FOOD GRAIN PRODUCTION IN INDIA – AN ANALYSIS OF TREND AND SEASONAL PATTERN DURING THE POST-GREEN REVOLUTION PERIOD

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Introduction

Food grains comprising of cereals, millets and pulses, form the primary and staple food of majority of the population in India. Food grain production in India increased from a low level of 72 million tonnes (1965-66) to 152 million tonnes (1983-84) and touched a peak of 209 million tonnes (1999-2000). Thus it took 18 years to double and another 16 years to treble the production. This increase has put the country from a net food scarcity to food surplus status. In the recent past, favourable monsoons have enhanced the food grain buffer stocks to about 60 million tonnes. However, it is a great concern that due to lack of purchasing power a significant proportion of the Indian population is going hungry to the bed. From the producer's viewpoint, surplus production meant, inadequate market opportunities and discouragement for further continuance of such crops.

The substantial increases in production have been made possible due to technological innovations in terms of varieties, enhanced irrigation capabilities and better infrastructure. Given the variety of agro-climatic situations across the country and weather abnormalities in the long run, one would be tempted to analyse the trend and the seasonal pattern of food grain production in terms of changes in the area, productivity and production as such. These changes may present a clue for policy analysis like incentives to farmers for anchoring to food grain area. Hence, the present paper attempts to analyse the trend and seasonal pattern of food grain area, productivity and production in India at the aggregate level in the past 35 years.

Methodology

Data on area, productivity (per ha) and production of food grains- both season-wise (kharif and rabi) and annual for the period 1966-67 to 2000-01 were

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collected from the web site of the Ministry of Agriculture and Co-operation, Government of India. Trend curves were fitted for the total area, productivity and production of food grains. Based on the trend type, whether linear or logarithmic or polynomial, projections for a further period of 15 years i.e. up to 2015-16 were made. The growth in production was further analysed, using the decomposition technique into area effect, yield effect and interaction effect. The changes in the seasonal area and production were analysed by relative percentages, while the productivity changes were compared in terms of growth rates and percentage changes. The moving averages of the data at three-year interval were also estimated for the area, productivity and production.

Results and Discussion

The results of the analysis are presented in four sections viz. trend, decomposition of growth, seasonal pattern and forecasts.

Trend

The trend of the time series data for the total food grain crop area, productivity of food grain crops and total food grain production over the period 1966-67 to 2000-01 was estimated. The type of curve was decided based on the value of coefficient of multiple determination (R^2). Thus for the total area under food grains, polynomial function with a degree of two was found to be the best fit, while for the total productivity and production, linear function was appropriate. The trend curves are given in figures-1, 2 and 3. The linear trends in respect of productivity and production are purely in the long run. However, in the short run, say 2-3 years, both the productivity and production will be increasing and decreasing due to various reasons. Hence, the real changes in the trend could be noted in the moving averages. The three-year moving averages for the total area, productivity and production are given in Table-1.

The three-year moving average for the food crop area slightly decreased up to 1981-82 but declined subsequently. Whereas, the productivity increased from 736 Kg/ha (1966-67) to 1598 Kg/ha (2000-01), an increase of more than 117 per cent in 35 years. Consequently, the total food grain production increased by 125 per cent in the reference period.

Table-1: Three-Year Moving averages of Food Grain Area, Productivity and Production

3-year period	Total area (million ha)	Productivity (Kg/ha)	Total production (million tonnes)
1966-67/68-69	119.05	736.00	87.76
1969-70/71-72	123.50	845.00	104.36
1972-73/74-75	122.30	821.33	100.51
1975-76/77-78	126.69	943.00	119.54
1978-79/80-81	126.96	973.67	123.73
1981-82/83-84	128.47	1076.33	138.40
1984-85/86-87	127.30	1150.67	146.47
1987-88/89-90	124.71	1284.33	160.44
1990-91/92-93	124.29	1406.33	174.75
1993-94/95-96	122.54	1512.67	185.39
1996-97/98-99	124.20	1597.67	198.44

Decomposition of Growth

The growth in food production obviously comes from area growth and yield growth. There will be contribution from the interaction effect also. This decomposition can be modelled as follows:

$^{a}P = A_0 . {}^{a}Y + Y_0 . {}^{a}A + {}^{a}A \, {}^{a}Y$

(change in Production) (yield effect) (area effect) (interaction effect)

Where-

^{a}P : Change in production between two points of time (t_1-t_0)

A_0 : Base year yield

Y_0 : Base year yield

^{a}A : Change in area between two points of time (t_1-t_0)

^{a}Y : Change in Yield between two points of time (t_1-t_0)

The changes in production for certain intervals were decomposed using the above model. The results of such an analysis are given in Table-2. It may be noted that the highest incremental production was recorded in the green

revolution period, followed by the decade 1981-82 to 1990-91. The yield effect was significantly higher through out the reference period, while the area effect decreased from 17.02 per cent to –10.76 per cent. Interaction effect was positive only during 1966-67 to 1980-81. Due to negative effect of area from 1981-82 onwards, the gains in productivity were slightly offset and impacted the total production.

Table-2: Decomposition of Food Grain Production Changes

(in million tonnes)

Period	Incremental Production	Yield Effect	Area Effect	Interaction Effect
1966-67 to 70-71	34.19	26.31	5.82	2.06
	(100.00)	(76.95)	(17.02)	(6.03)
1971-72 to 80-81	24.42	20.27	3.48	0.67
	(100.00)	(83.01)	(14.25)	(2.74)
1981-82 to 90-81	43.09	44.88	-1.34	-0.45
	(100.00)	(104.15)	(-3.11)	(-1.04)
1991-92 to 2000-01	27.69	31.22	-2.98	-0.55
	(100.00)	(112.75)	(-10.76)	(-1.99)

N.B.: Figures in parentheses indicate percentages to total

Seasonal Pattern

The share of area and production of food grains in the country by seasons at different points of time during the past three and half decades is given in Table-3. It may be seen that both the area and production from Kharif season have reduced over the study period 1966-67 to 2000-01. The decrease in the area was 5 per cent compared to 13 per cent in case of production. Obviously the loss in Kharif season's share was due to increase in rabi area and productivity. The relative proportion of food grains production, which was more favoured towards Kharif at 2:1 in 1966-67, was approaching towards 1:1 by 2000-01. This meant the greater reliance on rainfed food grains production is giving way to sustainable rain (water) harvest production. The increase in rabi contribution to the food grains kitty may further be analysed through, the changes in seasonal food grain crop productivity (Table-4).

Table-4: Food Grain Crops' Productivity by Seasons (Kg/ha)

Year	Kharif	Rabi	Pooled
1966-67	625	683	644
1970-71	837	941	872
1980-81	933	1195	1023
1990-91	1231	1635	1380
2000-01	1371	2088	1638

The overall productivity of food grain crops has increased from 644 kg/ha (1966-67) to 1638 kg/ha (2000-01). This amounts to an increase of 154 per cent. The productivity increase across seasons was higher in case of rabi at 206 per cent compared to about 119 per cent for Kharif food grain crops.

Forecasting

Kumar and Mathur (1996) and Kumar (1997) adopted the compound growth rate and total factor productivity approach and forecast the supply of food grains in the country. The former study projected a food grains supply of 243.2 million tonnes from 120.80 million ha of area for 2006-07. Whereas, the latter reported that the food grain supply would be 271.3 million tonnes in 2010. In another study, Goel (2000) projected a food grains supply of 270 million tonnes by 2011. The present study employed the trend method, which is basically slope of the trend (curve), and forecast the area, productivity and production of food grains in India for the next 15 years. The figures for different points of time are presented in the Table-5. The trend of forecast may also be noted from the figures 1-3.

Table-5: Forecasts of Food Grain Area, Productivity and Production

Year	Area (million ha)	Productivity (kg/ha)	Production (million tones)
2001-02	119.43	1682	209.00
2005-06	115.60	1780	223.55
2010-11	109.68	1947	241.73
2015-16	102.53	2093	259.91

The forecasts are conservative as compared to that of similar studies quoted in the paper. It is also likely that after a few years, the productivity will reach a plateau due to limitations of land and technological capabilities, which will limit the production consequently. The decreasing trend in case of food grain crop area may be due to replacement by the commercial crop, as indicated by the quadratic trend of the area under food grain crops (figure-1).

Conclusions

The trend analysis indicated that the area under food grains slightly increased in the long run and started declining from 1987-88 onwards. This is justified since the farmers could offset the area loss by increased yields to a large extent. However, the use of food grain area for other crops is not likely to come back due to better remuneration from such crops. This will be a concern in the future, as the decrease in food crop area reaches unmanageable proportions. The shift in greater burden of production from kharif towards equal contribution from both kharif and rabi is good for two reasons viz. spread of risks of production as also scope of uniform employment for the farm families and the agricultural labour. The unfavourable terms of trade of farmers for food grains in terms of disproportionate increase in input prices and more or less stagnant output prices will gradually discourage farmers to allocate increased areas under food grain crops. Further, deliberate policy efforts are required to reduce the huge buffer stocks of food grains, which propel the demand and consequently supply from the farmers.

References

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Fig-1:Total Area under Food Grains

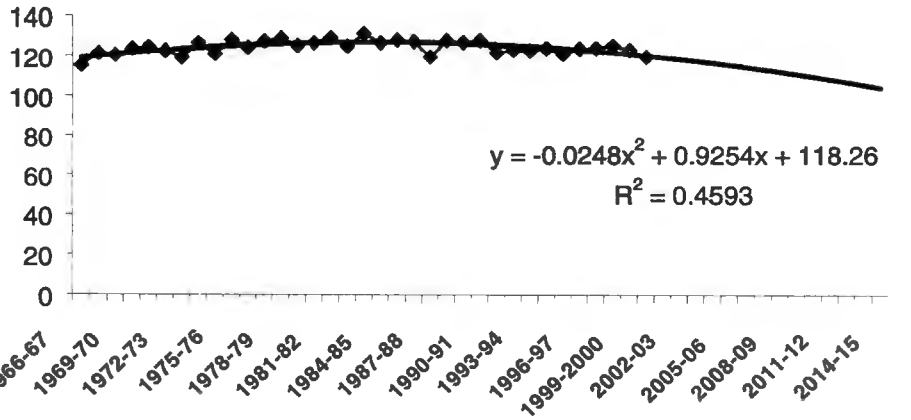

Fig-2:Total Productivity of Food Grains

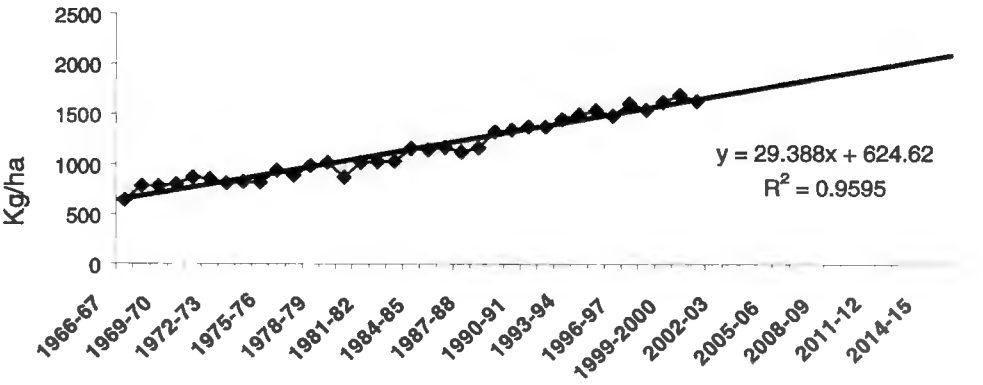

Fig-3:Total Food Grain Production