Bangladesh J. Agric. Econs XXV, 1 (2002) 1-16

CHANGES IN THE MAJOR FOOD GRAINS PRODUCTION IN BANGLADESH AND THEIR SOURCES DURING THE PERIOD FROM 1979/80 TO 1998/99

N. Akter
W.M.H. Jaim

ABSTRACT

Based on national level data from secondary sources, the magnitude of changes in average production and the sources of changes for the Bangladesh as a whole were measured for major food grains - rice (Aus, Aman and Boro) and wheat during 1979/80 to 1998/99 which was again sub-divided between two time periods, before full-implementation of privatization policies (1979/80-1988/89) and after full-implementation of privatization policies (1989/90-1998/99). The findings showed that average area of Boro rice and wheat increased during the whole period of study. However, during the period after full-implementation of privatization policies the areas under Aus, wheat as well as total food grains decreased. Further, it was found that except Aus, average production of all types of food grains increased and except wheat, average yield of all types of food grains also increased during the same period. The analysis showed that in the cases of Aus and Boro rice as well as total food grains, change in mean area; and in the cases of Aman rice and wheat changes in mean yield were the main sources of change in mean production in Bangladesh. It was also found that Boro rice appeared to be the highest and Aus rice appeared to be the lowest contributors in increasing mean production of total food grains. Finally, some policy conclusions are drawn with respect to improvement of production levels of major food grains.

I. INTRODUCTION

Until recently, Bangladesh experienced chronic food grain shortage over a long period particularly due to continuous increase in population and decrease in per capita cultivated land area. So, to attain food grain self-sufficiency the government of Bangladesh gave special emphasis to increase production through expansion of HYV seed-fertilizer-irrigation technology since 1960's. As a result, food grain production increased substantially in recent years. Bangladesh produced 13.35 million metric tons of food grain in the year 1979/80 and it increased to 24.90 million metric tons in 1999/2000 (BBS, 1985 and MOF, 2000). In spite of this, Bangladesh faced deficit in food grain in every year except 1999/2000 (MOF, 2000).

Private investment in irrigation and deregulation of agricultural inputs during 1980s abruptly improved the diffusion of new technologies (Akteruzzaman and Jaim, 1997). Liberalization of fertilizer and the irrigation equipment was the dominant features of the reform that made a substantial impact on production (Ahmed, 1995). The process of privatization and market liberalization started from early eighties and ended at-the beginning of nineties. Therefore, full effects of privatization and market liberalization started from early

The authors are respectively Lecturer, Department of Farm Economics, Chittagong Government Veterinary College, Chittagong and Professor, in the Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, Bangladesh.

nineties. Although food grain production increased during the whole period of study, it is important to identify the impact of these policy reforms on food grain production during two sub-periods : before and after full-implementation of privatization policies.

The present study was undertaken with the objective of measuring and analyzing the magnitude of changes in food grain production and their sources with special emphasis on the role of privatization policies related to modern technology.

The reminder of this paper has been organized as follows: Section II discusses the sources of data and analytical procedures of the study. Section III discusses the magnitude of changes in mean area, yield and production of different food grain crops between two periods. Section IV discusses sources of change in mean production with special emphasis on the role of privatization policies related to modern technology, their magnitude and contribution of different regions to change in mean production of Bangladesh. Some concluding observations are made in section V.

II. DATA AND ANALYTICAL METHODS

The data required for this study relate to aggregate (national) and district (regional) level data of major food grain crops (Aus rice, Aman rice and Boro rice, and wheat). The data used here were collected from the published documents of the Bangladesh Bureau of Statistics (BBS) of different years (1985, 1987, 1989, 1993, 1997 and 2001). These data were however checked with other published and unpublished data sources and corrected when major errors were detected.

As mentioned earlier, changes in average production and their sources for major food grains - Aus rice, Aman rice, Boro rice and wheat were measured between the two time periods. The first period was before full-implementation of privatization policies which covered the period from 1979/80 to 1988/89 and the second period was after full-implementation of privatization polices, covering the period from 1989/90 to 1998/99. Analysis was done both at the national and regional levels. In this study, the country was disaggregated into 21 regions, which considered the former 23 districts. The regions are: Chittagong, Chittagong Hill Tracts (Rangamati, Bandarban, Khagrachari), Comilla, Noakhali, Sylhet, Dhaka, Faridpur, Jamalpur, Kishoreganj, Mymensingh, Tangail, Barisal, Jessore, Khulna, Kushtia, Patuakhali, Bogra, Dinajpur, Pabna, Rajshahi and Rangpur. In the case of wheat, Chittagong, Chittagong Hill Tracts, Noakhali, Barisal, Khulna and Patuakhali districts have been considered together as `Other regions' as their contributions in total production of wheat was found to be small.

To analyze the sources of changes in food grain production Hazell's Variance Decomposition Procedure (1982)[1] was used. To use this model following adjustments were made:

The area and yield data for each crop and region were detrended using linear relations of the form

$Z_t = a + bt + e_t$ .....(i)

Where, Z_t denotes the dependent variable (area or yield), t is time and e_t is a random residual with a zero mean and variance σ^2. Separate regressions were run for each of the two time periods to ensure that $\Sigma_t e_t = 0$ for each period.

After detrending the residuals were centered on the mean areas or yields for each period, $\bar{Z}$, resulting in detrended times-series data of the form

$Z = e_t + \bar{Z}$

where, Z is detrended series which is adjusted by mean, $\bar{Z}$ is mean value and e_t is detrended series.

Time series data on detrended production for each crop and region were then calculated as the product of the detrended areas and yields.

The models used in this study are as follows:

The total production (Q) of each crop and region can be expressed as:

$Q = AY$ .....(1)

where A denotes area sown and Y denotes yield.

Average production, E(Q), can be expressed as:

$E(Q) = \bar{A}\bar{Y} + Cov(A,Y)$ ..... (2)

where, $\bar{A}$ and $\bar{Y}$ denote the mean areas and mean yield.

Using equation (2), average production in the first period is

$E(Q_I) = \bar{A}_I\bar{Y}_I + Cov(A_I, Y_I)$ .....(3)

and the average production in the second period is:

$E(Q_{II}) = \bar{A}_{II}\bar{Y}_{II} + Cov(A_{II}, Y_{II})$ .....(4)

Each variable in the second period can be expressed as its counterpart in the first plus the change in the variable between the two. Thus, the change in average production, $\Delta E(Q)$, can be decomposed in the following way :

$\Delta E(Q) = \bar{A}_I\Delta\bar{Y} + \bar{Y}_I\Delta\bar{A} + \Delta\bar{A}\,\Delta\bar{Y} + \Delta Cov(A,Y)$ .....(5)

Decomposition can be done using two methods: in method I, the first period can be considered as the base and in the method II the second period can be considered as the base. Both the methods are mathematically correct, but since the method II combines pure and interaction effects, it is less useful for this type of analysis. Thus method I was used in this study. For detailed discussion of these methods see Akter (2002).

There are four sources of change in average production $\Delta E(Q)$. Two parts, $\bar{A}_I\Delta\bar{Y}$ and $\bar{Y}_I\Delta\bar{A}$, arise from the changes in the mean yield and the mean area. These are "pure effects" they arise even if there are no other sources of change. The term $\Delta\bar{A}\,\Delta\bar{Y}$ is an interaction effect, which arises from the simultaneous occurrence of changes in mean yield

and mean area. Obviously, this term will be zero if either the mean yield or the mean area remains unchanged. The last term, Δ Cov(A,Y), arises from changes in the variability of area and yields.

Since Cov(A,Y) = $\rho[V(A)\ V(Y)]^{1/2}$, where ρ is the correlation coefficient, then it can be seen that Δ Cov(A,Y) arises from changes in the variances of areas and yields and from changes in the correlation between areas and yields.

Contribution of crops and regions to change in mean production are as follows:

Contribution of different crops to change in mean production of total food grain was estimated by using equation (6).

[Contribution of i^{th} crops to change in mean production of total food grains]	$= \frac{\Delta Q_i}{\sum_{i=1}^{4} \Delta Q_i} =$	Change in mean production of crop i Change in mean production of total food grains

.....(6)

Where, ΔQ denotes change in mean production and i denotes different crops.

Contribution of different regions to change in mean production of crops was estimated by using equation (7).

[Contribution of j^{th} regions to change in mean production of crop i]	$= \frac{\Delta Q_j}{\sum_{j=1}^{22} \Delta Q_j} =$	Change in mean production of region j Change in mean production of Bangladesh

.....(7)

where, ΔQ denotes change in mean production and j denotes different regions.

III. CHANGES IN AREA, YIELD AND PRODUCTION OF DIFFERENT FOOD GRAIN CROPS

Changes at National Level

In Bangladesh, a significant change occurred in food grain production during the selected periods. Table 1 shows that average area, production and yield of different food grains changed to a large extent. Average area of Aus rice, Aman rice as well as total food grains decreased, and average area of Boro rice and wheat increased in the second period. Average production of all food grains except Aus increased in the second period. Average

Table 1. Changes in average area, production and yield of different food grain crops during the periods 1979/80-1988/89 and 1989/90-1998/99

Crops	Average area (Million Hectares)			Average production (Million Metric tons)			Average yield (Metric tons/hectare)		
	First period	Second period	Change (%)	First period	Second period	Change (%)	First period	Second period	Change (%)
Aus	2.98	1.75	- 41.30	3.00	1.97	- 34.07	1.01	1.13	12.40
Aman	5.85	5.68	- 2.93	7.66	9.02	17.78	1.31	1.59	21.15
Boro	1.56	2.74	76.10	3.69	7.26	96.54	2.36	2.63	11.58
Wheat	0.56	0.68	21.40	1.07	1.30	21.53	1.93	1.91	- 1.09
Total Foodgrains	10.94	10.84	- 0.87	15.42	19.56	26.84	1.41	1.80	27.96

Source: Calculated from Bangladesh Bureau of Statistics (Various Issues) data.

yield of all food grains except wheat also increased in the period of after full-implementation of privatization policies. Boro area, production and yield increased by about 76, 97 and 12 percent respectively. Aus area and production decreased by 41 and 34 percent respectively, but yield increased by 12 percent. In the case of Aman, average production and yield increased by 18 and 21 percent respectively, but area decreased by about 3 percent. For wheat there were about 21 and 22 percent increase in area and production but about 1 percent increase in yield. Total food grain area decreased by .87 percent but production and yield increased by about 27 and 28 percent respectively.

Changes at Regional Levels

Table 2 indicated that Aus mean area decreased in the second period than in the first period in all the regions as well as Bangladesh as a whole. Aman mean area also decreased in the second period in all the regions except Chittagong, Chittagong H.T, Jessore, Kushtia, Patuakhali, Dinajpur and Rangpur. Mean area of Boro on the other hand has increased in the second period in all the regions except Chittagong H.T. and Patuakhali. Changes in mean area of Boro was the highest in Kushtia (437 percent) because compared to other regions there was a big change in Boro area in Kushtia during the second period compared to that of first period.. Further, mean area of wheat also increased except Comilla, Bogra and Rangpur. It was also observed that out of 21 regions, mean area of food grains declined in 11 regions and increased in 10 regions. On the whole, mean area under food grain crops of Bangladesh has decreased by 0.87 percent during the second period.

Table 2. Percentage changes in mean area between the periods 1979/80-1988/89 and1989/90-1998/99 by crops and by regions

(Percent)

Regions / Crops	Aus	Aman	Boro	Wheat	Total Foodgrains
Chittagong	-41.09	7.08	7.90	-	-0.73
Chitagong H.T.	-24.13	6.69	-2.03	-	-7.31
Comilla	-38.31	-2.56	79.98	-25.90	0.63
Noakhali	-26.68	-8.85	58.06	-	-4.54
Sylhet	-0.21	-3.86	17.61	-	3.16
Dhaka	-52.93	-29.60	66.07	21.34	-12.37
Faridpur	-20.50	-19.46	74.51	18.99	-8.42
Jamalpur	-49.66	-13.42	87.72	38.08	-6.96
Kishoreganj	-41.50	-15.39	40.09	100.81	2.10
Mymensingh	-38.31	-6.39	82.54	49.88	-5.07
Tangail	-51.13	-25.90	32.76	16.17	-19.04
Barisal	-17.49	-4.26	36.92	-	-5.61
Jessore	-48.44	19.14	221.17	41.83	10.25
Khulna	-25.81	-2.33	98.23	-	1.17
Kushtia	-36.22	48.13	436.68	2.26	2.69
Patuakhali	-10.21	8.84	-19.14	-	4.21
Bogra	-88.51	-2.34	152.65	-23.98	7.45
Dinajpur	-66.49	12.33	365.34	59.07	8.56
Pabna	-70.13	-24.47	97.56	83.70	-11.00
Rajshahi	-36.75	-2.66	165.61	22.88	9.50
Rangpur	-67.60	5.43	160.71	-5.81	-4.60
Other regions*	-	-	-	9.56	-
Bangladesh	-41.30	-2.93	76.10	21.40	-0.87

Source: Calculated from Bangladesh Bureau of Statistics (Various Issues) data.

Note: *'Other regions' included Chittagong, Chittagong H.T., Noakhali, Sylhet, Barisal, Khulna and Patuakhali. It is only valid for wheat.

Mean yield of Aman as well as food grains as a whole has increased in all the regions in the second period compared to that of the first period (Table 3). In the case of Aus, it was also found that out of 21 regions Aus mean yield increased in 13 regions and in 8 regions itdecreased. The highest positive change in mean yield of Aus was in Rajshahi (41.04 percent). In the case of Aman it was in Jessore (43.35 percent). For Boro and wheat the highest positive changes were in Patuakhali (28.91 percent) and Comilla (8.41 percent) respectively. The highest increase in food grain yield as a whole was found in Jessore (56.32 percent).

Table 3. Percentage changes in mean yield between the periods 1979/80-1988/89 and 1989/90 - 1998/99 by crops and by regions

(Percent)

Regions/Crops	Aus	Aman	Boro	Wheat	Total Food Grains
Chittagong	19.00	19.21	-7.62	-	11.95
Chittagong H.T.	12.74	15.04	-7.05	-	12.77
Comilla	12.03	26.13	4.90	8.41	27.15
Noakhali	-11.48	15.64	4.74	-	15.84
Sylhet	23.72	28.61	9.18	-	21.23
Dhaka	-11.78	9.28	6.96	8.35	29.81
Faridpur	15.79	22.86	6.63	-11.06	31.21
Jamalpur	-12.24	20.60	14.16	8.20	30.75
Kishoreganj	18.42	20.47	11.91	-2.72	24.68
Mymensingh	-4.77	5.14	27.32	-19.32	17.88
Tangail	-16.45	22.71	-0.27	-8.92	23.12
Barisal	-4.24	2.74	10.91	-	5.74
Jessore	36.94	43.35	16.62	2.47	56.32
Khulna	40.63	20.99	13.10	-	24.57
Kushtia	26.73	35.55	11.50	-5.00	32.94
Patuakhali	24.84	0.35	28.91	-	5.04
Bogra	9.33	22.72	-0.15	6.40	33.28
Dinajpur	-0.11	17.94	4.86	4.34	28.61
Pabna	-1.27	34.48	8.97	-7.18	44.52
Rajshahi	41.04	40.95	15.90	2.13	49.63
Rangpur	31.22	16.35	10.40	0.97	36.86
Other regions*	-	-	-	5.14	-
Bangladesh	12.40	21.15	11.59	-1.09	27.96

Source: Calculated from Bangladesh Bureau of Statistics (Various Issues) data.
Note: * 'Other regions' included Chittagong, Chittagong H.T., Noakhali, Sylhet, Barisal, Khulna and Patuakhali. It is only valid for wheat.

Table 4. Percentage changes in mean production between the periods 1979/80-1988/89 and 1989/90-1998/99 by crops and by regions

(Percent)

Regions / Crops	Aus	Aman	Boro	Wheat	Total Food Grains
Chittagong	-30.07	27.25	0.46	-	10.94
Chittagong H.T.	-11.05	23.05	-8.62	-	5.44
Comilla	-23.35	23.50	88.01	-20.24	27.76
Noakhali	-34.28	5.36	66.03	-	10.13
Sylhet	23.70	23.68	28.91	-	25.25
Dhaka	-57.77	-23.05	79.35	30.46	13.48
Faridpur	-9.22	-0.51	84.00	6.79	18.93
Jamalpur	-55.54	5.16	111.39	51.14	22.24
Kishoreganj	-23.18	2.65	56.88	99.63	27.68
Mymensingh	-41.33	-1.58	128.95	27.22	11.92
Tangail	-58.94	-7.76	31.92	8.08	0.63
Barisal	-20.93	-1.34	54.85	-	0.16
Jessore	-30.30	71.90	251.03	50.15	71.99
Khulna	1.74	17.96	122.61	-	25.88
Kushtia	-19.81	97.71	462.21	-2.17	35.83
Patuakhali	12.95	9.10	3.66	-	9.59
Bogra	-85.94	20.35	155.93	-18.98	43.15
Dinajpur	-66.81	31.72	390.19	68.96	39.64
Pabna	-17.21	1.30	111.68	76.50	29.88
Rajshahi	-12.69	37.88	211.97	26.83	64.13
Rangpur	-57.89	22.95	193.63	-4.92	30.61
Other regions*	-	-	-	4.98	-
Bangladesh	-34.07	17.78	96.54	21.53	26.84

Source: Calculated from Bangladesh Bureau of Statistics (Various Issues) data.
Note: *'Other regions' included Chittagong, Chittagong H.T., Noakhali, Sylhet, Barisal, Khulna and Patuakhali. It is only valid for wheat.

Mean production of Boro and total food grains increased in almost all the regions (except Chittagong H.T. in the case of Boro), but mean production of Aus decreased in all the regions except Sylhet, Khulna and Patuakhali (Table 4). In the case of Aman average production increased in all the regions except Dhaka, Faridpur, Mymensingh, Tangail and Barisal. Average wheat production also increased in all the regions except Comilla, Kushtia, Bogra and Rangpur.

IV. SOURCES OF CHANGE IN FOOD GRAINS PRODUCTION AND CONTRIBUTION OF DIFFERENT REGIONS TO THIS CHANGE

Sources of Changes in Mean Production

At National Level

Table 5 shows the sources of change in mean production at national level for different food grain crops between the two periods. For Aus, Boro and total food grains change in mean area was the principal contributor to change in production of these crops. It contributed about 121, 78 and 307 percent of the changes respectively. But for Aman, contribution of change in mean area was negative (-32.06 percent). Here production changed mainly due to the change in mean yield (135.55 percent). Now the question arises why did such situation occur? This was mainly due to increase in yield may be through adopting HYV seed and other modern technologies. In Aman season, rice is grown as the main crop in Bangladesh and there is very little scope to expand Aman area, but possibilities exist to increase production through increasing yield by adopting modern technologies.

Table 5. Components of change in mean production of individual crops in Bangladesh between the two periods 1979/80-1988/89 and 1989/90-1998/99

(Percent)

Source of change		Aus	Aman	Boro	Wheat	Total Food Grains
Description	Symbol					
Change in mean yield	$\Delta \bar{Y}$	-36.43	135.55	12.67	47.99	-245
Change in mean area	$\Delta \bar{A}$	121.32	-32.06	77.75	41.34	307
Interaction between change in mean yield and mean area	$\Delta \bar{Y}, \Delta \bar{A}$	15.05	-3.98	9.64	10.27	38.1
Change in area-yield covariance	Δ COV (A,Y)	0.06	0.49	-0.07	0.40	-0.17

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).
Note: Mean Production of Aman and Boro rice, wheat, and total foodgrains increased during the 1979/80-1998/99 period, but mean production of Aus rice decreased during the 1979/80-1998/99 period.

In the case of Aus, area had contributed to the decrease in Aus production but yield had a negative effect on the reduction in Aus production. In other words, decrease in Aus production would have been higher unless there was an increase in yield.

In the case of Boro rice, area had contributed largely to the increase in Boro production and yield also played positive role to increase Boro production during the second period. Area under Boro crop increased due to the availability of high yielding varieties and assured irrigation facilities and comparative profitability of this crop.

In the case of total food grains, change in mean area had a positive impact and change in mean yield had a negative impact to change in mean production. Interaction effect of mean area and yield positively contributed to change in total food grain production (38.1 percent) in Bangladesh.

In the case of wheat, positive changes in mean area (41.34 percent) and changes in mean yield (47.99 percent) significantly contributed to change in mean production. This means that production changed mainly due to increased yield through adopting modern technologies. Wheat production also changed through expanding area due to the availability of high yielding varieties, assured irrigation facilities and comparative profitability of this crop. Moreover, there is further scope to increase wheat production through increase in yield and expanding area.

At Regional Level

Aus : The sources of change in average Aus production in different regions of Bangladesh are shown in Table 6. Changes in mean Aus area appeared to be the largest responsible factor for decrease in mean production in all the regions except Sylhet, Khulna and Patuakhali. This means that the change has come through the reduction of area under Aus production in the second period.

Table 6. Analysis of the components of change in average Aus rice production between the two periods 1979/80-1988/89 and 1989/90-1998/99 by regions

(Percent)

Regions	ΔY	ΔA	$\Delta Y, \Delta A$	Δ COV (A,Y)
Chittagong	-63.56	137.47	26.11	-0.02
Chitt.H.Tract	-90.60	171.58	21.86	-2.84
Comilla	-39.38	125.45	15.09	-1.16
Noakhali	33.58	78.01	-8.96	-2.63
Sylhet	100.19	-0.87	-0.21	0.89
Dhaka	20.13	90.47	-10.65	0.06
Faridpur	-191.40	248.39	39.23	3.78
Jamalpur	21.89	88.80	-10.87	0.18
Kishorgong	-59.27	133.51	24.60	1.16
Mymensingh	11.61	93.39	-4.45	-0.55
Tangail	28.07	87.25	-14.35	-0.96
Barisal	19.83	81.23	-3.47	2.41
Jessore	-124.30	163.00	60.21	1.09
Khulna	1089.50	-692.20	-281.24	-16.06
Kushtia	-142.74	193.45	51.70	-2.41
Patuakhali	232.62	-95.67	-23.76	-13.19
Bogra	-10.90	103.39	9.65	-2.13
Dinajpur	0.16	99.95	-0.11	0.00
Pabna	2.68	100.92	-1.88	-1.72
Rajshahi	-371.41	332.62	136.49	2.30
Rangpur	-54.09	117.11	36.56	0.42
Bangladesh	-36.43	121.32	15.05	0.06

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).

In Sylhet, Khulna and Patuakhali regions change in mean area influenced negatively but change in mean yield influenced positively to a large extent to increase in Aus production. This means that the reduction of mean area decreased production, but increase in mean yield contributed to maintain production level. Contribution of these three regions to change in national average production was negative which implies that production of these regions increased in the second period although the national production decreased.

Aman : The sources of change in average Aman production in different regions of Bangladesh are shown in Table 7. At the national level, the main source of change in average Aman production was the change in average yield and it was responsible for about 136 percent of the change. This pattern was observed in all the regions except Dhaka, Faridpur, Jamalpur, Mymensingh, Tangail, Kushtia, Dinajpur and Pabna regions. Change in mean area was the main source of change in average production of these regions. It was observed that change in mean yield and change in mean area were more or less equally important to change in average production in Barisal region. In Fairdpur and Dinajpur, change in mean yield influenced negatively to the change in mean production but change in mean area influenced positively to a large extent. Interaction effect in Faridpur and covariance effect in Dinajpur were also important sources to change in average Aman production.

Table 7. Analysis of the components of change in average Aman rice production between the two periods 1979/80-1988/89 and 1989/90-1998/99 by regions

(Percent)

Regions	$\Delta \bar{Y}$	$\Delta \bar{A}$	$\Delta \bar{Y}, \Delta \bar{A}$	Δ COV (A,Y)
Chittagong	68.40	25.49	4.84	1.27
Chitt.H.Tract	63.43	33.32	4.24	-1.00
Comilla	129.67	-27.55	-3.31	1.20
Noakhali	59.81	46.11	-5.29	-0.62
Sylhet	122.85	-19.99	-4.74	1.88
Dhaka	30.55	76.78	-9.04	1.72
Faridpur	-234.98	289.54	45.73	-0.29
Jamalpur	50.78	55.68	-6.82	0.36
Kishorgong	831.39	625.12	-127.97	-21.70
Mymensingh	44.47	59.61	-2.84	-1.24
Tangail	43.89	69.09	-11.37	-1.61
Barisal	50.81	50.66	-2.16	0.69
Jessore	58.67	30.40	11.23	-0.31
Khulna	108.28	-6.22	-2.53	0.46
Kushtia	30.60	55.10	14.73	-0.43
Patuakhali	69.29	24.67	6.13	-0.08
Bogra	124.76	-31.30	-2.92	9.46
Dinajpur	-0.78	90.77	-0.10	10.10
Pabna	7.22	94.66	-1.77	-0.11
Rajshahi	110.34	-7.15	-2.93	-0.25
Rangpur	81.00	14.10	4.40	0.51
Bangladesh	135.55	-32.06	-3.98	0.49

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).

Boro : Table 8 presents the sources of change in mean production of Boro rice in different regions of the country. Changes in mean area appeared to be the largest source of change in mean production in all the regions as well as at the national level except Chittagong, Chittagong Hill Tracts, Sylhet and Patuakhali regions. Change in mean area also contributed positively to change in mean production of Chittagong and Sylhet. This means that the change has come through the expansion of area under Boro production. Area under Boro production particularly HYV Boro production increased in the period of after full-implementation of privatization policy period because production of HYV became comparatively profitable than local Boro production in that period. The next source of change in average production was change in mean yield which was due to adoption of modern technologies. In Chittagong, Chittagong Hill Tracts, Sylhet and Patuakhali change in mean yield played significant positive role to change in mean production. It was also observed that in Chittagong Hill Tracts and Patuakhali regions, changes in mean area negatively contributed to change in mean production. Interaction effect was not significant but positive in 11 regions and negative in other 10 regions. Covariance effect was too small to change in mean production.

Table 8. Analysis of the components of change in average Boro rice production between the two periods 1979/80-1988/89 and 1989/901998/99 by regions

(Percent)

Regions	$\Delta \bar{Y}$	$\Delta \bar{A}$	$\Delta \bar{Y}, \Delta \bar{A}$	Δ COV (A,Y)
Chittagong	66.39	27.60	5.24	0.77
Chitt.H.Tract	130.58	-20.79	-2.65	-7.14
Comilla	11.98	79.69	9.58	-1.26
Noakhali	-28.79	145.58	-16.72	-0.07
Sylhet	52.66	39.10	9.27	-1.03
Dhaka	-24.84	139.38	-16.41	1.88
Faridpur	15.65	73.83	11.66	-1.13
Jamalpur	-18.73	134.23	-16.43	0.94
Kishorgong	27.98	60.88	11.22	-0.07
Mymensingh	-6.44	111.48	-5.31	0.27
Tangail	-152.23	303.12	-49.87	-1.02
Barisal	-13.05	112.90	-4.82	4.97
Jessore	10.83	64.88	23.96	0.33
Khulna	22.58	54.58	22.18	0.67
Kushtia	4.59	75.07	20.06	0.27
Patuakhali	705.88	-551.35	-136.93	82.39
Bogra	5.28	86.38	8.06	0.28
Dinajpur	-0.03	100.08	-0.11	0.05
Pabna	-1.96	102.65	-1.92	1.23
Rajshahi	15.00	60.54	24.84	-0.38
Rangpur	12.94	66.59	20.79	-0.32
Bangladesh	12.67	77.75	9.64	-0.07

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).

Wheat : Table 9 reports the sources of change in average wheat production in different regions of Bangladesh. This Table reveals that change in mean area was the most important source of change in average production in all the regions except Kushtia, Rajshahi, Rangpur

and 'Other regions'. Change in mean yield was the main reason for change in mean production in these four regions. In Dhaka, Faridpur, Kishoreganj, Tangail, Bogra and Dinajpur regions change in mean yield, and in Kushtia, Rajshahi, and 'Other regions' change in mean area had a positive contribution to change in mean production. Change in mean area had a negative contribution to the change in Rangpur region. It was found that covariance effect was too small in all regions except in Comilla region.

Table 9. Analysis of the components of change in average wheat production between the two periods 1979/80-1988/89 and 1989/90 - 1998/99 by regions

(Percent)

Regions	$\Delta \bar{Y}$	$\Delta \bar{A}$	$\Delta \bar{Y}, \Delta \bar{A}$	Δ COV (A,Y)
Comilla	-149.70	204.08	38.77	6.85
Dhaka	36.31	60.82	7.75	-4.89
Faridpur	35.68	56.34	6.78	1.21
Jamalpur	-52.82	175.17	-20.11	-2.23
Kishorgong	15.83	67.27	15.96	0.95
Mymensingh	-37.60	159.28	-18.76	-2.93
Tangail	46.51	47.63	7.52	-1.66
Jessore	-49.60	169.48	-20.75	0.86
Kushtia	89.50	10.96	2.02	-2.47
Bogra	17.65	88.82	-4.23	-2.23
Dinajpur	18.99	97.05	-15.97	-0.08
Pabna	-5.56	109.12	-4.66	1.10
Rajshahi	53.32	33.02	12.20	1.46
Rangpur	127.26	-18.19	-7.39	-1.68
Other regions	69.12	24.73	6.61	-0.47
Bangladesh	47.99	41.34	10.27	0.40

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).
Note: * 'Other regions' included Chittagong, Chittagong H.T., Noakhali, Sylhet, Barisal, Khulna and Patuakhali.

Total Food Grains : Table 10 presents the sources of change in average production of total food grains in different regions of Bangladesh. It is observed that change in mean yield was the major source of change in average production in Chittagong, Sylhet, Kishoreganj, Jessore, Khulna, Kushtia, Patuakhali, Bogra, Rajshahi and Rangpur regions. Changes in mean area largely contributed to food grain production in other regions. In Chittagong Hill Tracts, Comilla and Faridpur change in mean yield influenced negatively and change in mean area influenced positively to change in food grain production. In Noakhali, Dhaka, Jamalpur, Mymensingh, Tangail, Barisal and Pabna change in mean yield also contributed significantly to change in mean production. Interaction effect was not significant in all the regions except Chittagong, Comilla and Faridpur. Covariance effect was found to be too small to change in mean production in all the regions except Bogra.

Table 10. Analysis of the components of change in average total foodgrains production between the two periods 1979/80-1988/89 and 1989/90-1998/99 by regions

(Percent)

Regions	$\Delta \bar{Y}$	$\Delta \bar{A}$	$\Delta \bar{Y}, \Delta \bar{A}$	Δ COV (A,Y)
Chittagong	99.95	-765.35	-145.39	11.29
Chitt.H.Tract	-85.66	164.45	20.95	0.26
Comilla	-293.69	349.87	42.08	1.74
Noakhali	43.71	64.71	-7.43	-0.99
Sylhet	339.83	-194.69	-46.18	1.05
Dhaka	34.12	74.26	-8.74	0.37
Faridpur	-266.32	314.44	49.66	2.22
Jamalpur	38.60	70.03	-8.57	-0.06
Kishorgong	106.80	-809.93	-149.20	-8.95
Mymensingh	21.04	83.58	-3.98	-0.64
Tangail	37.46	75.78	-12.47	-0.78
Barisal	19.55	83.62	-3.57	0.40
Jessore	127.99	-19.99	-7.38	-0.61
Khulna	182.14	-58.83	-23.90	0.60
Kushtia	191.55	-72.76	-19.45	0.66
Patuakhali	183.02	-65.17	-16.18	-1.66
Bogra	171.75	-160.90	-150.25	142.63
Dinajpur	1.41	108.42	-0.11	-9.72
Pabna	6.84	96.79	-1.81	-1.83
Rajshahi	132.76	-22.91	-9.40	-0.46
Rangpur	491.53	-298.46	-93.19	0.11
Bangladesh	-245.09	307.16	38.10	-0.17

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).

Contribution of Different Food Grain Crops and Regions to Change in Mean Production of Bangladesh

In this section contribution of different crops and regions to change in mean production of Bangladesh has been discussed and it is summarized in the Table 11. The calculations were done by using the equations (6) and (7) of section II.

Contribution of Different Food Grain Crops to Change in Mean Production

Considering major food grain crops of Bangladesh, Boro rice appeared to be the major contributor in increasing food grain production. Boro alone contributed to about 86 percent of total change in average food grains production. The second contributing crop was Aman rice contributed to about 33 percent while Aus rice contributed negatively (about 25 percent) to total change in average food grain production. Wheat contributed only about 6 percent to change in mean production of total food grains in Bangladesh (Table 11).

Table 11. Contribution of different foodgrain crops and regions to change in mean production between the periods 1979/80-1988/89 and 1989/90-1998/99

(Percent)

Regions/Crops	Aus	Aman	Boro	Wheat	Total Foodgrains
Chittagong	3.11	8.62	0.04	-	2.16
Chitagong H.T.	0.33	0.79	-0.06	-	0.13
Comilla	6.40	7.71	8.28	-10.85	7.49
Noakhali	5.69	1.44	3.06	-	1.72
Sylhet	-4.58	8.91	3.37	-	6.90
Dhaka	8.69	-4.89	7.03	6.59	2.62
Faridpur	1.49	-0.08	3.53	2.32	2.74
Jamalpur	6.40	0.89	4.43	3.77	2.73
Kishoreganj	3.65	0.58	7.04	11.41	5.93
Mymensingh	9.03	-0.41	5.04	2.03	2.10
Tangail	5.28	-0.95	1.86	1.42	0.08
Barisal	3.92	-0.45	1.19	-	0.03
Jessore	5.97	17.02	8.62	16.37	12.50
Khulna	-0.09	6.68	2.03	-	3.94
Kushtia	3.04	6.83	2.00	-1.00	3.2.0
Patuakhali	-0.95	2.29	0.01	-	1.00
Bogra	7.89	5.52	9.26	-4.37	7.59
Dinajpur	11.06	11.48	5.75	33.68	7.93
Pabna	7.19	0.17	4.42	29.31	3.71
Rajshahi	1.91	13.64	11.58	12.16	14.61
Rangpur	14.58	14.22	11.55	-3.38	10.90
Other regions*	-	-	-	0.56	-
Bangladesh[1]	-24.66	32.90	86.18	5.58	100

Source: Authors calculation based on data gathered from Bangladesh Bureau of Statistics (Various Issues).
Notes: * 'Other regions' included Chittagong, Chittagong H.T., Noakhali, Sylhet, Barisal, Khulna and Patuakhali.

[1]The figures for Bangladesh are related to contribution of different food grain crops to total food grain production and not related to regional figures.

Contribution of Different Regions to Change in Mean Production

Contribution of different Regions by crops to change in mean production of Bangladesh has been summarized in Table 11 and discussed below:

Aus : Table 11 explains the contribution of different regions to changes in national average production of Aus rice. Contribution of Dhaka, Mymensingh, Bogra, Dinajpur, Pabna and Rangpur regions were comparatively higher than other regions. These regions together contributed about 58 percent to the total change in Aus production. Contribution of each of Comilla, Noakhali, Jamalpur, Tangail and Jessore regions was more or less 6 percent. Sylhet, Khulna and Patuakhali regions were negative contribution to changes in national average production.

Aman : It was also found from the Table 11 that the contributions of Dhaka, Faridpur, Mymensingh, Tangail and Barisal regions were negative to change in mean Aman production of Bangladesh. Jessore, Dinajpur, Rajshahi and Rangpur regions' contributions were comparatively higher than other regions. These regions together contributed about 56 percent to the total change in mean production of Bangladesh. Contribution of each of Chittagong,

Comilla and Sylhet region was more or less 8 percent and Khulna, Kushtia, Bogra was more or less 6 percent to the change in mean production of Aman.

Boro : All the regions except Chittagong Hill Tracts contributed positively to change in mean production of Bangladesh. Amongst the regions, the contribution of Comilla, Dhaka, Kishoreganj, Jessore, Bogra, Rajshahi and Rangpur were prominent. These seven regions together contributed to about 63 percent of the change in mean Boro production of Bangladesh. Contribution of each of Jamalpur, Mymensingh, Dinajpur and Pabna were more or less 5 percent.

Wheat : All the regions except Comilla, Kushtia, Bogra, and Rangpur contributed positively to change in mean wheat production of Bangladesh. Amongst the regions, Dinajpur and Pabna appeared to be the major contributing regions which contributed together 63 percent of the total change in mean production of wheat. Kishoreganj, Jessore and Rajshahi regions also significantly contributed to change in mean wheat production of Bangladesh.

Total Food Grains : All the regions positively contributed to change in mean food grain production of Bangladesh. Among the regions, contributions of Comilla, Jessore, Bogra, Dinajpur, Rajshahi and Rangpur were prominent and shared together about 61 percent of the change in mean food grain production of Bangladesh.

V. SUMMARY AND CONCLUSIONS

The findings of this piece of research show that average area of Aus, Aman and total food grains; average production of Aus; and average yield of wheat decreased in the period of after fulll-implementation of privatization policies. Production of Aman rice, Boro rice, wheat and total food grains increased by about 18, 97, 22 and 27 percent respectively. Whereas, Aus production decreased by 34 percent. Area under Aus rice, Aman rice and total food grains decreased by 41, 3 and 0.87 percent respectively, and Boro rice and wheat area increased by 76 and 21 percent respectively. Yield of Aus rice, Aman rice, Boro rice and total food grains increased by 12, 21, 12 and 28 percent respectively. However, wheat yield decreased by 1 percent.

Change in area appeared to be the main source of increase in production of Boro and total food grains, and to decrease in Aus production. It also significantly contributed to increase in Wheat production. Change in yield was the largest contributor to the change in production of Aman and Wheat.

Considering major food grains, Boro rice appeared to be the highest and Aus rice appeared to be the lowest contributors to increase in mean production of Bangladesh. Among the regions contribution of Comilla, Jessore, Borga, Dinajpur, Rajshahi and Rangpur were prominent to increase mean production of total food grains. Following policy conclusions may be drawn from the findings of this study:

In Bangladesh production of major food grains (Aman rice, Boro rice and wheat) has increased except Aus rice in the period of after full-implementation of privatization policies. So, government should emphasize more on privatization policies related to modern technology of major food grains.

1. Change in mean area has decreased Aus rice production although yield has increased production. Thus research efforts are needed to increase Aus yield, which may turn increase in Aus production.
2. Increase in the mean yield is the main source of increase in Aman rice production. Yield of Aman rice can be increased by shifting HYV Aman cultivation to areas where local Aman varieties are currently being grown. Development of technology suitable for areas affected by drought, flood and salinity, and the establishment of drainage facilities would increase yield and output of Aman rice.
3. As privatization policies related to modern technology has increased the production of Boro rice and wheat through area expansion and increase in yield, government should pursue policy measures that would lead to an increase in acreage and yield of these crops. Boro rice and wheat yield can be increased through shifting from local varieties to high yielding varieties and by using other modern technologies. Area under these two crops can be increased by expanding irrigation facilities.

REFERENCES

Ahmed, R. (1995): Liberalization of Agricultural Input Market in Bangladesh: Process, Impact and Lessons, Agricultural Economics, Vol. 12, March, pp. 118-19.

Akter, N. (2002): Instability in Major Food grain Production in Bangladesh during the Period from 1979/80 to 1998/99, An Unpublished M.S. Theses, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Akteruzzaman, M. and W.M.H. Jaim (1999): The Impact of Privatization and Deregulation of New Technology Diffusion and Agricultural Growth Performance in Bangladesh - A Macro View, The Bangladesh Journal of Agricultural Economics, Vol. 22, No. 1, June, pp.51-62.

BBS (1985): The Yearbook of Agricultural Statistics of Bangladesh, 1983/84, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (1987): The Yearbook of Agricultural Statistics of Bangladesh, 1985/86, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (1989): The Yearbook of Agricultural Statistics of Bangladesh, 1987/88, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (1993): The Yearbook of Agricultural Statistics of Bangladesh, 1992, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (1997): The Yearbook of Agricultural Statistics of Bangladesh, 1995, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (2001): The Yearbook of Agricultural Statistics of Bangladesh, 1999, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Hazell, P.B.R. (1982): Instability in India Food grain Production, Research report No. 30, Washington, International Food Policy Research Institute.

MOF (2000): Database of Food Situation in Bangladesh, Food Planning and Monitoring Unit, Ministry of Food, December 2000, Government of People's Republic of Bangladesh, Dhaka, December, 2000.

Foot Note:

1.Hazell's Variance Decomposition Procedure allows quantification of contribution of different sources of change in mean and sources of change in variance of the total production such as change in mean yield, change in mean area, change in yield variance, change in area variance, interaction between mean yield and mean area etc.