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Shifting from Rice to Non-rice Crop Production in Bangladesh: An Analysis of Farmers' View

M. Shahe Alam* and M.A Quayum

Agril. Economics Division, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh
**Corresponding author: E-mail: msalam_07@yahoo.com*

Abstract
A study was conducted to determine the magnitude of area shifting to different crops over the years, assess the profitability of maize cultivation and to evaluate the factors determining area devotion to maize cultivation in Bangladesh. Sample survey was done in five districts capturing both favourable and drought prone production environment. Two villages under each district were chosen in consultation with local extension experts. A total of 240 farmers were finally selected for interview. Both descriptive and inferential statistics were employed in analyzing the data. Analysis indicated that the level of area shifting to MV Boro increased to 6% and 19% in drought prone and favourable area respectively during 2007-08 compared to 2003-04. Although the area under MV Aus increased marginally in drought prone area but in favourable areas the decrease was almost 16%. The area devoted to other crops like maize, ground nut, vegetables and chilli increased over the study period. The area under Aman rice increased by 2% in drought prone area but a reverse picture appeared in the favourable area i.c, the magnitude of area shifting from rice to non-rice under favourable area was negative. The per hectare costs of maize cultivation in drought prone and favourable area were similar. The net return and benefit cost ratio (BCR) in maize production were higher in favourable area compared to drought prone area. The study further indicated that, farm size, family agricultural labor and market availability were the vital determinants of area devotion to maize cultivation. Nearly 68 % of the sample farmers devoted their lands to maize production considering it as a profitable enterprise. Similarly, about 40% farmers adopted maize as an alternate crop since it involves much less irrigation cost.

Keywords: Non-rice crop, drought-prone, profit margin, maize crop, sequential crop etc

1. Introduction

Rice is the staple food crop in Bangladesh and nearly 75 percent of the country's total cropped area is devoted to rice production (BBS. 2006). However, it has been widely noticed in the recent years that in many areas of the country there have been notable shift of rice areas to other non-rice crops, especially maize. In fact, maize is thought to be the third important cereal crop in Bangladesh just after rice and wheat. The yield of maize is higher than that of rice and wheat. In Bangladesh, maize is grown both in Rabi and Kharif seasons. Besides, it can be grown as a relay crop with potato, carrot, sugarcane etc and also as a sequential crop. It has more food value than rice (BARI, 2006). Maize is used as cattle, fish and poultry feed as well as fuel (Ahmed, 2003). Maize grain contents about 7-12% oil (Hossain, 1993)**.** Usually, maize oil, corn flux, corn syrup, etc are prepared out of maize. In Bangladesh, the demand for maize is increasing as days go with the increase of poultry farms. Further more, it is often argued that food security can be ensured through increasing maize area and production as well as changing food habits. The people of different Asian countries like

Pakistan, India, Nepal, Thailand, China, Japan, Turkey, Philippines and in different countries of Europe also prefer maize as food. The available statistics support that, area under maize and its production have increased by 17 and 33%, respectively during 1999-2000 compared to that of 1986-87 (BBS, 2005). This happened due to varietal improvement of maize through technological advancement during the last couple of years. Some times maize is grown at zero tillage which involves less production cost and more income. Maize production is considered to be more profitable and its cultivation practice is easy. Farmers are interested to grow maize due to its diversified use. At present, several inbreed and hybrid maize varieties such as Bornali, Shuvra, Mahor, Khaiyabhutta, Sweet corn, etc. are grown at the farm level. Although cultivation of maize causes exhaustion in soil fertility, in maize-legume inter cropping, maize yield was not seriously affected by legumes but legume yield was affected by maize crop (Saha *et al*., 2001). Maize and bush bean may be grown as one of such important cereal-legume intercropping and this system possibly helps improve availability of residual nitrogen in the soil (Islam *et. al*., 2004). However, there have been very limited studies on digging into the issues of producers' reasons for shifting areas from rice to non-rice crops over the years. As such the present study was designed to take into account of the aforesaid issues. This study was therefore, expected to be of immense use for the researchers, policy planners as a whole.

The specific objectives of the present study were:

- To determine the magnitude of area devotion to different crop cultivation in the study areas over the years;
- To assess the input use level and profitability in maize cultivation at farm level,
- To examine the factors determining the area devotion to maize cultivation in the study areas; and
- To assess farmers' perceptions on the level of nutrition uptake due to maize cultivation and its effect on the succeeding crops.

2. Methodology

Primary data were used for this study and sample survey was carried out in five districts namely: Bogra, Dinajpur, Lalmonirhat, Chapai Nawabgonj and Chuadanga. One upazila under each district was selected purposively. Then, intensive maize growing villages (two villages in each district) were selected in consultation with the local agricutural extension personnel. From each village twenty four sample farms were chosen from a comprehensive list of maize growers. In selecting the sample farms, random sampling technique was followed. Finally, a total of 240 farmers were taken under the study. The study was undertaken during the year 2007-08. Both descriptive and inferential statistics were employed in analyzing the data. In this regard, multiple linear regression model of the following form was used (Draper and Smith,1966).

$Y= \alpha+ \Sigma\beta_i\Sigma X_i+\in_i$

Where,

Y= area devotion to maize (hectare/farm),

X_i= exogenous variables,

β_i = regression coefficients to be estimated,

α= intercept,

$\in$ = random error.

3. Results and Discussion

3.1. Shifting of area under different crops in different seasons

The level of area shifting to different crops in different seasons at farmers' level is shown in Table 1. The average area devotion to MV Boro rice increased to 6 and 19% in drought prone and favourable environment respectively in the year 2007-08 compared to 2002-03. The other important crops whose area increased were maize, mustard, ground nut, lentil, onion, garlic etc. The area under sugarcane has increased in favourable environment but decreased in drought prone area.

Table 1. Level of shifting of area under different crops in the study areas over the period of 2002-03 to 2007-08

Season/crops	Changes in area devotion (%)	
	Drought prone area	Favourable
MV Boro	6.05	18.88
Potato	-5.31	0.31
Maize	69.56	31.70
Mustard	12.05	156.41
Wheat	-44.92	-68.31
Pepper	-8.33	-31.49
Vegetables	4.39	-58.41
Mug	-50..00	-0.18
Kalai	-17.65	-20.30
Tobacco	-79.77	-11.23
Ground nut	-4.17	50.00
Zinzer	-20.00	5.00
Sugarcane	-21.30	177.69
Lentil	28.57	-6.66
Onion	50.00	6.25
Garlic	-0.99	20.00
Aus season:		
MV Aus	28.77	-16.02
LV Aus	-20.00	0.68
Total	25.64	-15.51
Jute	-81.50	-58.42
Maize	231.91	36.65
Ground nut	50.00	-14.29
Vegetables	4.54	18.57
Pepper	25.00	21.74
Til	-6.00	-
Aman season:		
MV Aman	3.19	-18.67
LV Aman	-83.33	133.76
Total	2.44	-18.06

Source: Field survey; 2007-08

The area devotion to overall Aus rice has increased to 26% in drought prone area while it decreased to 16% in favourable area in the year 2007-08 compared to 2002-03. Interestingly the area under MV Aus has increased sustantially (29%) in the drought prone areas. However, the area under other crops like maize, ground nut, vegetables and pepper had also the increasing trend over the years.

It appears from the analysis that in T. Aman season, there is little scope of shifting area from rice to non-rice crops**.** Shifting in area of over all Aman rice has increased by only 2% in drought prone area, while it decreased to 18% in favourable area in the year 2007-08 compared to 2002-03. On the other hand, shifting in MV Aman area has increased to 3% in drought prone area and decreased to 19% in favourable area. It is important to note that devotion of area to LV Aman rice has decreased to 83% in the drought prone areas during the afore said period.

Table 2. Level of input use for Maize cultivation at the farmers' field, 2008

Inputs used	Drought prone area	Favourable	Average
Seeds (kg/ha):	23	19	20
Purchased	23	19	20
Fertilizer (kg/ha):			
Urea	392	340	358
TSP	115	166	149
MP	67	110	96
Gypsum	77	47	57
SSP/DAP	21	2	8
$ZnSo_4$	12	5	7
Manure	4453	6952	6119
Labor (mandays/ha):	174	159	164
Family	83	84	83
Hired	91	75	81
Bullock power (hr/ha):			
Family	71	45	53
Power tiller (hr/ha):			
Hired	11	14	13

Table 3. Cost of maize cultivation (Taka/ha) at some selected areas of Bangladesh

Items used	Drought prone area	Favourable	Average
Total human labor:	19628	18701	19010
Family	9562	9804	9723
Hired	10066	8897	9286
Land preparation:	5714	3924	4521
Bullock power	1411	413	746
Power tiller	4303	3511	3775
Seeds:			
Purchased	4699	4352	4468
Fertilizer:			
Inorganic	9819	11042	10634
Organic	3646	5472	4863
Insecticides	486	920	775
Irrigation	5658	3781	4407
Interest @ 5% for 4 months	584	542	556
Land rent	10514	10598	10570
Total cost	60747	59331	59803

3.2. Input use level and cost of maize cultivation

Per hectare input used for maize cultivation is shown in Table 2. The average seed rate of maize was 20 kg/ha, (23 kg/ha in drought prone area and 19 kg/ha in favourable area). The average rates of urea, TSP and MP were 358, 149 and 96 kg/ha, respectively. Farmers both in

drought prone and favourable areas used manure at the rate of 4453 and 6952 kg/ha, respectively. The human labor requirement was found more or less equal for both the environments**.**

The cost of human labor for maize production in drought prone and favorable areas were more or less equal, averaged to Tk.19010/ha (Table 3). The average land preparation cost was Tk. 4521/ha. The cost of seed and fertilizer was Tk. 4468/ha and Tk. 10634/ha, respectively. The irrigation cost was found higher in drought prone area compared to favourable area. The total cost of maize cultivation in drought prone and favourable area was more or less equal and on average the total cost was Tk. 59803 per hectare.

3.3. Farm level maize yield and benefits obtained

The estimated yield of maize was 8157 kg/ha in favourable area which was almost 14 % higher compared to that in drought prone area. This higher yield enabled the maize growers under favourable area obtaining enhanced gross return. However, on average the gross and net returns were Tk.79711 and Tk.20379/ha, respectively in favourable area on full cost basis. The other economic indicator i.e. benefit cost ratio which indicates the level of return from investing each taka in the production process, was also much higher (2.6) in case of favourable area compared to that of drought prone area.

3.4. Determinants of area devotion to maize

In order to examine the influence of different socioeconomic and biophysical factors on area devotion to maize cultivation, regression analysis was done employing the following empirical model:

$$Y= \alpha+\beta_1 \text{ farm} + \beta_2 \text{ Ag. Lab} + \beta_3 \text{ Irrigation} + \beta_4 \text{ market} + \beta_5 \text{ educ} + \beta_6 \text{ price ratio} + D_1 \text{ tenancy} + D_2 \text{ Land} + e_i$$

Where, Y = area under maize (acre/farm)

farm = farm size (in acre)
Ag. Lab = Number of Agril. labour/farm
Irrigation = % area under irrigation
Market = distance to market (in km)
Educ = Respondent's education (schooling year)
Price = Maize-rice price ratio
Tenancy = Tenancy dummy (taking own plot=1, otherwise=0)
Land = Land type dummy (taking medium land=1, otherwise 0)
e = random disturbance

The OLS estimates of the multiple linear regression model are presented in Table 5. The over all significance of the model was good as implied by the significant F-value.

The coefficient of determination (R^2) was 0.77 implying the fact that, 77 percent of the variability in devoting crop lands for growing maize per farm was explained by the specified explanatory variables. The coefficients of most of the explanatory variables had the expected signs. As expected, the variable farm size exhibited the highest coefficient (0.42); it was positive and highly significant implying that, the larger is the farm-size, the higher will be the area devotion to maize. Similarly, the coefficients of number of family agricultural labour per household and access to market were positive and statistically significant indicating their importance in relation to devoting land under maize production by the sampled farms.

The sign of the estimates of the coefficient of area under irrigation was in consonance with a *priori* expectation and theoretically sound. It was negative, implying that, with an increase in irrigated area the sample farms tended to devote less land for maize cultivation, and release some area for irrigated rice production and obtain higher productivity.

Table 4. Structure of costs and return (Tk./ha) for Maize cultivation at some selected areas of Bangladesh

Items used	Drought prone area	Favourable	Average
Yield (kg/ha)	7187	8157	7834
Gross return (Tk/ha)	7623	-	-
Total cost (Tk./ha):	77623	80811	79748
Full cost basis	60747	59331	59803
Cash cost basis	35031	32502	33345
Net return (Tk./ha):			
Full cost basis	16876	21480	19945
Cash cost basis	42592	48309	46403
BCR:			
Full cost basis	1.28	1.36	1.33
Cash cost basis	2.22	2.49	2.39

Table 5. OLS estimates for the factors affecting area devotion to maize in the study areas

Independent variables	Reg. coefficients	t-statistics
Intercept	-11.493 ns	-0.180
X_1= Farm size (ha)	0.422***	8.026
X_2= Family agril. labor	0.235 *	1.750
X_3= Area under irrigation	-0.204	1.014
X_4= Market availability/ distance to market)	-1.439 *	-1.844
X_5= Farmers' education	1.387	1.018
X_6= Tenancy dummy (own plot=1, otherwise 0)	0.449 ns	1.687
X_7= Land type dummy (medium land =1, otherwise 0)	1.987 ns	0.963
X_8= Maize-rice price ratio	1.357 ns	1.824
F-value	42.528***	4.372
(R^2) Coefficient of determination	0.777	

Note: *, ** and *** means significant at 10% , 5% and 1% level respectively

3.4. Nutrition uptake due to maize cultivation

Farmers' perception on the level of soil nutrition uptake due to maize cultivation was also evaluated and the findings are presented in Table 6. Eighty eight percent farmers reported that, they applied additional fertilizer of 45 kg/ha for the succeeding crop for which an additional amount of Tk. 709/ha was needed. Eighty two percent farmers reported that, in order to adjust the nutritional deficit in soils that happened due to growing maize, they applied more fertilizer for increasing the yield in the succeeding crop.

Moreover, farmers' estimate on yield loss in the succeeding crop if the additional amount of fertilizer not applied was also assessed. According to the stated estimate, nearly 9.5% yield loss in the succeeding crop was experienced by the sample farms during the study season (Table 6).

3.5. Reasons for growing maize

Farmers' reasoning for shifting areas for maize are summarized in Table 8. About 68 % farmers grew maize considering it's less cost involvement and higher profitability. On the other hand, 40% farmers reported that they had shifted the wheat land towards growing maize, because both yield and profitability of wheat are less compared to those of maize. Moreover, cultivation of wheat involves more irrigation which is a costly input, while maize requires much less water.

Table 6. Nutrition uptake by maize at some selected areas of Bangladesh

Factors	Quantity/(%)	% farmers implemented
Additional fertilizer applied for the succeeding crop (kg/ha)	45 kg	88
Additional cost incurred for succeeding crop (Tk/ha)	709 Tk	88
Level of yield loss in succeeding crop (%) (if additional fertilizer not applied)	9.37	64

Figures in the parentheses indicate amount per hectare

Table 7. Common practices followed by the sample farms in increasing the yield of the succeeding crop grown after maize

Practices adopted	% farmers opined
Applying more fertilizer	81.7
Applying more manure	48.8
Growing legume crops	36.5
Keeping the land fallow	10.71

Table 8. Farmers' stated reasons for devoting land under maize production in the study areas, 2007-08.

	Description	Percent farmers opined
1	Achieve more profit and less cost involvement	68.3
2	Less yield of suitable crop (wheat) and less profit	36.5
3	Less irrigation needed	40.0
4	Get early benefit (cash money)	15.4
5	Land suitable for growing maize	10.5
6	Less crop loss due to hail storm	18.3

4. Conclusions

The study has revealed that the area devotion to wheat in the study areas decreased substantially over the years and this decrease in wheat area was due to high cost of wheat cultivation and low yield. On the other hand, area devotion to maize increased both in the rainfed and unfavourable areas over the period 2002/03 to 2007/08 due to higher profitability. Area under some non-rice crops like potato, tomato and vegetables increased due to high profit. Area devotion to Aman rice slightly decreased in favourable environment; because farmers had the scope of growing some high value crops, such as potato, tomato, mustard and short duration vegetables as sequential crops and after harvesting these crops they could accommodate winter rice and also maize in the same land. The human labor requirement for maize production was almost equal for both the environments involving similar cost on this input. Irrigation cost was 49% higher in drought prone area compared to that of favourable area. The average yield of maize was also higher (13.5%) in favourable area which enabled the farms achieving higher gross return and net return as well. Farm size, family agricultural worker and access to market were the important determinants of area devotion for maize production in the sampled areas.

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