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## ***PRODUCTION AND PRICE STRUCTURE OF POTATO IN BANGLADESH***

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### **ABSTRACT**

This study is an attempt to estimate the growth rates in area, production and productivity of potato and to study the behaviour of trend, seasonal fluctuation and existence of cycles of potato price in Bangladesh. The study shows that the production of potato in Bangladesh increased by more than 5 percent per annum whereas the growth rate in area and productivity were over 3 and 2 percent respectively during the last two decades. The current price of potato increased significantly over the years but wide seasonal fluctuation occurred in all the selected markets. There is no cycle of potato price but the correlogram analysis shows oscillation in a remarkable way in all the markets.

### **I. INTRODUCTION**

Bangladesh has made a remarkable progress in the production of potato during the last two decades. Area under potato has doubled and production has increased three fold during the same period. But a cold storage facility has not been expanded at the same rate to cope with the increased production of potato. The potentiality to export potato is not so bright due to low quality and non-availability of proper shipping facilities. The scope to consume potato is limited due to paucity of processing industries. Under such a situation a bumper harvest due to favourable weather condition results in abnormally low price in the domestic market. Furthermore, there is a violent price fluctuation within a year. Hence, the large production, seasonal and perishable nature of this crop and limited storage facilities has a profound effect on growers income and economic efficiency of the production due to wide fluctuation of potato price. On the basis of problematic situation this study is an attempt to estimate the growth

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rates in area, production and productivity of potato and to study the behaviour of trend, seasonal fluctuation and the existence of cycles of potato price in Bangladesh.

## II. METHODOLOGY

### Selectin of the Study Area

Five important potato growing districts (old) namely Dhaka, Comilla, Rajshahi, Rangpur and Bogra contributing about 66 per cent of the country's production were selected for this study. In order to study the price behaviour, one important market from each district was chosen. The selected markets were Mirkadim, Chandpur, Rajshahi, Nilphamari and Bogra. Time series data for the period 1960-61 to 1981-82 were employed for this study.

### Analytical Framework

#### Compound Growth Rate

Compound growth rate of area, production and productivity were worked out by exponential function of the type :

$$Y=ae^{bt} \text{ or } \log_e Y=\log_e a+bt$$

where,  $e^b - 1$  be the compound growth rate.

Further, compound growth rates were calculated for the pre and post-liberation periods separately.

#### Trend and Seasonal Variation

The trend movements in price of potato for each selected market was worked out by fitting both linear and quadratic function. For estimating seasonal variation a multiplicative model was considered. Trend was estimated by simple 12 months moving average method and seasonal indices were worked out by averaging the detrended series.

#### Cyclical Variation

**Periodogram Analysis :** To find out the cyclical variation in potato prices, fourier analysis was employed. For this, 5 periods of 2, 3, 4, 5 and 6 years of length were taken and squared amplitude were computed for each specific period by finding the fourier coefficients. This as shown below :

For investigating the existence of a cycle of Period 'p' the data were grouped as under

$$\begin{array}{l} Y_1, Y_2, \dots, Y_p \\ Y_{p+1}, Y_{p+2}, \dots, Y_{2p} \\ \dots \\ Y_{p(m-1)+1}, Y_{p(m-1)+2}, \dots, Y_{mp} \\ \hline \text{Sum } U_1, U_2, \dots, U_p \end{array}$$

For fourier coefficients, Ap and Bp were calculated using the formula :

$$A_p = \frac{2 \left[ \sum_{j=1}^p U_j \cos \left( \frac{360j}{p} \right) \right]}{mp}$$

$$B_p = \frac{2 \left[ \sum_{j=1}^p U_j \sin \left( \frac{360j}{p} \right) \right]}{mp}$$

The square amplitude  $R_p^2$  was obtained by adding  $A_p^2$  and  $B_p^2$  i.e.  $R_p^2 = A_p^2 + B_p^2$ .

Periodogram analysis was used to test the significance of square amplitudes. This was done as follows :

I. Calculate the mean square amplitude as :

$$R_m^2 = \frac{4\sigma^2}{N} \text{ where, } \sigma^2 \text{ is the variance of series } Y_t$$

II. Calculate  $K = \frac{R_p^2}{R_m^2}$

III. Apply schuster test to determine the statistical significance of calculated K. If it is significant then the series has a cycle of period P.

**Correlogram Analysis :** Correlogram analysis was applied to find out the hidden periodicities present in the series. A correlogram is the array of the coefficients of

serial correlation  $r_0, r_1, r_2, \dots, r_k$

Where,

$$r_k = \frac{\text{Cov}(Y_t, Y_{t-k})}{\sqrt{\text{Var}(Y_t) \text{Var}(Y_{t+k})}}$$

### III. COMPOUND GROWTH RATE

Compound growth rates in production, area and productivity of potato for different districts and for the country as a whole calculated by fitting exponential function are presented in Table 1. The production of potato in Bangladesh has increased by 5.49 per cent per annum whereas the growth rate in area and productivity were 3.13 and 2.29 per cent respectively. In all but Rangpur district the growth rates in area were higher than those in productivity. Further, the growth rate in area, production and productivity for the eastern districts (Dhaka and Comilla) were higher than those for northern districts (Rajshahi, Rangpur and Bogra). The growth rates for the eastern districts were higher due to availability of better irrigation facilities, expansion of cold storage facilities and adoption of high yielding varieties (HYV) of potato.

The compound growth rates in production as well as in productivity were highest for Comilla district, followed by Dhaka, Rajshahi and Bogra districts. But the growth rate in area was highest for Dhaka district due to the construction of more cold storage in Dhaka district.

In the northern districts, the HYV of potato has not been much popular because farmers prefer to grow 'Deshi' varieties in these districts. Despite low yield, the 'Deshi' varieties are grown in the northern areas possibly because farmers receive higher price for 'Deshi' potato due to early harvest and good taste. That is why the rates of growth of productivity for the northern districts were lower. Furthermore, the growth rates in area in the northern region were lower than national growth rate. The slow growth of cold storage and lower price during the harvesting period in the northern areas may be the factors responsible for lower expansion in area under potato.

Further, attempt was made to calculate the compound growth rates during pre- and post-liberation period, which are presented in Table 2. The results show that the growth rates in production, area and productivity during the pre-liberation period were by and large higher than those for post-liberation period. But there is an exception for Bogra district where growth rates in production, area and productivity were higher during the post-liberation period because only recently the HYV of potato has become popular in the region. On the whole, the productivity in the post-liberation period was more or less stagnant. The production has mainly increased due to expansion of acreage under potato crop. On the other hand both area and productivity in the pre-liberation period had increased significantly.

**TABLE 1. COMPOUND GROWTH RATE OF PRODUCTION, AREA AND PRODUCTIVITY OF POTATO IN BANGLADESH AND SELECTED DISTRICTS, 1960-61 TO 1981-82**

Nation/ District		Growth rate (%)	R <sup>2</sup>
Bangladesh	Production	5.4873*	0.7862
	Area	3.1264*	0.8432
	Productivity	2.2892*	0.6234
Dhaka	Production	11.3525*	0.7186
	Area	8.9432*	0.7875
	Productivity	2.2280*	0.4252
Comilla	Production	13.1358*	0.8067
	Area	7.6465*	0.7659
	Productivity	5.0928*	0.7867
Rajshahi	Production	3.2376*	0.5426
	Area	1.7419*	0.6774
	Productivity	1.4888*	0.3004
Rangpur	Production	3.5261*	0.4283
	Area	1.3818*	0.4314
	Productivity	2.1116*	0.2267
Bogra	Production	2.5416*	0.6637
	Area	1.7501*	0.5599
	Productivity	0.7875	0.1208

\*Significant at 5 per cent level

TABLE 2. COMPOUND GROWTH RATE OF PRODUCTION, AREA AND PRODUCTIVITY OF POTATO IN THE PRE-LIBERATION (1960-61 TO 1969-70) AND POST-LIBERATION (1972-73 TO 1981-82) PERIOD OF BANGLADESH (DISTRICTWISE)

Nation/ District	1960-61 to 1969-70		1972-73 to 1981-82	
	Growth rate (%)	R <sup>2</sup>	Growth rate (%)	R <sup>2</sup>
Bangladesh	Production	0.9051	3.5716*	0.6707
	Area	5.4703*	2.8206*	0.5919
	Productivity	6.8839*	0.9019	0.5331
Dhaka	Production	29.0497*	0.8817	0.4098
	Area	19.1151*	0.8497	0.6553
	Productivity	8.3438*	0.8257	0.1621
Comilla	Production	28.4014*	0.7985	0.6906
	Area	16.4505*	0.7895	0.3271
	Productivity	10.2537*	0.6957	0.9268
Rajshahi	Production	7.8355*	0.5269	0.2078
	Area	3.9074*	0.8595	0.2559
	Productivity	3.6926*	0.2368	0.0856
Rangpur	Production	7.9649*	0.4191	0.0963
	Area	-1.0239*	0.1663	0.1741
	Productivity	9.0985*	0.5673	0.6184
Bogra	Production	3.8195	0.2228	0.8981
	Area	0.5741	0.0399	0.4915
	Productivity	3.3525	0.2911	0.7489

\* Significant at 5 per cent level

#### IV. PRICE BEHAVIOUR

##### Trend in Potato Price

Trend exhibits the general direction of change over a period of time. The trend in price is affected by the forces of demand and supply. Change in demand arises from the change in population, income, taste, habits, custom etc, whereas change in supply arises out of the development of cold storage, processing industries and marketing facilities, production technology and market arrivals.

The trend in potato price as obtained by fitting both linear and quadratic function for different markets in Bangladesh during the period 1963 to 1982 are shown in Table 3. Linear function shows better fit for Mirkadim, Chandpur, Rajshahi markets while for Nilphamari and Bogra markets quadratic forms have better fit. The 'b' values were highly significant in all the markets, showing significant increase in potato prices over the years. Since monetary price was taken to estimate the trend, the influence of inflation on the price of potato can not be ruled out. Indeed, compared to general price index for agricultural commodities, price of potato did not increase.

The result indicates that the increment in potato price was higher for the northern districts than that for eastern districts. This may be due to more supply in the eastern markets because of more production

##### Seasonal Price Variation

The seasonal variation in prices arises from the seasonal production, poor storage facilities and lack of retention power of the growers. The quantity of potato arrived in the market during post harvesting period was more than local need for consumption which created glut in the market resulting in lowering down of prices. Since most of the growers dispose of their products just after harvest the low price during the post-harvest period ultimately affected the income of the growers adversely. On the other hand, during the sowing period the farmers purchase seed of potato from the market at a very high price. Thus seasonal price variation play dual role in creating uncertainty in the income level of the potato farmers.

The indices of seasonal variation of prices for different markets are shown in Table 4 and in Figure 1. It is evident from the table and figure that wide seasonal fluctuations occurred in potato prices in all the selected markets. The seasonal variation in prices were of similar nature in all markets. The index of seasonal price variation of potato was lowest in February, followed by that in March. The price begin to firm up by July and reach the peak level in the month of November. The price index remained below average (100) from January to June and above average from August to December.



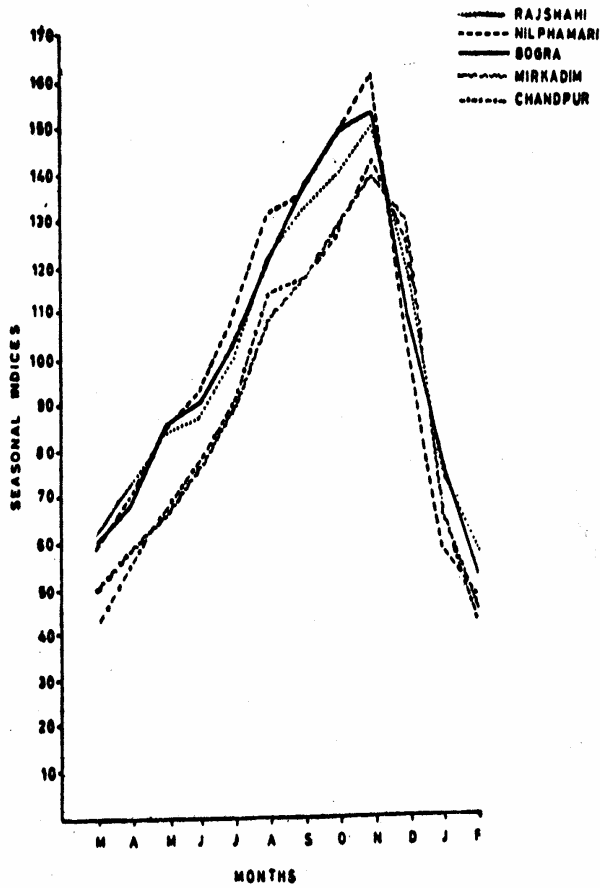


FIG...1, SEASONAL INDICES OF PRICES IN SELECTED MARKETS

## Production and Price of Potato : Sabur

TABLE 3. TREND IN POTATO PRICE OF DIFFERENT MARKETS IN BANGLADESH FOR THE PERIOD 1963 TO 1968

Name of Market	Type of equation	Constant (a)	Regression coefficient			R <sup>2</sup>
			(b)	(c)	(d)	
Mirshadim	Linear	0.2364	3.8831* (0.6206)	—	—	0.6676
Chandpur	Linear	5.9105	4.2820* (0.6746)	—	—	0.6710
Rasahi	Linear	5.4997	5.0546* (0.6645)	—	—	0.7405
Nilphamari	Quadratic	16.5011	1.6752* (0.5302)	0.1421* (0.0254)	—	0.8024
Bogra	Quadratic	14.4854	2.2778* (0.6261)	0.0956* (0.0290)	—	0.7074

\* Significant at 5 per cent level. Figures in parentheses are standard errors.

TABLE 4. SEASONAL INDICES OF POTATO PRICE OF DIFFERENT MARKETS

Month	Mirhatim	Chandpur	Rajshahi	Nilphamari	Bogra
January	76.97	75.77	74.36	59.52	67.39
February	55.85	52.58	57.98	48.68	53.07
March	59.82	52.37	61.75	58.27	60.22
April	68.55	66.21	72.36	69.68	68.86
May	76.11	77.61	83.84	84.30	86.29
June	86.40	88.27	87.43	92.31	90.72
July	99.52	101.18	99.84	108.73	103.24
August	119.09	123.49	122.38	130.91	121.18
September	126.99	127.37	132.10	135.33	137.08
October	139.28	137.19	139.54	147.40	149.11
November	150.53	152.88	149.72	161.82	153.53
December	140.89	145.08	118.70	103.05	109.31
Difference between highest and lowest indices	94.68	100.51	91.74	113.14	100.46

The difference between highest and lowest indices was maximum for Nilphamari market (113.14), followed by Chandpur (100.51), Bogra (100.46), Mirkadim (94.68) and Rajshahi market (91.74).

#### Cyclical Variation

**Periodogram Analysis :** The results of periodogram analysis for potato prices are presented in Table 5. No definite cycle has been found to be significant in any market. However, the value of square amplitude for 5 years cycle in Mirkadim, Rajshahi, Nilphamari and Bogra markets and 6 years period for Chandpur market was high but not statistically significant. The periodogram analysis shows that there was no cycle of uniform period in potato price in Bangladesh. This indicates that no definite fashion of annual fluctuation in potato price prevailed in Bangladesh. The price data shows that there was continuous fluctuation in potato prices every year during the pre-liberation period while during post-liberation period the cycle in price has been disturbed by the inflationary pressure.

**Correlogram Analysis :** Correlogram analysis also support the results obtained from periodogram analysis. The serial correlation coefficients of prices of potato are presented in Table 6 while the correlograms are shown in Figure 2. The correlogram of price series shows a divergent pattern in the behaviour of prices of this crop. Oscillation keep the prices away from reaching the equilibrium. In brief, correlogram analysis shows that the existence of harmonic terms in prices of potato in Bangladesh can not be rejected.

#### V. CONCLUSION

Though the study shows that 60 per cent of the growth in production was from area expansion, but henceforth it may be difficult to increase the area under potato because of higher and stable price, better marketing facilities and better technology for the cereal crops. Further, in the traditional diet of Bangladesh, the requirement of cereals is far more than the requirement of potato which is considered as a vegetable. Under such a situation, a policy of shift of area from cereals to potato may not be appreciated. Therefore, a meaningful solution must be thought of largely in terms of increasing gross cropped area by intensive cultivation.

The analysis shows that after liberation the growth rate in productivity is very low. Hence, attempt must be made to elevate productivity by supplying good quality and disease free seeds to the farmers.

TABLE 5 : FOURIER COEFFICIENTS AND RATIO 'K' FOR PRICES OF POTATO IN DIFFERENT MARKETS

Markets	Period P	Fourier Coefficients		Square Amplitude Rp <sup>2</sup>	Mean Square Amplitude Rp <sup>2</sup>	Ratio K Rp <sup>2</sup> /Rp <sup>2</sup>
		Ap	Bp			
Mirshadim	2	-5.4180	0.0000	29.3547	226.9966	0.1293
	3	-3.5600	7.3865	67.2340		0.2962
	4	-9.0980	7.0840	132.9366		0.5816
	5	-18.7367	-0.1233	286.3532		1.2618
	6	11.6378	12.0410	280.4246		1.2354
Chandpur	2	-8.5640	0.0000	73.3429	302.4996	0.2424
	3	-4.5933	5.2098	96.4808		0.3189
	4	-13.0989	10.0359	373.0189		1.2331
	5	-20.0300	11.9532	544.0799		1.7986
	6	13.7694	21.2568	641.4479		2.1205
Rajshahi	2	6.7191	0.0000	45.1463	222.4320	0.2029
	3	-4.1682	5.2392	43.0331		0.2024
	4	-7.1537	8.0018	115.2052		0.5179
	5	-14.0440	8.8758	364.7726		1.6398
	6	9.1122	10.0051	183.1342		0.8232
Nilphamari	2	2.4844	0.0000	6.1772	164.3426	0.0375
	3	3.9822	-3.3014	22.1102		0.1345
	4	-3.9827	-3.9123	85.1255		0.5180
	5	-16.3739	3.9999	324.1032		1.9721
	6	-0.0830	1.9131	3.6668		0.0223
Bogra	2	-1.4855	0.0000	2.2068	215.2271	0.0103
	3	-1.0297	-0.8240	1.7392		0.0081
	4	-11.9038	4.1286	144.8212		1.5729
	5	-1.1173	6.6343	31.8709		1.5284
	6	9.0943	10.5254	193.9903		0.8990

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TABLE 6. CORRELIOGRAM (%) OF PRICE OF DIFFERENT MARKETS

K	Mitkadin	Chandpur	Rajshahi	Nitphamari	Bogra
0	1.0000	1.0000	1.0000	1.0000	1.0000
1	0.5499	0.6712	0.6982	0.5143	0.6474
2	0.1211	0.0333	0.2418	0.1108	0.1904
3	-0.1122	-0.1897	-0.1187	-0.1356	-0.1742
4	-0.4164	-0.3520	-0.4311	-0.4189	-0.4289
5	-0.3574	-0.3653	-0.5584	-0.5656	-0.4977
6	-0.3638	-0.3782	-0.5487	-0.5005	-0.5349
7	-0.5175	-0.5454	-0.5623	-0.4082	-0.4932
8	-0.2955	-0.4672	-0.3822	-0.3242	-0.3965
9	-0.0383	-0.0897	0.0191	0.1761	0.0518
10	0.3494	0.3990	0.5149	0.5512	0.5514
11	0.6422	0.7805	0.7727	0.3071	0.6665
12	0.3350	0.4544	0.5171	0.0146	0.4171
13	-0.1756	-0.1583	0.0522	0.2435	-0.0279
14	0.2269	0.1673	0.2001	0.4616	-0.1925
15	0.1623	-0.1099	0.1994	0.3403	0.1946
16	0.7658	0.6004	0.6659	0.7245	0.8074
17	0.7426	0.9641	0.9505	-0.2323	0.6073
18	-1.0000	0.0672	-0.1524	-1.0000	-1.0000

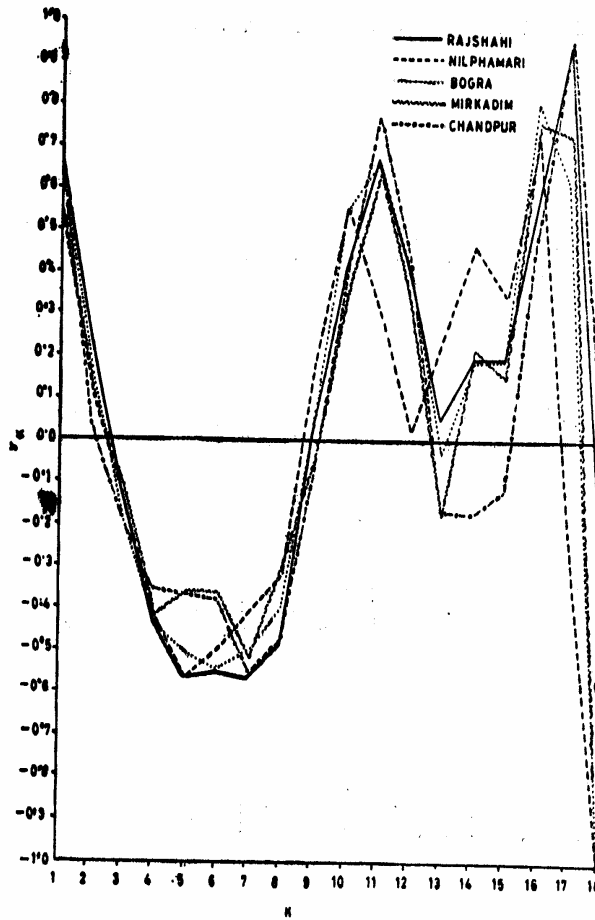


FIG...2. CORRELOGRAM IN POTATO PRICES IN SELECTED MARKETS

The violent seasonal variation in prices was mainly due to seasonal fluctuation in the arrival of potato in the market. Strong programme of constructing cold storages and processing units can be of great help in preventing seasonal fluctuation in price in short run. As a long run measure, however, the domestic as well as foreign demand need to be stimulated for bringing stability in potato prices and production.

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