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Research Note

GROWTH, PRICE INSTABILITY AND FLEXIBILITY OF MAJOR CROPS IN BANGLADESH

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ABSTRACT

The key concern of this research is to assess the growth, fluctuation and price flexibility of Aus, Aman, Boro, wheat and jute crops during the last two decades of the twentieth century. Real prices of all the crops have been falling significantly during the study period. The price instability was higher than area and yield instability for all these crops studied. The extent of real price fluctuations was higher relative to area, production and yield fluctuation of all the crops. It was observed that supply of Aus, wheat and jute production played insignificant role to determine their own post-harvest prices, but Boro, Aman and Aus production had significant role on the prices of crops of Aus, wheat and jute through significant cross effects. On the other hand, Aman and Boro production had significant influence on post-harvest price determination of these rice varieties as revealed by price flexibility co-efficients. So price policy measures cannot be taken on a single crop basis in Bangladesh.

I. INTRODUCTION

This paper has attempted to assess the changes of prices of crops along with their growth in area, yield and production over the years, and tried to quantify the extent of annual price fluctuation as well as measured the degree of instability for identifying riskiness of selected crops in relation to other crops. The generated information may help farmers to take decision to allocate their limited resources among suitable less risky crops. Many researchers worked with supply response (price-supply relationship) analyses, *i.e.* real price changes and relationship in corresponding areas, but work on price flexibility was not done before to understand how much the present quantity harvested influences the post-harvest prices in the markets. Price flexibility concept is particularly important for agricultural products. It is because, most of agricultural products are perishable, and thus current supply of commodity determines the current market prices. Current supply of agricultural products is very important in determining market prices and the profitability of the crops produced. Besides this, Government determines procurement prices of rice after the current production to help farmers in the face of falling prices. By the price flexibility estimates of different crops, and their cross effects, policy measures on price fixation and amount to be procured for price stabilization may be decided by policy makers taking help of supply price relationship (flexibility) and assessing extent of price instabilities. In Bangladesh, so far, none has estimated price flexibility co-efficient of crops to see how much the current supply of any crop influences its

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market prices (thus the extent of procurement drive needed can be predicted to raise the target price level). Besides these introductory comments, the methodology followed in analyzing the data is presented in section II. Results obtained and their interpretations are presented in the penultimate section. Specific policy conclusions are derived from the analytical results in section IV.

II. METHODOLOGY OF THE STUDY

Selection of Crops

The leading crops, Aus, Aman, Boro rice, wheat and jute have been selected for the study due to their dominancy (in terms of area covered) in crops sub-sector. These crops occupy the largest cultivated area (82.12 %) together out of total cultivated area in Bangladesh (BBS, 2001, p. 33) while jute is important cash crop. After all, food deficit/surplus condition depends on the production performance of the cereal crops.

Selection of Prices

In the present study harvest prices of selected crops have been taken for analysis. Harvest prices are farm gate prices selling by the farmers during harvest time which 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 (covering cost of storage and risk) than what the farmers get. Moreover, bulk of the agricultural products is marketed during the harvest or immediately post harvest period. So, harvest pieces are thought to be the most relevant prices for the producer farmers.

Selection of Period of the Study

The study covers the period of 19 years from 1980/81 to 1998/99, as the recent data available. This period indicates apparently the last two decades of the twentieth century covering the period of intensified liberalized economy than any other time before.

Sources of Data

The research was based on secondary data that were gathered from various publications of the Ministry of Planning *(i.e* BBS, Yearbook of Agricultural Statistics of Bangladesh, Handbook of Agricultural Statistics, Economic Review of Bangladesh). Harvest prices of respective crops have been deflated by agricultural raw materials prices index to get the prices in real terms (disentangling inflationary price increases).

Analytical Techniques:

Compound growth rate estimation

To know the growth rate of price, area, production and yield of selected crops in Bangladesh for the period from 1980/81 to 1998/99, following formula was used (Gujarati 1998 p. 169):

$Y_t = Y_o(1+r)^t$

Where, Y_t = real price/area/production/yield of selected crops in year t

Y_o = initial (*i.e.*, 1980/81) real price/area/production/yield of selected crops

r = the compound (*i.e.*, over time) rate of growth of Y_t. Where t stands for price, area, production or yield in the year t. For estimating growth in agricultural sector, annual compound growth rates are used largely.

To check the significance of growth co-efficient, t-test was employed.

Instability estimation

Instability was measured by using instability index as follows:

$I = (C.V.)^2 \times (1-R^2)$ obviously, $1 \leq (C.V)^2$ (Mitra 1989)

Where, I = instability index,

C.V. = co-efficient of variation,

R^2 = co-efficient of determination.

Thus instability index captures both explained and unexplained variations of the concerned variable and should better reflect the true instability situation. Besides, instability index is effective when growth rate is high.

Annual fluctuation estimation

The changes in price over time essentially mean price fluctuations. The change may be in either direction. The inter year fluctuation in prices was estimated by the simplest method change in price year by year. It is estimated as:

$\Delta P_t = [(P_t - P_{t-1})/P_{t-1}] \times 100$

Where, ΔP_t = percentage change of price in year t over the last period (year)

P_t = current year's price in year t

P_{t-1} = previous year's price in year t-1

Price flexibility and cross price flexibility estimation

Price flexibility co-efficient implies that price is a function of the quantity of the supply of a particular crop. On the other hand, the cross price flexibility [*i.e.*$P_{it} = f(Q_{it}, Q_{jt})$] is the percentage change in the price of crop i in response to a one percent change in the quantity of crop j other factors remaining constant. The cross flexibility based on the quantity variable of a substitute crop is expected to be negative. Cross price flexibility of a crop will be estimated with other crop which has substitution relationship between each other (*e.g.*, Aus and jute). To measure flexibility and cross price flexibility, the following equation was used:

$LnP_{it} = Lna_o + b_1 LnQ_{it} + b_2 LnQ_{jt} + U_t$

Where, P_{it} = price of crop i in year t

Q_{it} = production of crop i in year t

Q_{jt} = production of crop j in year t

U_t = error term.

III. RESULTS AND DISCUSSION

Compound Growth Rates

Significant declining compound growth rates of real price of selected crops were found during the study period (1980/81 to 1998/99). The declining rate of Boro price occupied the top position followed by Aus, Aman, jute and wheat (Table 1). The areas of Aus, Aman and jute decreased while Boro and wheat areas increased during the study period even in the face of declining real prices. The yield of Aus, Aman, and jute increased significantly during the entire period. In spite of increasing yield, Aus and jute production

Table 1: Compound growth rates of real price, area, yield and production of major crops, 1980/81 - 1998/99

In percentage

Crops	Real price	Area	Yield	Production
Aus	-3.6 ^{hs}	-4.6^{hs}	0.9^{hs}	-3.4
	(-6.14)	(-7.65)	(4.89)	(-.56)
Aman	-3.6^{hs}	-0.60^{c}	1.6^{hs}	0.9^{s}
	(-6.01)	(-1.76)	(4.5)	(2.71)
Boro	-4.2^{hs}	4.0^{hs}	0.30	4.6^{hs}
	(-7.87)	(3.4)	(0.57)	(3.96)
Wheat	-2.7^{hs}	1.9^{hs}	1.00	2.6^{c}
	(-4.2)	(5.2)	(0.60)	(1.8)
Jute	-3.2^{hs}	-1.9^{s}	1.2^{hs}	-0.7
	(-2.7)	(-2.68)	(6.38)	(-0.96)

Source: Computed from the Appendix Table A6-A9, hs, s and c denote highly significant, significant and critically significant at 1%, 5% and 10% error level respectively. Figures in parentheses indicate t-values,
Data source: Barua (2001)

decreased during the whole period due to declining areas of these crops. Yield increase of Boro and wheat have not been significant, which tells that technological breakthrough has reached to a level of stagnation for wheat as well as Boro. Productions of Aman, Boro and wheat significantly grew during the whole period in spite of declining real price (by taking advantages of higher seed-fertilizer technology) and increase in area particularly in case of Boro and wheat.

Instabilities

The real price of jute occupied the highest level of instability followed by wheat, Boro, Aman, and Aus during the study period (Table 2). International situation may have more influence on jute price instability rather than domestic production. Real price instability was higher than area and yield instability in case of all crops studied. Price instability caused mainly due to production instability in case of Aus, Boro and wheat crops. Because production instability of these crops were very much higher than price, area and yield

Table 2: Instabilities of real price, area, yield and production of major crops, 1980/81- 1998/99

Crops	Instability Index (I)*			
	Real Price	Area	Yield	Production
Aus	176	172	17	571
Aman	185	84	64	69
Boro	186	158	44	692
Wheat	260	88	48	406
Jute	882	374	19	386

*I= $[(C.V.)^2 X (1-R^2)]$, Data source: Barua (2001)

instability (Table 2). On the other hand, Aman and jute price instability happened due to combined effect of area and production instability during the study period (Table 2). Noticeable that yield instability was minimum for all crops studied. So production instability was largely influenced by area instability during the entire period.

Annual Fluctuation

For all rices and wheat, yearly price fluctuation have highly increased from 1992/93 and continued more or less until the mid nineties, 1995/96 (Tables A1-A4). During this period cereal prices have been highly volatile. Jute prices (lagged by one year) and area moved in unison in the same direction and extent of fluctuation had close correspondence except 1987/88 price and 1988/89 area. Aman and jute price revealed the minimum and maximum extent of annual price variation respectively during the study period. The extent of annual fluctuations of prices of Aus and Boro were more or less same during the study period (Table 3). Yearly fluctuation of Aman area was extremely higher during 1985/86 and 1986/87 though in other years in general Aman area fluctuations were lower than Aus area fluctuations (Tables A1-A2). Both Aman yield and production fluctuations were higher than Aus variety. A large area is covered by Aman and therefore probabilities of fluctuation of area, production and yield were higher for Aman than other varieties of rice.

Table 3: Extent of annual fluctuation of lagged real price, area, yield and production of major crops, 1980/81 –1998/99

Crops	The Extent of Fluctuations of			
	Real Price*	Area	Yield	Production
Aus	-30 to 46	-16 to 3	-14 to 11	-8 to 8
Aman	-29 to 39	-25 to 40	-13 to 34	-23 to 28
Boro	-44 to 31	-3 to 26	-6 to 30	-4 to 7
Wheat	-32 to 40	-20 to 29	-29 to 24	-18 to 17
Jute	-50 to 136	-34 to 56	-30 to 69	-11 to 9

Source: Computed from the Appendix Tables A1 – A5, * Price deflated by the Agricultural Raw Materials Prices Index.

Yearly price fluctuation for Boro has increased during the later part of the eighties and during the nineties (Table A3). Jute prices have been stabilized during the nineties. Wheat and Aman crops may be cultivated largely than competing crops because of little price risk observed during the last two decades.

Table 4: Price flexibilities and cross price flexibilities * of major crops, 1980/81 to 1998/99 (Price Deflator: Agricultural Raw Material Prices Index)

Dependent Variable (Price)	Constant	Quantity coefficient					R^2	Estimator	D-W Statistic	D.F	Auto correlation Status
		Aus	Aman	Boro	Wheat	Jute					
Aus	5.90	-0.01 (-0.29)		-0.50^{hs} (-4.68)			0.58	ML	1.76	15	1st order auto correlation corrected
Aman	8.17	0.50^{s} (2.77)	-1.16^{s} (-2.77)				0.72	OLS	1.54	16	No auto correlation
Boro	10.07		-0.60 (-1.37)	-0.55^{hs} (-2.48)			0.80	ML	1.97	14	2nd order auto correlation corrected
Wheat	15.99		-1.37^{s} (-3.62)		-0.29 (-1.58)		0.51	OLS	1.20	16	No auto correlation
Jute	-1.20	0.71^{c} (2.28)				-0.37 (-0.83)	0.25	OLS	1.75	16	No auto correlation

*$\text{Ln } P_{it} = \text{Ln}a_o + \text{Ln}Q_{it} + \text{Ln}Q_{jt} + U_t$

Figure in parenthesis shows t-statistic hs, s and c indicates highly significant, significant and critically significant at 1%, 5% and 10% error level respectively.

Price Flexibility and Cross Price Flexibility

In agriculture, producers do not know what prices they will get for the commodity to be harvested when they plan to produce or decide area allocation for any particular crop. So, either they were moved by some sort of desired future price for the commodity in their minds (price expectations at work) or based their plans only on the last period's realized prices (pertinence of static price expectations). However, the truth is that the level of current supply largely determines the current price of agricultural products supplied in the markets. That is, crop supply influences price determination rather than demand. Though, demand for agricultural commodities remain more or less stable and the demand nature is usually inelastic for which supply variation creates price fluctuations in agriculture. For this, year to year high production variations create volatility in agricultural prices. Any crop supply, creates how much price fluctuation for that commodity can be seen by the estimates of price flexibility. Price flexibility analysis revealed that harvested amount and the post-harvest price has negative relationship for all the crops studied in general (Table 4). Aman supply (production) reduces current year's Aman price drastically (flexibility co-efficient elastic). A hundred per cent increase in Aman production reduces price 116 per cent in the same production season (Table 4). If any crop is produced over larger production of cultivable area, flexibility coefficient usually show elastic magnitudes (conversely, price response elasticity will be inelastic) which has become true in case of Aman. If Boro production increases a one hundred per cent in any year, Boro price in that year will go down by 55 per cent (Table 4). So, by assessing the level of current supply, one would be able to say on average, how much price will go down in that year. For all other crops, viz, Aus, wheat and jute, current production has little impact on current prices. This become so when, proportion of area under the crop is low or product has close substitute (s) or the domestic prices is determined by the export demand. Aus has a close substitute with closeness in seasonal production with Boro. So, its own price is not much influenced by its own supply, rather production level of Boro determines current price of Aus significantly. A one hundred per cent increase in Boro production (cross price flexibility for a substitute) reduces Aus price 50 per cent (Table 4). This is practical when Boro rice in general is preferred than Aus rice for consumption. Cross price flexibility of Aman with Aus, and jute with Aus has shown positive flexibility relationship, meaning the two products are competitive in production for using the same resources. A good Aus production increases Aman price, meaning in the year Aus area is inversely related to Aman area under cultivation. That means, increase in transplanted Aus area reduces Aman area and as a result this decreases total production of Aman and price tends to get increased. Increased Aus quantity (meaning less jute area under cultivation) by one hundred per cent increases jute price 71 per cent (due to lower total jute production). So, one of the way to give higher price benefit to the jute producers (if so wished by the policy makers) would be encouraging more area allocation to Aus crop and thus reducing jute area. Therefore, there is interrelationship of production of one crop and price increase/decrease of

other competing or substitute crops. Technological advancement for one crop thus affect price to be prevailed for other crops. So, policy prescription may not be taken only as a single crop/product basis in crop sub-sector of Agriculture.

IV. POLICY CONCLUSIONS

The present study revealed the falling real price trend for all the crops studied. Real prices decreased annually from 2.7 per cent (wheat) to the highest 4.2 per cent for Boro rice. Price fluctuated more than area, yield and production. It is because that price is absolutely out of control of farmers. Government should provide incentive to wheat production (due to minimum real price falling) instead of Boro (due to maximum real price falling), which are competitive crops to each other in term of area allocation and cash resources. If the situation of lower real prices of Boro tend to prevail, farmers may choose more wheat area than Boro for cultivation. Reduction of area instability would reduce production instability largely. Stabilization of prices may not reduce area instability but reduction of area instability would reduce production instability. Market liberalization (reducing market failure) would ensure easy availability of modern factor inputs and easy movement of produces from surplus to deficit areas and this would in turn help stabilization of prices. Easy availability of modern factor inputs and sustained supply would reduce area instability largely. Price support for Boro will affect Aus prices to be prevailed and price support for jute will affect Aus and Aman production. Technological advancement for one crop affects prices of other crops. So price support or subsidy program for any crop must be judiciously taken considering price and quantity effects for other crops. Aman (minimum degree of production instability) and wheat (minimum falling price) are suggested to be cultivated increasingly. Production of these crops reduced their respective real prices during the study period. So surplus production of these crops should be stored by the Government taking procurement policy and necessary steps for export to be taken. Moreover procurement policy for Boro and Aus rice should be taken together by considering their cross price flexibility effects for attaining success in the program. Falling real prices can only be faced by technological advances of production practices, which could reduce unit costs of production. Increased budgetary allocation is urgently needed for varietal improvements of crops.

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APPENDIX

Table A1: Fluctuations of lagged price, area, production and yield of Aus 1980/81 to 1998/99

In Percentage

Years	Lagged Price*	Area	Production	Yield
1981/82	5.98	1.11	-0.58	-1.61
1982/83	-6.36	0.40	-6.27	-6.63
1983/84	24.14	-0.61	5.12	5.77
1984/85	-25.24	-6.41	-13.63	-7.79
1985/86	0.19	-3.16	1.62	4.96
1986/87	-9.35	2.07	10.68	8.45
1987/88	8.52	-3.97	-4.38	-0.46
1988/89	7.75	-3.76	-4.58	-0.84
1989/90	-11.73	-15.97	-13.34	3.20
1990/91	-9.35	-6.55	-8.65	-2.28
1991/92	-1.57	-9.08	-3.63	5.96
1992/93	6.62	-9.44	-4.77	5.19
1993/94	-28.10	-4.94	-10.83	-6.19
1994/95	-16.93	0.86	-3.22	-4.10
1995/96	45.94	-7.32	-6.29	1.12
1996/97	5.76	3.28	11.44	7.90
1997/98	-29.81	-1.70	0.24	1.96
1998/99	-0.50	-9.01	-13.74	-5.18
Extent of Fluctuation	-30 to 46	-16 to 3	-14 to 11	-8 to 8

Source: Derived from Barua (2001), pp. 123-125*Price deflated by the Agricultural Raw Materials Prices Index

Table A2: Fluctuations of lagged price, area, production and yield of Aman 1980/81 to 1998/99

In Percentage

Years	Lagged Price*	Area	Production	Yield
1981/82	-12.29	-0.42	-9.48	-9.10
1982/83	1.61	-0.29	4.26	4.59
1983/84	-0.59	0.26	4.35	4.07
1984/85	-11.79	-4.97	1.11	6.44
1985/86	-11.88	40.43	7.72	-23.33
1986/87	-7.09	-24.52	-3.22	28.26
1987/88	22.09	-7.63	-6.98	0.73
1988/89	-4.94	-8.76	-10.83	-2.33
1989/90	-10.29	11.80	34.20	20.09
1990/91	-18.76	1.28	-0.38	-1.67
1991/92	12.54	-1.44	1.11	2.58
1992/93	0.78	2.66	4.43	1.72
1993/94	-27.27	-0.01	-2.69	-2.66
1994/95	-1.30	-4.10	-9.72	-5.83
1995/96	39.52	0.80	3.36	2.50
1996/97	-5.91	2.82	8.66	5.72
1997/98	-29.18	0.06	-7.34	-7.42
1998/99	0.75	-11.09	-12.59	-1.71
Extent of Fluctuation	-29 to 40	-25 to 40	-13 to 34	-23 to 28

Source: Derived from Barua (2001), pp. 123-125*Price deflated by the Agricultural Raw Materials Prices Index

Table A3: Fluctuations of lagged price, area, production and yield of Boro 1980/81 to 1998/99

In Percentage

Years	Lagged Price*	Area	Production	Yield
1981/82	-13.36	12.39	19.85	6.66
1982/83	3.28	9.90	12.56	2.40
1983/84	2.89	-2.21	-5.58	-3.43
1984/85	8.80	12.36	16.69	3.85
1985/86	-44.40	-2.62	-6.09	-3.58
1986/87	18.67	7.73	9.23	1.42
1987/88	9.89	17.62	17.98	0.29
1988/89	-25.63	25.50	23.25	-1.81
1989/90	17.80	0.63	3.46	2.84
1990/91	-11.77	3.84	5.37	1.46
1991/92	7.88	3.41	7.08	3.53
1992/93	-4.53	-1.37	-3.25	-1.90
1993/94	-11.15	-0.70	2.83	3.55
1994/95	-17.80	-0.67	-3.46	-2.82
1995/96	30.66	7.40	10.45	2.86
1996/97	-18.47	1.06	3.30	2.21
1997/98	-6.05	3.85	9.09	5.04
1998/99	0.79	22.03	29.67	6.25
Extent of Fluctuation	-44 to 31	-3 to 26	-6 to 30	-4 to 7

Source: Derived from Barua (2001), pp. 123-125*Price deflated by the Agricultural Raw Materials Prices Index

TableA4 Fluctuations lagged price, area, production and yield of Wheat 1980/81 to 1998/99

In Percentage

Years	Lagged Price*	Area	Production	Yield
1981/82	-3.84	-9.73	-11.54	-2.00
1982/83	7.33	-2.74	13.66	16.85
1983/84	4.92	1.33	11.93	10.50
1984/85	-28.64	28.54	20.67	-6.16
1985/86	-21.66	-20.10	-28.52	-10.53
1986/87	17.76	8.24	3.02	-4.79
1987/88	6.83	2.14	-4.03	-6.05
1988/89	-10.32	-6.23	-2.48	3.99
1989/90	0.24	5.71	-12.92	-17.64
1990/91	-3.21	1.17	12.81	11.51
1991/92	-6.39	-4.06	6.08	10.56
1992/93	12.04	10.84	10.42	-0.38
1993/94	-31.54	-3.42	-3.83	-0.38
1994/95	1.23	3.95	10.08	5.87
1995/96	39.94	9.62	9.96	0.31
1996/97	-4.89	0.98	6.21	5.17
1997/98	-6.04	13.67	23.99	9.10
1998/99	-1.09	9.68	5.86	-3.48
Extent of Fluctuation	-32 to 40	-20 to 29	-29 to 24	-18 to 17

Source: Derived from Barua (2001), pp. 123-125*Price deflated by the Agricultural Raw Materials Prices Index

Table A5: Fluctuations of lagged price, area, production and yield of Jute 1980/81 to 1998/99

In Percentage

Years	Lagged Price*	Area	Production	Yield
1981/82	8.68	-10.02	-6.01	4.32
1982/83	-3.82	0.93	5.06	4.21
1983/84	38.43	19.37	6.86	-10.48
1984/85	-22.93	-1.77	-1.92	-0.29
1985/86	57.31	56.44	69.27	8.32
1986/87	-47.69	-27.01	-22.02	6.87
1987/88	-50.06	-33.64	-30.40	4.79
1988/89	135.93	6.07	-5.36	-10.70
1989/90	-28.41	-0.29	4.29	4.51
1990/91	7.85	7.70	14.29	6.19
1991/92	15.91	0.75	-0.55	-1.27
1992/93	-24.24	-14.93	-15.56	-0.80
1993/94	-19.93	-4.40	-0.25	4.40
1994/95	-5.89	17.07	19.23	1.84
1995/96	13.57	-18.08	-23.62	-6.82
1996/97	51.79	10.58	20.30	8.88
1997/98	-2.92	13.87	19.69	5.11
1998/99	-3.65	-17.18	-23.15	-7.27
Extent of Fluctuation	-50 to 136	-34 to 56	-30 to 69	-11 to 9

Source: Derived from Barua (2001), pp. 123-125*Price deflated by the Agricultural Raw Materials Prices Index

Appendix Table A6: Exponential* trends of deflated price of major crops, 1980/81 to1998/99(price deflator: Agricultural Raw Material Prices Index)

Dependent Variable (price)	Constant	Trend Coefficient	R^2	Estimator	D-W Statistic	D.F	Auto correlation Status
Aus	4.47	-0.06^{hs} (-6.14)	0.69	OLS	1.94	17	No auto correlation
Aman	4.85	-0.06^{hs} (-6.00)	0.68	OLS	1.76	17	No auto correlation
Boro	5.37	-0.04^{hs} (-7.86)	0.78	OLS	2.33	17	No auto correlation
Wheat	4.03	-0.02^{hs} (-4.20)	0.51	OLS	1.21	15	No auto correlation
Jute	4.73	-0.03^{hs} (-2.65)	0.29	OLS	1.79	17	No auto correlation

*$\text{Ln } P_t = \text{Ln}a_o + bT + U_t$ Figure in parenthesis shows t-ratio hs indicates highly significant at 1% error level

Appendix Table A7: Exponential* trends of areas of major crops, 1980/81 to1998/99 (price deflator: Agricultural Raw Material Prices Index)

Dependent Variable (Area)	Constant	Trend Coefficient	R^2	Estimator	D-W Statistic	D.F	Auto correlation Status
Aus	11.90	0.04^{hs} (-7.65)	0.79	ML	1.53	16	1st order auto correlation corrected
Aman	9.23	0.00^{c} (-1.75)	0.15	OLS	1.95	17	No auto correlation
Boro	2.34	0.05^{hs} (8.40)	0.83	ML	1.94	15	2nd order auto correlation corrected
Wheat	4.64	0.01^{hs} (5.23)	0.62	OLS	1.29	17	No auto correlation
Jute	8.08	-0.01^{s} (2.68)	0.30	OLS	1.36	17	No auto correlation

*$\text{Ln } A_t = \text{Ln}a_o + bT + U_t$ Figure in parenthesis shows t-ratio, hs indicates highly significant at 1% error level

Appendix TableA8: Exponential* trends of production of major crops, 1980/81 to1998/99 (price deflator: Agricultural Raw Material Prices Index)

Dependent Variable (production)	Constant	Trend Coefficient	R^2	Estimator	D-W Statistic	D.F	Auto correlation Status
Aus	11.42	0.03^{hs} (-0.55)	0.03	ML	1.92	15	2^{nd} order auto correlation corrected
Aman	8.14	0.00^{s} (2.71)	0.30	OLS	1.35	17	No auto correlation
Boro	4.46	0.04^{hs} (3.95)	0.48	OLS	1.03	17	No auto correlation
Wheat	4.77	0.02^{c} (1.80)	0.20	ML	1.93	16	1^{st} order auto correlation corrected
Jute	7.45	-0.00 (-0.96)	0.05	OLS	1.51	17	No auto correlation

*Ln $Q_t = Lna_o+bT+U_t$, Figure in parenthesis shows t-ratio, hs indicates highly significant at 1% error level

Appendix Table A 9:Exponential* trends of yield of major crops, 1980/81 to1998/99(price deflator: Agricultural Raw Material Prices Index).

Dependent Variable (price)	Constant	Trend Coefficient	R^2	Estimator	D-W Statistic	**D.F**	Auto correlation Status
Aus	-0.011	0.009^{hs} (4.88)	0.58	OLS	1.48	17	No auto correlation
Aman	0.20	0.016^{hs} (4.498)	0.54	OLS	1.60	17	No auto correlation
Boro	0.405	0.003 (0.57)	0.01	ML	1.94	15	2^{nd} order auto correlation corrected
Wheat	-0.124	0.012 (0.41)	0.58	ML	1.79	16	1^{st} order auto correlation corrected
Jute	0.34	0.012^{hs} (6.375)	0.71	OLS	1.95	17	No auto correlation

*Ln $Y_t = a_o+ bT+U_t$, Figure in parenthesis shows t-statistic, h s indicates highly significant at 1% error level at two tailed test