A SEMINAR PAPER ON

Competitiveness, Profitability, Input Demand and Output Supply of Maize Production in Bangladesh

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COMPETITIVENESS, PROFITABILITY, INPUT DEMAND AND OUTPUT SUPPLY OF MAIZE PRODUCTION IN BANGLADESH

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ABSTRACT

The aim of this study was to highlight the growth scenario, competitiveness of maize production, financial profitability at the farm level and responsiveness of the maize farmers to input and output price changes in order to judge the potential of the maize sector as a driver of agricultural growth in Bangladesh. Demand for maize is increasing day by day in the world as well as in Bangladesh due to its diversified uses. If the rigid food habit of Bangladeshis is to be diversified from rice to maize, it would probably be possible to reduce food shortage to a great extent. Because, it is a high yielding and low-cost crop compared to rice and wheat. Growth rates of maize in terms of area, production and yield were comparatively higher in the period (1987-88 to 2005-06) than the period (1971-72 to 1986-87) as composite and hybrid varieties were just introduced after independence. Maize showed upward growth rates in terms of area, production and yield over the years. Results revealed that maize production is globally competitive and, therefore, can successfully substitute its import. Maize production is also profitable at the farm level (Benefit Cost Ratio = 1.21) with no adverse influence of farm size on yield and profitability. Maize farmers are also responsive to changes in market prices of inputs and outputs. A 1% increase in maize price will increase output supply by 0.4%. The most dominant driver of maize supply and other input demands is land. A 1% increase in available land will increase maize supply by a substantial 3.9%. In addition, landless laborers will benefit through an increase in hired labor demand when land area increases. Investments in research and development, tenurial reform to consolidate land holding and smooth functioning of the hired labor market can be effective policies in order to increase maize production and profitability in Bangladesh.

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CHAPTER I

INTODUCTION

Bangladesh is first and foremost an agricultural based country restrained by crop production. Bangladesh escalates by and large a sub-tropical monsoon climate. Bangladesh has been reputed for growing large variety of tropical crops particularly rice, wheat, Maize, jute, pulses, oilseeds, sugarcane etc. Maize is one of the utmost indispensable cereals crops and it is one of the foremost crops in the world. It is not only highly productive but also nutritious crop used as a human food, feed for poultry and fodder for livestock. Maize industry is a prospective industry and its escalation is also connected with national GDP. Bangladesh is one of the high populous countries in the world. Maize has an abundant panorama in Bangladesh. It has a substantial implication in nationalized economy. Maize in Bangladesh is fetching a vital crop in the rice grounded cropping system. It is grown just about done with Bangladesh in all season. It has prodigious probable which can subsidize for the improvement of animal industry and can come across rural energy requirement. The land of Bangladesh is suitable for maize production.

Maize (zea mays) is the utmost extensively grown cereal crop in the world. Maize is an industrially significant money-making crop. In the middle of the world's cereal crops, maize ranks second to wheat in production. Nonetheless, amongst the developing countries maize rank first in Latin America and Africa but third after rice and wheat in Asia (Dowswell et al., 1996). As the demand for maize crop has been shifting increasingly in the world, particularly in the developing countries, its requirement will also increase from 282 million tons in 1995 to 504 million tons in 2020 (Pingali and Pandey, 2000).

Traditionally, rice provides the largest carbohydrate source for most of South Asia's farm families, although with increasing affluence and preferences for fish and poultry protein in diets, maize production has increased from 20.51 to 35.47 Mt in last decade, with grain sold primarily to the feed industry (FAOSTAT, 2015). Maize adoption has been especially high in Bangladesh, where it was cultivated on approximately 1500 ha in 1984, but area rose rapidly to about 0.20 M ha in 2007–2008 and to 0.36 M ha in 2012–2013, largely through the replacement of pulses, oilseeds and wheat (FAOSTAT, 2015).

Compared to rice, production of other food crops- maize and wheat, were 2.36 million mt, and 1.34 million mt., respectively (BBS, 2016). Country's annual maize output reached the new high of 2.75

million tonnes in 2015-16 and 90 percent of the homegrown maize is feeding a burgeoning poultry and fish feed industry. With over 34 million tonnes of annual rice output, Bangladesh is now self-sufficient in the staple while the country largely depends on imports to meet over five million tonnes of yearly wheat requirements. Domestic production of wheat hovers around one to 1.3 million tonnes only, depending on weather and acreage factors (BBS, 2016). High profitability of maize cultivation continued to incentivise the farmers to produce more maize. Production of maize rose significantly, registering a 23.7 per cent growth (BBS, 2017).

A limited number of socio-economic investigations were conducted on maize cultivation in Bangladesh, which revealed that it is a more profitable crop than rice (Hussain et al, 1995, Fokhrul et al,1995) and mustard (Haque, 1999). Rahman et al (2014) and Rahman et al. (2012) noted that maize production is not only profitable but the technical and economic efficiency of the maize farmers is much higher than those of rice and wheat farmers. Although Rahman et al. (2012) noted that the gross return is the main driver of choosing winter maize production in Bangladesh, it is not known whether maize production is internationally competitive or not. Conventionally maize was imported to Bangladesh which drained valuable foreign currency reserves to pay for import. Therefore, if maize is globally competitive, then an increase in the production of maize can fruitfully substitute its import and save foreign currency. Further the nature of sensitivity of the maize farmers to changes in input and output prices is not known. This information is important because Bangladeshi farmers not only need to be more efficient in their production activities, but also to be responsive to market indicators, so that the scarce resources are utilized efficiently to increase productivity as well as profitability in order to ensure supply to the urban market (Rahman, 2003) and increase farmers' welfare. Furthermore, the government of Bangladesh is seeking to diversify its agricultural sector to other cereals than rice (i.e., wheat and maize) as well as non-cereals (e.g., potatoes, vegetables and spices, etc.). In fact, the Fifth Five Year Plan (1997–2002) emphasized set specific objectives to attain self-sufficiency in food-grain production and increased production of other nutritional crops and earmarked 8.9% of the total agricultural allocation to promote crop diversification. Subsequently, the Poverty Reduction Strategy Paper (2005) and the Sixth Five Year Plan (2011–2015) also emphasized crop diversification.

This study is intended at highlighting the aspect of success among farms growing Maize; it is indispensable both for the farmers and planners to carry out a programme considered for eliciting agricultural production. Updating knowledge on competitiveness and profitability of Maize is one

rationalization of this study. It is crucial to evaluate substitute profitability of this investment in terms of land and other resources keen to Maize farming. Overall the study is envisioned at providing a holistic picture of the maize sector in order to judge its potential as a driver of agricultural growth in Bangladesh.

Objectives

Given this background, the present study specifically reviews the performance of the maize sector and aims to:

1. To highlight the growth scenario of maize in terms of area, production and yield,
2. To investigate global competitiveness and the financial profitability of maize production at the farm level in Bangladesh and
3. To assess input demand, output supply and fixed factor elasticities of maize production at the farm level in Bangladesh.

CHAPTER- II

MATERIALS AND METHODS

This seminar paper is utterly a review paper so all of the information has been collected from the secondary sources. During preparation of this paper, I went through various comprehensive studies of relevant books, journals, proceedings, reports, publications etc. Different published reports of different journals mainly supported in providing data for this paper. Findings related to my topic have been reviewed with the help of the library facilities of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU). Information has also collected from Department of Agricultural Economics, BSMRAU. I have also searched related internet web sites to collect information. All the latest information regarding Maize production in Bangladesh have been collected from some published research papers and specially from BBS (Bangladesh Bureau of Statistics). Besides I acquired constructive suggestions and valuable information from my major professor and course instructors for the improvement of the paper. After accumulating all the available information, I myself compiled and prepared this seminar paper.

CHAPTER- III

REVIEW OF FINDINGS

Production of Maize:

Maize is the third grain crop in Bangladesh. It can be grown in all the three seasons of the year. Winter maize is, however, found to be predominant with a share of 84% of the country's total maize area. Among different districts, Dinajpur, Chuadanga, Takurgaon, Lalmonirhat, Rajshahi Kushtia, Rangpur and Bogra are noted to be more progressive in maize production with higher rates of growth. Since 2010 to 2016, maize production showed progressive growth compared to other cereals. Compared to 2010-2011, maize production almost doubled in 2015-2016. It indicated steady growth.

Table 1. Production of Major crops in Bangladesh

Production of Major Crops (lac metric ton)						
Major Crops	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**
Aus	21.33	23.32	21.58	23.26	23.28	22.89
Aman	127.91	127.98	128.97	130.23	131.9	131.9
Boro	186.17	187.59	187.78	190.07	191.92	191.92
Wheat	9.72	9.95	12.55	13.03	13.48	13.48
Major cereals	345.13	348.85	350.88	356.59	360.58	360.19
Maize	10.18	12.98	15.48	21.24	23.5	23.6
Jute	83.96	80.03	76.11	74.36	75.01	75.58

Source: Bangladesh Bureau of Statistics

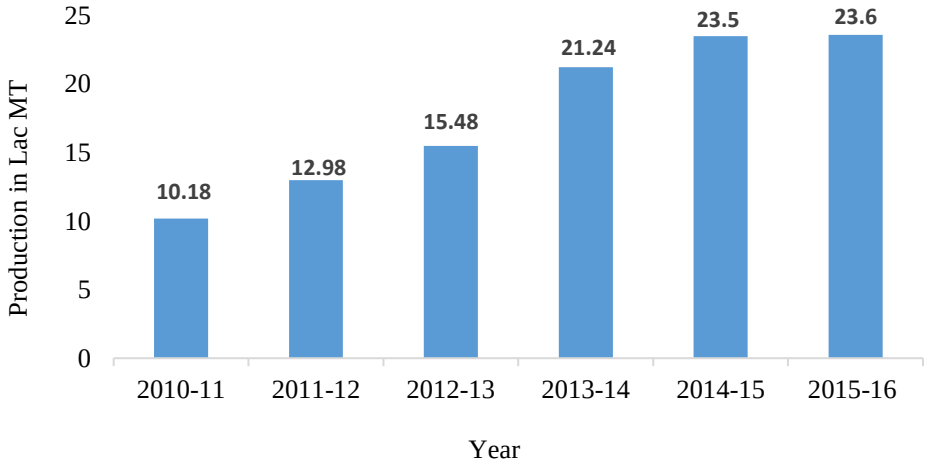

Figure 1: Production of Maize in Bangladesh.

Here Table 2. provides the area (in acres) of maize crop by all tenureship of owned land, share crop, mortgage, lease and others for the survey year 2014. Percentage distribution of land by tenancy type is also shown in the table. It shows that a total of 725701 acres of land are under maize crop of which an overwhelming majority of 522888 acres are owned land (72.05%) followed by 85778 acres lease land (11.82%), 60202 acres of mortgage land (8.30%), 53095 acres share crop land (7.32%) and 3737 acres other land (0.52%).

Table 2. Percentage distribution of maize cultivation area (acre) by tenancy

Farming time	Land tenancy											
	Total		Owned		Crop Share		Mortgage		Lease		Other	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Total	725701	100	522888	72.05	53096	7.32	60202	8.30	85778	11.82	37376	0.52
Rabi	622235	85.74	447269	61.63	46292	6.38	49892	6.88	75982	10.47	2800	0.39
Kharif	103466	14.26	75619	10.42	6804	0.94	10310	1.42	9796	1.35	936	0.13

Source: Maize Productivity Survey 2014

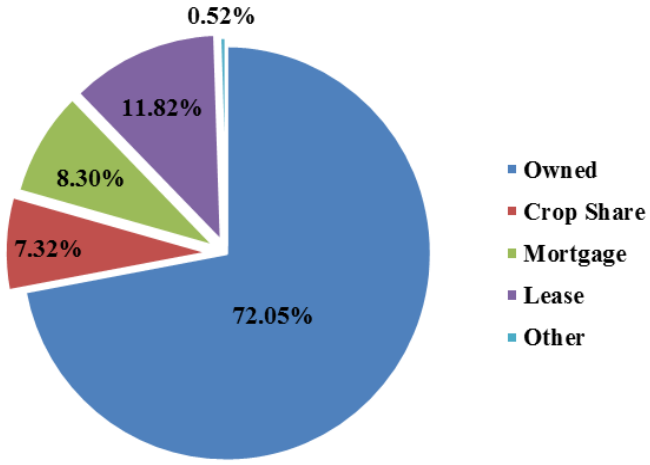

Figure 2: Percentage distribution of maize cultivation area by tenancy.

It is observed from the Table 2. that 622235 acres of land are under rabi farming (85.74%) followed by 103466 acres in kharif farming time (14.26%) showing that a great majority of the maize cultivation is under rabi farming and only about one-sixth of the maize cultivation is under kharif farming time.

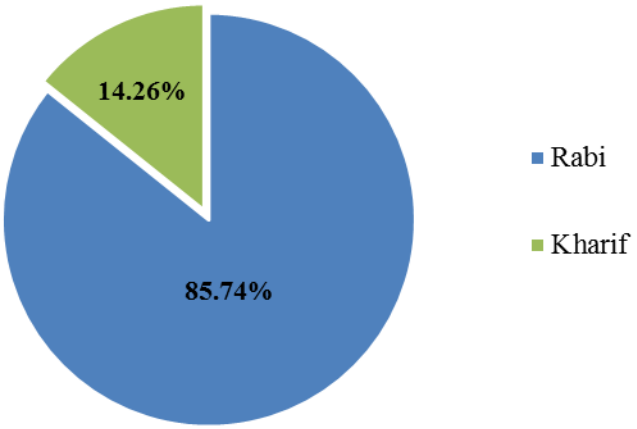

Figure 3: Percentage distribution of maize cultivation household by farming time.

Table 3. distributes the maize producing area (acre) by cultivation type of single and mixed crops by farming time. The table shows that out of total 725700 acres of land and overwhelming majority 671360 acres (92.51%) are used for single crop trailing far behind by mixed crop of 54340 acres of land (7.49%).

Table 3. Percentage distribution of maize producing area (acre) by cultivation type & farming time

Farming time	**Type of cultivation**					
	Total		**Single**		**Mixed**	
	Area	**%**	**Area**	**%**	**Area**	**%**
Total	725700	100.00	671360	92.51	54340	7.49
Rabi/winter	622235	85.74	579566	79.86	42669	5.88
Kharif/summer	103466	14.26	91794	12.65	11672	1.61

Source: Maize Productivity Survey 2014

Figure 4. shows the percentage distribution of maize producing area (acre) of single crop (79.86%) and mixed crop (5.88%) in Rabi season and single crop (12.65%) and mixed crop (1.61%) in Kharif season respectively.

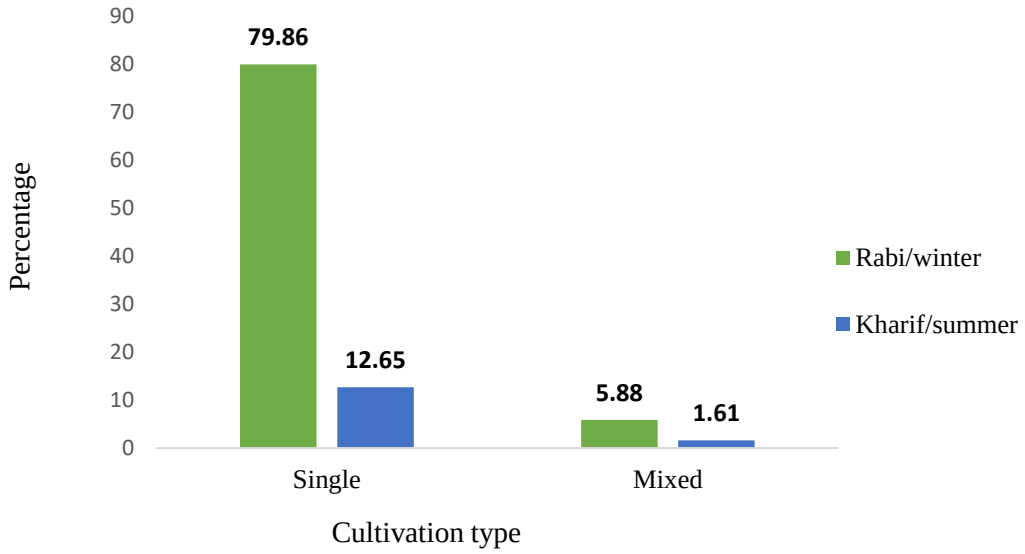

Figure 4: Percentage distribution of maize producing area (acre) by cultivation type & farming.

Growth Analysis of Maize

The spread of maize cultivation in Bangladesh is in an increasing trend with the increase of poultry industry as well as increase of wheat price. Increasing trend in area, production level and yield need to be identified for better understanding the potential productivity of maize in Bangladesh. Three periods were considered for the growth rate calculation of maize (Hasan, 2008). First, from 1971-72 to 1986-87, i.e., before the release of the composite varieties and hybrids of maize, second, from 1987-88 to 2005-06, i.e., from the beginning of the released varieties up to the study period considered and third from whole study period it was 1971-72 to 2005-06. Growth rates experienced in maize area, production and yield after independence of the country (1971) and phenomenon of acceleration/deceleration or no change in growth rates over time in Bangladesh is presented in Table 4.

Table 4. Growth rate of area, production and yield of maize in Bangladesh during 1971-2006

Growth rate indicators	Period	Growth rate (%)	Mean	CV
Area	I (1971-72 to 1986-87)	0.257 (-0.001)	2.65	23.77
	II (1987-88 to 2005-06)	0.985** (0.969)	22.03	115.16
	All (1971-72 to 2005-06)	0.892** (0.790)	13.17	158.69
Production	I (1971-72 to 1986-87)	0.049 (-0.069)	2.06	35.92
	II (1987-88 to 2005-06)	0.978** (0.954)	103.56	134.47
	All (1971-72 to 2005-06)	0.896** (0.796)	57.16	198.71
Yield	I (1971-72 to 1986-87)	-0.108 (-0.059)	0.77	20.77
	II (1987-88 to 2005-06)	0.834** (0.677)	2.77	58.12
	All (1971-72 to 2005-06)	0.842** (0.7.01)	1.85	83.78

**indicates significance at 1% level Source: Hasan, 2008

Table 4 illustrate that during first 16 years from 1971-72 to 1986-87, the annual rate of change of area, production and yield of maize were 0.257, 0.049 and -0.108 percent respectively. After the release of composite varieties and hybrids of maize, i.e., after 1986-87, comparatively high growth rate was found in area, production as well as in yield of maize since 1987-88 to 2005-06. The average area, production and yield of maize increased sharply and the rate of change were 0.985, 0.978 and 0.834 percent respectively. This might be due to release of composite and hybrid varieties and subsequently the adoption of those varieties by the farmers. The respective mean and coefficient of variation values also supported such findings.

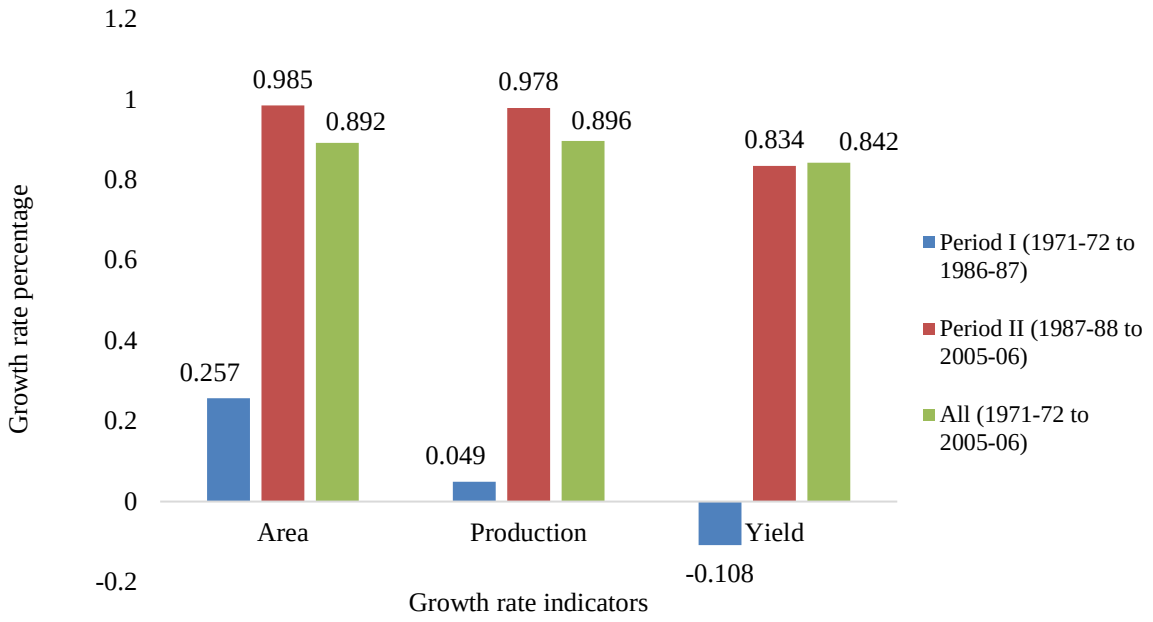

Figure 5: Growth rate percentage of maize in terms of area, production and yield in Bangladesh during 1971-2006.

Figure 5 clearly highlight that the growth rates of maize in terms of area, production and yield were comparatively higher in the period II (1987-88 to 2005-06) than the period I (1971-72 to 1986-87) as composite and hybrid varieties were just introduced.

Competitiveness of Maize

A country should specialize in producing commodities in which they are competitive in the global market (Reddy et al, 2012). Conventionally, maize was imported to Bangladesh as the sector was not successful in the past.

The PAM (Policy Analysis Matrix) framework is used to calculate important indicators for policy analysis. Popular measures of global competitiveness are: Nominal Protection Coefficient (NPC) and Effective Protection Coefficient (EPC). Nominal Protection Coefficient on output and input is applied (Rahman et al, 2016).

Where Nominal Protection Coefficient on Output (NPCO) > 1 means that domestic farm gate price is greater than the world price of output and is uncompetitive. On the contrary, if NPCO < 1, the production system is competitive. Nominal Protection Coefficient on Input (NPCI) shows the

variation of domestic prices for tradable inputs from their social prices. This ratio shows how much domestic prices for tradable inputs differ from their social prices. When NPCI >1, the domestic input cost is greater than the comparable world prices and the system is taxed by policy. If NPCI < 1, the system is subsidized by policy. An EPC (Effective Protection Coefficient) > 1 suggests that government policy protects the producers, while EPC < 1 indicates that producers are unprotected through policy interventions. The DRC (Domestic Resource Cost) is used to measure comparative advantage. When DRC < 1, then the system practices domestic resources efficiently and thus has a comparative advantage. If DRC > 1, then the system displays inefficiency in domestic resource use and has a comparative disadvantage.

Table 5 illustrates the results of the competitiveness analysis of maize. Maize production generates a substantial profit at social prices because of the low level tradable input use (Kazal et al., 2013). Analysis of NPCO (Nominal Protection Coefficient on Output), NPCI (Nominal Protection Coefficient on Input) and EPC (Effective Protection Coefficient) exhibited that maize producers are competitive (NPCO < 1 and EPC < 1) although the inputs were subsidized by government policy (NPCI < 1). The DRC value for maize was found to be less than one (0.54), indicating that Bangladesh has comparative advantage in producing maize for import substitution. This is plausibly attributed to the higher yield of hybrid maize, which results in lower cost of production per unit of land. Moreover, higher demand for maize in the poultry and fisheries industries has led to efficient production of maize.

Table 5. Competitiveness of maize

Items	Values
Revenue at social prices (BDT)	22,529.90
Tradable inputs at social prices (BDT)	2827.96
Domestic factors at social prices (BDT)	10,721.99
Profits at social prices (BDT)	8979.96
Nominal Protection Coefficient on Output (NPCO)	0.71
Nominal Protection Coefficient on Input (NPCI)	0.51
Effective Protection Coefficient (EPC)	0.73
Domestic Resource Cost (DRC)	0.54

Exchange rate: USD 1.00 = BDT 81.86 Source: Rahman et al, 2016

Profitability of Maize

Profitability or Cost-Benefit Analysis (CBA) includes calculation of detailed financial costs of production and returns from maize on a per hectare basis. The total cost (TC) is composed of total variable costs (TVC) and total fixed costs (TFC). TVC includes costs of human labor (both family supplied and hired labor, wherein the cost of family supplied labor was estimated by imputing market wage rate), mechanical power; seed, manure, chemical fertilizers; pesticides; and irrigation. TFC includes land rent (if owned land was used, then the imputed value of market rate of land rent was applied) and interest on operating capital. The gross return (GR) was calculated as total maize output multiplied by the market price of maize. Profits or gross margin (GM) was computed as GR–TVC, whereas the Net Return (NR) was computed as GR–TC. Finally, the Benefit Cost Ratio (BCR) was computed as GR/TC (Rahman and Rahman, 2014).

Maize production is profitable based on net return and undiscounted BCR in the northwestern region (Table 6). The net return and BCR for the marginal farms were the highest followed by medium/large farms and small farms. The net returns per hectare were BDT 19,633.17, BDT 14,699.51 and BDT 17,687.20 for marginal, small and medium/large farms respectively (Rahman et al, 2016). However, the differences were not statistically significant, implying that farm size has no influence on yield and profitability of maize.

Table 6. Financial profitability of HYV winter Maize according to farm size in northwestern region

Region and Farm Type	Yield (t/ha)	Sale Price (BDT/ton)	Gross Return (BDT/ha)	Variable Cost (BDT/ha)	Total Cost (BDT/ha)	Gross Margin (BDT/ha)	Net Return (BDT/ha)	Undiscounted BCR
All	6.23	15,793.18	101,772.66	51,105.68	84,393.72	50,672.89	17,378.94	1.21
Marginal	6.18	16,248.16	103,399.44	51,487.78	83,746.27	51,911.66	19,653.17	1.23
Small	6.33	15,340.91	100,900.94	52,299.88	86,201.43	48,601.06	14,699.51	1.17
Medium & Large	6.18	15,778.07	101,035.32	49,529.37	83,348.12	51,505.95	17,687.20	1.21
Chi square	0.01						1.38	

Source: Rahman et al, 2016

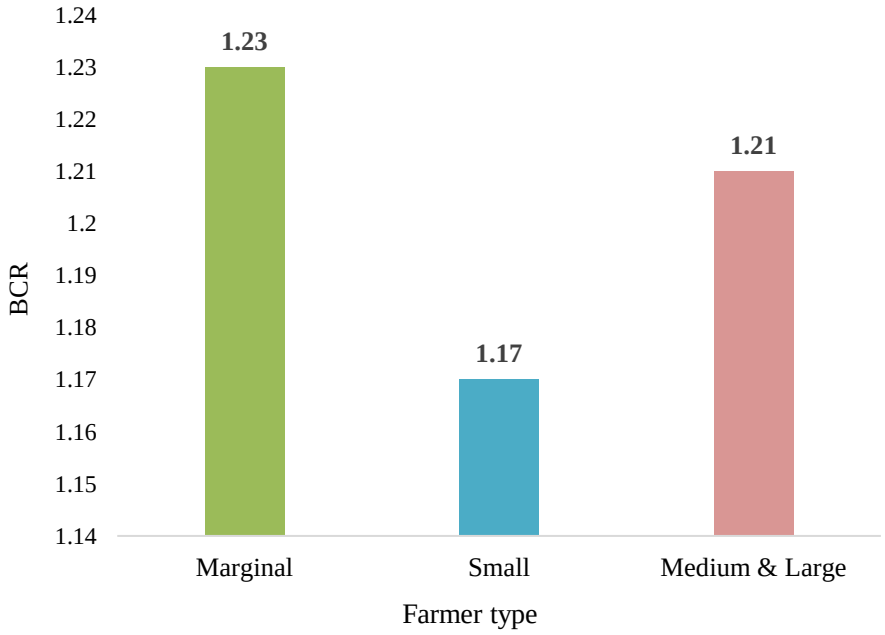

Figure 6: Financial profitability of Maize farmers in Bangladesh.

Comparative economics of maize and wheat cultivation

According to national statistics, it is revealed from the Table 7 that the area, production and yield of wheat are decreasing in each year from 1999-00 to 2005-06, while it is increasing for maize in each year during the same period. It is also revealed that the area and production of wheat were found to be decreasing (Hasan, 2006). Kabir et al. (2005) reported that gross margin and benefit cost ratio of wheat were Tk. 11063 per hectare and 1.67, respectively, while Tk. 21091 per hectare and 1.90 in case of maize, respectively. It is found here that the profitability of maize was higher compared to wheat.

The average yield of maize in 2003 in the world was 4.47 tons per hectare as compared to 2.67 and 3.84 tons per hectare for wheat and rice (paddy), respectively (FAO, 2004). The area,

production, and yield of wheat and maize from 1999-00 to 2005-06 are presented in Table 10. It is revealed from the table that area, production, and yield of wheat are decreasing in each year from 1999-00 to 2005-06, while it is increasing for maize in each year during the same period. Maize ranked 1st among the cereals in terms of yield (maize: 5.30 mt/ha; wheat: 1.60 mt/ha and rice: 2.52 mt/ha), but in terms of area and production, it ranked 3rd just after rice and wheat (BBS, 2006).

Table 7. Area, production and yield of wheat and maize over the period from 1999- 2000 to 2005-2006

Year	Wheat			Maize		
	Area (ha)	Production (mt)	Yield (mt/ha)	Area (ha)	Production (mt)	Yield (mt/ha)
1999-00	832000	1840000	2.21	3161	4075	1.29
2000-01	772000	1673000	2.17	4901	10350	2.11
2001-02	742000	1606000	2.16	19972	64335	3.22
2002-03	706000	1507000	2.13	29059	117255	4.04
2003-04	567000	1248000	2.20	50030	241460	4.83
2004-05	558000	976000	1.75	66803	356280	5.33
2005-06	481000	772000	1.60	98408	521525	5.30

Source: BBS (2003, 2006)

Figure 7 and 8 highlights that area and production of wheat are decreasing in each year from 1999-00 to 2005-06, while it is increasing for maize in each year during the same period. Wheat exhibited downward trendline on the other hand Maize showed upward trendline both in terms of area and production as well yield.

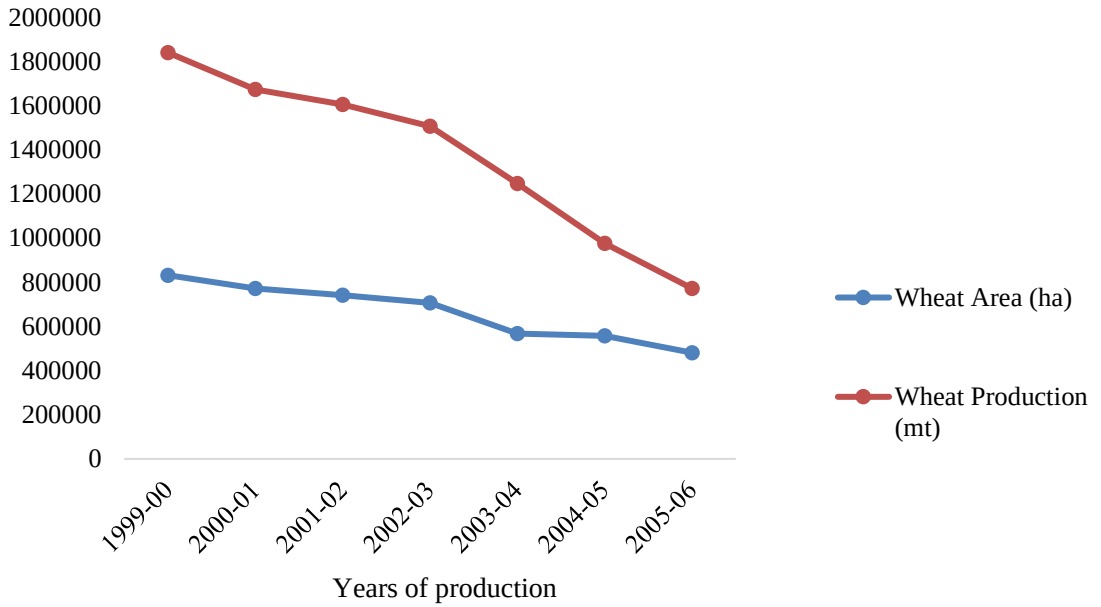

Figure 7: Area and production trend of wheat over the period from 1999- 2000 to 2005-2006.

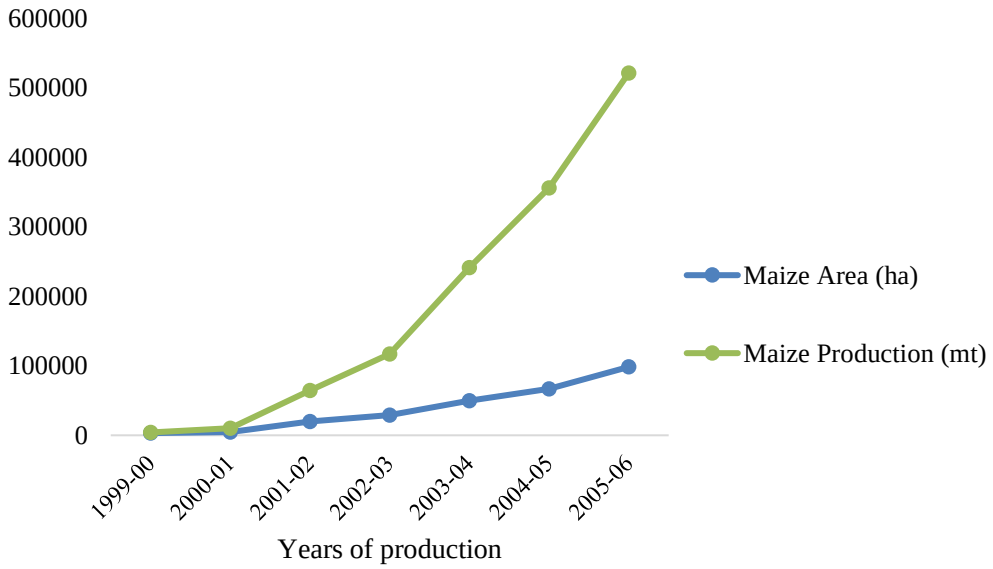

Figure 8: Area and production trend of Maize over the period from 1999- 2000 to 2005-2006.

Output Supply, Input Demand and Fixed Factor Elasticities of Maize Production

The parameter estimates of the profit function model were used to estimate the elasticities with respect to variable input demand, output supply and fixed factors (Table 8). All own price elasticities have negative signs consistent with theory, but all of them are in the inelastic range except labor, which is highly elastic. Results of the cross-price elasticities of demand are mixed with some being complements and some being substitutes (Rahman et al, 2016).

Table 8. Estimated elasticities of the translog profit function of maize

Parameters	Output Price	Fertilizer Price	Labor Wage	Machine Price	Seed Price	Land	Experience	Irrigation	Education	Land Fragmentation
Output supply	0.4001 ***	0.0295	0.0247	0.0273	0.0322	3.8790 **	0.0045	1.1680	0.3650	1.3514
	(2.63)	(1.13)	(1.10)	(0.34)	(0.13)	(2.24)	(0.00)	(1.45)	(0.52)	(0.52)
Fertilizer demand	0.1810	0.2958 ***	0.4371	0.3403	0.0180	4.0596 **	0.4913	1.2011	0.0780	1.4819
	(1.41)	(2.64)	(0.04)	(2.10)	(0.48)	(2.24)	(0.13)	(1.50)	(0.13)	(0.61)
Labor demand	7.1893	1.4913	4.1243	1.0926	0.4810	4.4387 **	0.7242	0.6539	0.4867	0.3443
	(1.42)	(0.06)	(2.07) **	(0.96)	(0.58)	(2.07)	(0.05)	(1.50)	(0.10)	(0.32)
Machine demand	0.6491	0.8645 *	1.6981	0.0096	0.1748	3.712*	1.7255	1.4472	0.0087	0.5637
	(0.99)	(1.3)	(0.54)	(2.43)**	(0.99)	(1.94)	(0.27)	(1.52)	(0.06)	(0.23)
Seed demand	2.2636	0.2628	0.4149	0.1632	0.3357 ***	4.0773 **	1.2120	1.2300	0.1103	2.0106
	(0.22)	(0.42)	(0.49)	(0.95)	(4.26)	(2.19)	(0.20)	(1.43)	(0.16)	(0.62)

Source: Rahman et al, 2016

*** Significant at 1% level ($p < 0.01$); ** Significant at 5% level ($p < 0.05$); * Significant at 10% level ($p < 0.10$).

Calculation of Variable Input Demand and Output Supply Elasticities

The following formulas are used in calculation of Variable Input Demand and Output Supply Elasticities:

The own price elasticity of demand for variable input j (Π_{jj}) was computed as

$$\eta_{jj} = -S_j - \frac{\gamma_{jj}}{S_j} - 1$$

S_j is the share of jth input at the sample mean.

For the cross-price elasticity of demand for jth variable input with respect to the price of kth variable input (η_{jk}) was computed as

$$\eta_{jk} = -S_k - \frac{\gamma_{jk}}{S_j} for\, j \neq k$$

The elasticity of demand for variable input with respect to output price, Py (η_{jy}) was computed as

$$\eta_{jy} = S_y + \sum_{j=1}^{4} \frac{\gamma_{jk}}{S_j}$$

where S_y is the output share at the sample mean.

The elasticity of demand for variable input with respect to the lth fixed factor, (η_{jl}) was computed as

$$\eta_{jl} = \beta_l + \delta_{jl} \ln P'_j + \sum_{l=1}^{5} \theta_{jl} \ln Z_l - \frac{\delta_{jl}}{S_j}$$

The elasticity of output supply with respect to price of jth variable input (ε_{yi}) was computed as

$$\varepsilon_{yj} = -S_j - \frac{\sum_{j=1}^{4} \gamma_{jk}}{S_y}$$

The elasticity of output supply with respect to its own price (ε_{yy}) was computed as

$$\varepsilon_{yy} = \sum_{j=1}^{4} S_j + \frac{\sum_{j=1}^{4} \gamma_{jk}}{S_y}$$

Finally the output supply with respect to lth fixed factor (ε_{yl}) was computed as

$$\varepsilon_{yl} = \left(\beta_l + \sum_{j=1}^{4} \delta_{jk} \ln P'_j + \sum_{l=1}^{5} \theta_{lt} \ln Z_l \right) + \frac{\sum_{j=1}^{4} \delta_{jl}}{S_y}$$

Source: Rahman et al, 2016

On the whole, changes in market price of inputs and output significantly influence farmers' resource use and productivity (maize supply) as expected. The output supply response to output price change is positive consistent with theory. The elasticity value of 0.40 indicates that a 1% increase in maize price will increase output supply by 0.4%. The output supply response is higher than for HYV rice estimated at 0.27 (Rahman, 2007) but much lower than HYV wheat estimated

at 0.95 (Rahman, 2012) in Bangladesh. Demand for fertilizer and labor will increase in response to an increase in output price consistent with expectation. This rise in labor demand in response to maize price increase will lead to a redistribution of gains accrued from modern agriculture to landless laborers via wages, an argument in favor of widespread diffusion of modern agricultural technology in the first place (Rahman, 2011). In fact, labor input alone accounted for 24.4% of the total input costs or 40.3% of total variable costs in maize production. However, demand for machine and seed will not increase with an increase in maize price. The main reason may be due to the fact that seeds must be applied at a more or less fixed rate in order to ensure optimum yield and therefore, increase in output price is not going to increase seed use rate substantially as overuse of seed will not increase yield but may increase weeding costs (Rahman, 2016).

The responsiveness of labor demand to wage increase is substantial. This is expected because labor is the main variable input in maize production as mentioned above. Therefore, the farmers' response to an increase in wage is quite high, estimated at 4.12, implying that a 1% increase in labor wage will reduce labor demand by 4.12%. Among the conventional fixed factors, the role of land area in influencing productivity and resource use remains dominant. This is expected in a land-scarce country like Bangladesh where the average farm size is only 0.37 ha (BBS, 2010). Therefore, an increase in the availability of land dramatically increases the supply of maize and will result in a consequent increase in the use of variable inputs. The elasticity value of 3.88 for the land variable indicates that a one percent increase in land area under maize will increase output supply by a substantial 3.88 percent. Similarly, an increase in land area under maize will increase demand for all inputs substantially, consistent with expectation. Once again, landless laborers will gain access to the profit generated by maize production via higher demand for hired labor owing to an increase in maize area. From the study of Rahman, 2007 and Rahman, 2012, it is clear that the elasticity values are substantially higher than HYV rice and HYV wheat.

CHAPTER- IV

CONCLUSION

The main reason behind cultivating Maize is the far and wide detained observation that Maize is emerging as a lucrative crop. Maize is well thought-out as the third most important cereals crops and has more multipurpose usages in Bangladesh. High production of maize depends on the spreading out of HYV and hybrid variety of seed, improved management and timely supplying of inputs. The rate of taking up of modern technology and sustainability of maize production depend largely on its economic prosperity. The situation of Maize production & its industry is extremely to a great extent competitive. The profits it begets and hope it will help to add tax in the national economy is an immense contribution. Results revealed that maize production is competitive in Bangladesh and can be a good substitute for maize import even when international price of maize varies slightly. Maize is also profitable at the farm level (BCR = 1.21) with no adverse influence of farm size on yield as well as profitability. Farmers are responsive to changes in market prices of maize and inputs although the level of responsiveness is not up to the mark. However, an increase in the land available for maize will have a dramatic increase in maize supply and corresponding demand for other inputs. Investment in research and development can further enhance productivity of maize, which would not only increase profitability at the farm level but will also successfully substitute maize imports. Measures should be implemented to improve land available for maize production at the farm level. The average farm size in Bangladesh is declining over time due to population pressure on a closing land frontier. Landless and marginal farmers can acquire land if tenurial policies aim at refining land rental market. Thus, maize supply can significantly improve. This is particularly important since there is no adverse effect of farm size on maize profitability. By lifting smooth operation of the hired labor market will enable the landless laborers to reap the benefits of increased maize production through wages as labor is the major variable input in the maize production process. Boosting maize production will substitute its import and curb consumption demand for rice as the key staple in the Bangladeshi diet and improve the socio-economic condition of the farmers in terms of higher profits.

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