A Study of the Impact of Production Variables on Indian Food Grains Productivity

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Abstract

Agriculture plays an essential role in the process of economic development of less developed countries like India. Besides providing food to nation, agriculture releases labour, provides saving, contributes to market of industrial goods and earns foreign exchange. In India, agriculture was the main source of national income and occupation at the time of Independence. Agricultural sector occupies a key position in the Indian economy, mainly because of three reasons. First, agriculture constitutes largest share of country's national income though the share has declined from 55 percent in early 1950s to about 14.6 percent by the turn of the century. Second, more than half of India's work force is employed in agriculture sector. Third, growth of other sectors and overall economy depends on performance of agriculture to a considerable extent. Because of these reasons agriculture continues to be the dominant sector in Indian Economy. Through this paper, we tried to study the determinants of various food grain productions in India. In order to find out the determinants of Indian food grains production in pre and post economic reforms, the study adopted the Ordinary Least Square (OLS) regression model.

Keywords: Agriculture; Productivity; Food Grains; Pre & Post Economic Reforms Period; OLS Model.

Introduction

Agricultural development treated as precursor to industrial development in nations across the world, passes through distinct but relatively definite phases of modernization. It is always worthwhile to understand these phases and their prime features so as to learn from the experiences of the nations which have successfully passed these phases and the strategies adopted to do away with the complications, tackle the challenges and exploit. Agricultural development in nations passes through the following phases.

Traditional Agricultural

This is the primary and the most backward state of development of agriculture, which exists where the nation is in primary state of development. In this phase, technique of production is not just obsolete, it is even primitive and labour intensive.

Technologically Dynamic Agriculture – Low Capital Technology

In this phase, agricultural remains the main stay of the population with still more than 60 percent of the population depending on it for their

livelihood, agriculture also contributes more than between one –third and one half of the national income through its contribution consistently falls in this phases capital for industrial development is particularly scarce and returns are rising. Unfavorable labour –capital cost relationship rules out the possibility of increased use of labour saving mechanization in agriculture. The most distinguishing features of the second phases is the constant generation and application of technology.

Technologically Dynamic Agriculture – High Capital Technology

This is the most advanced phase of agricultural that exists in mostly the advanced nations. The significance of agricultural sector in terms of the dependence of the population on it as source of livelihood and contribution to national incomes goes down and the secondary and tertiary sectors of the Food grains production occupies the most dominant position in India's agriculture, covering over 65 per cent of the gross cropped area. Since the beginning of the green revolution in the mid sixties, the country has shown impressive growth in food grains production. Just after independence, there was enough brought for increasing production of food grains through expansion of the cultivated area.

In this study, we mainly concentrated on Rice, Wheat, Coarse cereals and Pulses because India contribute major share in these types of food grains in the world. As India's food security vitally depends upon wheat and rice production. Rice, which is the predominant food grain crop in India, is extensively cultivated in almost all parts of the country. In India, rice cultivation has a long history marked by a series of technological break-through and has the largest area under rice in the world. India ranks second next to china and the country contributes nearly 22 percent of the global rice production. The principal rice producing states in India are West Bengal, Uttar Pradesh and Punjab. Rice, India's preeminent crop is the staple food of the people of the eastern and southern parts of the country. In context of wheat, in which India holds the second position among the wheat producing countries of the world, next to China. Uttar Pradesh, Punjab, Haryana and Madhya Pradesh are the major wheat producing states in India. Coarse cereals are a group of six cereals, namely jawar, Bajra, maize, ragi, barley and millets. In the production of coarse cereals, India holds the sixth position in the world next to US, China, Brazil, the Russian Federation and France. In India, coarse cereals are grown mainly in the rain fed areas where the coverage of irrigation is only about 12 per cent. In context of Pulses production, India ranks first in the world. The leading producer states of pulses in the country are Madhya Pradesh, Uttar Pradesh and Rajasthan. Sorghum and millet, the principal coarse grains, are dry land crops most frequently grown as staples in central and western India. Corn and barley are staple foods grown mainly near and in the Himalayan region. As the result of increased yields, the production of coarse grains has doubled since 1950; there was hardly any change in the area sown for these grains. Pulses are an important source of protein in the vegetarian diet; the small improvement in production along with the increase in population meant a reduced availability of pulses per capita. Before the Green Revolution, coarse grains showed satisfactory rates of growth but afterward lost cultivated areas to wheat and rice, and their growth declined.

An Introduction to Food grains Production under Different Phases

Agricultural sector of India has passed thorough different stages of development. A comprehensive analysis of the process and stages demands great dedication and time from any researcher. The present study seeks to discuss the food grains production trends in Indian agriculture in the post independence era that too in the planning period starting from 1951-52. This is done as it was during this period that a transformation from the first stages i.e. the stages of traditional agriculture' to the second stage i.e. 'technologically dynamic agriculture' took place and the planning process in the country started that aimed at planned and rapid development of the agricultural sector. It was only after the attainment of independence and launching of economic planning in India that facing the food crisis and the constant need to import food grains to meet domestic demand the Government of India launched programme for rapid development of agriculture and in different plan period adopted policies and strategies to boost agricultural production and regulate agricultural prices. The performance of food grains was particularly dismal with the modest growth in area under food grains, the performance of was almost Malthusian in its mechanism with population pressing against land performance responding with diminishing returns. The present study divides the entire period after the launch of economic planning in the country i.e. a period of more than 58 years into two broad phases:

- The first phase that existed prior to the launch of economic reforms in (1951-52 to 1990-91)
- The second phase that came into being after the launch of economic reforms (1991-92 to 2009-10).

Review of Literature

Hanumantha Rao (1968) in his study stated that inputs like fertilizers and improved seeds if used under the conditions of assured irrigation may promote growth with stability, but if used under the conditions of uncertain rainfall may increase the range of fluctuations in output with growth. Since jowar, bajra and almost all the pulses crops are grown on marginal lands under rain fed conditions; these crops

have shown very high degree of instability/fluctuation in output with positive and high growth. Thus, the above statement undoubtedly holds good for Maharashtra. Kahlan, A. S. and Bal, H.K. (1977) in their study implemented cobb-douglas production functions at all India level for two periods representing pre green revolution periods (1960-61 to 1964-65) and the post-Green Revolution periods (1967-68 to 1972-73) to compare factor shares. They took the value of agricultural production as dependent variables and net sown area, proportion of irrigated area, tractors, bullock labour, human labour, fertilizers, and rainfall as explanatory variables. Their study concludes that the highest contribution is made by human labour followed by the net sown area in both periods. The shares of fertilizes however increased from 7.20 percent in period first to 15.56 percent period second while labour shares declined from 48.55 percent to 46.03 percent. Singh and Singh (1991) in their study measured the changes in cropping pattern and production pattern in Haryana agriculture between1966-89 based on secondary data. The study reveals that the area under rice and wheat has been increasing at the rate of 9.29 percent and 6.34 percent respectively during the 1966-67 to 1988-89. The area under food grains like Jowar, Bajra, Maize, Barley and the area under important pulses crops has been increasing at the rate of 11.60% per annum during this period. The total production of Jowar, Maize, Barley gram and the other pulses crops has been declining. According to Ministry of Agriculture (2000) report, fertilizer, quality seeds, and better land preparation can raise cereal yields by about 85 percent; the maximum would be for pearl millet (127 percent) and the minimum for barley (32 percent). Potential increases for sorghum and wheat can reach 100 percent. Sinha and Kumar (2003) in a study related to the impact of agricultural price policy on production, productivity and cropping pattern in the state of Bihar pointed out that the analysis of production and productivity in sample districts shows that the yield of important crops is distressingly low and below the national average with few exceptions. The study also reveals that the area under paddy, wheat, pulses and oil seeds increased but it has declined in case of maize and jute crops. Besides, the rate of crop diversification is merging. This does not indicate an encouraging trend and in this relation the authors' addresses some policy measures which broadly suggest conversation of price policy into an approach for integration of production and distribution objectives. Mathur and Das (2006) studied the determinants of agricultural growth at all India level for the period 1990-91 to 2003-04. They suggested that the government investment in agriculture, subsidy, agriculture prices and usage of electricity are the significant factors that decide flows of production of Indian agriculture. Tupe and Kamat (2010) discussed the determinants of agricultural gross domestic production for the pre and post economic reforms period stated that institutional credit sources, consumption of fertilizer and net sown area are major determinants of AGDP (Agricultural gross domestic production) for the, the pre-reforms period, India's membership of WTO is the significant determinants of AGDP in the post reforms periods. This study also reveals that the Indian agriculture sector witness decreasing return's to scale phase during the seventies, eighties and nineties and there is need to increase the abundant and continuous flow of inputs so that the problems such as food security, poverty reduction, unemployment, and increasing price level of food grains can be minimized.

Objective of the study

The main objective of this study is to accentuate the impact of production variables (inputs) on food grains production growth in India.

Research Methodology

The present study is based on time series data (1951-52 to 2009-10) on production, area, and yield of food grains production such as, rice, wheat, coarse cereals and pulses, available on the website of handbook of RBI, source of Ministry of Agriculture. The total time period is classified into three decade, namely pre-green revolution period (1951-52 to 1965-66), green revolution period (1966-67 to 1979-80), the maturing period of green revolution period (1980-81 to 1990-91) and post reforms period (1991-92 to 2009-10). In order to satisfy the above objective, the study employs simple descriptive as well as some econometric techniques. The study uses simple ordinary least square technique in order to find out the determinants of Indian food grains production in pre and post economic reforms.

The study adopts the following model:

$Y=\beta_0+\beta_1 \log X_1+ \beta 2 \log X_2+ \beta_3 \log X_3+U$…….. (1)

Where, Y is the log of Agricultural GDP

X_1 is the log of net sown areas

X_2 is the log Net Irrigated area

X_3 is the log Consumption of Fertilizer

Here, researcher used the Cobb-Douglas production function to find out the determinants of Indian Food grains production.

$$Y = \beta_0 X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3}$$

$\text{Log}Y= \log \beta_0+ \beta_1 \log X_1+ \beta_2 \log X_2+ \beta_3 \log X_3$

$\beta_1+ \beta_2+ \beta_3$ (sum of the coefficients shows the returns to scale)

Data A

nalysis and Interpretation

In this section, an attempt has been made by researcher to accentuate the impact of production variables (inputs) on food grains production growth. In India, inputs use in agriculture has been increasing since green revolution in the late sixties with increasing use of high yielding seeds, synthetic fertilizers and extent of irrigation, mechanical power and electricity in farm operations. The pattern and the rate of growth of demand for major factors of production is influenced by a number of factors such as increasing population, growing urbanization, using household income, changing life styles and structural changes taking place in the economy. New agricultural technology demanding higher input use in the forms of seed (high yielding varieties), fertilizers irrigation, electricity, tractor power tiller plus diesel engine plus electric motor) for crop production and post-harvest operations which are increasing in India over time period to achieve higher productivity and processing of increasing volumes of agricultural produces. The time series data in the study were obtained from various published sources. Here, Cobb Douglas production function was used to analyze the efficiency of various factors of production.

In this study, we took three main inputs of food grains production. These were net sown area, net irrigated area and consumption of fertilizers. Net Area Sown represents the total area sown with crops and orchards. Area has sown more than once in the same year is counted only once. Net Irrigated Area is the area irrigated through any source once in a year for a particular crop. Consumption of fertilizers is a key input of agriculture as they provide additional nitrogen, phosphorus and potassium to the crops. Use of fertilizers remains one of the principal determinants of crop yield. Modern agriculture largely depends on the use of fertilizers. The nitrogen (N), phosphorus (P), and potassium (k) fertilizers consumption in India has increased from 0.05 (million tonnes) in 1963-64 to 18.1 (million tonnes) 2007-08. India has been the third largest consumers of fertilizers (Pasricha and Singh, 2005).

This sections aims at analyzing the impact of production variables (inputs) on agricultural output growth in Indian agriculture from 1951-51 to 2007-08. For this purpose, we used Cobb Douglas production function methodology in order to find out the determinants of Indian Food grains Production Gross for the pre and post economic reforms. All variables values are converted into natural log before running the regression. This model is linear in the parameter $\beta 0$, $\beta 1$, $\beta 2$, and $\beta 3$. Therefore it is a linear regression model and all parameters are the respective elasticity's. The sign of parameters show the relationship between inputs and total production. This model is also known as linear model. The parameters of model give information about the returns to scale. The sum of ($\beta 1$, $\beta 2$, $\beta 3$) coefficients give information about the returns to scale, which is the response of output to a proportionate change in output. The response of output to a proportionate change in the inputs is measured in this model. If this sum of these parameters becomes 1, then it is understood that there is constant returns to scale, and if the sum is found as greater than 1, then there is increasing returns to scale if the sum less than 1 then there is return to

Table: 1 Determinants of Agricultural Production in India
(Cobb Douglas Production Function Methodology)

Period Model	1951-52 TO 1965-66		1966- 67 TO 1979-80		1980-81 TO 1990-91		1991-92 TO 2007-08	
	Coefficient	T	Coefficient	T	Coefficient	t	Coefficient	t
β_0	**-196.20***	-4.094	**-496.042***	-3.673	-125.519	-1339	**-258.34***	-2.165
β_1	**1.951***	2.628	**3.734***	3.837	**1.877***	3.553	1.831	1.942
β_2	.711	.213	2.139	1.749	-1.435	-.502	3.213	1.436
β_3	-1.259	-.830	-2.28	-.453	.836	2.427	.113	.417
R^2	.861		.935		.965		.915	
$\overline{R}^2$	.82		.836		.948		.838	
F	22.66		23.011		55.956		22.356	
SE	4.168		5.94		3.70079		7.50246	
Phase	IRS		IRS		IRS		IRS	

Notes: * shows that 5 Percent Significance of Level, Dependent variable Y, Independent variable β_1, β_2, β_3

Phases: IRS= Increasing Returns to Scale, CRS= Constant Returns to Scale, NRS= Negative Returns to Scale.

Model (1) (1950-51 to 1965-66) used only three variables for measuring the production because as we stated that we could not get complete data on the remaining variables. The results appeared from the model (1), point out that net sown area and irrigated area shows positive impact on the agricultural production. However, the impact of the consumption of the fertilizers has negative impact on the growth of agricultural production. The R2 value of the model 0.86, which can be concluded as about 86 percent it, means that the variation in growth of food grains production is explained by above variables. This model also shows that Indian agricultural had witnessed increasing return to scale for the period (1951-52 to 1965-66).

Model (2) (1966-67 to 1979-80) reveals that the net sown area and net irrigated area exhibits positive sign of elasticity, but none of the variables is significant expect the variable net sown area, which shows positive significance elasticity. However, the consumption of fertilizers shows negative elasticity the r value 0.93, which can be concluded as about 93 percent variation in the growth of agricultural production is explained by the above three variables .

Model (3) (1980-81 to 1990-91) shows that net sown area and consumption of fertilizers shows positive effect on the growth of agricultural production but only net sown area, which shows positive significant elasticity. The net irrigated area shows negative elasticity. The value of r is 0.96, which shows that the variation in agricultural production is explained by these variables. The model designed to examine the association between input and output before the ten years of liberalization policy that were introduced in 1991. The result of this model shows that Indian agriculture sector has witnessed the increasing return to scale of production the findings of the model match with the conclusion drown by the earlier studies conducted during the period of eighties.

Model (4) (1990-91 to 2007-08) shows that the variables net shown area and irrigated area and consumption of fertilizers shows positive effect on the growth of food grains production but, they are not statistically significant. Findings emerged from this model can be interpreted as Indian agricultural sector has witnessed decreasing returns to scales stage of production after the introduction of new economic reform and India's joining as member of WTO. This was mainly due to the government of India has reduced the subsidy support given agriculture in the move of reducing public expenditure under the pressure of WTO. Banking reforms have also forced the banks to collect old dept for reducing their NPA and sanction new credit to farmers on selective basis.

It is clear from the above discussion that the model (1), (2), (3) and model (4) show the increasing return to scale since independence. It can be also shown in the table that the net sown area have positive impact in model (1), (2) and model (3) and statistically significant while net irrigated area have positive impact on food grains production in three phases but not statistically significant. Consumption of fertilizers have negative impact on the growth of food grains production in model (1) and (2) and positive impact on third and fourth model but not statistically significant. These models also show that the Indian agriculture had witnessed increasing return to scale which infers that net irrigated area, net sown area and consumption of fertilizers are very vital input for food grains production. In order to maintain this level in future due consideration should be given to these inputs.

Conclusion

In this study, we examined the impact of three agricultural inputs (Net sown area, Net irrigated area and consumption of fertilizers) on food grains production in the four phases i.e. [1951-52 to 1965-66 (Pre-green revolution phase), 1966-67 to 1979-80 (Green revolution phase), 1980-81 to 1990-91(Post- green revolution phase), 1991-1992 to 2007-08 (Post economic reforms phase)]. Results in this context deciphers that, in all the four phases food grains production have increasing return to scale because net sown area, net irrigated area are very vital input for food grains production. At last, it can be stated increasing in growth rate of production was only due to increase in the growth rate of yield. It seems that the agricultural pricing policy, especially after economic reforms, by ensuring the remunerative prices to the farmers and supplying the significant amount of inputs, especially fertilizers at the subsidized prices, has been the most important factor to promote the farmers to increase the production of agricultural crops.

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