Guru Arjan Dev Institute of Development Studies

Are Disparities in Indian Agriculture Growing?

Status, Constraints and Determinants

Dr Gursharan Singh Kainth and Dr Rajinder Singh Bawa

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STATUS, CONSTRAINTS AND POLICY IMPLICATIONS

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Preface

India is a global agricultural powerhouse. It is the world's largest producer of milk, pulses, and spices, and has the world's largest cattle herd (buffaloes), as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, farmed fish, sheep & goat meat, fruit, vegetables and tea. The country has some 195 m ha under cultivation of which some 63 per cent are rainfed (roughly 125m ha) while 37 per cent are irrigated (70m ha). In addition, forests cover some 65m ha of India's land. While agriculture's share in India's economy has progressively declined to less than 15 per cent due to the high growth rates of the industrial and services sectors, the sector's importance in India's economic and social fabric goes well beyond this indicator. First, nearly three-quarters of India's families depend on rural incomes. Second, the majority of India's poor (some 770 million people or about 70 per cent) are found in rural areas. And third, India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. To do so, a productive, competitive, diversified and sustainable agricultural sector will need to emerge at an accelerated pace.

One of the major concerns is regional variations in the growth of food production. The overall growth in productivity at the national level can mask significant disparities between high- and low productive regions. For instance, if regional growth rates diverge over time owing to the uneven adoption of GR technology, then this new technology itself will become an important source of inter-regional variation in food production capacity. Significant changes in yield growth rates as well as production of food grain (rice and wheat) in the post-GR period (1969–1984) was due differences in the pattern of modern input use as the major source of regional disparity differences in agriculture and infrastructure were the largest source of regional inequality from the beginning of the GR period until first half of the 1990s. Total Factor Productivity (TFP) indices capture the effect of improvements in technology as well as investments in infrastructure such as irrigation, roads and electricity, in the form of research and development. Higher TFP is desirable as it not only implies higher output from application of technology and better utilization of resources, but also leads to a reduction in poverty in rural areas. This is another major policy objective of the Indian government. On the other hand, differing rates of TFP growth among regions can also be responsible for persistent regional inequality. Therefore, from a policy perspective, it is important to examine the long-term trends in regional growth patterns of agricultural productivity and to take effective measures to correct any imbalances.

Authors

Executive Summary

Growth rates of State Domestic products from agriculture were high for many states during the 1990's. However, growth decelerated in all the states except Madhya Pradesh during the period 2000's. The deceleration is the highest in the states with greater proportion of rain-fed areas (Gujarat, Rajasthan, M.P., Karnataka and Maharashtra). Recent experience, however, shows that Gujarat recorded the highest growth of around 9 per cent during 2000/01 to 2007/08. During this period, six states viz., Gujarat, Rajasthan, Himachal Pradesh, Andhra Pradesh, Chhattisgarh and Bihar recoded more than 4 per cent growth per annum.

Public investment in infrastructure like irrigation, power, roads, watersheds, check dams, technology like BT cotton and diversification in agriculture played crucial roles in raising agricultural growth in Gujarat. Other states can learn from the experience of Gujarat. There is a need to shift rice cultivation to Eastern region from Punjab and Haryana for growth, equity and environment reasons. In order to encourage the States to invest more towards agriculture and allied sectors and to achieve 4 per cent growth in agriculture, the government launched the ***Rashtriya Krishi Vikas Yojana (RKVY)*** *in 2007-08 with an outlay of Rs.25, 000 crores for the 11th Five Year Plan. The scheme requires the States to prepare District agriculture plans and provides adequate flexibility and autonomy to State governments. The States should make use of this scheme to improve the agriculture sector.*

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ARE DISPARITIES IN INDIAN AGRICULTURE GROWING?

Indian agriculture is known for its diversity which is mainly the result of variations in resource endowments, climate, topography and historical, institutional and socio-economic factors. Policies followed in the country and nature of technology that became available over time has reinforced some of the variations resulting from natural factors. These regional variations have remained a subject of concern for couples of reasons. Large variations in productivity leads to regional disparities and is generally considered as discriminatory. It is against the democratic polity to leave some regions behind the other in making economic progress. Identification of various levels of productivity helps to analyze the reason for variations in performance and in developing location specific strategies for future growth and development. Variation in productivity also indicates scope to raise production and attain higher growth.

As a consequence, production performance of agriculture sector has followed an uneven path and large gaps have developed in productivity between different geographic locations across the country. These regional variations have remained a subject of concern for couple of reasons. Large variation in productivity leads to regional disparities and is generally considered as discriminatory. It is against the democratic policy to leave some regions behind other in making economic progress. Identification of various levels of productivity helps to analyze the reasons for variation in performance and in developing location specific strategies for future growth and development. Variation in productivity also indicates scope to raise production and attain growth.

Indian agriculture has witnessed tremendous changes during the last 3 decades following the adoption of green revolution technology during late 1960's. The green revolution technology was initially adopted on a large scale in the regions well endowed with irrigation. As this technology possessed vast potential for increase in productivity, it led to impressive growth in agricultural output in the regions where it was adopted. Because the spread of green revolution technology was highly skewed in favour of certain states and regions, this led to a high growth in agricultural output in selected regions while the other regions suffered from stagnancy or poor growth in agricultural output.

Consequently, the first decade following green revolution is believed to have increased interstate disparities in development and incomes. During the decade of 1980's efforts were made to spur agricultural growth in low productivity and stagnant states and regions. For this, special drives were launched to diffuse improved agricultural technology *in hitherto* under-developed states. New crop varieties, technologies and enterprises were developed for rainfed, dry-land and other ecological settings to improve agricultural productivity and income in such regions. Some studies have observed that these efforts have borne fruits and agricultural growth during the decade of 1990's has become broad based. It has been demonstrated based on specific crops or group of crops that agricultural growth has picked up in low productivity eastern states. Such indications have been used to create an impression that agriculturally underdeveloped states have progressed at a fast rate during 1980's and early 1990's which is further interpreted to infer that regional differences in agriculture income and productivity across states have narrowed down after initial phase of green revolution.

Though there has been some improvement in recent years, the conditions in agriculture have not changed much and are almost the same that they were about three decades back. The rate of soil exhaustion which takes place in the normal process of agriculture is not being replenished through natural and artificial methods. And there has been a fall or decline from the low level of fertility or productivity where it was believed to have stabilized. The fear of decline is greater now and is likely to be still more in future because in increasing production quickly, the possibilities are there of exploiting the land resources ignoring the ideas of natural balance and thus damaging or impairing its inherent productive capacity.

This study is an attempt to examine the interstate variations in agricultural productivity. However, conclusions about inter-state disparities in agricultural development based on single crop, group of crops or even crop sector can be misleading. There has been progressive diversification towards livestock production within agricultural sector which implies that exclusion of livestock sub sector while evaluating growth performance is not justifiable. Thus, interstate performance of agricultural sector should be analyzed based on state domestic product from the total agriculture.

II
The Research Method

The present study deals with determinants of interstate variations in productivity of Indian Agriculture. In this section, an attempt has been made to discuss briefly the nature of the study and also explains the various statistical methods applied to interpret the data connected with the empirical testing of the interstate variations in agriculture productivity.

Data Base

Agriculture Productivity was selected due to the fact that it is the most prosperous and productivity of the inter-state variation with the highest production. The nature of the problem suggested the use of primary data. The data on the volume of net domestic product by the origin of industry have been taken from the estimates brought out by the Economic and Statistical Organization of Government of India, Department of Agriculture & Cooperation and Ministry of Agriculture. The estimates available are in two series, both at current and constant prices. The first one called revised series was worked out on 1990's. The new series are built upon 2000's. In this study three revised series has been used because it will be more useful than the new series for showing the income distribution right from the base year 1990-91. The data relating to different parameters has been mainly taken from various issues of ***Economic Survey -*** *an annual publications of Ministry of Finance Government of India****; Hand Book of Indian Economy -*** *an annual publication of Reserve Bank of India****; Agricultural Statistics in India***- an annual publication of Department of Agriculture and Cooperation, Ministry of Agriculture Government of India and ***Statistical Abstract of Punjab -*** *an annual publication of Economic and Statistical Adviser, Government of Punjab*, ***National Income Statistical*** published by Centre for Monitoring Indian Economy (CMIE) Mumbai.

Choice of Period:

It is interesting to see how agricultural growth has contributed to growing gap between rich and poor states in the new economic era i.e. after 1990-91. The time frame of the study was, therefore, two decades spanning from 1990-91 through 2009-10. The choice of the period was dictated by the availability of complete and comparable data across different states of Indian Union. Three distinct phases has been identified as described below:

(i) Phase I: Period of wider dissemination (1990-91 to 1992-93)

(ii) Phase II: Post-Reform Period (2000-01 to 2002-03)

(iii) Phase III: Period of Recovery (2006-07 to 2009-10

Accordingly, we have examined the trend in agricultural productivity, output growth and regional divergence in per rural person and per hectare of Net state Domestic Product (NSDP) from agriculture during the period 1990-91 through 2009-10. Inter-state divergence was measured using a simple measure of coefficient of variation (CV).

The periods 1990-91 to 2009-10 have also been chosen to examine the growth performance and divided into two equal sub-periods: 1990-91 to 1999-2000 and 2000-01 to 2009-10. Trends for the entire period 1990-91 to 2009-10 were also studied. The classification also helps us to see the extent to which the agricultural sector was a constraining factor in the nineties as compared to twenties.

Statistical Tools:

Depending upon the nature of the data, various statistical techniques such as mean, standard deviation, variance, co-variance, coefficient of correlation, regression and factor analysis were applied. To test the level of significance, t-ratio, Z-ratio and F-ratio were worked out.

The arithmetic mean is written simply as ($\bar{X}$) and was computed by using the formula:

$$\bar{X} = \frac{\sum X}{N}$$

The limits of the summation were omitted. The summation was understood to extend over all available values of X.

The variance is written as

$$s^2 = \frac{\sum (X - \bar{X})^2}{N-1}$$

$$= \frac{\sum (X^2 - \bar{X}^2 - 2X\bar{X})^2}{N-1}$$

$$= \frac{\sum X^2 + N\bar{X}^2 - 2N\bar{X}^2}{N-1}$$

$$= \frac{\sum X^2 - N\bar{X}^2}{N-1}$$

In this derivation the summation of $\overline{X}^2$ over N is $N\overline{X}^2$; also the summation of $2X\overline{X}$ is $2\overline{X}\sum X = 2N\overline{X}^2$, since $EX = N\overline{X}$.

The standard deviation is given by

$$s = \sqrt{\frac{\sum X^2 - N\overline{X}^2}{N-1}}$$

Thus to calculate the standard deviation using this formula, we sum the squares of the original observations, subtract from this N times the square of the arithmetic mean, divide by N-1, and then take the square root. An alternative formula for the standard deviation which avoids the calculation of the arithmetic mean and is, therefore, useful for certain computational purposes is

$$s = \sqrt{\frac{N\sum X^2 - \left(\sum X\right)^2}{N(N-1)}}$$

This formula requires one operation of division only.

In situations where sets of observed and the theoretical frequencies are to be compared, Chi-square (X^2), is defined by

$$X^2 = \sum \frac{(0-E)^2}{E}$$

where 0 and E denote the observed the expected, or theoretical, frequencies respectively. Inspection of this definition shows that X^2 is a descriptive measure of the magnitude of the discrepancies between the observed and expected frequencies. The larger these discrepancies, the larger X^2 will tend to be. If no discrepancies exist, and the observed and expected frequencies are the same, X^2 will be 0. The value of X^2 in this definition is always 0 or a positive number. Negative values cannot occur.

Further, to test the difference in the average level of agricultural productivity, Z-statistics was used. Z value was calculated by using the formula

$$Z = \frac{\overline{x}_1 - \overline{x}_2}{\sqrt{\frac{6_1^{\,2}}{n_1} + \frac{6_2^{\,2}}{n_2}}}$$

When the sample was large (N>30), t-statistics was estimated

The t-statistics for comparison of two population means is similar to the procedure of using the Z-statistics for comparison of two population means.

Two additional elements are considered when using the t-test. These are:

- The number of degrees of freedom is the sum of the degrees of freedom for each sample. When n_1 is the sample size from population 1, and n_2 is the sample size from population 2, the number of degrees of freedom would be expressed as:

$$df = (n_1-1) + (n_2-1)$$
$$= (n_1 + n_2 -2)$$

- The two standard deviations S_1 and S_2 calculated from the two samples of size n_1 and n_2 respectively, are pooled together to form a single estimate (s_p) of the population standard deviation, where (s_p) is calculated as:

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}}$$

Then, the t-statistics is calculated by the following formula.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s^2{}_p\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

Where

x_1 = mean of the first sample

x_2 = mean of the second sample

n_1 = size of the first sample

n_2 = size of the second sample

sp = pooled estimate of population

This calculated t-statistics is compared with the critical t-score from the table in a given level of significance and (n_1+n_2-2) degrees of freedom and a decision is made whether to accept or reject a null hypothesis.

To examine the relationship between determinants of interstate variation in agricultural productivity, coefficient of correlation was computed using the formula.

$$r^2 = \frac{n\left(\sum XY\right) - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{n\left(\sum X\right)^2 - \left(\sum X\right)^2}\sqrt{n\left(\sum Y\right)^2 - \left(\sum Y\right)^2}}$$

Where,

n=Number of paired observations

$\sum XY$ =Summation of Individual products of values of X and Y.

$\sum X$ =Summation of the X variable

$\sum Y$ =Summation of the Y variable

$\sum X^2$ =The X variable is squared and then summed.

$(\sum X)^2$ =The X variable is summed and then squared.

$\sum Y^2$ =The Y variable is squared and then summed.

$(\sum Y)^2$ =This Y variable is summed and then squared.

The Coefficient of Determination r^2

The coefficient of determination (r^2), the square of the coefficient of correlation (r), is a more precise measure of the strength of the relationship between the two variables and lends itself to more precise interpretation because it can be presented as a proportion or as a percentage.

The coefficient of determination (r^2) can be defined as the proportion of the variation in the dependent variable Y that is explained by the variation in dependent variable X, in the regression model. In other words:

$$r^2 = \frac{Explained\ \ Variation}{Total\ Variation}$$

$$= \frac{\sum\left(Y_c - \bar{Y}\right)^2}{\sum\left(Y - \bar{Y}\right)^2}$$

$$= \frac{b_0 \sum Y + b_1 \sum XY - \frac{\left(\sum Y\right)^2}{n}}{\sum (Y)^2 - \frac{\left(\sum Y\right)^2}{n}}$$

For predicting the effect of various independent variables on the level of agricultural productivity, liner regression equation was estimated through ordinary least squares method

$$Js = b_0 + b_1 \times x_i$$

Where Js= level of agricultural productivity

and X_i= value of its independent variables

b_0 and b_1 are the two pieces of information called parameters which determine the position of the line completely. Parameter b_1 is known as the Y-intercept and parameter b_0 determines the slope of the regression line which is the change variables for each unit change in Y.

Following formula was used to estimate the value of b_0 and b_1

$$b_1 = \frac{n\left(\sum XY\right) - \left(\sum X\right)\left(\sum Y\right)}{n\left(\sum X^2\right) - \left(\sum X\right)^2}$$

$$\text{and; } b_0 = \frac{n\left(\sum Y\right) - \left(\sum X^2\right) - \left(\sum X\right)\left(\sum XY\right)}{n\left(\sum X^2\right) - \left(\sum X\right)^2}$$

To test the level of significance of b_1, t-value was estimated using the formula

$$t = \frac{b_1}{SE_{b1}}$$

Standard error of b_1 was estimated using the formula.

$$S_{yx} = \sqrt{\frac{\sum (Y)^2 - b_0\left(\sum Y\right) - b_1\left(\sum XY\right)}{n-2}}$$

Determinants of State Income:

The statistical analysis used for measuring the net influence of the selected causal factor on different aspects of state income, namely, net state domestic product and gross domestic product, income generated from one major sectors, via, primary sector.

In the first approach, state income was regressed upon each of the explanatory variables separately to study the extent to which each one of the selected variable (V_i) explained variations in state income. Two types of regression models namely linear and log-linear (Double log) were tried. The second was an approach of multi-variant regression analysis. Following two types of functional models were tried.

$$V_j = V_{oj} + \sum_{i=1}^{n} b_{ij} V_{ij}$$

$$V_j = V_{oj} \prod_{i=1}^{n} V_{ij}^{bij}$$

The final selection of the model was made on the basis of the following Statistical and Economic criteria:

(i) The Significance status of the individual regression coefficients;

(ii) The size of the coefficient of multiple determination; and

(iii) The ability of the function to provide economically meaningful results.

In multivariate regression analysis, only those variables which significantly affected the growth of state income where considered. However, all these selected variables could not be considered simultaneously due to various methodological limitations. These, *inter alia*, include the problem of multicollinearity, small sample size, most of regression coefficients carried improper sign and the explanatory power of the fitted models did not improve significantly.

However, these two techniques gave only limited information of the whole picture because the explanatory variables are highly correlated among themselves, that is, the pressure of multicollinearity. This necessitated the use of some more powerful technique which could not only take care of multicollinearity, but in which regression coefficients are not required independently. The technique of Factor Analysis based on the principle of mutual inter-dependence, seems to provide a simpler, though relatively crude, alternative. The basic structural features of the total situation under examination are reflected by a set of indices often referred in literature as Factors. These factors are in fact some linear combinations of original variables and between factors the variations are more than within the factors. The procedure of Factor Analysis attempts to estimate the values of regression coefficients where the original variables are regressed on the factors. These coefficients of regression are referred to as factor loadings. In the present study Principal Axes Method has been used to estimate these coefficients. These factor loadings are rotated in order to have a set of new factor loadings with better explanation and interpretation. However, in case of present study, unrotated factor loadings gave better results than the rotated ones. Therefore, unrotated factor loadings are listed and discussed.

Factor Analysis

To identify the factors which influenced the level of determinants of Agricultural productivity in India and determinants of inter-state variation of Agriculture productivity factor analytic approach had been used. This is a statistical approach that could be used to analyze interrelations among a large number of variables and to explain these variables in terms of their common underlying dimensions (factors). The factor analysis is designated as the queen of analytical methods because of its power and elegance.

The general purpose of factor analytic technique was to find a way in condensing (summating) the information contained in a number of original variables into a smaller set of new, composite dimensions(factors) with a minimum loss of information, that was, to search for and define the fundamental constructs or dimensions assumed to underline the original variables.

The suitability of data for factor analysis can be tested on the basis of following criterion:

- A visual inspection of the correlation data matrix can reveal whether there were sufficient correlations to justify factor analysis.
- Anti-image correlation matrix showed the negative values of partial correlation among variables. In order for true factors to exit in data these values must be small.
- Kaiser-Meyer-Olin Measure of Sampling Adequacy (KMO) was another measure to quantify the degree of inter-correlations among the variables and appropriateness of factor analysis. The index ranged from 0 to 1. Small values for KMO measure indicated that a factor analysis of variables may not be a good idea, since correlation between pairs of variables cannot be explained by the other variables. A high value between 0.5 to 1.0 indicated that the factor analysis was appropriate technique to be used.

There were two basic models that the analysis can utilize to obtain factor solutions. They were known as common factor and principal components analysis. The common factor and principal component analysis models were both widely utilized. Selection of the extraction method depends upon the analysts' objective. Principal component analysis was used when the objective was to summarize most of the original information (variance) in a minimum number of factors for prediction purposes. In contrast, common factor analysis was used primarily to identify underlying factors or dimensions reflecting what the variables share in common. In the present study principal components method of factoring has been used. This was the most common type of factor analysis. It was a statistical technique that linearly transformed an original set of variables into a substantially smaller set of uncorrelated variables that represented most of the information in the original set of variables. A small set of uncorrelated variables was much easier to understand and use in further analysis than a large set of correlated variables.

Here linear combinations of variables were used to account for variation (spread) of each dimension in a multivariate space. The variance of the factors was called Eigen Values, characteristic root or Latent Root. Communality was the amount of variance an original variable shares with others. Factor loadings were the correlation between the original variable and the factor. Guidelines existed for identifying significant factor loadings based on simple size.

Squared factor loadings indicated what percentage of the variance in an original variable was explained by a factor. When the set of variables was large, the analyst first extracted the largest and best combinations of variables and then proceeded to smaller less understandable combinations. Hence, the number of factors to be extracted became an important issue in the absence of any set criterion.

The four possible criteria were: (I) In a Priori Criterion, the analysis already knew how many factors to extract and accordingly instructs the computer; (ii) In Latent Root Criterion, only those factors which have latent roots greater than 1 were considered significant; (iii) In percentage of Variance Criterion, the cumulative percentage of variance extracted by successive factors was considered. In social sciences, it was common to consider a solution satisfactory when it accounts for 60 percent of the total variance (and sometimes even less); and (IV) In Scree Test Criterion, at least one factor more than latent root criterion was usually extracted. The later factors extracted in principal component factor analysis model, contain both common and unique variance- the proportion of unique variance was much higher in later than in earlier factors. The Scree Test was used to identify the optimum number of factors that can be extracted before the amount of unique variance begins to dominate the common variance structure. In the present study, exploratory efforts were made with all of the above methods. Initially, latent root was used as guideline and then the Scree test was used. In all the attempts percentage of the explained variance was also taken into consideration. Further an interpretation and assessment of the structure matrix was made in each case. Thus, several factors solutions with different number of factors were examined before a satisfactory solution was reached.

Factor Rotation

An important step in factor analysis was the rotation of factors. Loadings were rotated to make them more interpretable by making the loadings for each factor either large or small, not in between .For rotation; either Orthogonal or Oblique method can be employed. In Orthogonal Rotation method, the axis was maintained at 90 degrees so that the resulting factors were uncorrelated. In Oblique Rotation method, the axis was rotated, without maintaining the 90 degree angle between them. This makes the method more flexible. However, analytical procedure for oblique rotations was still controversial. Within orthogonal method, either Varimax or Quatrimax method can be employed. Varimax method simplified the columns in a matrix whereas Quatrimax method stressed on simplifying the rows. In the present study, Orthogonal Rotation along with the Varimax method of rotation of factors was used in order to have more clarity in factor solution. Varimax Rotation was probably the most popular Orthogonal Rotation Procedure. The Varimax criteria maximized the sum of the variances of the squared loading within each column of the loading matrix. This tends to produce some high loadings and some loading near zero, which was is one of the aspects of simple structure. This statistical approach had been used to condense the information collected by using questionnaires. On 10 selected variables to know the perception of the agriculture productivity on the important aspects related to pull and push factor of Agricultural Productivity.

Specifications of Variables:

To identify the determinants of interstate variation of agricultural productivity the basic set of ten variable relating to Agriculture Productivity was considered. All these variables were regressed upon agricultural productivity. Two types of functional models, namely, linear and log-linear were tried to examine the impact of these selected variable. Final selection of these variables was made based upon the following criteria:

1. The significance status of the individual regression coefficient.
2. The size of the coefficient determination.

To isolate the factors affecting interstate variations in agriculture productivity in India following ten explanatory variables were selected for all the three different periods under review.

*1. **TPC** (Total Power Consumption): It is measured as the total consumption of power in Giga Watt for agriculture purposes.*

*2. **HPC** (Per hectare power consumption): It is measured as the consumption of power per hectare of gross cropped area.*

*3. **TRL** (Total Road Surface length): It is measured as the length of total metalled road in kilometer.*

*4. **RD** (Road Density): It defined as total length of metalled roads per 1000 sq. km. of geographical area.*

*5. **GIA** (Gross Irrigated Area): It defined as the ratio of total area under crop irrigated once and/ or more than once in a year to the gross cropped area.. It is estimated using the formula:*

$$GIA = \frac{Gross\ Irrigated\ Area}{Gross\ Cropped\ Area} \times 100$$

*6. **NIA** (Net Irrigated Area): It is defined as the ratio of net area irrigated through any source once in a year for a particular crop to the net area sown. It is estimated using the formula:*

$$NIA = \frac{Net\ Irrigated\ Area}{Net\ Sown\ Area} \times 100$$

*7. **CPH** (Credit per Hectare): It is measured as credit advanced in rupees crores for agricultural purposes per hectare of gross cropped area.*

*8. **TFC** (Total Fertilizer Consumption): It is measured as the total consumption of fertilizer in nutrient kg, thousand tones.*

*9. **PHF** (Per Hectare Fertilizer Consumption): It is measured as the consumption fertilizer in (NPK) nutrient kg, thousand tonnes for agricultural purposed per hectare of gross cropped area.*

*10. **TPH** (Tractor per hectare): It is defined as the number of tractors registered per hectare of gross cropped area.*

Problem of Multicollinearity

When two or more independent variables are highly inter-correlated, there arises the problem of multicollinearity and it becomes difficult to ascertain their separate effect on the dependent variable. Before, fitting appropriate functions, the problem of multicollinearity was looked into. For this purpose, Zero-Order Correlation matrix was worked out.

A set of variables are multi-collinear when one of them can be expressed as an exact linear combinations of the others. Inter-correlation between the explanatory variables is not said to be a serious problem unless it is high relative to the overall degree of multiple correlation among all variables simultaneously. In simple words, value of simple correlation coefficient is greater than the magnitude of coefficient of multiple determinations. In the present study, both the tests were satisfied before fitting the algebraic functions. Besides this, wherever the data allowed, simple statistical analysis, like, compound growth rates, percentages, etc., and simple logical tabular analysis was done and results were interpreted accordingly.

III

Variations in Agricultural Productivity

Agricultural productivity here is defined as net domestic product from agriculture and allied activities at constant prices. During the triennium ending 1990-93, Uttar Pradesh was at the top of the ladder in respect of total Agricultural productivity. This was followed by Maharashtra and Andhra Pradesh. On the other hand, Goa was at the bottom of scale in respect of total agricultural productivity. This was followed by Nagaland, Meghalaya and Manipur. All these states belong to the underdeveloped north eastern region of India. Agricultural productivity was higher than the national average (of Rs. 9255) in 10 States, viz., Andhra Pradesh, Bihar, Gujarat, Karnataka; Madhya Pradesh; Maharashtra; Punjab; Rajasthan; Tamil Nadu; Uttar Pradesh and West Bengal. Haryana was just close to the national average.

During the triennium ending 2000-03, Uttar Pradesh was again at the top of the ladder in respect total agricultural productivity at the constant Prices. This was followed by Maharashtra and Andhra Pradesh. On the other hand, Goa was at the bottom of the scale in respect of total agricultural productivity at the constant Prices. This was followed by Nagaland, Manipur and Meghalaya. All these states are part of underdeveloped north western region. Total agricultural productivity at the constant Prices was higher than the national average (of Rs. 15380) in 11 States, viz., West Bengal, Punjab, Karnataka, Rajasthan, Madhya Pradesh, Tamil Nadu, Bihar, Haryana, Gujarat, Orissa and Assam.

During the triennium ending 2007-10, Uttar Pradesh keep hold of its top position in respect of total agricultural productivity at the constant Prices followed by Andhra Pradesh and Maharashtra. On the other hand, Goa was at the bottom of the scale in respect of total agricultural productivity at the constant prices. This was followed by Meghalaya, Nagaland, and Tripura. Total agricultural productivity at the constant Prices was higher than the national average (of Rs. 19749) in 11 States, viz., West Bengal, Punjab, Madhya Pradesh, Karnataka, Rajasthan, Tamil Nadu, Gujarat, Haryana, Bihar, Orissa and Kerala.

From the above discussion, it was clear that Uttar Pradesh keep hold of its top position throughout the study period. Maharashtra has slipped its position from second to third during the study period. Moreover, Jammu & Kashmir and Nagaland had deteriorated its relative position continuously from 17 to 18 to 19 and 21 to 22 to 23 respectively during the study period.

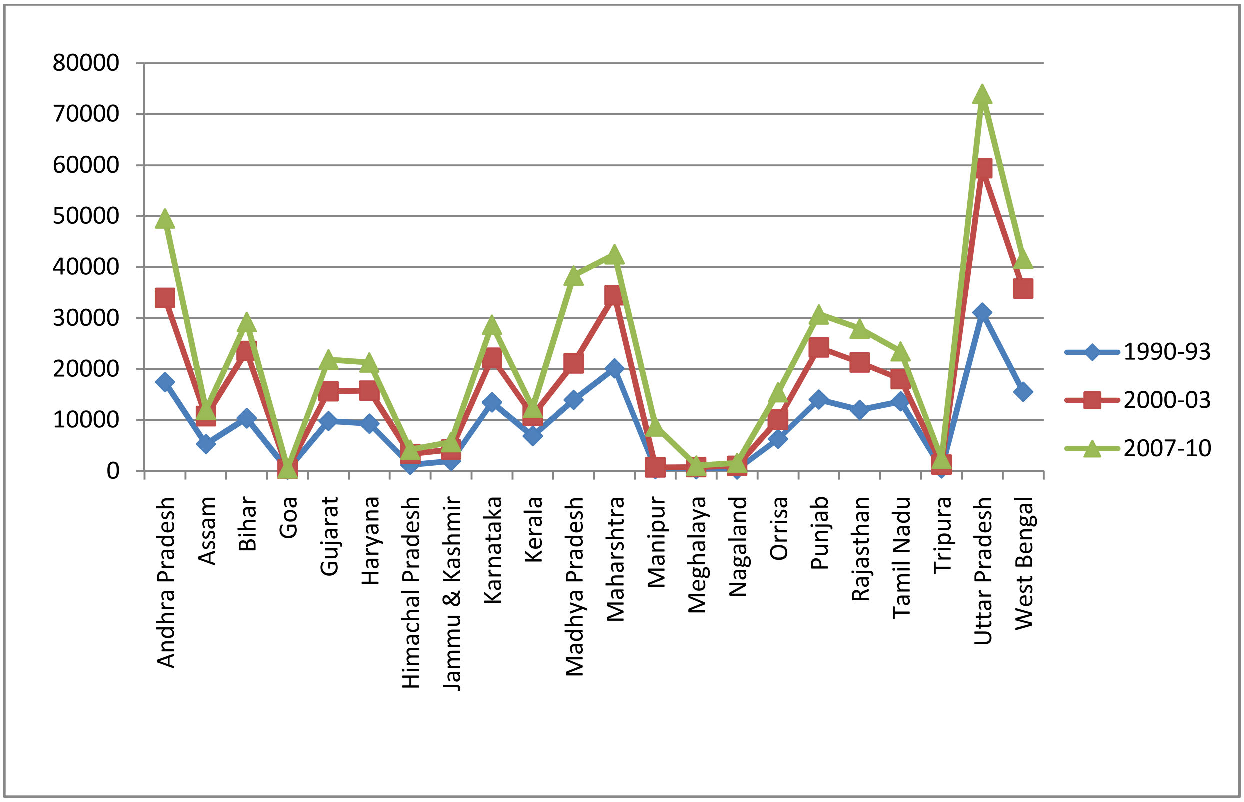

Fig1: Total Agricultural productivity in Different States of India

Table.1: Total Agricultural Productivity in Different States of India at Constant Prices

States	Total Agricultural Productivity (Rs. Crores)			Growth Rate (per cent)		
	Triennium ending 1990-93	Triennium ending 2000-2003	Triennium ending 2007-2010	1990-1991 to 1999-2000	2000-2001 to 2009-2010	1990-1991 to 2009-2010
Andhra Pradesh	17422	33989	49562	6.9	3.8	5.3
Assam	5268	10793	12011	7.4	1.0	4.2
Bihar	10327	18213	20923	5.8	1.3	3.5
Chhattisgarh	NA	4782	8311	NC	5.6	NC
Goa	251	410	531	5.0	2.6	3.8
Gujarat	9793	15653	21892	4.7	3.4	4.1
Haryana	9253	15757	21318	5.4	3.0	4.2
Himachal Pradesh	1184	3330	4210	10.8	2.3	6.5
Jammu& Kashmir	1924	4233	5701	8.1	3.0	5.5
Jharkhand	NA	5327	8366	NC	4.6	NC
Karnataka	13448	22250	28721	5.1	2.5	3.8
Kerala	6854	10876	12399	4.7	1.3	3.0
Madhya Pradesh	13912	16354	30041	1.6	6.2	3.9
Maharashtra	20090	34496	42553	5.5	2.1	3.8
Manipur	368	755	8775	7.4	1.5	4.4
Meghalaya	345	775	1095	8.1	3.5	5.9
Nagaland	286	1021	1587	13.5	4.5	8.9

Orissa	*6253*	*10096*	*15471*	*4.9*	*4.3*	*4.6*
Punjab	*13990*	*24263*	*30755*	*5.6*	*2.3*	*4.0*
Rajasthan	*11953*	*21286*	*27955*	*5.9*	*2.7*	*4.3*
Tamil Nadu	*13628*	*18036*	*23494*	*2.8*	*2.6*	*2.7*
Tripura	*502*	*1297*	*2411*	*9.9*	*6.3*	*8.1*
Uttar Pradesh	*31050*	*56135*	*70361*	*6.0*	*2.2*	*4.1*
Uttarakhand		*3246*	*3672*		*1.2*	
West Bengal	*15509*	*35797*	*41630*	*8.7*	*1.5*	*5.0*
CV	*85.6*	*92.26*	*89.94*			

*Source: CMIE**: Various Issues of National Income Statistics;** Centre for Monitoring Indian Economy, Mumbai*

Manipur which had slipped its position from 19 to 24 during 1990-93 through 2001-03 had improved its relative position to sixteen by the triennium ending 2007-10.

Growth of agricultural productivity of the nation as a whole showed an acceleration of 4.71 per cent during the twenty years under review spanning from 1990-91 through 2009-2010. However, there is lot of variations in productivity growth at the state level which varies from 8.9 per cent in Nagaland to 2.7 per cent in Tamil Nadu. Productivity growth was higher than national average during the reference period in Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir; Meghalaya; Tripura; West Bengal and Nagaland. Productivity growth was approaching to national average in Orissa.

Furthermore, growth in agricultural productivity during 1990's was 6.54 per cent which sharply declined to 3.01 during 2000's. Decline in growth of agricultural productivity has been noticed in all the states of Indian Union with the only exception of Madhya Pradesh where agricultural productivity had increased from 1.6 per cent during 1990's to 6.2 per cent during 2000's. Sharpest declined (80 per cent and more) in productivity growth has been observed in Assam; West Bengal and Manipur. Least decline (less than 20 per cent) has been noticed in Tamil Nadu and Orissa. Decline in the agricultural productivity in Andhra Pradesh; Goa; Karnataka; Meghalaya; Punjab; Rajasthan and Haryana varied between 40 to 60 per cent.

Agriculture Productivity and Growth

During the triennium ending 1990-93, Kerala was at the top of the ladder in respect of agricultural productivity per hectare of gross cropped area at the constant prices. This was followed by Tamil Nadu and Manipur. On the other hand, Madhya Pradesh was at the bottom of scale in respect of per hectare agricultural productivity at constant Prices followed by Rajasthan and Orissa. Per hectare agricultural productivity was higher than the national average (of Rs. 13523) in 9 States, viz., Kerala; Tamil Nadu; Manipur; Punjab; Assam; Goa; Haryana; Jammu & Kashmir and Meghalaya.

During the triennium ending 2000-03, Nagaland was at the top of the ladder followed by Jharkhand and Jammu & Kashmir. On the other hand, Chhattisgarh was at the bottom of the scale followed by Madhya Pradesh and Rajasthan. Per hectare agricultural productivity was

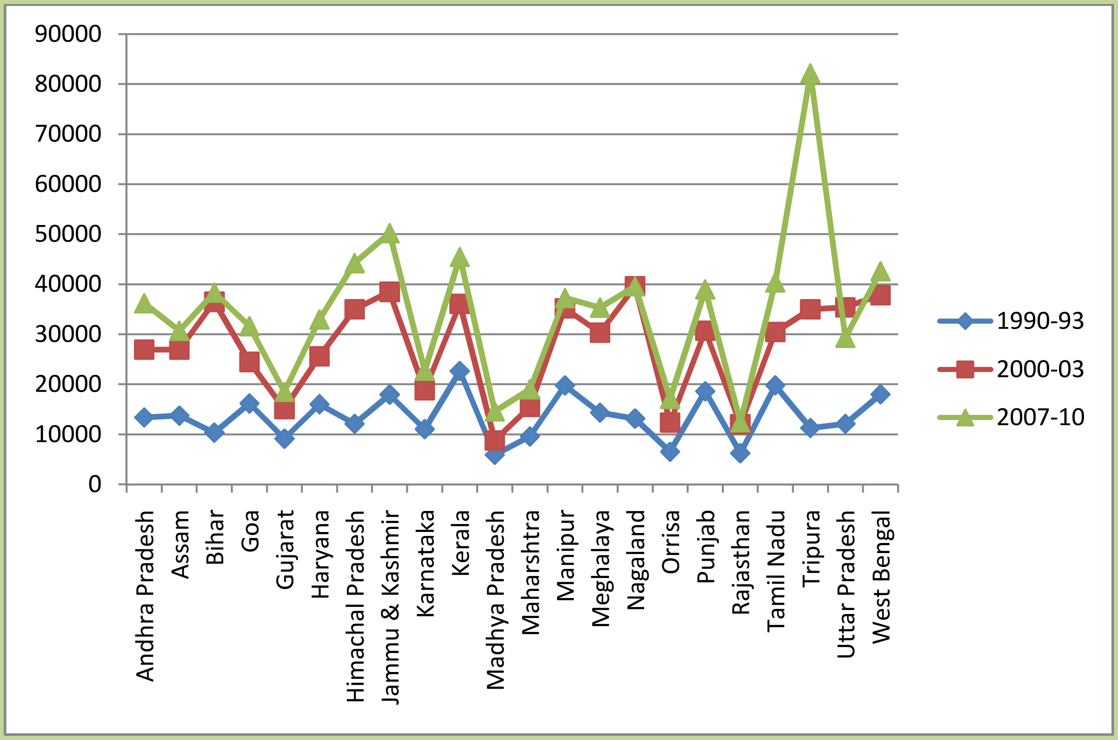

Fig 2: Per Hectare Agricultural Productivity in Different States of India

Table.2: Per Hectare Agricultural Productivity in Different States of India at Constant Prices

States	Per Hectare Agricultural Productivity (Rs. Crores)			Growth rate (per cent)		
	Triennium ending 1990-93	Triennium ending 2000-2003	Triennium ending 2007-2010	1990-1991 to 1999-2000	2000-2001 to 2009-2010	1990-1991 to 2009-2010
Andhra Pradesh	13354	26932	36180	7.2	2.9	5.1
Assam	13730	26951	30707	6.9	1.2	1.09
Bihar	10331	34464	26889	12.7	-2.4	4.8
Chhattisgarh	NA	8630	14541	NC	5.3	Nc
Goa	16158	24477	31607	4.2	2.5	3.3
Gujarat	9127	15011	18489	5.07	2.09	3.5
Haryana	16007	25600	32943	4.7	2.4	3.6
Himachal Pradesh	12089	34997	44222	11.1	2.3	6.6
Jammu& Kashmir	17930	38495	50206	7.9	2.6	5.2
Jharkhand	NA	38532	49738	NC	2.5	NC
Karnataka	11033	18810	22739	5.4	1.9	3.6
Kerala	22625	36085	45450	4.7	2.3	3.5
Madhya Pradesh	5896	8904	14627	4.2	5.07	4.6
Maharashtra	9570	15514	19012	4.9	2.0	-0.3
Manipur	19749	35184	37261	5.9	0.48	3.2
Meghalaya	14335	30328	35322	7.7	1.4	4.6
Nagaland	13139	39600	39576	11.6	-0.1	5.6

Orissa	*6508*	*12347*	*17107*	*6.05*	*3.2*	*4.9*
Punjab	*18593*	*30710*	*38974*	*5.1*	*2.3*	*3.7*
Rajasthan	*6221*	*11993*	*12430*	*6.7*	*0.29*	*3.5*
Tamil Nadu	*19773*	*30474*	*40371*	*4.4*	*2.8*	*3.6*
Tripura	*11264*	*35012*	*82146*	*11.9*	*8.8*	*10.4*
Uttar Pradesh	*12099*	*33234*	*27668*	*10.6*	*-0.1*	*4.2*
Uttarakhand	*NA*	*37571*	*30922*	*NC*	*-0.1*	*NC*
West Bengal	*17986*	*37805*	*42579*	*7.7.*	*1.1*	*4.3*
CV	*42.42*	*36.43*	*47.34*			

*Source: CMIE: **Various Issues of National Income Statistics;** Centre for Monitoring Indian Economy, Mumbai* higher than the national average (of Rs. 27506) in 14 States, viz., Bihar; Himachal Pradesh; Jammu & Kashmir; Jharkhand; Kerala; Manipur; Meghalaya; Nagaland; Punjab; Tamil Nadu; Tripura; Uttar Pradesh; Uttarakhand and West Bengal. Haryana was at the level of national average.

During the triennium ending 2007-10, Tripura was at the top of the ladder followed by Jammu & Kashmir and Jharkhand. On the other hand, Rajasthan was at the bottom of the scale in respect of per hectare agricultural productivity. This was followed by Madhya Pradesh and Chhattisgarh. Per hectare agricultural productivity was higher than the national average of Rs. 33668 in 12 States, viz., Andhra Pradesh; Himachal Pradesh; Jammu & Kashmir; Jharkhand; Kerala; Manipur; Meghalaya; Nagaland; Punjab; Tamil Nadu; Tripura and West Bengal.

During the period of 1990-1991 to 1999-2000 the growth rate of per hectare agricultural productivity in different states of India at constant prices was found to be highest in Tripura at 10.4 per cent followed by Himachal Pradesh at 6.6 per cent and Tripura at 5.6 per cent. On the other hand, Maharashtra with (–) 0.3 per cent was at the bottom of the scale of per hectare agricultural productivity growth at constant prices. Maharashtra was followed by Assam and Manipur. Per hectare agricultural productivity grow at higher than the national average of 4.21 per cent only in four states, namely, Andhra Pradesh; Himachal Pradesh; Jammu & Kashmir and Nagaland.

During the year 2000-2001 to 2009-2010 the growth rate of per hectare agricultural productivity in different states of India at constant prices was highest in Tripura followed by Chhattisgarh and Madhya Pradesh. On the other hand, Bihar was at the bottom of the scale of growth rate of per hectare agricultural productivity followed by Nagaland; Uttar Pradesh and Uttarakhand. There were four states where growth rate was higher than the national average of 2.11 per cent (these 4 states are Chhattisgarh; Tripura, Madhya Pradesh and Orissa). During 1900’s, Bihar was having highest growth of per hectare agricultural productivity followed by Tripura and Nagaland. On the other hand, Goa was at the bottom followed by Madhya Pradesh and Tamil Nadu.

Furthermore, growth rates of per hectare agricultural has deteriorated during 2000’s as compared to 1990’s in all the states of Indian Union with the only exception of Madhya Pradesh where per hectare agricultural productivity has grown at the rate of 5.07 per cent – slightly more than that of 1990'sat 4.7 per cent. Moreover 11 states have equal to or less than two per cent growth of per hectare agricultural productivity (four have negative growth rates).

Variations in Per Rural Capita Productivity:

Inter-state variation in agricultural productivity was also judged from the variation in NSDP from agriculture per rural person (Table 3). This includes variation due to agricultural productivity and land-man ratio. Rural per capita agricultural productivity for the country as a whole was around Rs. 800 in the early 1990's. It increased at the rate of 1 per cent during 2001's and by 1.44 per cent per annum at the end of 2010 decade.

During the triennium ending 1990-1993 Punjab was at the top of ladder in respect of per capita productivity. Punjab was followed by Haryana, Tamil Nadu and Karnataka. On other hand, Bihar was at the bottom of scale followed by Tripura, Meghalaya and Orissa. Moreover per capita agricultural productivity was more than the national average of Rs. 2711 in six states, namely, Haryana, Karnataka, Madhya Pradesh, Punjab, Rajasthan and Tamil Nadu.

During the triennium ending 2000-2003 per capita agricultural productivity was found to be highest again in Punjab followed by Haryana, Nagaland and Himachal Pradesh. On the other hand, per capita agricultural productivity was found to be lowest in Jharkhand followed by Chhattisgarh, Bihar and Orissa. There were 8 states where per capita agricultural productivity was more than national average of Rs. 4914. These states were Andhra Pradesh, Haryana, Himachal Pradesh, Jammu Kashmir, Nagaland, Punjab and West Bengal.

During the triennium ending 2007-2010 Punjab was again at the top of the ladder in respect of per capita agricultural productivity. Punjab was followed by Haryana, Nagaland and Himachal Pradesh. On the other hand Bihar was at the bottom with respect to per capita agricultural productivity followed by Jharkhand, Manipur and Kerala. There were 7 states in India which were having per capita agricultural productivity more than the national average of Rs. 5221, namely, Andhra Pradesh, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Nagaland and Punjab.

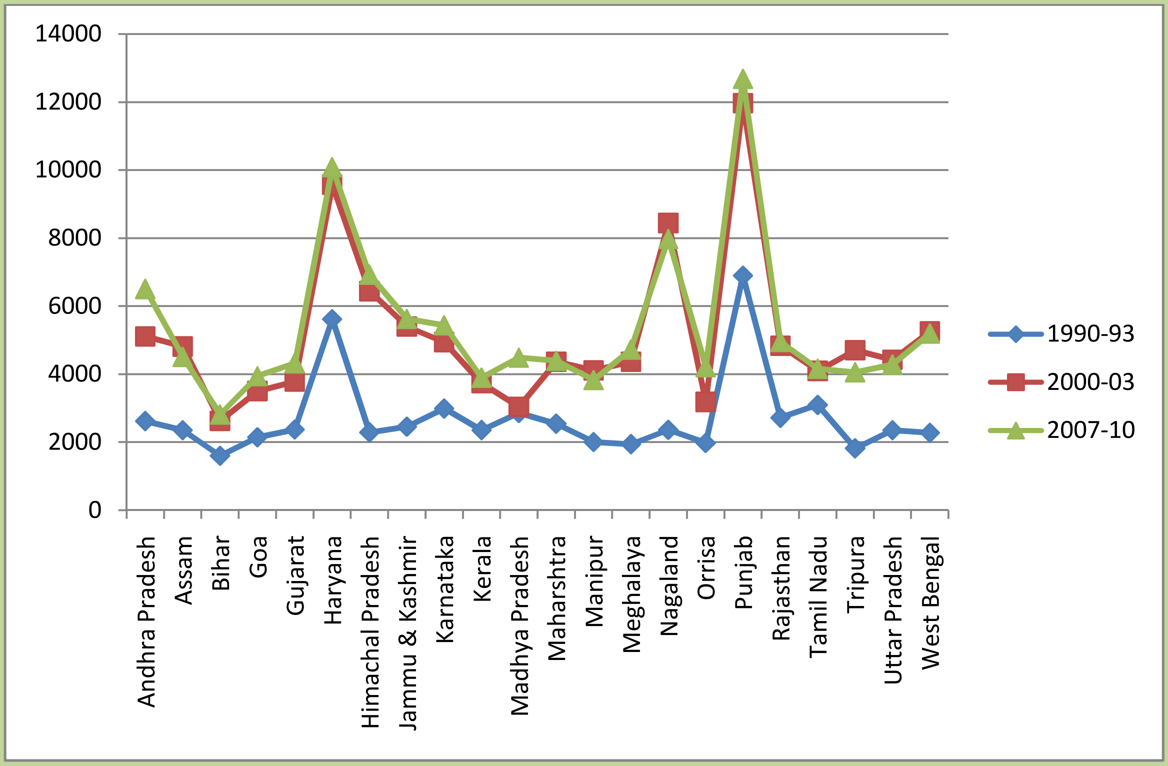

Fig 3: Per Capita Agricultural productivity in Different States of India

Table.3: Rural Per Capita Agricultural Productivity in Different States of India at Constant Prices

States	**Rural Per Capita Agricultural Productivity (Rs. Crores)**			**Growth Rate (per cent)**		
	Triennium ending 1990-93	**Triennium ending 2000-2003**	**Triennium ending 2007-2010**	**1990-1991 to 1999-2000**	**2000-2001 to 2009-2010**	**1990-1991 to 2009-2010**
Andhra Pradesh	*2619*	*5110*	*6503*	*6.9*	*2.4*	*4.6*
Assam	*2350*	*4815*	*4506*	*7.3*	*-0.7*	*3.3*
Bihar	*1600*	*2822*	*2520*	*5.8*	*-1.1*	*2.2*
Chhattisgarh	*NA*	*2715*	*3989*	*NC*	*3.9*	*NC*
Goa	*2145*	*3507*	*3939*	*5.0*	*1.1*	*3.0*
Gujarat	*2370*	*3789*	*4320*	*4.8*	*1.3*	*3.0*
Haryana	*5620*	*9570*	*10081*	*5.4*	*0.4*	*2.9*
Himachal Pradesh	*2289*	*6441*	*6926*	*10.8*	*0.6*	*5.6*
Jammu& Kashmir	*2455*	*5401*	*5620*	*8.2*	*0.3*	*4.2*
Jharkhand	*NA*	*2438*	*3104*	*NC*	*2.4*	*NC*
Karnataka	*2989*	*4946*	*5434*	*5.1*	*0.8*	*3.0*
Kerala	*2355*	*3737*	*3894*	*4.6*	*0.3*	*2.5*
Madhya Pradesh	*2864*	*3367*	*4977*	*1.5*	*3.9*	*2.8*
Maharashtra	*2545*	*4370*	*4392*	*5.5*	*0.1*	*2.7*
Manipur	*2003*	*4111*	*3825*	*7.4*	*-0.7*	*3.2*
Meghalaya	*1943*	*4368*	*4721*	*8.4*	*0.7*	*4.5*

Nagaland	*2363*	*8443*	*7974*	*13.5*	*-0.6*	*6.2*
Orissa	*1975*	*3188*	*4203*	*4.8*	*2.8*	*3.8*
Punjab	*6897*	*11962*	*12677*	*5.6*	*0.5*	*3.0*
Rajasthan	*2716*	*4837*	*4947*	*5.9*	*0.1*	*3.0*
Tamil Nadu	*3096*	*4098*	*4157*	*2.8*	*0.09*	*1.4*
Tripura	*1820*	*4707*	*4056*	*9.9*	*-1.4*	*4.0*
Uttar Pradesh	*2351*	*4250*	*4233*	*6.1*	*0.1*	*2.9*
Uttarakhand	*NA*	*4603*	*4325*	*NC*	*0.6*	*NC*
West Bengal	*2278*	*5258*	*5192*	*8.7*	*-0.2*	*4.2*
CV	*46.57*	*49.55*	*41.60*			

Source: CMIE: ***Various Issues of National Income Statistics;*** *Centre for Monitoring Indian Economy, Mumbai*

During the period of 1990-1991 to 2009-2010, the growth rate of per capita agricultural productivity in different states of India at constant prices was found highest in Nagaland followed by Himachal Pradesh. Andhra Pradesh, Jammu & Kashmir, Tripura and Meghalaya were having around 4 per cent in their per capita agricultural productivity. On the other hand, Tamil Nadu was at the bottom of the scale of per capita agricultural productivity. Seven states were having higher growth rate as compared to national growth rate (Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Nagaland, Orissa and West Bengal).

During the period of 1990-1991 to 1999-2000 the growth rate of per capita agricultural productivity in different states of India at constant prices was found to be highest in Nagaland followed by Himachal Pradesh, Tripura and West Bengal. On the other hand, Madhya Pradesh was at the bottom of the scale of per capita agricultural productivity growth at constant prices. The growth rate of per capita agricultural productivity was higher than the national average of 10.5 per cent only in two states, namely, Himachal Pradesh and Nagaland.

During the year 2000-2001 to 2009-2010 the growth rate of per capita agricultural productivity in different states of India at constant prices was highest in two states, namely, Chhattisgarh and Madhya Pradesh followed by Andhra Pradesh, Jharkhand and Orissa. Tripura was at the bottom of the scale of growth rate of per capita agricultural productivity. There were 8 states where growth rate was higher than the national average of 0.71 per cent (these 8 states are Andhra Pradesh, Goa, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh and Orissa).

Furthermore, growth rates of per capita agricultural has deteriorated during 2000’s as compared to 1990’s in all the states of Indian Union with the only exception of Madhya Pradesh where per capita agricultural productivity has grown at the rate of 3.9 per cent – more than that of 1990’s. Moreover 18 states have less than one per cent growth of per capita agricultural productivity (Six have negative growth rates.

Regional Disparities

Variations in total agricultural productivity, per hectare agricultural productivity and rural per capita agricultural productivity among the different states of Indian Union for different years are measured through coefficient of variation. There is a clear upward trend in coefficient of variation of both agricultural productivity per unit of area as well as agricultural income per rural person. Variation in total productivity was estimated 85.6 per cent at the beginning of 1990’s which increased to 92.26 per cent by the beginning of 2000’s but declined marginally to 89.94

per cent by the end of 2000's. Apparently interstate variation in agricultural productivity over period of time has increased.

Likewise, regional disparities in per hectare agricultural productivity have increased from 42.42 per cent from the beginning of 1990's to 47.34 per cent by the end of 2000's. Rural per capita agricultural productivity showed similar trend as that of total agricultural productivity but with little lesser magnitude. This is because interstate variation in agriculture productivity has been further sharpened due to inequality in land-man ratio and creation of some more states. There is clear evidence that since 1990-91 regional divergence in agricultural productivity and income have grown and the gap between underdeveloped and developed, and, poor and rich states has continued to increase. This has happened despite special efforts made to reduce inter-state disparities by promoting level of agricultural development in underdeveloped states. There is a need to make more vigorous efforts on technological, institutional, and infrastructural fronts to raise productivity and to accelerate growth rate not only of crop sector but also of livestock and other sub sectors of agriculture in under developed states. Special and immediate focus is needed for eastern states namely, Bihar, Orissa and Assam, hill regions and eastern Uttar Pradesh. There is no room for complacency on this score.

HAS THE PATTERN CHANGED?

The changes in the productivity pattern can be classified into two categories, that is, (i) Shifts, and (ii) Deviations,

When two or more patterns are compared on arranging the level of productivity under the same state on an increasing or decreasing order and if they do not exhibit similarity between them, ***"Shifts"*** are said to have occurred. On the other hand, when difference in the level of productivity between the states, than they are taken as ***"Deviations"***.

There have not been much variations or shifts in the pattern during twenty years under review spanning from 1990-91 through 2009 to 2010. However some deviations do occur as the farmers respond to change in seasonal conditions, price differentials and other influencing factors. No major change has been observed in the productivity pattern across different states of Indian union during the period under review. In respect to per hectare agricultural productivity, during the period triennium ending 2001 to 2003 over 1990-1993, Nagaland had improved its position to a great extent, that is, from twelve to first and Bihar from seventeen to fourth. On the other hand, Goa had deteriorated its relative position from seven to sixteen; Punjab from fourth to twelve and Tamil Nadu from second to tenth. However, Tripura and Uttar Pradesh had also deteriorated its relative position. During the triennium ending 2007-2010 over triennium ending 2001-03, Tripura had improved its relative position from eighth to first while Uttar Pradesh has deteriorated its relative position from sixth to sixteen.

Likewise, with regards to per capita agricultural productivity, Himachal Pradesh has improved its relative position from fifteen to fourth; West Bengal from sixteen to eight and Meghalaya from twenty to tenth during the reference period of twenty years. On the other hand, Kerala has deteriorated its relative position from twelve to twenty; Madhya Pradesh from fifth to twelfth and Tamil Nadu from third to seventeen. No major change has been observed during 2000's with the only exception of Madhya Pradesh which has improved its relative position from twenty first to twelfth. However during 1990's Himachal Pradesh ahs improved is position from fifteen to fourth; Nagaland from eleven to third; West Bengal from sixteen to sixth and Tripura from twenty first to eleventh. On the other hand, Madhya Pradesh has deteriorated its relative position from fifth to twenty first and Tamil Nadu from third to sixteen.

To test whether there is a shift in the productivity pattern; Kendall's Rank Correlation coefficient was computed. Ranks were assigned to each state on the basis of its percentage and correlation coefficients were worked out for each pair of years. All the correlation coefficients were very highly significant. This indicates that there have not been any shifts in the productivity pattern between the years.

Further the total changeover the period under review, that is, 1990-91 through 2009-10 was examined by the test of concordance. The estimated value of the concordance coefficients was computed to be 0.8952 and was significant at 0.01 level of significance. Hence it can be definitely concluded that there have been no shifts in the productivity pattern between the years or over a period of twenty years.

IV
DETERMINANTS OF INTER-STATE VARIATION IN AGRICULTURAL PRODUCTIVITY

The productivity of a region's farms is important for many reasons. Aside from providing more food, increasing the productivity of farms affects the region's prospects for growth and competitiveness on the agricultural market, income distribution and savings, and labour migration. An increase in a region's agricultural productivity implies a more efficient distribution of scarce resources. As farmers adopt new techniques and differences in productivity arise, the more productive farmers benefit from an increase in their welfare while farmers who are not productive enough will exit the market to seek success elsewhere. As a region's farms become more productive, its comparative advantage in agricultural products increases, which means, that it can produce these products at a lower opportunity cost than can other regions. Therefore, the region becomes more competitive on the world market, which means that it can attract more consumers since they are able to buy more of the products offered for the same amount of money.

Increases in agricultural productivity lead also to agricultural growth and can help to alleviate poverty in poor and developing countries, where agriculture often employs the greatest portion of the population. As farms become more productive, the wages earned by those who work in agriculture also increase. At the same time, food prices decrease and food supplies become more stable. Labourers, therefore have more money to spend on food as well as other products. This also leads to agricultural growth. People see that there is a greater opportunity earn their living by farming and are attracted to agriculture either as owners of farms themselves or as labourers. However, it is not only the people employed in agriculture who benefit from increases in agricultural productivity. Those employed in other sectors also enjoy lower food prices and a more stable food supply. Their wages may also increase.

Agricultural productivity is becoming increasingly important as the world population continues to grow. India, one of the world's most populous countries, has taken steps in the past decades to increase its land productivity. Forty years ago, North India produced only wheat, but with the advent of the earlier maturing high-yielding wheat’s and rice’s, the wheat could be harvested in time to plant rice. This wheat/rice combination is now widely used throughout the Punjab, Haryana, and parts of Uttar Pradesh. The wheat yield of three tons and rice yield of two tons combine for five tons of grain per hectare, helping to feed India's 2 billion people.

Increases in agricultural productivity are often linked with questions about sustainability and sustainable development. Changes in agricultural practices necessarily bring changes in demands on resources. This means that as regions implement measures to increase the productivity of their farm land, they must also find ways to ensure that future generations will also have the resources they will need to live and thrive.

Agriculture indifferent states of India played an important role towards the economic growth and social structure of each and every individual Indian state. Agricultural productivity is measured as the ratio of agricultural outputs to agricultural inputs. Agricultural productivity may also be measured by what is termed total factor productivity (TFP). This method of calculating agricultural productivity compares an index of agricultural inputs to an index of outputs. This measures of agricultural productivity was established to remedy the short comings of the partial measures of productivity; notably that it is often hard to identify the factors cause them to change. In this chapter an attempt was made to identify the various factors associated with their level of Agricultural Productivity. No doubt, numerous variables contribute to Agricultural Productivity; the contribution of each factor may vary widely.

Determinants during Wider Dissemination Period:

Two types of functional models, namely, linear and log-linear were tried to examine the impact of these selected variable on interstate variation in agricultural productivity. However log liner model satisfied all the conditions/criteria whereas other type of function did not satisfy all the criteria. Thus double-log model were selected for each period and results discussed accordingly. The resulting estimates of the regression analysis for the triennium ending 1990-93 are reported in Table 4. These results reveal the availability of irrigation infrastructure (in both the form, that is, net area irrigated as well as gross cropped area irrigated) was the most important variable explaining interstate variation in agricultural productivity. These functional models explain 88 per cent of the total variations. Elasticity with respect to irrigation was estimated at +0.947 in both the cases and are very highly significant.

Table 4: Estimated Value of Regression Coefficient Affecting Inter State Variation in Agricultural Productivity during Wider Dissemination Period: Triennium Ending 1990-93

Model: Log linear ***Nos. of observation: 25***

Variables	***Constant***	***Regression Coefficient***	$\bar{R}^2$	***F-ratio***	***DW***
TPC	*+2.283*** (9.256)*	*+0.627*** (4.103)*	*0.482*	*16.834*	*1.520*
HPC	*+3.339*** (5.434)*	*+0.061ns (0.232)*	*-0.059*	*0.054*	*2.036*
NIA	*+0.182ns (0.672)*	*+0.947*** (11.315)*	*0.882*	*128.040*	*2.779*
GIA	*+0.085ns (0.304)*	*+0.947*** (11.325)*	*0.882*	*128.248*	*2.368*
CPH	*+3.410*** (5.385)*	*+0.212 ns (0.340)*	*-0.055*	*0.115*	*2.092*
TPH	*+3.100*** (16.432)*	*+0.248ns (0.843)*	*-0.017*	*0.710*	*2.040*
TFC	*+1.111*** (4.400)*	*+0.827*** (8.550)*	*0.809*	*73.102*	*2.193*
PHF	*+1.104ns (1.101)*	*+1.175** (2.110)*	*0.169*	*4.453*	*2.568*
TRL	*-1.812 ns (-2.365)*	*+1.098*** (6.579)*	*0.713*	*43.277*	*1.807*
RD	*+2.104** (2.572)*	*+0.382* (1.361)*	*0.048*	*1.853*	*1.853*

Figures in parentheses are t-values of the respective parameters
**** implies significant at 0.01 level of significance for two tailed test*
**** implies significant at 0.05 level of significance for two tailed test*
** implies significant at 0.10 level of significance for two tailed test*
ns: implies significant at non significant for two tailed test

The next important variable explaining interstate variation was consumption of fertilizer and this model explains 81 per cent of the variations. Elasticity coefficients was estimated at +.0.827 and was highly significant.

Road infrastructure measured as total road length also turned out to be the most significant variable explaining interstate variations in agricultural productivity. Its elasticity coefficient was estimated at +1.098 which was also highly significant and explained 71 per cent of the variations.

Total power consumption by agriculture sector also significantly explained (48 per cent) interstate variation in agricultural productivity. Its elasticity coefficient was (+0.627) was also highly significant. Road density was found to be the least important variable affecting interstate variation in agricultural productivity and it explains only 5 per cent of the variation. Other three variables namely, per hectare power consumption; per hectare credit and per hectare tractorization - a proxy for farm mechanization did not explain significantly interstate variation in agricultural productivity during triennium ending 1990-93.

All the regression coefficients have proper sign and significantly affect the interstate variation in Agriculture productivity. To study the simultaneous effect of these selected variables in explaining interstate variation in agricultural productivity, multiple regressions were run. However resulting estimates did not yield any conclusive results due to problem of multicollinearity and smaller number of observations. Hence these results are not discussed here.

Determinants during Post-Reform Period:

The resulting estimates of log-linear regression analysis for the triennium ending 2000-03 are reported in Table 5 Here again consumption of power for agricultural sector followed by irrigation infrastructure turned out to be the most significant factors explaining interstate variations in agricultural productivity. These variables explained more than 55 per cent of the variations. Elasticity coefficients were estimated at +0.426; +0.723 and +0.708 respectively for power consumption; net sown area irrigated and gross cropped area irrigated.

Here again tractorization turned out to be non significant variable in explain interstate variation in agricultural productivity. Other selected variables though significantly affect the interstate variation in agricultural productivity but to the lesser extent. The estimated value of R^{-2} varied in the range of 21 per cent to 48 per cent. To study the simultaneous effect of these selected variables in explaining interstate variation in agricultural productivity, multiple regressions were

Table 5: Estimated Value of Regression Coefficient Affecting Interstate Variation in Agricultural Productivity during Post-Reform Period: (Triennium Ending 2000-2003)

Model: Log Linear ***Nos. Of Observation: 25***

Variables	Constant	Regression Coefficient	R^{-2}	F-ratio	DW
TPC	+1.882*** (10.466)	+0.426*** (6.763)	0.641	45.743	2.292
HPC	+3.559*** (20.104)	+0.641*** (4.855)	0.474	23.573	2.183
NIA	+0.890** (2.439)	+0.723*** (5.782)	0.563	33.435	2.058
GIA	+0.830* (2.153)	+0.708*** (5.618)	0.550	31.564	2.059
CPH	+3.520*** (10.858)	+1.029** (2.122)	0.123	4.502	1.561
TPH	+2.696*** (9.951)	+0.284ns (0.980)	-0.002	0.959	1.563
TFC	+2.019*** (5.724)	+0.408** (2.759)	0.209	7.613	1.887
PHF	+0.981* (1.722)	+1.103*** (3.486)	0.308	12.154	2.034
TRL	-0.579 ns (-0.662)	+0.807*** (4.025)	0.378	16.197	1.492
RD	+1.208ns (1.210)	+0.602** (1.726)	0.073	2.979	1.740

Figures in parentheses are t-values of the respective parameters
**** implies significant at 0.01 level of significance for two tailed test*
**** implies significant at 0.05 level of significance for two tailed test*
** implies significant at 0.10 level of significance for two tailed test*
ns: implies significant at non significant for two tailed test

run. However resulting estimates did not yield any conclusive results due to problem of multi-co linearity and smaller number of observations .Hence these results are not discussed here.

Determinants during Period of Recovery:

The resulting estimates of log-linear regression analysis for the triennium ending 2000-03 are reported in Table 6. Here again availability of irrigation infrastructure coupled with consumption of fertilizer turned out to be the most significant factors explaining interstate variations in agricultural productivity. These variables explained more than 83 per cent of the variations. Elasticity coefficients were estimated at +0.889; +0.854 and +0.713 respectively for net irrigated

Table 6: Estimated Value of Regression Coefficient Affecting Interstate Variation in Agricultural Productivity* Period of Recovery: *Triennium Ending 2007-2010

Model: Log Linear ***Nos. Of Observation: 25***

Variables	Constant	Regression Coefficient	R^{-2}	F-ratio	DW
TPC	+1.866*** (11.344)	+0.430*** (7.831)	0.715	61.325	1.808
HPC	+3.485*** (21.165)	+0.556*** (4.436)	0.437	19.674	2.081
NIA	+0.392** (1.742)	+0.889*** (11.886)	0.854	141.284	1.846
GIA	+0.386* (1.655)	+0.854*** (11.499)	0.845	132.237	1.940
CPH	+2.974*** (18.472)	+0.023 ns (0.061)	-0.043	0.004	1.994
TPH	+1.982*** (7.443)	+1.010*** (4.187)	0.408	17.528	1.574
TFC	+1.266*** (7.481)	+0.713*** (10.923)	0.831	119.301	1.490
PHF	+4.532*** (10.394)	+1.493*** (3.732)	0.350	13.924	2.252
TRL	-2.688 ns (-3.120)	1.236*** (6.612)	0.640	43.715	1.890
RD	+3.393** (2.583)	-0.140 ns (-0.321)	-0.039	0.1028	1.916

Figures in parentheses are t-values of the respective parameters
***** implies significant at 0.01 level of significance for two tailed test**
***** implies significant at 0.05 level of significance for two tailed test**
** implies significant at 0.10 level of significance for two tailed test*
ns: implies significant at non significant for two tailed test

area and gross cropped area irrigated and total fertilizer consumption. Consumption of power for agricultural sector also turned out to be significant variable explaining 72 per cent of the variations. Elasticity coefficients was estimated to be +0.430 which was highly significant.

Here again credit per hectare coupled with road density turned out to be non significant variable in explaining interstate variation in agricultural productivity. Other selected variables though significantly affect the interstate variation in agricultural productivity but to the lesser extent.

The estimated value of R^{-2} varied in the range of 35 per cent to 48 per cent. To study the simultaneous effect of these selected variables in explaining interstate variation in agricultural productivity, multiple regressions were run. However resulting estimates did not yield any conclusive results due to problem of multicollinearity and smaller number of observations. Hence these results are not discussed here.

Thus, the analysis reveals that the variables considered in the analysis were of complementary nature and have to be provided simultaneously to favourably affect interstate variations in Agriculture Productivity. For increasing the Agriculture sector through reduction in interstate variation, different variables, like availability of irrigation infrastructure, power supply, availability of fertilizer at the right time and kind and road infrastructure have to be provided simultaneously. New techniques, ***seed-water-fertilizer*** can, therefore, go a long way in stepping up the agricultural productivity through reduction in interstate variations. This calls for a New Green Revolution. This requires huge investment both in the public as well as private sector to strengthened different infrastructure structures such as water resource management, availability of power for tube wells operation and fertilizer applications.

FACTOR ANALYSIS

The whole exercise/ above discussion gave inconclusive results. Most of the variables were not significant and majority of the regression coefficients had improper signs in multi-variate analysis. Furthermore, the lower size of the coefficient of multiple determination; non-significant status of the individual regression coefficients and the ability of the function to provide economically meaningful results compelled to have alternative solution to the problem.

Factor analytic approach was used to extract the various factors responsible for interstate variations in agricultural productivity. It was generally used to analysis inter- relationship among a large number of variables and explain these variables in terms of their common underlying dimensions (factors). It is designed as the queen of analytical method because of its power and elegance. The general purpose of Factor Analytic technique is to find a way in condensing(summarizing) the information contained in a number of original variables into a smaller set of new composite dimensions(Factors) with a minimum loss of information, that is, to search for and define the fundamental constructs or dimensions assumed to underline the original variables.

In order to test the suitability of data for Principal Component Analysis, the correlation matrix was computed and enough correlations were found to go ahead with factor analysis. Further Kaiser-Meyer-Oklin measure of sample Adequacy(KMG) was calculated (0.649;0.786 and 0.754) which supports that the sample was good enough for factor analysis. Further, Anti- image correlations calculated revealed that partial correlations were low, indicating that true factors existed in the data. Hence, the data was found fit for factor analysis.

Extraction Method and Number of Factors Extracted

Principal component Analysis was employed for extracting factors and the number of factors to be extracted were finalized on the basis of 'Latent Root Criterion' i.e. variables having Eigen values greater than 1. Finally, the principal component Analysis with Orthogonal Rotation has been used in the present study. In Orthogonal Rotation, it was assumed that factors operated independently of each other. Varimax rotated factor Analysis which was the most popular method of orthogonal rotation had been used. The results were obtained through orthogonal rotations with Varimax and all factor loadings greater than 0.5 (ignoring signs) were retained.

The resulting estimates of Principal component analysis with Varimax rotation for interstate variations in agricultural productivities were presented in Table 7 through Table 9. Besides factor loadings, two additional sets of information are reported in these Tables. In the last column, it was the communality of each variable and in the last row, it was the percentage variation explained by each factor. The estimates revealed that three factors were extracted which together explained 84.2006 percentage of the total variance by the information contained in the factor matrix. The percentage of variance explained by factor I, II and III is 3.2116, 24.436 and 56.553 respectively. The percentage of total variance was used as an Index to determine how well a particular factor solution accounted for what all the variables together represented. The communalities had been shown at the far right side of the Table 7 though Table 9 which showed the amount of variance in a variable that were accounted for by the factors taken together. The size of communality was a useful index for assessing how much variance in a particular variable was accounted for by the factor solution. Higher communalities indicated that large amount of variance in a variable had been extracted by the factor solution. Smaller communalities showed that a substantial portion of the variance in a variable was not accounted for by the factor solution.

TYPES OF FACTORS

A Factor loading represented the co-relation between the original variables and its factors. The signs were interpreted just like any other correlation coefficients. On each factor, 'like signs' of factor loadings mean that variables were negatively related. The factors and the loadings were summarized in Table 7 through Table 9 for the period ending 1990-93; 2001-03 and 2007-10 respectively and discussed as below:

Factor Loading During 1990-1993

Rotated correlation matrix in respect of interstate variation in agricultural productivity during the period 1990-1993 was reported in Table 4 and discussed as below. Three factor had been=-0xtracted which together explained 84.2006 percent of to total variance.

Factor I:

This Factor had emerged as a significant factor accounting for 32.116 per cent of the total variance explaining interstate variation in agricultural productivity during triennium ending 1990-93. Four variables were loaded on this factor which was highly and positively correlated. In these factor four out of 10 statements, namely, Net irrigated Area, Gross irrigated Area, Total Fertilizer consumption and Total Road length were highly correlated. Thus, this factor I (***Scientific Infrastructure***) had a high potential for determining inter- state variation in agricultural productivity in period 1990-93.

Factor II:

Second factor had emerged as a significant factor accounting for 24.436 per cent of the total variance for explaining interstate variation in agricultural productivity during period 1990-93. Three variables were loaded on this factor which was highly and positively correlated. These variables are (***Supporting Infrastructure***) per hectare power consumption, total power consumption, and Tractor per hector were highly correlated. Thus, this factor too had a high potential for determining interstate variation in agricultural productivity in period 1990-93.

Factor III:

Third factor had emerged as a significant factor accounting for 19.019 per cent of the total variance explaining interstate variation in agricultural productivity during the period 1990-93.

Table 7: Determinants of Inter State Variation for Agricultural Productivity during 1990-93

Variable(s)	Factor loading of factor			Communality
	I	II	III	
NIA (Net Irrigated Area)	.935	.157	-.194	.936
GIA (Gross Irrigated Area)	.896	.279	-.153	.905
TFC (Total Fertilizer Consumption)	*.830*	.177	.406	.885
TRL (Total Road Length)	.760	-.164	.342	.721
HPC (Hect. Power Consumption)	-.097	.899	.035	.820
TPC (Total Power consumption)	*.295*	.776	.391	.842
TPH (Tractor Per Hect.)	.251	.683	-.186	.563
CPH (Credit Per Hect.)	-.067	.149	.843	.738
PHF (Per Hect. Fertilizer)	.321	.540	.656	.825
RD (Road Density)	.044	-.302	.479	.323
Eigen Value	4.023	1.918	1.617	
Variance Explained (%)	32.116	24.436	56.553	
Cumulative Variance Explained (%)	32.116	56.553	75.572	

Extraction method: Principal Component Analysis
Rotation method: Varimax with Kaiser Normalization

Three statements (_______) were loaded on this factor which was highly and positively correlated. These statements are: availability of per hectare credit; per hectare fertilizer consumption and road density were highly correlated. Thus, these three factors had a high potential for determining interstate variation in agricultural productivity in period 1990-2000.

Factor Loading During Post-Reform Period

Rotated correlation matrix in respect of interstate variation in Agricultural productivity during period 2000-2003 was reported in Table 5 and discussed as below Three factor had been extracted which together explained 76.419 per cent of total variance.

Factor I:

Factor I had emerged as a significant factor accounting for 34.348 per cent of the total variance determining of interstate variation in agricultural productivity during 2000-2003. Four statements were loaded on this factor which was highly and positively correlated. These four statements, (***Irrigation Infrastructure***) namely, Gross irrigated Area, Net irrigated Area, Total Fertilizer consumption and Total Road length were highly correlated. Thus, this factor I had a high potential for determining inter- state variation in agricultural productivity during 2000-2003.

Factor II:

Second factor had emerged as a significant factor accounting for 27.545 per cent of the total variance for determinant of interstate variation in agricultural productivity during 2000-2010. Four statements were (***Physical Infrastructure***) loaded on this factor which was highly and positively correlated. These four out of 10 statements, namely, per hectare Power Consumption, Credit per Hectare, Total Power Consumption, and Per Hector Fertilizer were highly correlated. Thus, this factor II too had a high potential for determining interstate variation in agricultural productivity in period 2000-2010.

Factor III:

Third factor had emerged as a significant factor accounting for 14.526 percent of total variance for determinant of interstate variation in agricultural productivity in period 2000-2003. Two factors were loaded on this factor which was highly and positively correlated. This factor two out of 10 statements, (***Infrastructure for Movement)*** namely, availability of per hectare tractor and

Table 8: Determinants of Inter State Variation for Agricultural Productivity during Post-Reform Period

Variable(s)	***Factor loading of factor***			***Communality***
	I	***II***	***III***	
GIA (Gross Irrigated Area)	*.953*	*.130*	*.145*	*.784*
NIA (Net Irrigated Area)	*.949*	*.139*	*.175*	*.918*
TFC (Total Fertilizer Consumption)	*.839*	*.171*	*.036*	*.941*
TRL (Total Road Length)	*.683*	*.435*	*-.191*	*.946*
HPC (Hect. Power Consumption)	*.101*	*.919*	*.250*	*.626*
CPH (Credit Per Hect.)	*.083*	*.804*	*-.238*	*.692*
TPC (Total Power consumption)	*.329*	*.796*	*.206*	*.651*
PHF (Per Hect. Fertilizer)	*.501*	*.599*	*.129*	*.710*
TPH (Tractor Per Hect.)	*.290*	*.121*	*.743*	*.734*
RD (Road Density)	*.078*	*-.014*	*-.795*	*.639*
Eigen Value	*4.697*	*1.609*	*1.336*	
Variance Explained (%)	*34.348*	*27.545*	*14.526*	
Cumulative Variance Explained (%)	*34.348*	*61.893*	*76.419*	

Extraction method: Principal Component Analysis
Rotation method: Varimax with Kaiser Normalization

road density were highly correlated. Thus, this factor III too had a high potential for determining interstate variation in agricultural productivity in period 2000-2003.

Factor Loading During Period of Recovery:

Rotated correlation matrix in respect of interstate variation in Agricultural productivity during period III was reported in Table 6 and discussed as below four factors had been extracted which together explained 84.984 per cent of total variance.

Factor I:

First factor had emerged as a significant factor accounting for 35.882 percent of the total variance for determinant of interstate variation in agricultural productivity in period 2007-10. Five statements were loaded on this factor which was highly and positively correlated. These five out of 10 statements, namely, total Fertilizer consumption, Gross irrigated Area, total power consumption, Net irrigated Area and total Road length (***Scientific Infrastructure)*** were highly correlated. Thus, this factor had a very high potential for determining interstate variation in agricultural productivity in period 2007-2010.

Factor II:

Second factor had emerged as a major factor with percentage of variance equal to 23.288. Here again, two out of 10 statements were loaded in this factor. All these loadings, namely, per hectare availability of tractors and per hectare power consumption, ***(Supporting Infrastructure)*** was highly correlated. Thus factor II which had a high potential for determining interstate variation in agricultural productivity in period 2007 -2010.

Factor III:

Third factor had emerged as a major factor with percentage of variance equal to 14.932. Here again, one out of 10 statements was loaded in this factor. All these loadings, namely, Road density were highly correlated. All these loadings belong to factor III which had a high potential for determining interstate variation in agricultural productivity in period 2007-2010.

Factor IV:

Fourth factor had emerged as a major factor with percentage of variance equal to 10.882. Here again, one out of 10 statements was loaded in this factor. All these loadings namely, credit per hector was highly correlated. All these loadings belong to factor IV which had a high potential for determining interstate variation in agricultural productivity in period 2007-2010.

Table 9: Determinants of Inter State Variation for Agricultural Productivity **Period of Recovery**

Variables	Factor loading of factor				Communality
	Factor I	Factor II	Factor III	Factor IV	
TFC(Total fertilizer consumption	0.933	-0.232	0.008	0.058	0.891
GIA (Gross Area Irrigated)	0.862	-0.369	-0.249	-0.080	0.882
TPC(Total power consumption)	0.853	0.273	0.200	0.223	0.953
NIA(Net Area irrigated)	0.851	-0.411	-0.245	-0.020	0.948
TRL(Total Road Length)	0.824	-0.247	0.296	0.328	0.751
HPC(Hect Power Consumption)	0.634	0.673	0.286	0.100	0.784
TPH(Total power consumption)	0.445	0.529	-0.446	-0.323	0.928
PHF(Per hect fertilizer)	0.328	0.371	0.576	-0.359	0.687
RD(Road Density)	-0.231	-0.318	0.763	-0.046	0.739
CPH(Credit per hectare)	-0.176	0.246	-0.216	0.783	0.935
Eigen Value	4.819	1.353	1.301	1.025	
Variance Explained	35.882	23.288	14.932	10.882	
Cumulative Variance Explained	35.882	59.170	74.102	84.984	

Extraction method: Principal Component Analysis
Rotation method: Varimax with Kaiser Normalization

Thus, the analysis reveals that the variables considered in the analysis were of complementary nature and have to be provided simultaneously to favourably affect interstate variations in Agriculture Productivity. For increasing the Agriculture productivity through reduction in interstate variation, different variables, like availability of irrigation infrastructure, power supply, availability of fertilizer at the right time and kind and metalled road have to be provided simultaneously. Creation of ***scientific infrastructure*** supported by ***physical infrastructure*** can, therefore, go a long way in stepping up the agricultural productivity through reduction in interstate variations. This calls for a ***New Green Revolution***. This requires huge public investment to strengthened different infrastructure structures such as water resource management, availability of power for tube wells operation and fertilizer applications.

The historical and spatial growth analysis of Indian agriculture suggests that growth performance of the sector has been highly uneven across time and regions. The period of wider dissemination of technology can be considered as period during which the spread of green revolution technologies across regions aided in maintaining the growth tempo realized in the previous period. However, the post reforms period witnessed a visible deceleration of growth in most of the states and this can be attributed to a significant diversion of resources away from agriculture. Both public and private investment suffered a slow down during this period and the effect was manifested in sluggish performance in the sector as a whole. Moreover, the use of primary inputs in the sector also slowed down due to which the yield of most of the crops went down. The retardation of growth continued up to the year 2005-06 after which a sharp recovery in growth was realized, the reason for which can be attributed to a conscious hike in public and private investment and substantial improvement in terms of trade in favor of agricultural sector. More than a matter of chance or as a brief spell of improvement, the recovery can be considered as the result of an significant alteration in strategy that put considerable focus on the agriculture sector, be it a rapid expansion of agricultural credit, reinvigorated growth in the distribution of quality seeds or substantial outlay of public and private investment in the sector. However, the future growth in the sector relies a lot on the manner in which the resources in the sector are put into productive use and the degree to which farmers are incentivized to continue with farming profession.

To raise agriculture productivity of India is not just a cumbersome task in hand due to the fragmented land holding issue, but also quite important seeking a resolution at the earliest. It is believed that this problem to a great extent can be solved with the consolidation of land holding. With the primary aim to increase the self reliance of the Indian farmers, various steps and initiatives have to be adopted by government time and again. Productivity of all crops needs to climb in India. It is believed that labour and socio-economic factors are acting as major hindrance to the growth prospects of India's agricultural sector. India is witnessing the daunting challenge of addressing the growing issue of escalating demand for food stock. If the present manufacturing practices are continued, India may soon witness food crisis and poverty level go up tremendously.

It is believed that the India’s banking sector has adopted suggestive steps to assist the excluded or unbanked people residing in the hinterlands of India. Despite these measures, the rural poor condition has not changed much. A few of the major reasons for this situation are the inefficiencies in the formal finance institutions, poor regulatory framework, high transaction costs and also the risk factors of lending to agriculture sector. Farm loans are not available on time and it is hitting the productivity in a major way. Besides that, many at times, the farmers use the loans for different purposes such as marriage etc. Governments should ensure that farmers receive loans on time and also they are used only for agricultural purposes. The need of the hour is to build a strong public-private partnership (PPP) with the aim to resolve the growing issue of food security in the country.

Annex Table 1: Zero Order Correlation Matrix of Factor Affecting Inter State Variation in Agriculture Productivity: Average of 1990-1993

Variable	AP	TPC	HPC	NIA	GIA	CPH	TPH	TFC	PHF	TRL	RD
AP	1.00	.217	-.079	.895**	.907**	-.021	.383	.628**	.327	.599**	.059
TPC	×	1.00	.713**	.266	.379	.270	.425	.594**	.730**	.272	.011
HPC	×	×	1.00	.036	.147	.095	.494*	.100	.372	-.122	-.131
NIA	×	×	×	1.00	.975**	-.135	.367	.680**	.296	.526*	-.076
GIA	×	×	×	×	1.00	-.084	.416	.664**	.382	.473*	-.074
CPH	×	×	×	×	×	1.00	.036	.214	.630**	.204	.181
TPH	×	×	×	×	×	×	1.00	.164	.235	.081	-.069
TFC	×	×	×	×	×	×	×	1.00	.652**	.744**	.102
PHF	×	×	×	×	×	×	×	×	1.00	.225	.017
TRL	×	×	×	×	×	×	×	×	×	1.00	.185
RD	×	×	×	×	×	×	×	×	×	×	1.00

*: Correlation is significant at the 0.05 level (2-tailed).

**: Correlation is significant at the 0.01 level (2-tailed).

Annex Table2: Zero Order Correlation Matrix of Factor Affecting Inter State Variation in Agricultural Productivity Average of 2000-2003

Variable	AP	TPC	HPC	NIA	GIA	CPH	TPH	TFC	PHF	TRL	RD
AP	1.00	.423*	.228	.871**	.862**	.178	.178	.690**	.423*	.719**	.047
TPC	×	1.00	.871**	.492*	.441*	.436*	.240	.382	.513**	.606**	-.157
HPC	×	×	1.00	.288	.267	.587**	.325	.241	.606**	.369	-.121
NIA	×	×	×	1.00	.984**	.146	.396*	.736**	.494*	.690**	-.074
GIA	×	×	×	×	1.00	.165	.405*	.746**	.562**	.650**	-.019
CPH	×	×	×	×	×	1.00	.052	.233	.485*	.425*	.128
TPH	×	×	×	×	×	×	1.00	.262	.327	.014	-.284
TFC	×	×	×	×	×	×	×	1.00	.596**	.525**	.003
PHF	×	×	×	×	×	×	×	×	1.00	.421*	-.024
TRL	×	×	×	×	×	×	×	×	×	1.00	.016
RD	×	×	×	×	×	×	×	×	×	×	1.00

*: Correlation is significant at the 0.05 level (2-tailed).
**: Correlation is significant at the 0.01 level (2-tailed).

Annex Table3: Zero Order Correlation Matrix of Factor affecting Inter State Variation in Agriculture Productivity: Average of 2007-2010

Variable	AP	TPC	HPC	NIA	GIA	CPH	TPH	TFC	PHF	TRL	RD
AP	1.00	.448*	.198	.889**	.917**	-.117	.371	.868**	.302	.686**	-.129
TPC	×	1.00	.828**	.527**	.514**	-.093	.359	.734**	.422*	.798**	-.237
HPC	×	×	1.00	.245	.255	-.041	.429*	.414*	.494*	.491*	-.141
NIA	×	×	×	1.00	.981**	-.165	.419*	.851**	.237	.694**	-.203
GIA	×	×	×	×	1.00	-.166	.493*	.872**	.301	.659**	-.185
CPH	×	×	×	×	×	1.00	-.019	-.148	-.150	-.081	-.057
TPH	×	×	×	×	×	×	1.00	.373	.383	.094	-.369
TFC	×	×	×	×	×	×	×	1.00	.452*	.837**	-.158
PHF	×	×	×	×	×	×	×	×	1.00	.293	.090
TRL	×	×	×	×	×	×	×	×	×	1.00	.041
RD	×	×	×	×	×	×	×	×	×	×	1.00

*: Correlation is significant at the 0.05 level (2-tailed).

**: Correlation is significant at the 0.01 level (2-tailed).

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