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Factors affecting land allocation for maize cultivars in Lalmonirhat District of Bangladesh

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Abstract

Maize is considered as the third most important cereal crop and has more versatile uses in Bangladesh. The study was undertaken to examine the profitability and technical efficiency of maize production as well as to determine the influence of various socio-economic features on farmers' land allocation for maize farming in Bangladesh. In doing so, the study utilized the farm-level data collected by the field survey in Lalmonirhat district of Bangladesh. A total number of 60 farmers were selected by using stratified random sampling method among which 36, 20 and 4 farmers were selected under three strata, small, medium and large farmers, respectively. Data were analyzed using simple statistical techniques as well as OLS regression analysis. The comparative analysis among different strata of farmers by this study brought into being that large farmers received higher profit compared to the small and medium farmers. The other results of the study include that maize cultivation helped a lot in improving the nutritional status of the rural people; in creating employment opportunity for them and in increasing household income in the study area. The result of the OLS method suggests that factors like education level, neighbor's influence, farm size and higher output price of maize have significant influence upon the choice of farmer's land area allocation for maize cultivation in the study area. Based on the findings, this study recommends that proper initiatives must be undertaken by the responsible authority to ensure the efficient use of resources by the maize farmers.

Key words: Land allocation, maize cultivars, Lalmonirhat District, Bangladesh

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Introduction

Bangladesh is the 8th most populous country in the world with a total population of 155.8 million, population growth rate is 1.37% (BER 2014) and its density of population is 1015 persons per Km^2 (BER, 2014). More than 70% of the country's population as well as 48.40% of its labour force directly and indirectly depend on agriculture and contributing 12.64% to the GDP (BBS, 2014). Maize or corn (*Zea mays*) is cultivated globally being one of the most important cereal crops. In Bangladesh, the demand for maize has increased in recent years due to expansion of poultry and livestock industries. The spread of maize cultivation in Bangladesh is in an increasing trend with the increase in poultry industry as well as increase in maize price. Maize was introduced as relatively new crop in the cropping patterns of Bangladesh especially in the northern region of Bangladesh. Since two decades, maize production rose dramatically at this region. It is the third most important cereal crop in Bangladesh, after rice and wheat. It is a major cash

crop, and is one of the major sources of employment for the people in Lalmonirhat district of Bangladesh. In the last decade, a significant portion of land has been using for maize production in the northern region of Bangladesh. By division, Rangpur has the highest (53.2%) land area allocation (79234.6 ha) for maize cultivation and also highest (49.5%) share (388599 ton) of total maize production in Bangladesh (BBS, 2010). Increasing trend in area and production level in case of maize need to be identified for better understanding the potential productivity of maize in northern Bangladesh. The nutritional value of maize, its economic importance and its incredibly diverse uses have made significantly important for Bangladesh agriculture. Maize can also be considered as an alternative food to introduce food crop diversity, dietary variety and addressing issues of food security. If the rigid food habit is to be diversified from rice to maize, it would probably be possible to reduce food shortage to a great extent. Bangladesh has a great opportunity to sustain such kind of flow in maize cultivation, processing and marketing are postulated in scientific manner.

Most of the people in Northern region are directly involved in agriculture to earn their livelihood (Alam and Karim, 2010). Maize cultivation is one of the major sources of employment for the people of Lalmonirhat district**.** Maize is relatively new crop in the *Char* lands of Teesta and in this region, farmers always receive more profit from maize than other crops. As a result, most of the cultivated areas in this region cultivate maize and such new pattern of maize cultivation has also been significantly contributing to the poverty reduction and achieving economic self-reliance by the poor in recent years in the region. Most of the people in Lalmonirhat district are flood affected, as a result higher portion of land fall under the *Char* area. *Char* areas of Lalmonirhat district is more suitable for maize cultivation because it requires less water than rice and wheat, can be grown as relay and cash crop and less prone to insect and disease attack. But maize farmers are not very aware of the benefits of maize cultivation and are afraid to invest in maize cultivation due to insufficient information on maize farming and marketing techniques. While making production decision, they consider cost of production against the yield of the crop since the farmer in rural setting are often victims of risk and uncertainty. As a relatively new crop, few studies have been conducted on economic analysis of maize production (Hossain, 2015; Bashar, 2013; Alam and Karim, 2010; Moniruzzaman et. al, 2009; Uddin, et. Al, 2008; Alam and Karim, 2009), but there is no study conducted to search the reason behind such a huge land allocation for maize farming.

Thus, the present study was undertaken to determine the influence of various socio-economic features on farmers' land allocation for maize farming in Lalmonirhat District. The broad objective of the study is to examine the profitability and technical efficiency of maize production in Lalmonirhat district. The specific objectives are to identify the socio-economic characteristics of maize farmers, determine the profitability of maize production and examine the factors affecting the choice of land allocation for maize production.

Materials and Methods

Lalmonirhat is one of the important districts where the maize crop is grown intensively. In order to achieve the objectives under this study, survey was conducted in three villages namely Parulia, Barakhata and Dowabari under Hatibandha upazila. The purpose of the study was to determine the farmer's choice on land allocation for maize farming in Lalmonirhat District. To fulfill the purposes, the survey was conducted during the period of February-April, 2015 making frequent visits to the sample farmer's households. Total sample size was 60, among which 36 small farmers (land holdings 0.02 ha to 1.0 ha), 20 medium farmers (land holdings 1.01 ha to 2.0 ha) and 4 large farmers (land holdings 2.01 ha to above) were selected by using stratified random sampling technique. In order to determine the net returns from maize production, gross costs (variable and fixed costs) were deducted from gross returns. An

easy principle to determine costs and return was followed to determine the profitability of maize production. For this purpose, the following equation was used and applied for each of the selected farmers:

$\Pi = Pm* Ym+Pb* Yb-\Sigma (Pxi * Xi)-TFC$

Where, the variables are specified as follows;

Π = Net return;

Pm = Price of main product per units;

Ym = Total quantity of main product;

Pb = Price of by-product per unit;

Yb = Quantity of by-product;

Pxi = Price of ith input per unit used for maize Production;

Xi = Quantity of the ith input used for maize production; and

TFC = Total fixed cost; i= 1, 2, 3 .....n (number of input).

Finally, to analyze the factors affecting land area allocation for maize farmers, the Ordinary Least Square (OLS) regression method was employed. The specification of the OLS method is of the following form:

$$Y=\beta_0+\beta_1X_1+\beta_2X_{2+}\ \beta_3X_{3+}\ \beta_4X_{4+}\ \beta_5X_{5+}\ \beta_6X_{6+}\ \beta_7X_{7+}\ \beta_8X_{8+}\ \beta_9X_{9+}\ \beta_{10}X_{10+}u_i$$

Where, the variables are specified as follows:

Y = Farmers land allocation to Production of maize;

X_1 = Education of the household (schooling years);

X_2 = Credit facility used (dummy 1= yes; 0=no);

X_3 = extension service used;

X_4= neighbors influenced power;

X_5= farm size (ha);

X_6 = higher output price;

X_7 = off farm income;

X_8 = lower cost;

X_9 = land suitability;

X_{10} = age of household head (years);

β_0 = Intercept;

$\beta_{1...}\ \beta_{10}$ = Coefficients of respective independent variables; and

u_i = the error term.

Results and Discussion

Socio-economic characteristics of the maize farmers

This section describes the socio economic characteristics of sampled maize farmers. It was found that the age structure of the sample farmers was classified into four age groups: below 30, 31-40, 41-50, and above 50 years. Table 1 reveals that about 11.66% of the maize farmers fell into the less than 30 years of age group. About 21.67% were between 31-40 years, 51.67% were between 41-50 years and rest of the farmers belonged to above 50 years of age groups. Family size was explained by classifying the families into three groups: small (0-5 members), medium (6-8 members), and large families consisting of more than 8 members. Table 1 data shows that 38.33% families of maize growers are small, 40.00% medium and remaining 21.67% are large families. To examine the educational status of maize growing framers, sample farmers were divided into four categories. These were a. illiterate, b. primary level (class 1-5), c. secondary level (class 6-10), and d. above secondary level of education. Those who cannot put signature, read and write were considered as illiterate. Table 1 displays the educational levels of the maize growers. It is evident from Table 1 that, most farmers (45%) were illiterate, although 28.33% received primary education. Moreover, 20% had secondary education and only 6.6% got education above secondary level. Furthermore, the results also indicate that large farmers were more illiterate compared to other two groups. The Table 1 shows that agriculture was the main occupation of the maize farmers amounting 81.67%. Some were also engaged in small trading and services. The data from Table 1 displays that small farmers cultivated 96.77%, medium farmers 98.41%, large farmers 97.77% and all farmers were cultivated 97.60% of the land under maize production. From table 1, it is evident that, the large farmers are more capable to lease out their land than small farmers and medium farmers.

Table 1. Socioeconomic characteristics of maize farmers

Variables	Classification	Small farmers (0.02-1.0 ha)		Medium farmers (1.01-2.0 ha)		Large farmers (2.1 - above ha)		All farmers	
		No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Age structure	Less than 30	5	13.88	2	10	-	-	7	11.66
	31-40	8	22.22	5	25	-	-	13	21.67
	41-50	20	55.56	8	40	3	75	31	51.67
	51+	3	8.33	5	25	1	25	9	15.00
Family size	Small family (0-5)	15	41.67	8	40	-	-	23	38.33
	Medium family (6-8)	13	36.11	8	40	3	75	24	40.00
	Large family (above 8)	8	22.22	4	1	1	25	13	21.67
	All	36	100	20	100	4	100	60	100
Level of education	Illiterate	17	47.22	7	35	3	75	27	45.00
	Primary level	11	30.55	5	25	1	25	17	28.33
	Secondary level	6	16.66	6	20	-	-	10	20.00
	Above secondary level	2	5.55	2	20	-	-	4	6.6
	Total	36	100	20	100	4	100	60	100
Occupational pattern	Agriculture	28 (77.78)		17 (85.00)		4 (100)		49(81.67)	
	Small business	8 (22.22)		2 (10.00)				10(16.67)	
	Services	-		1 (5.00)				1(1.68)	
	Total	36		20		4 (100)		60	
Allocation of land to maize cultivation	Average cultivated land (ha)	0.62		1.26		3.14		1.67	
	Area under maize (ha)	0.60		1.24		3.07		1.63	
	Percentages of maize area to total cultivated land	96.77		98.41		97.77		97.60	
Average land distribution (ha)	Own land	0.58		1.25		3.17		1.66	
	Leased in/ Rented in	0.05		0.04		0.03		0.04	
	Leased out/ Rented out	0.00		0.05		0.10		0.075	
	Net cultivated area	0.63		1.34		3.3		1.75	

Source: Field survey, 2015; Note: Figures within parentheses indicate percentage of total maize growers

In the study area, wage rate of human labor, on an average, was Tk. 250 per man-day. The total average costs of labor were TK. 19315.51, TK. 21612.77 and TK. 24700.00 for the small, medium and large farms respectively. Human labor cost was the highest for large farmers and lowest for small farmers. The majority of farmers used power tiller for land preparation. Since most of the farmers had no power tiller of their own, they had to hire power tiller for preparing the fields. The power tiller owner supplies fuel as well as a driver for land preparation. Per hectare cost of power tiller was Tk. 7805.00 Tk. 7410.00 and Tk. 7409.00 for the small, medium and large farms respectively. The average cost of power tiller for all categories of farms appeared to be Tk. 7541.33.

In the study area, all farmers used purchased seeds. The cost was estimated on the basis of actual prices paid by them. Most of the farmers brought it from the local markets. On an average, the price of maize seed was Tk. 425 per kg in the study area. Per hectare total cost of seed for maize production were calculated Tk. 8285. 15, Tk. 8285.15 and Tk. 8397.99 for small, medium and large farmers, respectively. Cost of seeds was the highest for large farmers and lowest for small and medium farmers. Farmers used five types of fertilizer namely Urea, Triple super phosphate (TSP), Muriate of potash (MOP) Gypsum and Borax for Maize cultivation. Fertilizer cost was determined by the actual market prices paid by the farmers. Per hectare cost for small, medium and large farms were Tk. 25993.18, TK. 25973.82 and Tk. 26010.00. Fertilizer cost was the highest for large farmers and lowest for medium farmers. Usually the farmers in the study areas used cow dung as manure for producing maize. Cow dung cost per hectare was Tk. 1234.99, Tk. 1728.99 and Tk. 2222.99 for small, medium and large farms. The average cost of cow dung for all categories of farms appeared to be Tk. 1731.00.

Table 2. Per hectare cost of maize production/ Cost of maize production per hectare

Particulars	**Small Farmers**		**Medium Farmers**		**Large Farmers**		**All Farmers**	
	(Tk./ha)	**(%)**	**(Tk./ha)**	**(%)**	**(Tk./ha)**	**(%)**	**(Tk./ha)**	**(%)**
Variable costs								
Labour	19315.51	23.98	21612. 77	25.26	24700.90	27.81	21876.09	25.86
power tiller	7805.00	9.69	7410. 00	8.66	7409.00	8.34	7541.33	8.87
Seed	8285.15	10.28	8285. 15	9.68	8397.99	9.45	8322.76	9.79
Fertilizer	25993.18	32.27	25973. 82	30.36	26010.00	29.29	25992.33	30.59
Cow dung	1234.99	1.53	1728. 99	2.02	2222.99	2.50	1731.00	2.03
Pesticides	985.73	1.22	985. 73	1.15	988.59	1.11	987.77	1.16
Irrigation	9879. 99	12.26	12350. 15	14.43	11755.51	13.23	11328.55	13.33
Total variable cost	73499. 55		78346. 46		81484.98		77779.83	
Fixed costs								
Interest on Operating capital	2572. 00	3.19	2742. 00	3.20	2851.00	3.21	2721.66	3.20
Land use cost	4453.00	5.52	4453.00	5.20	4453.00	5.01	4453.00	5.24
Total fixed cost	7025.44		7195.00		7304.41		7174.95	
A. Total cost (A+B)	80525.47		85542.02		88789.42		84952.30	
D. Total Return	150175.96		158082.02		162037.92		156765.30	
E. Net Return(D-C)	69650.49		72540.00		73248.49		71812.99	
F.BCR (Undiscounted)	1.86		1.84		1.82		1.83	

Source: Field survey, 2015.

Farmers used different kinds of pesticides to keep their crop free from the attack of pests and diseases. The cost of pesticides was calculated according to the amount of money which the farmer actually paid for maize production. The price of the pesticides largely varied from brand to brand. The actual cost of pesticides was used. The total average costs of pesticides per acre were Tk. 985.73, TK. 986.00 and TK. 988.59 for small, medium and large farms respectively. Irrigation is a leading input for production of maize. Farmers apply irrigation 2-4 times for the production of maize, although the number of irrigation depends on the soil type and farmers economic condition. Farmers in all the villages used irrigation water in the maize fields during cultivation period. It may be noted here that maximum of the selected farmers had to buy water from the owners of shallow tube-wells (STWs) and a few of them had their own STWs. The total average costs of irrigation per acre were Tk. 9879.99, TK. 12350.15 and TK. 11755.51 for small, medium and large farms respectively. Irrigation cost was the highest for medium farmers and lowest for small farmers.

Interests on operating capital of maize were Tk. 2572.00, Tk. 2742.00 and Tk. 2851.00 for small, medium and large farmers respectively. The average interest on operating cost for all categories of farms appeared to be Tk. 2721.66. In the study area, most of the farmers had own land for producing maize. The seasonal rental cost of land was treated as land use cost for the farmers. Land use cost was a fixed cost for the producers. Per hectare land use cost amounted to Tk. 4453.00 for small, medium and large farmers, respectively. In the present study, per hectare gross costs of producing maize were TK. 80525.47, Tk. 85542.02 and Tk. 88789.42 for small, medium and large farmers respectively. As a result, it was found that the highest and lowest costs per hectare were occurred in large and small farms, respectively.

Total return per hectare was calculated by multiplying total yield of Maize produced by that of farm-gate price during the time of harvesting. The farmers sold their Maize at different markets and at different prices. The average unit price of Maize's per kg considered in the present study was Tk.16.00. Total return per hectare was the highest in large farms of Tk. 162037.92 followed by the medium farms Tk. 158082.02 and small farms Tk. 150175.96. Per acre total return for all categories of farms was estimated at Tk. 156765.30. Net return was calculated by deducting total cost from total return. Per hectare net returns were calculated at Tk. 69650.49, TK. 72540.00 and TK. 73248.49 for small, medium and large farm size, respectively and its average net return per hectare was Tk. 71812.99. The result presented in the table indicates that maize is a profitable crop but there is a difference in profitability among individual farm groups. It indicates that net return was positively related with farm size in the study area. Benefit cost ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. In this study, BCR of maize was calculated as a ratio of gross return and gross cost. Per hectare Benefit Cost Ratios (BCRs) were estimated at 1.86, 1.84, and 1.82 for small, medium and large farmers, respectively. However, average per hectare benefit cost ratio of producing maize was calculated as 1.84.

Factors influencing the choice of land allocation for maize farming

The main purpose of the Ordinary Least Square (OLS) model was to identify the main factors that influenced farmers' choice on land allocation for maize farming. Ten variables were included in the model (education, credit, age, neighbors influence, farm size, higher output price, off farm income, lower cost, land suitability and extension). The variables that significantly increased the adoption of maize production were education, neighbors influenced power, farm size, and higher output price. The variables such as age of the household head, family size, which were expected to influence the adoption of maize and were included in the model, were found to be insignificant regarding their influence on the adoption of maize cultivation.

Table 3. Regression analysis of the various factors affecting the choice of land allocation for maize farming

Model variable	**Un standardized Coefficients**		**Standardized Coefficients**	**T value**	**Significance**
	Coefficient (B)	Std. Error	Beta		
(Constant)	-81.424	67.006		-1.215	.230
Education	32.969*	12.710	.183	2.594	.013
Credit	-25.043	19.925	-.076	-1.257	.215
Extension	14.512	20.610	.042	.704	.485
Neighbors influence	31.289***	19.655	.094	1.592	.008
Farm size	229.350*	15.942	.864	14.387	.000
Higher output price	40.093***	24.276	.123	1.852	.055
Off farm income	23.735	31.462	.046	.754	.454
Lower cost	-25.169	29.407	-.052	-.856	.396
Land suitability	14.593	31.859	.027	.458	.649
Age	1.180	1.725	.059	.684	.497
Dependent Variable: area under maize, Adjusted R square = 0.827, F value = 26.602***, Note *significant at 1% level, **significant at 5% level and ***significant at 10% level					

The regression coefficient of education of the sample farmers was 0.183 and positively related with farmers' land allocation for maize production, implies that one percent increase in education, keeping other factors constant, would lead to an increase in the maize production by 0.183 percent for maize. Educated farmers cultivated maize on more land compared to the uneducated farmers. Neighbors influenced power of the sample farmers was 0.094 and positively related with farmer's land allocation for maize production. Neighbors play an important role in production. In the study area, many farmers started maize cultivation after seeing from the Neighbors. They gathered mainly at tea stall or nearest market and discussed about the cultivation of maize. The regression coefficient of farm size was 0.864 and positively related with farmer's land allocation for maize production. Large farmers allocated their land to earn more profit. In this way, large farmers are becoming commercial farmers.

The regression coefficient of higher output price was 0.123 and positively related with farmer's land allocation for maize production. It implies that one percent increase of higher output price, keeping other factors constant, would lead to an increase in the maize production by 0.123 percent for maize. Maize price was higher in the study area compared to other crops. It was found that farmers are more satisfied on maize price than they receive for rice. Table 4 shows a comparison between maize and rice price. This information could be alarming for the country as it is not known in future, how much land will be shifted from rice and other crops to maize. Proper policy needs to be addressed

Table 4. Output price of Maize and Rice received by farmers.

Name of crops	Maize	Rice
Price per kg	16	15
Production per acre (kg)	4464	2232
Profit per acre (Tk.)	71424	35712

Source: Field survey, 2015.

Other variables such as credit, extension service, off farm income, lower cost and land suitability which were found to be insignificant regarding their influence on the farmers' land allocation to maize production.

Conclusion

Maize is considered as the third most important cereals crops and has more versatile uses in Bangladesh.-High production of maize depends on the expansion of HYV and hybrid variety of seed, improved management and timely supplying of inputs. The rate of adoption of modern technology and sustainability of maize production depend largely on its economic profitability. As maize is a profitable enterprise, so government and other research institutions should provide adequate extension programs to expand maize production. Key findings of the study include that the decision on production of maize is influenced by a number of important factors including education, neighbors influence over cultivators, farm size, and higher output price. Educational status of the respondents is very poor. So GOs and NGOs should take collaborative programmers to address this issue. Price of fertilizers and machinery should be regulated strictly by the intervention of the Government. The study also found that maize production is profitable in the study area. The comparative analysis among different strata of farmers by this study brought into being that large farmers received higher profit compared to the small and medium farmers. The effects of increasing cost for inefficient use of inputs like seed, manure, fertilizer, irrigation and insecticide had significant impact on gross return from maize production in case of all farmers. Based on the findings, this study recommends that proper initiatives must be undertaken by the responsible authority to ensure the efficient use of resources by the maize farmers.

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