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Growth and Fluctuation of Productivity of Total Food grain in West Bengal as Compared to all India during 1980-81 to 2009-10

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Abstract: The present paper is an attempt to analyse the pattern of growth, and the nature and extent of fluctuation of productivity of total foodgrain in the state of West Bengal as compared to all-India. The entire research work is based on the secondary data of productivity of total foodgrain since 1980-81 to 2009-10, collected from "Directorate of Economics and Statistics", Ministry of Agriculture, and different issues of Statistical Abstract, Govt. of India. For a proper analysis of growth, break and fluctuation some methodological innovation is also introduced. It is observed from the analysis that growth of productivity of total foodgrain in the state of West Bengal is slightly greater than that in all-India for the whole period, but growth rates in different sub periods is more fluctuating in the state of West Bengal as compared to all-India. Moreover it is observed that the said growth rate in the state of West Bengal is declining after the introduction of New Economic Policy as opposed to all India. It is further observed that fluctuation from trend in the state of West Bengal is greater than that in all India for the whole period and that is mainly due to major breaks in the growth path. For the sub periods fluctuations from trend are reducing both in the state of West Bengal and all India. For both these regions fluctuations in different sub periods are mainly comprised of year-to-year fluctuation and this contribution of year-to-year fluctuation in overall fluctuation is increasing over sub periods.

Keywords: food grain, productivity, growth, break, fluctuation.

INTRODUCTION

Agriculture is the heart of the Indian economy. This sector provides the most important livelihood to the masses. At present, it provides livelihood to as much as 65% to 70% of the total population and the sector provides employment to 58% of country's work force, although the share of agriculture in GDP has fallen from 39.6 to 14.6 percent in between 1980-81 to 2009-10. In case of West Bengal nearly 72 percent population lives in the rural areas and agriculture is the backbone of the economy of the state, although the share of agriculture in the state GDP is recorded to have come down from about 34.37 percent in 1980-81 to about 18.7 percent in 2009-10. The agrarian economy of West Bengal is basically an economy of small and marginal farmers.

India is a densely populated country and Indian population is growing rapidly. India's population accounts for the world's 17.5 percent, second only to china that constitutes 19.5 percent of the world population. Therefore, more and more food needs to be produced. If we want to increase production at a large scale, area cannot play a vital role because we can increase area, even gross cropped area, up to a limited extent. To meet the needs of the growing population only productivity can play a crucial role. We may increase agricultural productivity through various measures like irrigation, new technology, high yielding varieties seeds, fertilizer, etc.

At the time of independence Indian agriculture was traditional in nature, fully dependent on climatic condition and fluctuation in agricultural production was inherent. Agricultural scientists are gradually introducing modern forms of agriculture though the introduction of new technology, HYV seeds, fertilizer, etc. As a result the agricultural sector in the post independent period is observing a positive growth in production and a reduction in its fluctuation. Growth and fluctuation are two common phenomena not only in Indian agricultural production but also in agricultural productivity because agricultural productivity is the most important component in the agricultural production.

The nature of growth and fluctuation in Indian agriculture has been a debatable issue both at the state and the national level. Saha and Swaminathan [1] observed an accelerated growth in agriculture for the

state of West Bengal during the eighties. Chattopadhy et al.[2] used standard curve fitting technique and found no statistical evidence in support of break in total foodgrain production in West Bengal in the eighties. Rawal and Swaminathan[3] who have used deterministic trend of exponential form, concluded on the basis of time series data spanning about 50 years that West Bengal has experienced acceleration in growth during and after major changes in agrarian institution and land relations. Foodgrain dominates the cropping pattern in the state of West Bengal[4,5]. According to Ghosh and Kuri [6] in the state of West Bengal performance of foodgrain production is well but in the recent years there is an evidence of stagnancy in foodgrain production. Boyce [7] has shown that the approach for the measurement of sub-period growth rates used so far suffers from "discontinuity bias". To overcome this difficulty Boyce [7] has introduced a new approach in which "kinked exponential model" is fitted for estimating sub-period growth rates.

In the Indian context, Dev [4] found that besides variations in rainfall the differences in the extent and quality of irrigation were also important to explain interstate disparities in growth and stability. The growth performance of agriculture at the national level was splendid during the 1980s and its deceleration during the 1990s was attributed to the reduction in and/or stagnation of public expenditure on agricultural infrastructure, defunct extension services and economic reforms[8-13]. Parikh[14] argued that "though after 1980's, India achieved self sufficiency in foodgrain production but there is no surety that this achievement would be sustained". G. Bhala and G. Singh [15] concluded that the growth rate of crops yields as well as total agricultural output in most of the states have decreased in the post reform period(1990-93 to2003-06) than the pre reform period (1980-83 to 1990-93). R.P.S Mallik [16] has found that the trend of growth of the agricultural production as well as the crops productivity has decreased after the adoption of liberalization policy. S K. Goyal and J. P. Singh [17] have observed that the foodgrains production has increased during the period of 1960-1999. Higher growth in agriculture assumes great importance and is a matter of concern for policy planners and research scholars in recent times[18-20].

An instability measure has mainly been evolved as a related issue to the growth measurement in agriculture. In regard to the measurement of instability in Agricultural production we set broadly two technique, summary measure and trend measure. The summary measure of instability was adopted by Barker et al [21]. Other [22-23] attributed that instability in agriculture production had increased with the adoption of new technology. Ray [24] found that the the pattern of growth and instability was due to an increase in the variability of rainfall and prices. Likewise, Rao et al [11] concluded that instability in agriculture production had increased in the post green revolution period on account of rise in the sensitivity of output to variations in rainfall which was traceable to high complementary of new seed-fertilizer technology with water and inadequate expansion of irrigation facilities. But Dev [4]) reported progressive but marginally declined instability in food grain production at the all India level and mixed result as state level. All these studies covered the initial phase of the green revolution technology (late 1970s or mid 1980s). Larson et al [25] concluded that the green revolution has been instrumental in increasing production of food grain and other crops in India but this has come at a cost of greater instability in production and yield, he covered a longer post green revolution period. Sharma et al[26] attributed that the production of individual crops and total food grains had become more stable during 90's compared to 80's. the study by Sharma et al, started from year 1980-81; it did not cover the initial phase of green revolution nor did cover the pre green revolution period. According to Ramesh et al[27] variability in yield of foodgrains as well as that of non-foodgrains was much lower in the first phase of green revolution period. Deviation of observed yield from trend witnessed decline during 1989-2007.

The above study of literature reveals that no comprehensive study has so far been made for measuring growth, break and fluctuation in agricultural productivity at the state or the national level. In this paper we attempt to estimate the nature of growth and fluctuation in productivity of total foodgrains in the state of West Bengal vis-à-vis all-India. It also tries to examine whether there is any significant difference or not in the growth and fluctuation of productivity of total foodgrain in different sub periods. This paper also estimates the nature and extent of fluctuation of productivity of total foodgrain in different sub periods and for the whole period in the state of West Bengal vis-à-vis all India. We also calculate the length of cyclical fluctuation of productivity of total foodgrain for the whole period and for different sub-periods in the state of West-Bengal vis-à-vis all-India.

In this paper we use time series data of productivity of total foodgrain for the state of West Bengal and all-India since 1980-81 to 2009-10, collected from "Directorate of Economics and Statistics", Ministry of Agriculture, and different issues of Statistical Abstract, Govt. of India.

METHODOLOGY

Growth and fluctuations are two common elements of time series. A uniform growth rate for the

whole period is generally calculated from the log-linear regression $\ln X_t = a + rt$. (r being the rate of exponential growth) and fluctuations are generally calculated by the residuals obtained from the above regression. In majority of time series we observe different growth rates in different sub periods leading to breaks in the growth path. We get break in trend or growth path due to policy changes and this break in trend is normally estimated by separate regressions for different sub periods or by a single regression with dummy variables for different sub periods or different policy regimes.

For a data set of T years, t = 1,2….T, if we have two regimes as 1, 2, …, k and k+1, k+2, …, T, we can estimate two growth rates from a single regression with dummy variables D_1 and D_2 such that D_1=1 and D_2=0 for the first sub period and D_1=0 and D_2=1 for the second sub period. The regression equation cab be taken in the form,

$$\ln X_t = a + r_1D_1t + a_2D_2 + r_2D_2t$$

Here D_1t and D_2t are slope dummies for two sub periods and D2 is the intercept dummy for the second sub period. In the 1st sub period when D_1=1 and D_2=0 the equation reduces to $\ln X_t = a + r_1t$, implying that r_1 is the growth rate of the first sub period. In the second sub period when D_1=0 and D_2=1 the equation reduces to $\ln X_t = (a+a_2) + r_2t$, implying that r_2 is the growth rate in the second sub period. D2 is accommodated or a_2 is estimated to adjust the change in the intercept with a break in between two sub periods. Intercept dummy D1 for the first sub period cannot be used. When both D_1 and D_2 are used in the same model as D_1+D_2 is always equal to 1 we shall be caught into a dummy variable trap because of perfect multicollinearity between D_1 and D_2.

We can reformulate the model by totally avoiding D_1 (Many econometricians suggest to use dummy variable one less in number from the number of sub periods present). The new model takes the following form,

$$\ln X_t = a + r_1t + a_2D_2 + r_2D_2t$$

where D_2 is the intercept dummy for the second sub period and D_2t is the slope dummy for the same. In the first sub period the equation reduces to $\ln X_t = a + r_1t$ as before. But in the second sub period it reduces to $\ln X_t = (a + a_2) + (r_1 + r_2)t$. Thus $(r_1 + r_2)$ is now the growth rate for the second sub period or r_2 is the difference between the growth rates of two sub periods. The advantage of this second model over the first is that in this second model we are able to test the significance of r_2, the difference between growth rates in two sub periods.

The problem with both of the above two models is that they may create discontinuity between the two growth paths estimated. To overcome this, restriction for continuity or kink is posed for the double dummy model as, $a + r_1k = (a + a_2) + r_2k$ or $a_2 = (r_1 – r_2)k$. The model now reduces to,

$$\ln X_t = a + r_1D_1t + (r_1 - r_2)kD_2 + r_2D_2t$$

or, $$\ln X_t = a + r_1(D_1t + kD_2) + r_2(D_2t – kD_2)$$

or, $$\ln X_t = a + rJ_1 + r_2J_2$$

Where, $J_1 = D_1t + kD_2$ and $J_2 = D_2t – kD_2$

This model will henceforth be called the J–Model.

In the same way restriction for continuity in the single dummy model is $a + r_1k = (a+a_2) + (r1+r_2)k$ or $a_2 = –r_2k$. The model now reduces to,

$$\ln X_t = a + r_1t - r_2kD_2 + r_2D_2t$$

or, $$\ln X_t = a + r_1t + r_2(D_2t – kD_2)$$

or, $$\ln X_t = a + rH_1 + r_2H_2,$$

where, H1 = t and $H2 = D_2t – kD_2$

This model will henceforth be called the H–Model.

In this way we can formulate dummy variable models for calculating growth rates of three or more sub periods and for comparing growth rates between two consecutive sub periods or between two sub periods leaving one or two small sub periods in between them.

In case of measurement of fluctuation in a time series Y_t, fluctuation is frequently interpreted in terms of fluctuation around the trend line. Fluctuation around the trend is generally estimated by the deviation of observed values from the estimated values in the regression mentioned above and it is denoted by e_t.. The fluctuation index is obtained through the residuals sum square (RSS) $=\Sigma e_t^2$ in the following way.

$$I_{RSS} = \sqrt{\frac{1}{T}\sum e_t^2} \;/\; \overline{lnX}_t$$

Coppock [28] has advocated an important methodology of measurement of fluctuation in a time series Y_t. Coppock measurement of the index of fluctuation is given by $I_{coppock} = \text{Exp}(SD(\ln(\frac{Yt+1}{Yt})))$, this measurement is based on year to year fluctuation. Now, in case of comparison between the two above mention methods, we face a problem. The RSS base measure has a zero lower limit and it can go beyond one – actually it has no upper limit. The coppock measure has a lower limit at one and it has no upper limit.

To overcome this difficulty, Mondal and Mondal Saha[29] have proposed some adjustment to the above measures. The adjusted Coppock measure of fluctuation is given by $I_{coppock}' = \frac{SD(\ln(\frac{Yt+1}{Yt}))}{2\,(\overline{lnX}t)}$. This index is

comparable to the RSS base index. The length of cyclical fluctuation can be calculated by squaring the value of the ratio of residuals base index divided by adjusted coppock index and then it is multiplied by 2.

In this paper we use the data set of productivity of total food grain from 1980-81 to 2009-10, for the state of West Bengal vis-à-vis all-India level. Some researchers in this area use same data set and take breaks arbitrarily or at the dates of policy changes (for example, introduction of green revolution, introduction of new economic policy etc.) without examining whether they are able to produce significant breaks at those points or not. Here we identify breaks from the data by assuming break at any point if it is found to be significant. A program is formulated to identify optimum break point in a line proposed by Bai and Perron [30]. After identifying the break points we try to analyze changes in pattern of growth, and nature and extent of fluctuation in the productivity of total food grain in the different sub-periods for the state of West Bengal vis-à-vis all India. If policy changes actually create breaks then it will be automatically incorporated in our method.

For the state of West Bengal, the study period (1950-51 to 2009-10) has been divided into four phases with the help of the above search methodology. The sub periods are: sub period-I (1980-81to 1982-83), sub period-II (1984-85 to 1991-92), sub period-III (1992-93 to 2005-06), sub period-IV (2005-06 to 2009-10). But in case of all-India the overall period (1950-51 to 2009-10) has been divided into three phases, viz., sub period-I (1980-81to 1987-88), sub period-II (1989-90 to 2001-02) and sub period- III(2003-04 to 2009-10).

RESULTS AND DISCUSSION

For the state of West Bengal (from table-1) it is observed that the growth rate of productivity of total food grain for the whole period (1980-81 to 2009-10) was 2.59 percent. In case of sub period-II, the growth rate of productivity was 3.54 percent and it was significant, now for the sub period-III, it is found that the growth rate has significantly decreased compared to the sub period-II. Thus we can say that, after the adoption of new economic policy (liberalization policy) the growth rate of productivity has significantly decreased and it is also traceable that in some recent years the growth rate of productivity highly decreased (from positive to negative) although this fall is not significant.

Table-1: Growth of productivity of total food grain for the state of West Bengal and all India.

WEST BENGAL			
TIME-PERIODS	**GROWTH RATES (%)**	***T-VALUE***	***P-VALUE***
Full period (1980-81 to 2009-10)	2.59	13.49	8.95E-14
Sub period- I(1980-81 to 1982-83)	-13.1	-5.27	2.39E-05
Sub period- II(1984-85 to 1991-92)	3.54	9.88	9.56E-10
Sub period- III(1992-93 to 2005-06)	1.82	9.67	1.42E-09
Sub period- IV(2007-08 to 2009-10)	-0.91	-0.57	0.5698

Difference between Sub periods growth rates (West Bengal)			
Difference	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Difference between Sub period-I & II	16.7	6.62	9.38E-07
Difference between Sub period-II &III	-1.72	-3.49	0.00195
Difference between Sub period-III &IV	-2.73	-1.71	0.09955

ALL INDIA			
TIME-PERIODS	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Full period (1980-81 to 2009-10)	2.05	18.02	6.09E-17
Sub period- I (1980-81 to 1987-88)	2.10	4.66	0.00180
Sub period- II(1989-90 to 2001-02)	1.98	10.21	5.15E-10
Sub period- III(2003-04 to 2008-09)	3.08	5.56	1.16E-09
Difference between Sub periods growth rates (all India)			
Difference	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Difference between Sub period-I & II	-0.12	-0.25	0.80
Difference between Sub period-II &III	1.09	1.87	0.0739

In case of All India, it is found that the growth rate of productivity of total food grain for the whole period (1980-81 to 2009-10) was 2.05 percent. In case of sub period – I, it is calculated that the growth rate of

productivity was 2.10 percent and it was significant but for the sub period-II, it is observed that the growth rate of productivity was slightly decreased from 2.10 percent to 1.98 percent although the difference between these two sub period growth rate was not significant. Therefore it is signifies that, after the adoption of 1991 economic policy the growth rate was marginally decreased in compared to the pre liberalization period (sub period - I). Now if we consider some recent years it is observed that the growth rate of productivity significantly increased but the difference between two sub periods (sub period-I and II) growth rate was not significant.

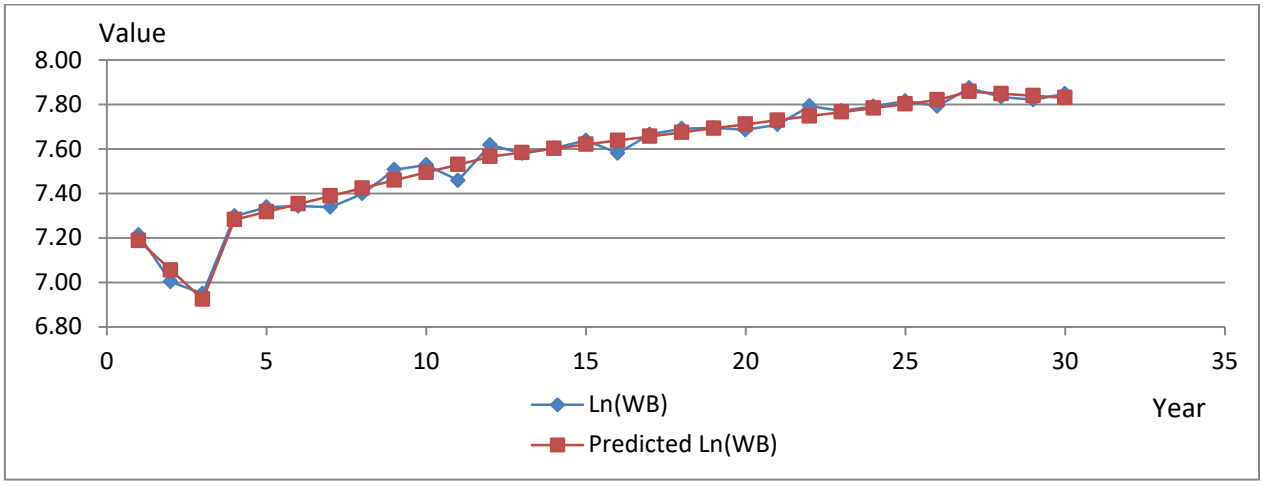

Fig 1a: Growth of productivity of total food grain for the state of West Bengal

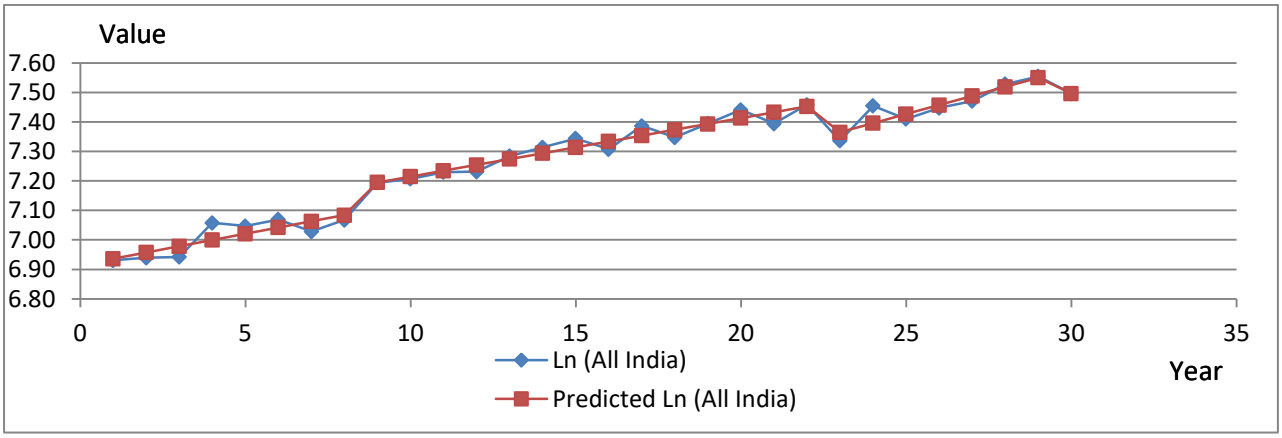

Fig 1b: Growth of productivity of total food grain for all India

In case of West Bengal (Table-2), the growth rate of productivity of total food grain for the whole period (1980-81 to 2009-10) was 2.59 percent. In case of sub period-II, the growth rate of productivity of total food grain was 3.54 percent and it was significant. Thus, it is observed that in the pre-liberalization period in the state of West Bengal the growth rate of productivity of total food grain was tremendously and significantly increased compared to the previous period and the difference between two sub period growth rate was also highly significant and in this phase. We find almost same picture regarding the growth rate of productivity of total food grain in the all India level. Now in the sub period-III, that is, after the adoption of 1991 new liberalization policy in India, the growth rate of productivity of total food grain for the state of West Bengal has significantly decreased from 3.54 percent to 1.82 percent and the difference between two sub period growth rate (-1.72) was also significant and in this phase also we observed the similar picture in case of all India level.

Table-2: Growth of productivity of total foodgrain for the state of West Bengal and all India according to optimum breaks found in West Bengal

WEST-BENGAL			
TIME-PERIODS	**GROWTH RATES (%)**	***T-VALUE***	***P-VALUE***
Full period (1980-81 to 2009-10)	2.59	13.49	8.95E-14
Sub period- I(1980-81 to 1982-83)	-13.1	-5.27	2.39E-05
Sub period- II(1984-85 to 1991-92)	3.54	9.88	9.56E-10
Sub period- III(1992-93 to 2005-06)	1.82	9.67	1.42E-09
Sub period- IV(2007-08 to 2009-10)	-0.91	-0.57	0.5698

Difference between Sub periods growth rates(WEST BENGAL)			
Difference	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Difference between Sub period-I & II	16.7	6.62	9.38E07
Difference between Sub period-II &III	-1.72	-3.49	0.00195
Difference between Sub period-III &IV	-2.73	-1.71	0.09955

ALL- INDIA			
TIME-PERIODS	**GROWTH RATES (%)**	***T-VALUE***	***P-VALUE***
Full period (1980-81 to 2009-10)	2.05	18.02	6.09E-17
Sub period- I(1980-81 to 1982-83)	0.58	0.19	0.843
Sub period- II(1984-85 to 1991-92)	3.38	8.07	3.68E-08
Sub period- III(1992-93 to 2005-06)	1.36	6.20	2.48E-06
Sub period- IV(2007-08 to 2009-10**)**	**1.01**	**0.55**	**0.5873**

Difference between Sub periods growth rates(ALL INDIA)			
Difference	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Difference between Sub period-I & II	2.80	0.94	0.352
Difference between Sub period-II &III	-2.02	-3.50	0.0019
Difference between Sub period-III &IV	-0.34	-0.18	0.8530

Table-3: Growth of productivity of total foodgrain for the state of West Bengal and all India according to optimum breaks found in all India

WEST BENGAL			
TIME-PERIODS	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Full period (1980-81 to 2009-10)	2.59	13.49	8.95E-14
Sub period- I (1980-81 to 1987-88)	4.99	4.56	0.00013
Sub period- II(1989-90 to 2001-02)	1.97	4.19	0.00034
Sub period- III(2003-04 to 2008-09)	1.03	0.77	0.44877
Difference between Sub periods growth rates(WEST BENGAL)			
Difference	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Difference between Sub period-I & II	-3.02	-2.53	0.18305
Difference between Sub period-II &III	-0.94	-0.66	0.5142
ALL INDIA			
TIME-PERIODS	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Full period (1980-81 to 2009-10)	2.05	18.02	6.09E-17
Sub period- I (1980-81 to 1987-88)	2.10	4.66	0.00180
Sub period- II(1989-90 to 2001-02)	1.98	10.21	5.15E-10
Sub period- III(2003-04 to 2008-09)	3.08	5.56	1.16E-09
Difference between Sub periods growth rates(ALL INDIA)			
Difference	GROWTH RATES (%)	***T-VALUE***	*P-VALUE*
Difference between Sub period-I & II	-0.12	-0.25	0.80
Difference between Sub period-II &III	1.09	1.87	0.0739

Now if we take some recent years (sub period-IV), it is observed that the growth rate of productivity of total food grain was decreased in compared to the sub period - III, not only decreased but it was negative also, although this negative growth rate was not significant, when we consider all India level, it is obvious that the growth of productivity was decreased but not negative. Thus, in the recent years the growth

rate of productivity of total food grain in the state of West Bengal decreased more than proportionately than the all India.

Therefore, for the whole period, the productivity of total food grain grew at 2.59 percent but it has to be noted that in the different sub periods the growth rate of productivity of total food grain was not stable for the state of West Bengal.

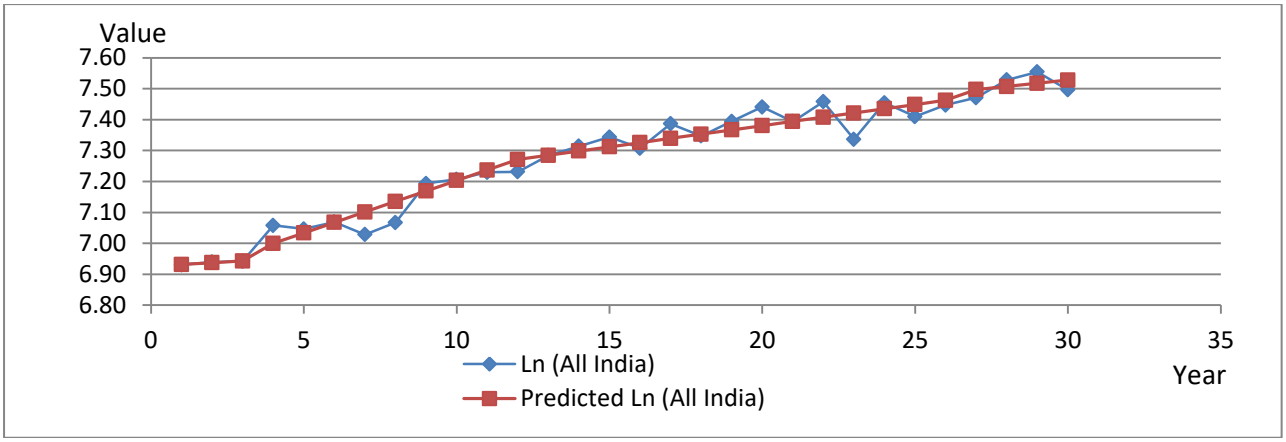

Fig 2a: Growth of productivity of total foodgrain for all India according to optimum breaks found in West Bengal

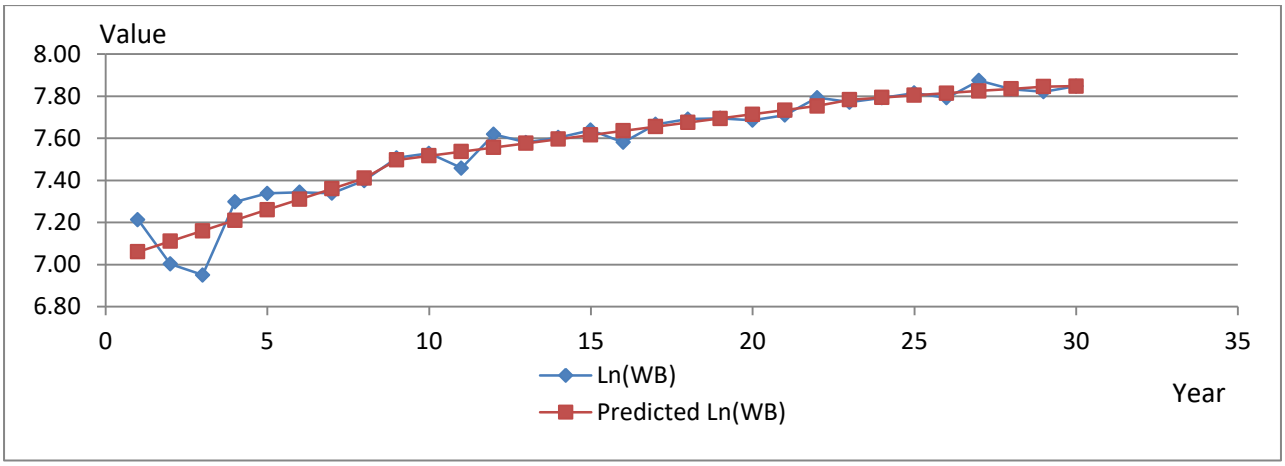

Fig 2b: Growth of productivity of total foodgrain for all India according to optimum breaks found in all India

In case of all India (Table-3, the growth rate of productivity of total food grain was 2.05 percent in the whole period, whereas in the state of West Bengal it was 2.59 percent. It is observed that for the sub period-I, the growth rate of productivity of total food grain was 2.10 percent and it was significant and it must be noted that in the state of West Bengal in this phase, the growth rate (4.99percent) was much higher than all India level. Thus, in the pre liberalization period high growth rate observed in case of West Bengal compared to the all India level. In case of sub period-II, the growth rate of productivity of total food grain was significantly decreased compared to the first sub period but the difference between two sub periods growth rate was not significant. Therefore after the adoption of new liberalization policy the growth rate of productivity of total food grain was significantly decreased in case of all India as well as in the state of West Bengal but it is noticeable that, in the state of West Bengal growth rate decreased more than proportionately than all India level. Now if we take some recent years, say 2003-04 to 2009-10, it is observed that the growth rate of productivity highly increased in all India level although the difference between two sub period (sub period-II & sub period-III) growth rate was not significant. In the state of West Bengal it has to be found that, in the recent years' growth rate of productivity marginally decreased although this fall was not significant.

Table-4: Nature and extent of fluctuation of productivity of total foodgrain for the state of West Bengal vis-à-vis all India according to optimum breaks found in West Bengal

WEST-BENGAL

Periods	Year to year fluctuation	Fluctuation from trend	Length of Cycle
Full period (1980-81 to 2009-10)	0.0060	0.0116	7.64
Sub period- I(1980-81 to 1982-83)	0.0056	0.0053	1.78
Sub period- II(1984-85 to 1991-92)	0.0044	0.0058	3.42
Sub period- III(1992-93 to 2005-06)	0.0026	0.0031	3.00
Sub period- IV(2005-06 to 2009-10)	0.0018	0.0021	2.75
ALL INDIA			
Periods	**Year to year fluctuation**	**Fluctuation from trend**	**Length of Cycle**
Full period (1980-81 to 2009-10)	0.0038	0.0072	7.24
Sub period- I(1980-81 to 1982-83)	0.0002	0.0002	1.78
Sub period- II(1984-85 to 1991-92)	0.0032	0.0049	4.67
Sub period- III(1992-93 to 2005-06)	0.0042	0.0051	2.95
Sub period- IV(2005-06 to 2009-10)	0.0032	0.0039	2.87

The fluctuation of productivity of total foodgrain as measured by the fluctuation from trend, it is observed that for the state of West Bengal (Table-4), fluctuation of productivity from the growth path of total foodgrain for the whole period (1980-81 to 2009-10) amounts to 1.16 per cent of mean. For the sub period-II, it is observed that fluctuation from trend of the productivity of total foodgrain was increased but year to year fluctuation was decreased compared to the first sub period. Due to this reason length of cyclical fluctuation has comparatively decreased than the first sub period. In case of sub period-III, it has to be noted that fluctuation from trend and as well as year to year fluctuation both decreased but fluctuation from trend decreased more than proportionately than year to year fluctuation for this reason length of cyclical fluctuation had decreased and it has to be also noted that percentage of year to year fluctuation in the fluctuation from trend was near about 80 percent and rest 20 percent fluctuation was arisen due to break in trend and cyclical fluctuation or irregular fluctuation for the state of West Bengal. Thus, after the adoption of 1991 new liberalization policy, length of cyclical fluctuation of productivity of total food grain had marginally increased, compared to the pre reform period. Now in case of sub period for the state of West Bengal, it is observed that fluctuation from trend as well as year to year fluctuation was decreased but fluctuation from trend was decreased more than proportionately than year to year fluctuation. Because of this reason again the length of cyclical fluctuation was increased and it is also observed that percentage of year to year fluctuation in the fluctuation from trend was near about 85 percent for the state of West Bengal.

Table-5: Nature and extent of fluctuation of productivity of total foodgrain for all India vis-à-vis West Bengal according to optimum breaks found in all India

ALL INDIA			
Periods	**Year to year fluctuation**	**Fluctuation from trend**	**Length of Cycle**
Full period (1980-81 to 2009-10)	0.0038	0.0072	7.24
Sub period- I (1980-81 to 1987-88)	0.0033	0.0045	3.82
Sub period- II(1989-90 to 2001-02)	0.0027	0.0031	2.75
Sub period- III(2003-04 to 2009-10)	0.0037	0.0032	1.52
WEST BENGAL			
Periods	**Year to year fluctuation**	**Fluctuation from trend**	**Length of Cycle**
Full period (1980-81 to 2009-10)	0.0060	0.116	7.64
Sub period- I (1980-81 to 1987-88)	0.0107	0.015	3.93
Sub period- II(1989-90 to 2001-02)	0.0039	0.0047	2.91
Sub period- III(2003-04 to 2009-10)	0.0024	0.0029	2.95

Therefore, the valuable point is that, for the state of West Bengal, in the various sub periods the length of cycle of the productivity of total good grain was not similar. In the second sub period, the length of cyclical fluctuation of productivity was decreased in the larger extent but in the sub period-II & III it was

increased simultaneously. If we compare this with the all India level, it is observed that almost same picture shows in case of various sub periods of the all India level.

In case of all India (Table-5), for the whole period, the fluctuation from trend of productivity of total foodgrain amounts to 72 percent of mean productivity and percentage of year to year fluctuation in the fluctuation from trend was 52 percent and rest 48 percent was arisen due to partly break in trend and partly cyclical fluctuation or irregular fluctuation. In case of sub period-I, the fluctuation from trend of productivity of total foodgrain amounts to 45 percent of mean productivity and percentage of year to year fluctuation in the fluctuation from trend was near about 72 percent of the all India. For the sub period- II, it is observed that fluctuation from trend as well as year to year fluctuation both decreased but fluctuation from trend decreased more than proportionately than year to year fluctuation. Because of this reason length of cyclical fluctuation was increased compared to the previous period. Thus, after the adoption of 1991 new liberalization policy length of cyclical fluctuation of productivity of total foodgrain was increased than the pre liberalization period. Now, for the sub period-III, it is observed that fluctuation from trend as well as year to year fluctuation was increased but year to year fluctuation was increased more than proportionately than the fluctuation from trend due to this reason length of cyclical fluctuation again increased compared to the previous sub periods. Thus, in the recent few years (2003-04 to2009-10) length of cyclical fluctuation of productivity of total foodgrain was increased for the all India level.

Therefore, in case of all India, it is observed that the length of cyclical fluctuation of productivity of total foodgrain has decreased continuously in the sub periods I, II & III. Now if we compare this with the state of West Bengal it has to be noted that, the length of cyclical fluctuation of productivity has decreased in the second sub period compared to the first sub period but in the third sub period the length of cyclical fluctuation has marginally increased compared to the second sub period.

CONCLUSION

In the state of West Bengal, the growth rate of productivity of total foodgrain was 2.59 per cent for the whole period as compared to the all India figure of 2.05 per cent. For the state of West Bengal as well as all India the rate of growth of productivity of total foodgrain has significantly decreased after the adoption of new economic policy (1991) and it is also notable that in the recent years growth rate of productivity of total foodgrain has decreased further for the state of West Bengal although this fall is not significant, but in case of all India level, it is observed that in the recent years (2003-4 to 2009-10) growth rate of productivity of total foodgrain has significantly increased.

Fluctuation in productivity as measured by fluctuation from trend amounts to 1.16 per cent of mean for the state of West Bengal as compared to 0.72 per cent for all India. This fluctuation is partly due to break in trend, partly due to cyclical fluctuation, partly due to year to year fluctuation and the rest is due to irregular fluctuation. It is observed that, for the state of West Bengal and all India level after the adoption of new economic policy (1991) fluctuation from trend as well as year to year fluctuation of productivity of total foodgrain has decreased but fluctuation from trend decreased more than proportionately than the year to year fluctuation, so the length of cycle has increased. In recent years (2005-06 to 2009-10), it is observed that for the state of West Bengal fluctuation from trend as well as year to year fluctuation of productivity of total foodgrain decreased, but fluctuation from trend decreased more than proportionately than the year to year fluctuation. Thus, the length of cycle has increased, but in case of all India level, it is found that for recent years (2003-04 to 2009-10) both fluctuation from trend and year to year both have increased and the length of cycle has also increased. It has to be noted that from a minute analysis, after the adoption of new economic policy in India the length of cyclical fluctuation of productivity of total foodgrain has increased for the state of West Bengal as well as all India level.

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