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SUPPLY RESPONSE OF BORO RICE IN BANGLADESH: COINTEGRATON AND ERROR CORRECTION MODELLING APPROACH

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Abstract

The aim of this study is to increase our understanding of the specification and estimation of Boro rice (principal rice) supply response in Bangladesh as well as to provide instrument for agriculture planting decision and price policy by using econometric tools-cointegration and error correction model with careful attention to time series data to avoid spurious regression of traditional econometric analysis Econometric model has been specified on the basis of theoretical arguments. This study also provides a theoretical argument that leads to formulate an empirical model from various aspects with price and non-price variables. The study is designed to identify statistically the acreage responses of Boro rice in Bangladesh. Time series data have been used in the analysis for the period 1972-73 to 2003-04. Econometric and statistical techniques are applied to estimate the supply responses of Boro rice at the national level. Long-run own price acreage elasticities for Boro is 0.95 (near to unitary elastic) respectively. Short-run own price acreage elasticities for Boro rice shows inelastic rang 0.21. Limitations and inadequate irrigation facilities at private level, distribution and availability of fertilizer in time are always problems in Bangladesh. Moreover, a main input like capital is insufficient in the short-run. These constraints helped to dampen the price elasticity of Boro rice supply in the short-run.The result suggests that farmers in Bangladesh are responsive to price incentives for Boro rice. If government promotes expanding expenditure at public and private level to build irrigation infrastructure and certified seeds it would give positive results on Boro supply in the country. Finally, if Bangladesh government follows a price stabilization policy it will reduce price risk and produce positive impact on Boro rice as well as overall crop supply situation in agriculture sector.

1. Background

It is observed that farmers adjust their production on the basis of price phenomena in the market. Price mechanism and its impact on farmers' supply behaviour are crucial issue for policy makers. In this connection price incentives or price support mechanism accelerate output in a country like Bangladesh. For this reason farmers' reaction or response to financial incentives is a prime concern for policy makers and for the government.

It is a prime concern to enhance the growth of rice production through increasing land productivity to meet the increasing food demand for the vast population of the country As the country has serious land constraints, significant differences in rice productivity among the different regions are also barriers to the production growth (Hossain, 1990; Hossain and Ahmed, 1989). Many steps to enhance the growth are being taken from the part of the government and non-Government agencies since the dependence of the country. For future

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planning it is necessary to forecast accurately through time series analysis in context of supply aspects of rice.

The total production of rice in 2005-06 is 280.76 lakh metric tonnes in which the share of aus, aman and Boro are contributed 6.2, 38.46 and 55.28 percent respectively. The growth rate of total rice production is 3.6 percent over the last ten years (1995-2005).Boro production growth was impressive. The area cultivated for Boro is increasing. Boro covers 28% of all rice area. The contribution of Boro rice is 54% in total rice production (Uttam and others, 2004:17).So, production performance of Boro rice has been treated as a pivotal factor in our rice economy.

In Least Developed Countries (LDCs) price policies have great impact on farmer's crop production and resource allocation. More specifically, price and non-price variables influenced farmers' supply decisions. This study will consider both *price* and *non-price* variables as Boro rice supply response factors through econometric representations. One of the most important issues in production economics is supply response since the responsiveness of farmers to economic incentives largely determines agriculture's contribution to the economy. Agricultural pricing policy plays a key role in increasing both farm production and incomes, and fundamental to an understanding of this price mechanism is supply response (Nerlove and Bachman, 1960).

In context of estimation procedures, the previous studies (Hossain 1984, Rahman,19'86, AIam1992,Yunnus 1993, Shahabuddn and Zohir 1995, Begum et al 2002, Hauque, Hossain and Rahman 2004) used traditional tools and techniques, like simple linear equation and Ordinary Least Square (OLS). These studies used time series data irrespective of stationary and nonstationary situation. But in practice it was observed that time series data were not essentially stationary. So, previous studies did not give any attention to time series variables whether it was stationery or not. Such non-stationary data could produce *spurious regression*. It means that outcomes of the regression did not forecast significant relationships among the variable. The aim of this study is to avoid spurious regression of traditional econometric analysis by using cointegration and error correction mechanism.

2. Objectives

- To identify pertinent factors causing changes in area allocation of Boro rice to the relevant variables which influenced supply response of Boro rice
- To estimate (elasticity) the long-run changes in terms of area yield, output, irrigated area and nominal prices of Boro rice.

3. Econometric Methodology

This section provides a discussion on empirical methodology, applied in this study. Methodologies include testing unit root, cointegration and Error Correction Mechanism (ECM). One of the key objectives of this study is to avoid spurious regression. As a first step to avoid this problem, it is important to test for the presence of unit roots among the series. In this respect, DF and Augmented Dickey-Fuller test are used.

The framework of cointegration testing procedures developed by Johansen (1988, 1995) and Johansen and Julious (1990, and 1992) can be applied to evaluate long-run relationships among the variables. Augmented Dickey-Fuller residual tests and Johansen's (1988) maximum likelihood estimation method of reduced rank can be used to test the null of no cointegration. The residual-based tests are analogous (similar way) to univariate tests used to specify the order of integration of the variables, but it is the residuals that are tested. One of the major limitations of the residual-based method is that it implies a unique cointegrating vector. So if the cointegrating regression has more than two variables, there may be more than one cointegrating vector. In this respect, the use of residual-based approach is not appropriate. As a result Johansen's method which allows the estimation of all the possible cointegrating relationship exists among the variable is preferred. When variables are cointegrated, it implies that there exists an ECM. In fact, ECM is a generalization of the partial adjustment model. This theorem is a vital result as it implies that cointegration and ECMs can be used as a unified empirical and theoretical framework for the analysis of both short-run and long-run behaviour.

4. Specification of Variables

Variables, those are included in this research are discussed as follows: In this study price. production, irrigated area and yield rate have been used as explanatory variables, which are responsive to area allocation of concerned crop.

Production: production (Output) of the concerned crop is one of the decision-making variables in crop production in Bangladesh. Farmers always maximize their crop output towards food self-sufficiency and profit maximization in comparison to other competitive crops

Selection of price: Price has an allocative influence on resources and is most important for policy purposes. In fact, farmers take planting decisions with respect to expected prices prevailed during the post harvest period. This expected price is generated on the basis of different expectation generators such as realized prices; last period expected price, variations in prices and the prevailing prices at different points in time in the preceding year. Harvest prices of Boro rice have been taken into consideration for the reason that whole sale and retail price may not reflect what farmers actually receive, because farmers are usually set at a considerably higher level than what farmers get. Moreover, in case of Bangladesh rural farmers sell large portion of their products at immediate post harvest periods price. Considering these, harvest prices of crops have been selected for analysis.

Area of Boro rice: Area of the crop plays important role in decision-making variable of farmers. This variable has been used as dependent variable, which is responsive to prices, output, yield, irrigated area and prices of concerned crops. Boro area (A_v) have been taken for this study. This are actual planted area of Boro rice measured in `000' acre.

Yield rate: Yield per acre in metric tonnes of the crop has been used in this study.

Irrigated area: Irrigation has a significant impact on rice production. Boro rices are being grown during mid-March to mid August and November to end of March respectively. In

Bangladesh, more than 85 percent of total annual rainfall occurs between June to September. So, irrigation and water availability are crucial factors for growing Boro. Irrigated area by different crops are measured in '000' acres

5. Data Description of Boro Rice

The following section organised on the basis of data series with visual inspection for initial checking of stationarity,

Table 1. Annual Rate of Growth (percent) in Area, Production and Yield (per acre) of Boro Rice.

Crop	1972-73 to 1980-81			1981-82 to 1990-91			1991-92 to 2000-01		
Boro	Area	Prod.	Yield	Area	Prod.	Yield	Area	Prod.	Yield
	1.97	2.78	.6	8.1	8.2.	0.1	4.5	7.0	2.5

Note: Computed from the data Appendix 1

Area of Boro

According to table 1, area under Boro rice is increased at a slower growth rate 1.97 during the period of 1972-73 to 1980-81. But later, area under Boro rice increased at an average rate of 8.1, 4.5 and 2.2 percent in the 1980s, 1990s, and 2000s respectively.

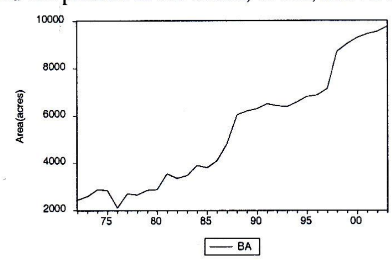

Figure 1. Trend of Boro Area

Area under High Yielding Variety (HYV) Boro is increased while the area under local varieties decline in the 1990s and the 2000s. This happens mainly due to the adoption of HYVs by farmers through replacement of local rice varieties. A sharp upward trend of Boro area is depicted in Figure 1.

5.1. Production of Boro Rice

Growth rate in production of Boro rice is 8.2, 7.0 and 4.4 percent during the 1980's, 1990's, and the 2000's, respectively. Growth in total rice production at the end of 20th century (1980s and 1990s) is mainly due to the growth in Boro rice production. Production of Boro rice is increased by 2.78 percent and its share in total rice is increased during the period 1972-73 to 1980-81. Figure 2 shows an upward trend of Boro production over the period 1972-73 to 2003-04.

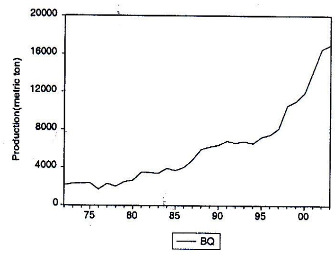

Figure 2. Trend of Boro Production

5.2. Yield of Boro Rice

Yield of all rice crops increases during the last 4 decades (since 1970s) except local transplantation of aman. Yield of Boro rice shows upward trend in Figure 3 during this periods.

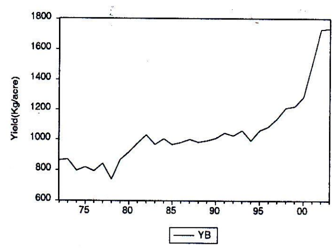

Figure 3. Trend of Boro rice yield

Yield of Boro rice is increased by 0.6, 0.1, 2.5 and 2.1 percent in the 1970s, 1980s, 1990s and 2000's respectively (see table 1).Year to year yield may fluctuate due to climatic factors, variation in input/output prices, managerial skills of producers, and controllability of the technology of production.

5.3. Irrigated Area of Boro

Irrigated area under Boro rice shows an upward trend over the period 1972-73 to 2003-04 in Figure 4. It is also seen that irrigated area under Boro rice significantly increases due to vast cultivation of Boro rice in the country during the 1980s. According to data table (see appendix 1 and table 1) that yield rate of Boro has increased remarkably.

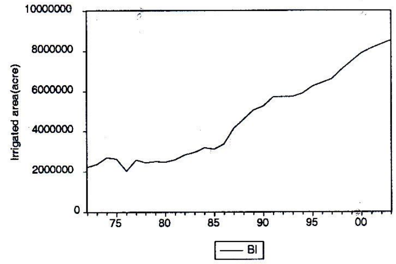

Figure 4. Trend of Irrigated Area of Boro Rice

5.4. Price of Boro Rice

Price of Boro rice shows an upward trend over the period in Figure 5. It has increased since 1972-73 continuously. It is mentionable that price of Boro increased sharply during 1974-75 due to eco-political instability in the country which is more politically explainable than economic phenomenon.

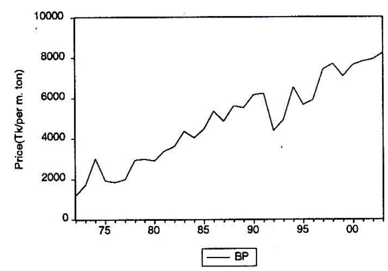

Figure 5. Trend of Boro Price

After the period of 1977-78 price level of Boro rice increased (see appendix 1) till 1991-92. This might be happening due to increase in food demand as well as input costing and finally commercialization of agriculture. But there is found significant decrease of the price level during the years 1992-93 to 1993-94.

6. Empirical Procedures

Empirical procedures are carried out in the following steps. *First,* annual data from 1972-73 to 2003-04 are obtained for five variables are subjected to a set of unit root tests. *After checking* unit root tests to confirm that each series is a *I(1)* processes, Johansen Maximum Likelihood procedures are used to test for cointegration and to estimate error correction parameters.

The long term effects of the variables can be represented by the estimated cointegration vector. This study is particularly interested in the long term effect of price, output, irrigation, yield rate on acreage decision, and the short term dynamics towards the steady state after an exogenous shock to price, output, irrigation and yield rate. In summary, the estimated co integration vector will answer the question of the long-run relations. All these procedures have been completed by applying Eviews software (version 3).

6.1 Unit Root

The presence or absence of unit root is of importance in empirical models based on time series data, where *price and non price* related variables are significant explanatory variables, when models examine relationship between these variables and supply response in agriculture. The data generating process of agriculture supply response has been assumed to be stationary (absence of a unit root) in almost all the earlier studies in Bangladesh (already mentioned in background section). However, in cases this assumption is not valid, standard asymptotic distribution theory can not be used for the purpose of drawing inference, because traditional regression analysis that includes variables with unit root can produce Spurious" or "crazy" regression result (Granger and Newbold 1986).

Although, it has become almost necessary to pre-test for the presence of unit root in applied econometric works, this by no means is a simple exercise. Practically most econometric time series data show trends and are non-stationary (Nelson and Plosser, 1982; Perron, 1988). Any time series has a unit root where its first difference is stationary. Therefore, as first step in any time series empirical analysis is to test for the presence of unit roots in order to remove the problem of spurious regression. In this stage it is needed to explore the order of each variable to establish whether it contains unit roots and how many times it needs to be differenced to draw a stationary series.

In this study acreage, yield price and irrigated area of rice are tested for unit roots for the period (1972-73 to 2003-04). Three types of rice and wheat data are available after independence of Bangladesh. Irrigated area variable is employed to represent technological change. Irrigated area is specifically thought to be the best supply shifters in the acreage equation.[2] Section 6.2 produces the results for testing the null hypothesis of a unit root against the alternative of stationarity using the Augmented Dickey-Fuller test (ADF).

6.2. Testing for Unit Roots

Before specifying the respective crop supply equations, the order of integration of the time of the variables, and the existence of cointegration between them need to be determined. All variables are in logarithmic form.

As first step to test the unit root of time series data, it is needed to observe graphical presentations of each series. Because it is convenient to detect qualitative feature such as trends and structural breaks. The Graphs of each series in levels and first differences are presented in Appendix at the end of this paper.

[2] Parikh and Triverdi (1979) assume that output elasticity in relation to irrigated acreage is treated as a measure of the contribution of technological progress to output.

Tests for unit roots are performed using the ADF tests. Akaike's Information Criterion is used to determine the optimal lag length for the augmented terms. The ADF tests for unit root are applied to check stationary property of the variables. The ADF test results for the logarithms of levels and first differences of all variables (area, production, price irrigated area and yield) are presented in Table: 2.

Table 2. **Boro Rice ADF test**

Variables	Levels	Difference
InAb	-0.284	-4.27
InIb	0.228	-4.298
InPb	*-1.77*	-8.41
InQb	0.187	-3.32
InYb	0.247	-3.75

Note: The ADF tests reported here are with intercept. The 1% Critical Value for Level -3.66, 5% CV -2.96 and 10% CV -2.62. The 1% Critical Value for Difference -3.66, 5% CV -2.96 and 10/% CV -2.62

Results of the unit root test of *InAb* , *InPb* , *Inlb*, *InQb*, and *InYb* are presented in Table 2. Results show that for all variables the null hypothesis of unit root are not rejected at 5 percent level. On the other hand, when the first differences are tested, the null hypothesis (nonstationarity) is rejected. Results of unit root tests indicate that area of Boro rice (*InAb)*> price of Boro (*InPb)*, irrigated area of Boro (*Inlb)*, production of Boro (*InQb)*, and yield of Boro (*InYb)* variables and they all have unit root I(1).

Therefore, results confirm that *InAb*, *InPb* > *Inlb*, *InQb* and *InYb* variables are integrated of order one in levels but integrated of order zero in first differences.

7. Theoretical Arguments and Model Specification for Boro Rice

Theory of supply response works as a basis of empirical works of supply response. Each theory provides a theoretical framework that leads to formulate an empirical model from various aspects. This section has been discussed in the light of theoretical perspective. Econometric model of supply response has been specified on the basis of theoretical arguments. The components of every model have been used as tools, for interpreting producers' behaviour in crop cultivation process. This study identifies variables that affect acreage at various circumstances. These variables are own price, price of inputs, technology and weather conditions. Most of previous studies (already mentioned in background section) in Bangladesh on supply response introduced price as only explanatory variable to measure supply response. So, concerned price and non-price variables need to be considered explaining supply response for a particular crop. Supply response may differ for the short-run versus long-run for rising and falling prices of own and competing crops. In this context, time lag is also a vital component of supply response. According to Tweeten, Pyles and Henneberry (1989) *"Any one-parameter estimation is unlikely to utilize all information and is subject to considerable error; the most reliable estimates of supply response will utilize not only direct econometric estimates at hand, but also results of previous estimates along with good judgment based on knowledge of circumstances"*.

Boro acreage (A_b) would be a function of nominal price (P_b), production (Q_b), irrigated area (I_b) and yield rate (Y_b). *It is needed to mention here that in cointegration model all variables are considered as endogenously (both way relationships).* We can write the function as:

$$A_b = [P_b, Q_b, I_b, Y_b]$$

This study applied Johansen's procedure to the rice acreage models. The first step of the Johansen procedure is the selection of the order of the Vector Auto Regressive (VAR) by using the following equation,

$$Z_t = A_1 Z_{t-1} + ... + A_k Z_{t-k} + u_t \qquad (7.1)$$

Here Z_t is an *(n×1)* vector of *I(1)* variables including both endogenous and exogenous variables, A_i is an (nxn) matrix of parameters, u_t is *(n×1)* vector of white noise errors. Each equation in (7.1) can be estimated by Ordinary Least Square (OLS) because each variable in Z_t regressed on the lagged values of its own and all other variables in the system.

Identification of Cointegration Vectors and Estimation of the Model

Following the steps of the Johansen procedure, hypothesis testing procedures were carried out to select the order of VAR, starting with a maximum lag length of four. A lag length of more than four is not considered because of the limited sample size (in context of cointegration model). If the residuals do not suffer from serial correlation, it is appropriate to select a lower lag length although incorporating additional coefficients will reduce the degree of freedom. Results from the lag length test suggest that possible lag lengths lie between one and four. Although a shorter lag length is preferred, there is no practical basis for considering order one for error correction model, because to do so would directly imply that there is no short-run dynamic part in the model after fixing the long-run behaviour. Thus the analysis is restricted to order two. The rank of the cointegration, i.e., the number of cointegrating vectors, is selected by using the maximum eigen value test.

The second step in the Johansen procedure is to test for the presence and number of cointegrating vectors among the series in the model. Results are presented in Table 3. This study used the 5 percent significance level except where stated.
Results of the cointegration test are displayed in Table 3.

Table 3. Results of Johansen's Cointegration Test

Cointegration rank	Eigen value	Likelihood ratio	5% Critical value	Decision
$r = 0$	0.70	80.59	65.52	none**
$r \leq 1$	0.55	43.88	47.21	At most 1

Note: L.R. test indicates cointegrating equation(s) at 5 percent significance level.

According to table 3, LR value is greater than critical value at 5 percent significance level which implies that the null hypotheses of no cointegration are rejected. The hypothesis of one cointegrating vector is accepted.The Johansen cointegration results from Table 3 indicate that the Boro acreage model has one cointegrating vector. It also means that unique long-run equilibrium relationship exists between the variables.

The Johansen model is a form of ECM and where exits only one cointegrating vectors its parameters can be interpreted as estimates of the long-run cointegrating relationship between variables (Hallam and Zanoli, 1993). Following the estimated parameter values from these equations when normalised on acreage is the long-run elasticities. The coefficient expresses estimates of long-run elasticities of Boro acreage with respect to price, output, irrigated area and yield.

If, cointegration is established among the variables, there is an error correction mechanism (ECM). The dynamic ECM framework is an ideal basis for supply response analysis because it provides information about the speed of adjustment to long-run equilibrium and avoids the spurious regression problem between the variables (Engle and Granger, 1987).The ECM for acreage is:

$$\Delta A = \delta_0 + \sum_{i=1}^{4} \delta_{1i} \Delta A_{t-1} +$$

$$\sum_{i=1}^{4} \delta_{2i} \Delta P_{t-1} + \sum_{i=1}^{4} \delta_{3i} \Delta Q_{t-1} + \sum_{i=1}^{4} \delta_{4i} \Delta I_{t-1} + \sum_{i=1}^{4} \delta_{5i} \Delta Y_{t-1} - \alpha EC_{t-1}$$

Where, $-\alpha EC_{t-1} = \alpha(A_{t-1} - \beta_1 P_{t-1} - \beta_2 Q_{t-1} - \beta_3 I_{t-1} - \beta_4 Y_{t-1})$

Table 4. illustrates long-run cointegrating vector of price, irrigated area and production. It also shows adjustment coefficient of acreage.

Table 4. Long-run Cointegrating Vectors (price vector with short-run coefficient)

Acreage	Prices		Irrigated area (Long-run)	Production (Long-run)	Adjustment coefficient of acreage
	Short-run	Long-run			
Boro	0.21 (-2.3)	0.95 (-1.5)	0.002^{NS} (-0.0014)	0.7 (-2.0)	0.37 (-4.06)

Note: NS-Non significance, Figures in Parentheses show the value of t-statistics

Table 4 shows the long-run coefficient of price (P_b) is 0.95, which is insignificant at 10 percent level. This implies that a 1 percent increase in price increases Boro area (A_b) increase at aggregate or national level by 0.95 percent in the long-run. Production or output variable (Q_b) has an impact on area distribution of Boro rice. The estimated coefficient for output is 0.7 at 5 percent significant level. Our results also suggest that the short-run acreage elasticity of Boro to own price is 0.21 which is significant at 5 percent level. This indicates that 1 percent increase in Boro price leads to increase Boro area by 0.21 percent.

The long-run price elasticity of Boro is elastic with 0.95 and is significant and short-run elasticity is 0.20 at 5 percent significance level. Production (output) variable has a little impact on acreage distribution. The coefficient for output is 0.7. The area adjustment of Boro rice is 0.37; it implies that area takes three years to achieve equilibrium after disequilibrium.

Results tell us that supply of Boro rice is responsive to its own price in the long-run. Price support policy is more appropriate for increasing Boro production at national level. Various types of price support policy are being used to insist farmers to allocate more area for that particular crop. It depends on degree of responsiveness of particular crop supply to its own price, prices of related product and demand for that crop.

The cointegration of Boro equation specifies the long term adjustment coefficients. This shows the extent to which the current change in vector Z is a response to the last time deviation to converge with the long term relation. In other words, the Figures in this row identify the fraction of the long gap that is adjusted in each period. The equation of Boro area (A_b) equation shows that the long-term area of Boro (A_b) gap adjust by about 37 percent in each period and that is highly significant. These results imply that area take short period to achieve equilibrium after shock.

8. Conclusion and Policy Implications

This study was designed to determine the Boro rice supply response to selected factors to analyze the short-run and long-run supply responses of Boro rice in Bangladesh. On the basis of analysis, the estimated elasticities could be used to meet the objectives of this study. It was found that the range of the short-run, elasticity was smalls in size (0.21).A common problem such as scarcity of inputs like land, capital and lack of well managed were found to be irrigation limited in the short-run. But in the long-run the elasticity of supply increases with time, because farmers are able to adjust their fixed factors or inputs in production process. As a result the long-run supply elasticity becomes higher than the corresponding short-run elasticities.

Findings of this study suggested that supply (acreage) of Boro is responsive to their own prices. So their production through expanding of Boro area can be increased by increasing t Boro prices. However, the price change of these crops would affect the production of other crops due to negative cross-price elasticities.

Supply elasticity of non-price factors (irrigated area and yield) are relatively lower than with respect to price. So it would be a prudent decision to increase public expenditure on irrigation schemes and other technological improvements. Because these factors mainly determined by the outside of the model.

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Appendix 1. Boro Rice Data 1972-2004

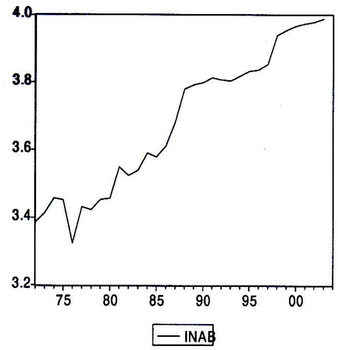
Period	Area ('000'acre)	Production ('000'm.ton)	Price (tk.per/m.ton)	Acre (irrigated area)	Yield rate (kg/acre)
	Ab	*Qb*	*Pb*	*Ib*	*Yb*
1972-73	2434	2104	1178	2220860	0.864
73-74	2595	2256	1716	2361900	0.869
74-75	2871	2286	3012	2699650	0.796
75-76	2837	2323	1922	2618126	0.819
76-77	2112	1676	1842	2022925	0.794
77-78	2703	2275	1977	2575285	0.842
78-79	2649	1960	2927	2436490	0.740
79-80	2839	2466	2987	2491750	0.869
80-81	2867	2630	2900	2467500	0.917
81-82	3542	3460	3390	2574043	0.977
82-83	3342	3446	3608	2816785	1.031
83-84	3463	3350	4359	2959685	0.967
84-85	3891	3909	4042	3175860	1.005
85-86	3789	3671	4457	3110760	0.969
86-87	4082	4010	5340	3368235	0.982
87-88	4800	4807	4844	4146396	1.001
88-89	6026	5925	5608	4608891	0.983
89-90	6205	6167	5512	5066220	0.994
90-91	6297	6357	6155	5257805	1.010
91-92	6512	6804	6225	5720510	1.045
92-93	6423	6587	4387	5733932	1.026
93-94	6378	6772	4918	5740850	1.062
94-95	6582	6538	6541	5910398	0.993
95-96	6804	7221	5664	6251916	1.061
96-97	6876	7460	5898	6430021	1.085
97-98	7138	8137	7414	6624000	1.140
98-99	8715	10552	7709	7086000	1.211
99-00	9024	11027	7078	7506000	1.222
00-01	9295	11920	7650	7900000	1.282
2001-02	9452	14253	7825	8145000	1.508
2002-03	9548	16520	7925	8345000	1.730
2003-04	9760	16954	8230	8540000	1.737

Source: Agriculture Statistical Year Book-98
Economic Trend, Bangladesh Bank 98
Statistical Year Book 1998, 2000
Economic Review 2006

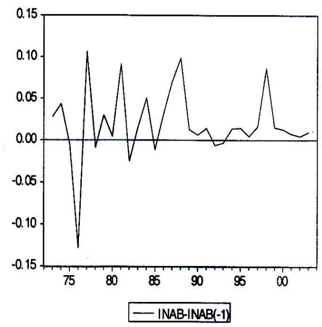
Appendix 2. Level and first differences of area, Price, Production, Yield rate.

Boro rice *(A_b)*

Level

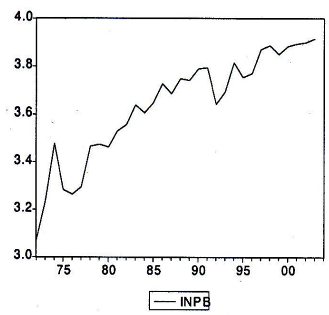


First difference



Price of Boro rice *(P_b)*

Level



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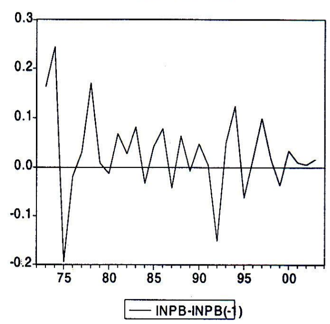
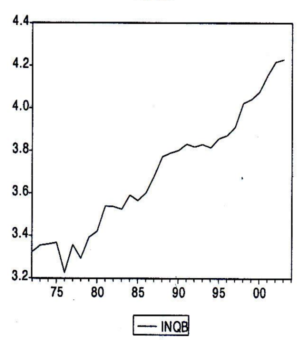


Production of Boro rice *(Q_b)*

Level



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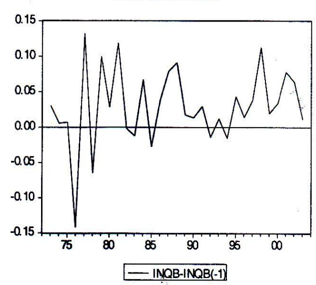
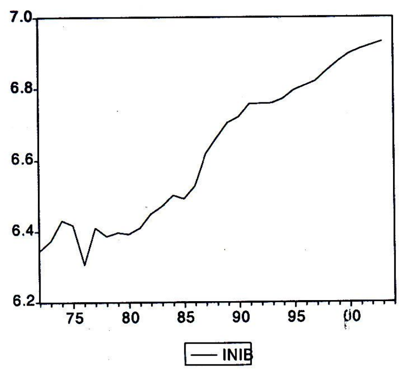


Irrigated area under Boro rice *(I_b)*

Level



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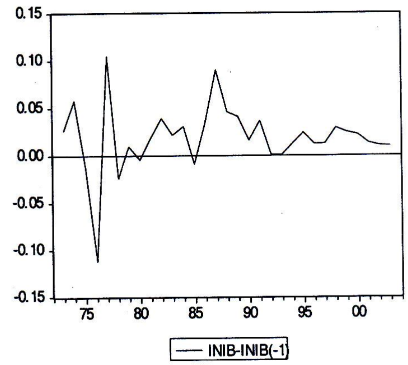
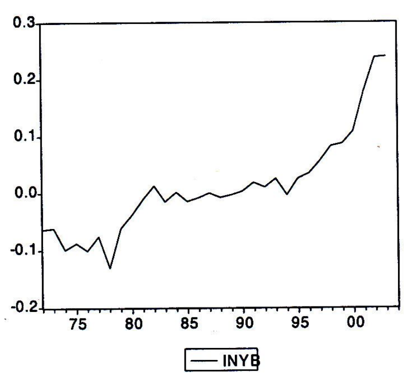


Yield of Boro rice *(Y_b)*

Level



First difference