in lentil and mustard production in the study area. The estimates of Cobb-Douglas production function are presented in table 5. The coefficients of farm area, pesticides, irrigation, MP and gypsum were statistically significant for lentil production which indicates that there were significant positive impacts on lentil production. All other inputs used in the production process had some positive and negative impacts however, they were not statistically significant. On the other hand, the coefficients of Cobb-Douglas production function of mustard crop of farm area, pesticides and manure were statistically significant, indicating they had significant effects on mustard production. All other factors had some effects on mustard production but they were not statistically significant.

The return to scale was calculated by summing up the coefficients of all inputs which was about 1.18 for lentil production and 1.06 for mustard production. This specifies that the Cobb-Douglas production function exhibited increasing return to scale for lentil production and constant return to scale for mustard production. The goodness of fit of production function represented by the coefficient of the determination (R^2) was estimated about 0.97 and 0.98 for lentil and mustard production, respectively. This implies that the production function was explained about 97% and 98% by the independent variables used Cobb-Douglas production function which was significant at 1% level statistically for both lentil and mustard production, respectively.

3.3. Problems and barriers along with suggestions of lentil & mustard production

In this study, the sampled farmers faced some problems during lentil and mustard cultivation, which along with farmers opinion and suggestions are explained below.

3.3.1. Production problems of lentil & mustard cultivation

Table 6 shows the list of production related problems that the lentil and mustard producers of Meherpur district have faced. One of the major problems producers faced was high input prices and more than 70% of both lentil and mustard producers mentioned it. After that, high labor cost and lack of capital covered more than 50% while unpredictable climate covered about 40% of the production problems for both lentil and mustard producers. Apart from these three major problems the producers have faced are unavailability of high productive seeds and unable to identify crop diseases. Moreover, insufficient amount of capital hindered the producers from applying sufficient amount of inputs at an optimum level for lentil and mustard production in the study area.

Table 6. Production problems of lentil & mustard producers

Problems	Lentil		Mustard	
	Number	%	Number	%
High input price	40	80	37	74
Unavailability of improved seed	25	50	15	30
Unavailability of fertilizer &pesticides	15	30	10	20
Unpredictable climate	20	40	24	48
Fragmentation of land	17	34	13	26
Lack of knowledge about improved seed	23	46	16	32
Lack of capital	28	56	25	50
High labor cost	30	60	26	52
Complexity in identifying crop diseases	16	32	14	28

Source: Field survey

3.3.2. Technical problems of the producers

Technical problems hinder producers to adopt new technology to be able to produce more than before. It is clear that more than 60% of the lentil and mustard producers were struggling with technical knowledge which is presented in table 7. Moving to that, 50% of the producers faced the problem of lack of improved machines and 40% of the lentil and mustard producers complained to have unskilled labor. In addition to this, there were others technical problems such as unavailability of storage, lack of training, and unavailability of modern technology which the farmers thought quite expensive to adopt.

3.3.3. Marketing problems of the producers

Farmers keep a certain amount of their produced crops for consumption and store them while rest are left for sale. Higher the portion of marketable surplus, greater it will lead to economic development. Marketing of crops is very challenging for any producer and also in this study, certain marketing problems are mentioned by the producers which are listed in table 8. One of the most unavoidable problems which above 80% of the producers of both lentil and mustard producers complained are the low price of these crops where more than 60 % of the producers complained about having delay in payments. The producers of both lentil and mustard are also facing difficulties regarding transportation, market structure, maintenance and regulations.

Table 7. Technical problems of lentil & mustard producers

Problems	Lentil		Mustard	
	Number	%	Number	%
Lack of skilled labor	24	48	21	42
Lack of training	23	46	15	30
Unavailability of storage facilities	15	30	17	34
Lack of improved machines	29	58	26	52
Unavailability of modern technology	15	30	12	24
Lack of technical knowledge	31	62	33	66

Source : Field Survey, 2017

Table 8. Marketing problems of lentil & mustard producers

Problems	Lentil		Mustard	
	Number	%	Number	%
High transportation cost	9	18	13	26
Lack of transportation means	14	28	17	34
Malpractices in the market	19	38	14	28
Unavailability of markets	20	40	24	48
Storage problem in the market	34	68	26	52
Improper grading & standardization	23	46	21	42
Complex market regulations	22	44	20	40
Delay in payment	35	70	33	66
High marketing charges	17	34	21	42
Market maintenance difficulties	25	50	27	54
Low price of mustard and lentil	45	90	42	84

Source: Field Survey, 2017.

Table 9. Suggestions from the lentil & mustard producers

Suggestions	Lentil		Mustard	
	Number	%	Number	%
Fair price of lentil and mustard in the market	45	90	41	82
Availability of inputs in market	15	30	20	40
Reduce input prices in market	45	90	48	96
Improved technology	27	54	30	60
Access to improved technology	34	68	22	44
Arrangement of training program	30	60	27	54
Facilities from Government	43	85	41	82
Storage facilities	17	34	9	18
Loan facilities	40	80	37	74

Source: Field Survey, 2017

3.3.4. Suggestions and opinions from the producers

The producers in the study area were very cooperative and shared their valuable opinions and suggested some important solutions in order to cope up with the problems mentioned earlier. Table 9 shows the list of their suggestions where more than 90% of the producers reported to reduce the price of inputs whereas more than 80% of the producers suggested to have fair price of lentil and mustard in the market and facilities from government for both lentil and mustard, respectively. Furthermore, more than 70% of the producers requested for loan facilities whereas more than 50% asked for training facilities for both lentil and mustard production. The other suggestions were to have storage facilities, access to improved technology and availability of inputs in the market and access to improved technology.

4. Conclusions

On an average, per hectare estimated gross return, gross margin and net returns for lentil were about Tk. 165,032, Tk. 117,905 and Tk. 86,590 whereas the equivalent values were Tk. 101,246, Tk. 68,957 and Tk. 38,718 for mustard production, respectively. The average yields of lentil and mustard were estimated at about 1,723 kg per hectare and 1,860 kg per hectare, respectively. The estimated rate of return was 2.1 times over total cost and 3.5 times over variable cost for lentil production, whereas it was 1.62 over total cost and 3.14 over variable costs for mustard production. The BCR were 2.32 and 1.73 for lentil and mustard, respectively, which indicates that both lentil and mustard production are profitable in the study area. The calculated DRC were 0.39 and 0.55 for lentil and mustard production was less than the unitary, implying that Bangladesh has a comparative advantage in both lentil and mustard production compared to other countries. The estimated Cobb-Douglas production function results indicate that the farm area, irrigation, pesticides and chemical fertilizers (Gypsum, MP) were statistically significantly affecting the lentil production whereas the farm area, irrigation and manure were statically significantly affecting the mustard production. The producers have enjoyed an increasing return to scale for lentil production and constant return to scale for mustard production. Most of the producers of lentil and mustard production have faced several problems regarding high input price, lack of modern technology and market regulation. Therefore, the policy makers and researchers should take necessary and appropriate policies for the further development of lentil and mustard production in Bangladesh.

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