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Research Note

GROWTH ESTIMATION OF SELECTED MAJOR CROPS IN BANGLADESH

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ABSTRACT

The keen interest of this research paper is to estimate the growth rates of area, production and yield of selected major crops viz., aus, aman, boro, jute and wheat in Bangladesh. The time series data have been used for this purpose. This study covers the time period of 1980/81 to 2009/10. The study was entirely based on secondary data. Growth rates of area, production and yield of major crops were estimated by fitting exponential trend function. Aus, aman, boro, jute and wheat are major crops grown in our country. It is observed that growth of area and production of aus has declined at the rate of 4.74 and 2.69 percent respectively which were statistically significant during the entire period (1980/81 to 2009/10). Increased growth rate of aman yield affected increased production significantly at the rate of 1.48 percent while area declining over the period and area and production of boro increase significantly at the rate of 4.67 and 6.43 percent respectively during the study period (1980/81- 2009/10). Growth rates of area and production of jute had declined significantly at the rate of 2.00 and 0.77 percent respectively over the whole period. But yield of jute showed significant positive growth at the rate of 1.23 percent during the whole period. Area of wheat grew at the rate of 0.93 percent which was statistically significant that helped obtaining increased production (1980/81 to 2005/06) but overall period it was negative and statistically insignificant. Area increase and yield increase helped increase production of crops of wheat, all boro and HYV boro. Analyzing and comparing the growth rates of area, production and yield of major crops may guide the risk averse farmers allowing judicious allocation of cultivated area which ultimately would increase the production and stabilize agricultural supply in Bangladesh. An appropriate price policy, supportive services and massive government program can bring about desired area allocation and consequently in the production of crops in Bangladesh. In short, findings from this research paper may be helpful for planners and policy makers in formulating strategies to improve the efficiency of agricultural sector which is backbone of the economy.

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I. INTRODUCTION

Agriculture has been playing a pioneering role in the economic growth and stability of the national economy of Bangladesh. The climate and the temperature are favorable for the growth of crop throughout the year. The most important issue in Bangladesh agriculture is to enhance and sustain growth in crops production. Crop production structure, changing production trends of different agricultural products and the effects of technical change of agriculture are prerequisites for a better understanding for the study of agricultural growth as well as the economic development in Bangladesh. As a developing country, Bangladesh has been striving for rapid development of its economy. In Bangladesh, its contribution to Gross Domestic Product (GDP), total employment, food supplies, export earning and poverty alleviation are very pronounced. The economic development is linked with the performance of the agricultural sectors. Growth of the economy of Bangladesh largely depends on the growth of agricultural sectors. The primary emphasis of development effort in agriculture since independence has been to replace the traditional and greatly unstable agriculture by a modern agriculture capable of sustained growth. Bangladesh has made some progress in agriculture during the post independence period. The rate of growth has however, been to low to enable the country to achieve self-sufficiency in food grains which has been the main objective of agricultural development for a long time of this country. The poor production performance of agriculture was identified with low level of technology characterizing traditional agriculture and overwhelming dependence on natural calamities. Agriculture being the dominant sector of Bangladesh economy, the share of agricultural sector in Gross Domestic Product (GDP) at the beginning of eighties (1980-81) was 33.07% which reduced gradually to 29.23 percent in 1990-91, 25.03 percent in 2000-01, 21.85 percent in 2005-06 and 20.24 percent in 2009/10 at constant prices (BBS,1985,1995,2005 and 2010). Agriculture is the single most important sector in Bangladesh's economy. The land of this country is very fertile and produces a great variety of crops. Rice by three seasonal varieties: aus, aman and boro, wheat and jute are the major crops grown in Bangladesh. Agriculture and food policies of Bangladesh have been production oriented and focused on increasing rice yields through increasing productivity and bringing new land areas under rice production. As a result, growth in the agricultural sector essentially mirrors the performance of crop production.

The agricultural sector is the mainstay of the Bangladesh's economy. It accounts for over 45 percent of the national value added. In the years to come, agriculture will continue to remain the prominent source of employment for the incremental labor force. The growth of this sector is therefore, critical to the growth and development of the national economy. Agriculture is the driving force behind economic growth in Bangladesh and as a result, increasing food and agricultural production have always been major concerns of Bangladeshi policy makers.

Cultivated Area Allocation for Selected Major Crops

Agriculture is the prominent sector in the economy of Bangladesh and vital factor determinant of economic growth and livelihood improvement of the rural farmers. A rapid and substantial increase in agricultural production is essential to fulfill the growing demand for food grain

emerged from high population growth. Agricultural sector of Bangladesh is dominated by rice production. Rice is the main item of food for the people of this country. Rice alone contributes 12.5 percent of total agricultural Gross Domestic Product (GDP). Rice, Wheat, jute are the major crops grown in Bangladesh out of the total land area of 14.11million hectares, total cultivated area of the country is 8.03 million hectares. Although the total land area is the same in each year, but the total cultivated area is decreasing year to year due to industrialization. Rice crop covers 78.26 percent while jute, wheat cover 2.92 percent, 2.74 percent showed in Table 1. After three-forth of the total cropped area is allocated to rice sector and hence, rice has exclusively led to the growth of crop agriculture. Within rice crop by three seasonal varieties, cultivated area of aman crop occupies the top level followed by boro and aus in terms of cultivated area allocation shown in Table 2 (BBS, 2010).

Table 1. Cultivated area under major crops in Bangladesh, 2008/09

Crops	Percentage of total cropped area
Rice	78.26
Wheat	2.74
Jute	2.92

Source: BBS (2010).

Table 2. Cultivated area of rice by varieties in Bangladesh, 2009/10

Rice Varieties	Percent
Aus	8.67
Aman	49.87
Boro	41.46
Total	100.00

Source: BBS (2010).

Crops economy in Bangladesh

Rice is the principal cereal crop which occupies almost three-quarters of the total crop land in Bangladesh. Rice production is vital to the Bangladesh economy. The experience of technological change led by varietals improvement in Bangladesh has significantly contributed to the growth of rice production during the last three decades. There are three seasons of rice grown which are known as aus, aman and boro. These three seasons of rice are grown and harvested in different period's of the year and vary in terms of quality. Table 3 shows the area of three seasonal varieties of rice during the period 2001/02, 2005/06 and 2005/06. Boro is the predominant type of rice crop followed by Aus and Aman. Likewise, area of boro has increased in 2005/06 and 2009/10 compared to 2001/02. Boro rice is an irrigated crop in Bangladesh. It is also comprised of local and high yielding varieties. Boro contribute maximum share to total production of rice. There are two types of aman which are broadcast aman (b. aman) and transplanted aman (t. aman) that can be categorized as either local or High Yielding Varieties (HYV). In the aman variety of rice, high yielding variety seeds are mostly confined to transplanted aman which is sown and harvested in the same period as traditional transplanted aman. Table 3 showed that area of aman was 5647.22 thousand hectares in 2001/02 but it decreased in 2005/06 which was 5429.01 thousand

hectares and then it had been increased in 2009/10. Aus involving traditional strains but more often including high yielding varieties. Area of Aus is also decreasing day by day (Table 3).

Table 3. Area of three seasonal varieties of rice during 2000/01, 2005/06 and 2009/10

	Area ('000ha)		
Year	**Aus**	**Aman**	**Boro**
2001/02	1242.18	5647.22	3771.34
2005/06	1034.27	5429.01	4065.81
2009/10	984.49	5665.12	4708.97

Source: BBS (2010).

Table 4 shows the area, production and yield of rice, jute and wheat during the period of 2000/01 and 2005/06. Rice production during the last three decades showed a spectacular growth in acreage and production. Rice production has doubled since independence without further increase in rice area (Table 4). So gains in the food grain sector that Bangladesh has achieved since its independence are mostly due to technological progress in the rice cultivation.

Jute as a cash crop and also a labor intensive crop gained importance in terms of relative share in the export earning, income distribution and employment impact for the majority of farmers. Once upon a time it occupied central position in export item, but with emergence of readymade garments and introduction of synthetic fibers, it started losing its position from the early 1980's. However, Bangladesh is still the predominant jute suppliers in the world market. Jute is one of the cheapest natural fibers. The industrial term for jute fiber is raw jute. During some years of 1980s, farmers in Bangladesh burnt their jute crops when adequate price could not be obtained. Farmers in Bangladesh have not completely ceased growing jute, however mainly due to demand in the international market. Recently (2005-06), the jute market began to recover and the price of raw jute increased more than 200 percent. The weather condition was favorable for jute crop during sowing period of 2005-06 all over the country. Table 4 also shows that jute area decreased in 2005-06 compared to 2000-01. Production and yield of jute were 4526 thousand hectares and 10.1 thousand bales in 2000-01. Production and yield were increased in 2005-06 which were 4619 thousand hectares and 11.49 thousand bales respectively. Jute is a natural fiber with golden and silky shine and hence, called the golden fiber. Jute which was the backbone of Bangladesh's economy over the past many decades is now fighting a losing battle for survival. Lack of proper planning, mismanagement and mindless plundering were responsible for the loss of golden fiber that was once the largest foreign currency earner of the country.

Wheat is the second most important cereal crop of the Rabi season and it has become an indispensable food item of the people of Bangladesh. Wheat cultivation is gaining popularity in Bangladesh but the average yield of this in the country is low as compared with other wheat growing country of the world. Wheat production is highly dependent on weather condition. Wheat crop is very sensitive to the level of temperature. With the exception of a few years, there has been a gradual decrease in the area, production and yield of wheat. But these decreases have been spectacular during the last few years. However, in each year Bangladesh is to import a great amount of wheat to meet its annual requirement of wheat. To maintain the stability of wheat production, it is necessary to identify the constraints of its

adoption at the farmers' level. The total area under wheat crop has been estimated at 479 thousand hectares in 2005/06 compared to 772.87 thousand hectares in the 2000/01 (Table 4). The wheat area is gradually decreases over the last several years. This has been happening due to increase of parallel crops like Boro, Potato etc. Average yield rate has been estimated at 1.53 tones per hectare in 2005/06 compared to 2.16 tones per hectare in 2000/01 (Table 4). The yield rate has declined by mainly relatively higher temperature and shortened of cold season drastically affected the yield of the crop.

Table 4. Area, production and yield of selected crops during 2000-01 to 2005-06

Selected Crops	Year	Area ('000ha)	Production ('000 tone)	Yield (tone/ha)
Rice	2000/01	10797.03	25085.50	2.32
	2001/02	10660.74	24300.00	2.28
	2002/03	10770.67	25191.30	2.34
	2003/04	10823.69	26189.40	2.42
	2004/05	10368.39	25156.10	2.45
	2005/06	10529.09	26530.30	2.52
	Year	Area ('000ha)	Production ('000 bales)	Yield (bales/ha)
Jute	2000/01	448.20	4526.00	10.10
	2001/02	456.50	4733.00	10.37
	2002/03	436.60	4407.80	10.10
	2003/04	407.90	4375.50	10.73
	2004/05	390.00	4035.00	10.33
	2005/06	399.00	4619.00	11.49
	Year	Area('000 ha)	Production ('000 tone)	Yield (tone/ha)
Wheat	2000/01	772.87	1673.00	2.16
	2001/02	741.80	1606.00	2.17
	2002/03	706.48	1506.70	2.13
	2003/04	641.87	1253.30	1.95
	2004/05	558.00	976.00	1.75
	2005/06	479.00	735.00	1.53

Source: BBS (2010).

II. METHODOLOGY

The main objective of this study is to estimate the growth rates of major crops in Bangladesh. For better understanding of the methodology used are discussed in each of the following aspects: selection of crops, selection of period of the study, selection of prices and empirical method used in relation to the estimation of growth rates of selected major crops are presented in this section:

Selection of crops

In this study three major categories of crops were selected. These are (a) Cereal crops: three seasonal varieties of rice (aus, aman and boro), wheat (b) Cash crop: jute. These crops have been selected on the basis of proportion of area allocation as well as production. The level of production determines the harvest prices of respective crops.

Selection of period of the study

The proposed study will cover the time period from 1980-81 up to 2009/10 which may be advancement in terms of information analysis. This period is chosen due to initial start of privatization as well as the rest of the period to capture the effects of a market enterprise economy and covering the period of intensified liberalized economy than any other time before.

Selection of price

In accordance with the selection of crops, appropriate prices were to be chosen. Price has an allocate influence on resources and is more important for policy purposes. In fact, farmers take area allocation decisions with respect to the expected prices prevailing during the post harvest period. In the present study, harvest prices of selected crops have been taken for analysis. Harvest prices have been taken into consideration for the reason that wholesale and retail prices may not reflect what the farmers actually receive, because they are set at a considerably higher level than what the farmers get. Moreover, in case of Bangladesh rural farmers sell large portion of their products at immediate post harvest period prices. So harvest prices are the most relevant prices for the producer farmers.

Growth estimation

Growth rates in production, area and yield of selected major crops are widely estimated for examining the growth performance of the crop sector and evaluated government policies. If the growth rate is not constant but depends on time the compound model cannot describe the actual picture of the growth scenario. Therefore, before performing growth analysis it is necessary to identify the growth model that best fits the time series. Exponential model is appropriate when the annual growth rate is constant over time. To know the growth rate of area, production and yield of major crops in Bangladesh for the period from 1980/81 to 2009/10, the following Exponential model has been used

$$Y_t = ae^{bt} \quad \text{.....(1)}$$

Where,

Y_t = Area/production/yield of selected crops in year t

a = intercept

b =absolute growth rate

t = independent variable (time)

e is a constant, with a value of 2.71828.....

Taking the natural logarithm of (1), we can write

$$\ln Y_t = \ln a + bt \ldots\ldots\ldots (2)$$

Here, b is the growth rate in ratio scale and when multiplied by 100 it expresses percentage growth, i.e., annual compound growth rate.

III. RESULT AND DISCUSSION

Growth rates of area, production and yield of selected major crops were widely estimated for examining growth performance of the crop sector and evaluating government policies. In this research paper, growth rates of selected major crops have been estimated by fitting Exponential function/Semi-log model, $\ln Y_t = \ln a + bt$ to the data to see the overall growth during the study period. Time series data have been divided into two sub-periods on the basis of implementation of privatization policies in agriculture. Period-1was before full implementation of privatization policies which covered the period from 1980/81 to 1990/91 and period-2 was after full implementation of privatization policies covering the period from 1990/91 to 2005/06. Policy changes with respect to agriculture were the basis of this demarcation with respect to period. The later period fell in the structural adjustment reform period. Growth rates in area, production and yield of aus, aman, boro, jute and wheat were computed to have a comparative measure to see the relative growth and their relationship during three decades (1980/81 to 2009/10).

Growth Rates of Area, Production and Yield of selected major crops during 1980/81 to 2005/06

Aus

In period-1 (1980/81-1990/91) area and production of all aus, HYV and local aus have decreased significantly at the rate of 3.65, 2.58, 3.86 and 2.94, 5.10, 2.06 percent respectively. Yield of all aus increased at the rate of 0.67 percent which has not been significant in period-1 (1980/81-1990/91), local aus also exhibited significant positive growth rate (Table 5) but HYV yield had decreased at the rate of 1.86 percent which was statistically significant during the same period. Area of all aus and local Aus have showed significant negative growth rate in period-2 (1990/91-2005/06) while area of HYV growth has been increased significantly at the rate of 1.56 percent during the same period (Table 5). All aus and local aus production were observed to have decreased at the rate of 1.43 and 4.72 percent respectively due to declining area of all aus and local aus but HYV production has increased significantly at the rate of 2.63 percent in period-2 (1990/91-2005/06) than the preceding period. However, it is observed that yield of all aus increased to 2.79 percent significantly than the previous period and yield of local aus also showed remaining positive significant growth rate of 2.95 percent (Table 5) and yield of HYV growth has not been significant in period-2 (1990/91-2005/06). All aus and local aus area decreased at the rate of 4.92 and 6.68 percent respectively which also have been significant during the period (1980/81-2005/06). HYV aus area showed negative insignificant growth rate during the whole period. Growth of all aus and local aus under yield also increased at the rate of 1.82 and 1.84 percent over the period (1980/81-2005/06) which had been significant. Area, production and yield of HYV showed negative

growth rate during the period (1980/81-2005/06) and there did not have any significant effect of area, production and yield of HYV aus. It is observed that growth of all aus production has been declined at the rate of 3.1 percent which was statistically significant during the period 1980/81-2005/06; local aus production has also exhibited significant negative growth rate of 6.68 percent during the same period. Table 5 also shows the growth rates of area (significantly negative), production (significantly negative) and yield (significantly positive) of all aus during the period from 1980/81 to 2009/10.

Table 5. Growth rates of area, production and yield of aus rice during 1980/81 to 2009/10

Variable		Period-1 (1980/81-1990/91)		Period-2 (1990/91-2005/06)		Period (1980/81-2005/06)		Overall period (1980/81-2009/10)	
		Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value
Area	All Aus	-3.65***	-5.83	-4.23***	-18.36	-4.92***	-27.62	-4.74***	-28.91
	HYV	-2.58***	-2.48	1.56***	4.74	-0.09	-0.33		
	Local	-3.86***	-6.53	-6.87***	-19.05	-6.68***	-28.82		
Production	All Aus	-2.94***	-4.31	-1.43***	-3.25	-3.1***	-11.34	-2.69***	-10.89
	HYV	-5.10***	-5.44	2.63***	6.23	-0.15	-0.36		
	Local	-2.06***	-2.88	-4.72***	-8.68	-5.19***	-16.98		
Yield	All Aus	0.67*	1.61	2.79***	7.75	1.82***	9.56	2.05***	13.23
	HYV	-2.51***	-8.48	0.26	0.38	-0.42*	-1.49		
	Local	1.86***	3.76	2.95***	3.45	1.84***	5.29		

*** Denotes significant at 1 percent level
** Denotes significant at 5 percent level
* Denotes significant at 10 percent level

Source: Author's calculation based on data gathered from BBS (various issues)

Aman

In period-1 (1980/81-1990/91), area of all aman, b. aman and t. aman showed negative growth rate of 0.91, 5.86 and 2.08 percent respectively that were also statistically significant. However, it is observed that yield of all aman and t. aman had a significant positive growth rate of 2.19 and 1.50 percent respectively in period-1(1980/81-1990/91).There did not have any significant effect on b. aman yield. Increased growth rate of all aman yield affected increased production of all aman at the rate of 1.28 percent during the same period. Period-1(1980/81-1990/91) also showed insignificant effect on b. aman and t. aman (Table 6). During the period-2 (1990/91-2005/06) under the study, it was observed that area of all aman, b. aman and t. aman exhibited significant negative growth rate of 0.37, 3.75 and 2.95 percent respectively. Growth of b. Aman yield grew very significantly at the rate of 1.16 than the previous period. Yield of all aman and t. aman also showed positive significant growth rate of

1.76 and 1.07 percent respectively but grew at a lower rate compared to the preceding period. Increased growth rate of all aman yield affected increased production to 1.41 percent significantly than the previous period. The period-2 (1990/91-2005/06) under study growth it was observed that b. aman and t. aman production declined significantly (Table 6) due to poor yield increased during the same period. During the period 1980/81-2005/06, area of all aman, b. aman and t. aman were observed to have negative insignificant growth rate of 0.32, 4.21 and 2.8 percent respectively. The contribution of yield to increase production can be considered to be the technological improvement and adoption of new technologies. Yield of all aman, b. aman and t. aman exhibited positive growth rate of 1.86, 0.63 and 0.87 percent respectively during the period. Increased growth rate of all aman yield affected increased production significantly at the rate of 1.52 percent while area declining over the period (1980/81 to 2005/06). B. aman and t. aman were observed to have decreased at the rate of 3.63 and 1.96 percent respectively which were also statistically significant due to poor yield increases and declined area. Table 5 also shows the growth rates of area (significantly negative), production (significantly positive) and yield (significantly positive) of all aman during the period from 1980/81 to 2009/10.

Table 6. Growth rates of area, production and yield of Aman rice during 1980/81 to 2009/10

Variable		Period-1 (1980/81-1990/91)		Period-2 (1990/91-2005/06)		Period (1980/81-2005/06)		Overall period (1980/81-2009/10)	
		Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t-value
Area	All aman	-0.91**	-2.16	-0.37**	-2.15	-0.32***	-3.13	-0.33***	-3.91
	b. aman	-5.86***	-7.43	-3.75***	-6.32	-4.21***	-15.52		
	t. aman	-2.08***	-4.41	-2.95***	-14.47	-2.8***	-23.95		
Production	All aman	1.28*	1.57	1.41***	2.79	1.52***	6.64	1.48***	8.12
	b. aman	-5.77***	-4.89	-2.61***	-2.57	-3.63***	-8.04		
	t. aman	-0.57	-0.68	-1.93***	-3.78	-1.96***	-7.95		
Yield	All aman	2.19***	4.19	1.76***	4.55	1.86***	11.18	1.81***	14.34
	b. aman	0.05	0.07	1.16**	2.17	0.63**	2.62		
	t. aman	1.50***	2.93	1.07**	2.37	0.87***	4.53		

*** Denotes significant at 1 percent level
** Denotes significant at 5 percent level
* Denotes significant at 10 percent level

Source: Author's calculation based on data gathered from BBS (various issues)

Boro

During the period-1(1980/81-1990/91), it was observed that area of all boro and HYV boro grew significantly at the higher rate of 7.97 and 10.94 percent respectively. But area of local boro exhibited significant negative growth rate of 3.47 percent during the same period. Area increases all boro and HYV boro helped production increases significantly (Table 7). Growth of production under local boro was observed to have declined significantly at the growth rate

of 5.30 percent in this period. There did not have any significant effect on all boro yields. In period-1 (1980/81-1990/91), growth of HYV boro and local boro exhibited negative growth rate of 0.62 and 1.85 percent respectively which were statistically significant. In period-2 (1990/91-2005/06) area of all boro and HYV boro showed significant positive growth rate of 3.80 and 4.33 percent respectively but grew at lower rate compared to the preceding period. Growth of local boro area remained to be decreasing in period-2 (1990/91-2005/06).Growth of all boro and HYV boro production grew significantly at the lower rate of 6.14 and 6.42 percent respectively. There had no significant effect on local boro production during the period-2 (1990/91-2005/06). Significant changes were observed in growth performance of all boro, HYV boro and local boro yield in period-2 (1990/91-2005/06). Yield of all boro, HYV boro and local boro increased significantly at the rate of 2.47, 2.07 and 2.86 percent respectively due to yield improvement over the previous period. Area of all boro and HYV boro grew significantly at the higher rate of 4.99 and 6.23 percent respectively during the period (1980/81-2005/06). However, it was observed that local boro area and production decreased during the period (1980/81-2005/06) (Table 7). Area expansion of all boro and HYV boro contributed largely increase in all boro and HYV production. Production of all boro and HYV boro were observed to have increased significantly at the growth rate of 6.52 and 7.27 percent respectively over the period (1980/81-2005/06). Yield increase of HYV boro has been significant during the period (1980/81-2005/06). HYV boro increased significantly at the rate of 1.04 percent and growth of local boro was observed to have increased at the rate of 1.12 percent but there did not have any significant effect of yield of all boro during the period (1980/81-2005/06). Table 7 also shows growth rates of area, production and yield of boro during the overall period from 1980/81 to 2009/10 those are significantly positive.

Table 7. Growth rates of area, production and yield of Boro rice during 1980/81 to 2009/10

Variable		Period-1 (1980/81-1990/91)		Period-2 (1990/91-2005/06)		Period (1980/81-2005/06)		Overall period (1980/81-2009/10)	
		Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value
Area	All boro	7.97***	11.35	3.80***	12.10	4.99***	19.98	4.67***	22.86
	HYV	10.94***	14.25	4.33***	13.28	6.23***	17.74		
	Local	-3.47***	-8.72	-3.06***	-9.28	-3.1***	-22.13		
Production	All boro	8.38***	11.11	6.14***	13.52	6.52***	28.39	6.43***	36.45
	HYV	10.33***	12.55	6.42***	13.96	7.27***	26.00		
	Local	-5.30***	-7.68	-0.28	-0.66	-1.93***	-6.13		
Yield	All boro	0.17	0.70	2.47***	14.83	1.54***	11.43	1.76***	15.49
	HYV	-0.62***	-2.92	2.07***	12.65	1.04***	6.78		
	Local	-1.85***	-2.99	2.86***	6.39	1.12***	3.61		

*** Denotes significant at 1 percent level
** Denotes significant at 5 percent level
*Denotes significant at 10 percent level

Source: Author's calculation based on data gathered from BBS (various issues)

Jute

The period-1 showed insignificant negative growth rate of 1.15 percent in jute area. Growth rate of production and yield under jute were observed to have increased during this period. In period-1 (1980/81-1990/91) yield of jute had a significant positive growth rate of 1.28 percent due to technological improvement which in turn contribute to jute production increase at the rate of 0.12 percent during the same period. Yield of jute remained to be increased significantly in period-2 (1990/91-2005/06). Growth of jute yield had increased to 1.38 percent than the previous period. Jute area and production exhibited significant negative growth rate during the period-2 (1990/91-2005/06) under this study. Growth rate of jute under area declined to 2.42 percent and production growth rate of jute was also observed to have decreased to 1.02 percent from 0.12 percent during the same period.

In the present study, area of jute had decreased significantly at the rate of 2.26 percent over the period (1980/81-2005/06) under this study (Table 8). Yield of jute showed significant positive growth rate of 1.31 percent during the period (1980/81-2005/06). However, it is observed that total jute production had declined significantly at the rate of 0.95 percent during the period (1980/81-2005/06) though yield increases due to technological development. Table 8 also shows growth rates of area (significantly negative), production (significantly negative) and yield (significantly positive) of jute for the whole study period 1980/81 to 2009/10.

Table 8. Growth rates of area, production and yield of Jute during 1980/81 to 2009/10

Variable	Period-1 (1980/81-1990/91)		Period-2 (1990/91-2005/06)		Period (1980/81-2005/06)		Overall period (1980/81-2009/10)	
	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value
Area	-1.15	-0.56	-2.42***	-5.60	-2.26***	-5.88	-2.00***	-6.78
Production	0.12	0.06	-1.02**	-1.83	-0.95**	-2.38	-0.77**	-2.44
Yield	1.28**	2.48	1.38***	7.22	1.31***	11.82	1.23***	8.26

*** Denotes significant at 1 percent level
** Denotes significant at 5 percent level
*Denotes significant at 10 percent level

Source: Author's calculation based on data gathered from BBS (various issues)

Wheat

Area, production and yield growth of wheat did not have any significant effect in period-1 (1980/81-1990/91). Production and yield of wheat have decreased at the rate of 1.44 and 2.19 percent respectively but area under wheat which showed insignificant positive growth rate of 0.74 percent during the same period. During period-2 (1990/91-2005/06), no significance changes were observed in case of area, production and yield growth rate of wheat. Production of wheat has increased to 0.15 percent than the preceding period which also has come through insignificant wheat yield increase at the rate of 0.45 percent. The growth rate of wheat under area has decreased to 0.04 percent in the period-2 (1990/91-2005/06) than the previous period. But in the present study, the period (1980/81-2005/06) showed significant positive growth rate under wheat area. During the period (1980/81-2005/06) area of wheat grew at the

rate of 0.93 percent which was statistically significant that helped obtaining increased production. Production was influenced by area increases. The growth of wheat production has increased at the rate of 0.99 percent insignificantly over the period (1980/81-2005/06) under this study. Though yield increase of wheat has not been significant which tells that technological breakthrough has reached to a level of stagnation also for wheat. Table 9 also shows growth rate of area, production and yield of wheat for the whole study period from 1980/81 to 2009/10 and those rates are statistically insignificant.

Table 9. Growth rates of area, production and yield of wheat during 1980/81 to 2009/10

Variable	Period-1 (1980/81-1990/91)		Period-2 (1990/91-2005/06)		Period (1980/81-2005/06)		Overall period (1980/81-2009/10)	
	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value	Growth rate (%)	t value
Area	0.74	1.01	-0.04	-0.05	0.93***	2.50	-0.51	-1.10
Production	-1.44	-1.16	0.15	0.10	0.99*	1.63	-021	-0.38
Yield	-2.19	-1.55	0.45	0.64	0.21	0.58	0.29	1.20

*** Denotes significant at 1 percent level
** Denotes significant at 5 percent level
*Denotes significant at 10 percent level

Source: Author's calculation based on data gathered from BBS (various issues)

Comparison of results with other studies

Analysis of growth rates in area, production and yield of selected major crops can be most useful for policy making since they help to understand the magnitudes and direction of the changes taking place. To achieve rapid agricultural growth and self-sufficiency in food grain production, a rapid expansion of multiple cropping due to the introduction of seed-fertilizer-irrigation technology, massive input subsidies and price support policies have been pursued in combinations as policy options for crops from the early eighties. The gradual withdrawal of input subsidies on fertilizers, pesticides and irrigation equipment has lowered profitabilities and allowed more roles for market actors in the distribution and pricing of modern factor inputs. Though public sector investment in agriculture has fallen, rapid expansion of roads, transportation has taken place and favourable export-import policies undertaken. In Bangladesh, several studies have been conducted to estimate the growth rates of area, production and yield of selected major crops viz., three seasonal rice varieties (aus, aman and boro), jute and wheat.

Alam (1997) worked out the yield growth of rice by three seasonal varieties viz.; aus, aman and boro for the period 1972/73 to 1982/83. He found that significant increasing of yield of respective rice varieties: aus, aman, boro (i.e. 1 percent, 2 percent, and 1 percent, respectively). He was also estimated that aus and boro area were significantly decreased (3 percent) and increased (5 percent) respectively.

But in the present study, annual growth of yield was the highest for all aman (1.86%) followed by local aus (1.84%) and local boro (1.12%).Yield of rice varieties was influenced by technological change (line sowing and modern inputs). It is observed that yield growth of local aus and local boro were increased than before due to technological advancement.

Alam (2000) studied the growth scenario of crops sector agriculture in Bangladesh for the last 25 years. The study showed that increase in area, yield and total production for wheat were 7.76 percent, 3 percent and 9.35 percent per annum respectively throughout the entire period 1971/72 to 1993/94.

Wahid (1995) found that area and yield of wheat increased at the rate of 9.22 and 3.11 percent respectively for the period 1972 to 1993, which increased the production significantly (12.64) during the same period. Borua (2001) also found that area of wheat grew at the rate of 1.9 percent which helped only the production increase significantly at the rate of 2.6 percent• for the period 1981 to 1999. But in the present study it is observed that area, production and yield of wheat to have exhibited marginal but positive growth rates of 0.93 percent, 0.99 percent and 0.21 percent, respectively over the whole period.

Patwary (2001) studied the regional variation in the production performance of food grains (aus, aman, boro) in Bangladesh during the period 1976/77 to 1997/98. Growth rates in area, production of crops were estimated by using exponential trend function.. The study showed that during the overall period for the country as a whole, the area growth rates of aus and aman were -4.14 and -0.20 and positive for boro, The growth rate of production was negative for aus (-3.13) and positive for aman and boro. But in the present study it is observed that the growth rates of area were also negative for aus and aman (-4.14 and -0.20) and positive for boro (4.99). The growth rate of production was negative for aus (-3.1) and positive for aman and boro (1.52 and 6.52).

Barua (2001, p-72) found that yield of jute growth increased to 1.2 percent significantly for the period (1980/81-1998/99) and jute area exhibited negative significant growth rate while the production of jute decrease has not been significant during his study period. But in the present study, it is observed that area of jute also negative (2.26 percent) over the overall period (1980/81-2005/06) and yield of jute (1.31 percent) increased than before due to technological development. Total jute production had declined significantly at the rate of 0.95 percent during the entire period.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

The focus of the present study was to estimate the growth rates in area, production, yield of major crops viz., Rice (by three seasonal varieties), wheat, jute in Bangladesh. The study covered the time period of 1980/81 to 2009/10. The base period was chosen due to the initial start of privatization as well as the rest of the period to capture the effect of the liberalized economy. Therefore, time series data for the period 1980/81 to 2009/10 were employed for this study. This study was entirely based on secondary data. Rice is the principal cereal crop. Rice is the largest with an average 71 percent share of the gross output value of crops and total rice crop covers 78.26 percent of the total cropped area while jute, wheat cover 2.92

percent and 2.74 percent respectively. Rice production has doubled since independence without further increase in rice area. Jute is the major export commodity. Area of jute was 634.9 thousand hectares in 1980/81 which decreased to 399 thousand hectares. Production also decreased in 2005/06 which was 4619 thousand tones. The decline in jute production is attributed to declining world prices for this crop and as a consequence declining area of jute. Wheat is the second most important cereal crop of the Rabi season. The wheat area is gradually decreases over the last several years. Growth rates of area, production and yield of major crops were estimated by fitting exponential function. During the overall study period for the country as a whole, growth rates of area which where negative for all aus, local aus, HYV aus, all aman, b. aman, t. aman and local boro, jute. The areas of wheat, boro increased significantly at the rate of 0.93 and 4.99 percent respectively during the period (1980/812005/06). The growth rates of yield was positive for wheat, jute, all aus, local aus, all boro, local boro, HYV boro, all aman, b, aman and t. aman. The contribution of yield to increase production can be considered to be the technological improvement and adoption of technologies by the farmers. Substantial technological progresses have taken place in crop production activities. Increase in production may be attained through increased area allocation from alternative uses and through yield increases. Area and yield increased of wheat, all boro, HYV boro which increased the production at the rate of 0.99, 6.52, and 7.27 percent respectively during the study period (1980/81-2005/06). Increased growth rate of all aman increased total production at the rate of 1.52 percent while area decreasing significantly at the rate of 0.32 percent. In spite of increasing yield of all aus, HYV aus, local aus, b. aman, t. aman and jute production decreased during the whole period (1980/81 to 2005/06) due to declining areas of these crops.

The findings indicate that the implementation of a farm support policy could be used to manipulate supply output in Bangladesh. If the government would follow a price stabilization policy, it would reduce price risk and would produce a positive impact on crop supply situation in Bangladesh. Agricultural research efforts should be made towards varietals improvement for increasing their yields. Greater emphasis should be given for evolving drought and disease resistant high yielding varieties of crop. Government should emphasize more on privatization policy related to modern technology to increase efficiency and to reduce wastage of resources of agricultural sector. The key factor of increasing export depends on the increase in total production of crops. Forecasting of price, target area, yield and production before sowing will be helpful to the farmers in allowing them to adjust the area. Extend the availability and improve the distribution of good quality certified seed. To do this one necessary step may be encouraging establishing a series of small cold stores by the private sector in the more remote growing areas. Area adjustment problems may be removed by ensuring supply of inputs, insecticides and pesticides and credit in proper time. Government should also take some programs to protect food grains from natural disasters and providing modern technology to the farmers.

Agricultural pricing policy plays a key role in increasing both farm production and incomes. Findings from this research paper are not only an initial effort from this perspective but also provide future issue for research and suggest necessary policy guidelines for future production and marketing strategies of the country.

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