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Regional Variations in Agricultural Development of Andhra Pradeshsh – A Factor Analysis

KEYWORDS: Regional Variations, Factor loadings, principal component

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ABSTRACT *The need for reducing regional disparities has been argued from various angles. The firs argument is in terms of social justice, it is believed that income inequalities can be reduced by way of reducing regional disparities. Hence, reduction in regional disparities is crucial from the point of accelerating the growth of the economy. There is complementary between reduction in regional disparities and the prosperity of the economy. The specific objectives of the study are to study the inter- regional and intra-regional disparities in the agricultural development of Andhra Pradesh and t o identify the factors causing the disparities in the agricultural development of Andhra Pradesh.*

Consistent with the objectives of the study. Present study uses Principal component analysis for the benchmark years 1990-91and 2011-12 in order to capture relative positions of individual districts/regions in terms of ranks have also been obtained. These ranks are to be understood in an inverse manner, to be precise, the lower the value of rank higher is the index of agriculture development and vice-versa.

Irrigation would play a critical role in the development process particularly public investment in surface irrigation; specifically canal irrigation should be increased. Priority should be given to backward regions and low rainfall regions. The most backward districts in respect of important and social variables have to identify and programmes should be implemented with close monitoring.

Regional inequalities are a development challenge in most developing countries, especially those with large geographic areas under their jurisdiction. Following India's market linearization in the early 1990's. Many development theories showed that regional disparities are inherent in the process of development, Myrdal (1975), the analysis of long run data showed that income inequalities across Indian states have increased mildly till mid eighties and rapidly afterwards (Subramanayam&Rajgopal, 2000 and Govind Rao et-al, 1999).

The need for reducing regional disparities has been argued from various angles. The firs argument is in terms of social justice, it is believed that income inequalities can be reduced by way of reducing regional disparities. Hence, reduction in regional disparities is crucial from the point of accelerating the growth of the economy. There is complementary between reduction in regional disparities and the prosperity of the economy.

In a federal state like India the policies and strategies formulated under plans at the national level have their implications at state level also. Therefore, inter regional and intra-regional disparities at the state level assume paramount importance. In order to capture inter and intra-regional disparities as well as influencing factors for agricultural development. The present paper made a modest attempt to examine the above aspects by taking the experience of Andhara Pradesh as case study.

The state of Andhra Pradesh is the fourth largest state in India both in terms of area and population came in to existence on November 1, 1956 under the State Re-Organization Act, which consists of 23 districts distributed over three geographical regions namely, Coastal Andhra (9 Districts), Rayalaseema (4 Districts) and Telanga(10 Districts). The state of Andhra Pradesh replicates growing inter--regional disparities in economic development these disparities may be due to disparities in industry or agriculture. The three constituent regions of Coastal Andhra, Rayalaseem and Telangana represent unequal economic development since, Andhra Pradesh continues to predominately agricultural state. 68 per cent of population depending on agriculture and, over 70 per cent cropped area under production of food grains. A study on regional disparities is necessary. Apart from this the resource endowment differences among districts in a particular region also influence the regional disparities in agricultural development. Though, there are quite a number of studies dealing with regional disparities they have not focused on regions and factors contributing to crucial problem of regional disparities. Hence, the present study made a modest attempt to identify the different factors and assess their role across the regions of Andhra Pradesh during the period of 1990-91 (ending triennium) to 2009-10 to overcome the year-to-year fluctuations triennium average is taken for the analysis.

OBJECTIVES OF THE STUDY:

1. To study the inter- regional and intra-regional disparities in the agricultural development of Andhra Pradesh.
2. To identify the factors causing the disparities in the agricultural development of Andhra Pradesh.

Towards the end of objectives mentioned, the following is the methodology adopted.

Methodology

There are two major problems in the construction of agricultural development index. First, related to the methodology to be used for deriving weights second and more important problem is the selection of indicators. Keeping in view of the facts present study has considered 12 indicators. The various possible factors which 'apriori' likely affect the agricultural development. The selection of indicators is based on the premise that agricultural development of any region or district depends on the following factors.

- Water availability
- Adoption of Modern Technology
- Availability of agricultural infrastructure facilities

It is presumed that better irrigation facilities and adoption of mechanization lead to faster agricultural development. Hence, the following indicators are selected in order to construct agriculture development index.

1. Irrigation Intensity,
2. Proportion of assured irrigated area.
7. Fertilizer consumption
8. Agricultural credit

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3. Cropping intensity.
4. Total rainfall.
5. Pump sets per 100 hect.
6. Tractors per 100 hect.
9. Spread of HYV
10. Agricultural workers
11. Agricultural Production
12. Literacy

Consistent with the objectives of the study. Present study uses Principal component analysis for the benchmark years 1990-91and 2011-12 in order to capture relative positions of individual districts/regions in terms of ranks have also been obtained. These ranks are to be understood in an inverse manner, to be precise, the lower the value of rank higher is the index of agriculture development and vice-versa.

Principal Component Analysis

Principal component method begins with normalizing the variables in such a way that mutual comparison is possible. Normalization is done by expressing the deviations from the original observations with regard to their arithmetical mean in their standard deviation. If the number of observations (districts) ranges from 1 to N and number of variables (indicators) from 1 to n, then X_1 be the Jth observed variable relating to ith observation.

For the purpose of normalizing the variables the following formulae is obtained;

$$Z = \frac{X_{ji}}{X_j} \qquad X = \frac{X_{ji}}{N}$$

$$X_j = {}^2{}_{xj} \qquad (X_{ji} - X_j)$$

Where

$X_{ji} = X_{ji} - X_j$

(j = 1, 2……n) (I = 1,2……N)

The expected value (i.e. the mean) of normalized variables like this equals 'O' and variance equals '1'. Each of the normalized variable Zj is then related separately to the hypothetical variables i.e., principal components. These relations are linear and have the following analytical expression.

$$Z_j = a_{jl} P_1 + a_{j2} P_2 + \ldots\ldots a_{ji} P_i + a_{jm} P_m \ldots\ldots (1)$$

The first principal component is the linear combination of weighted variables, which explains the maximum of variance. Then

$$P_i = a_{11} Z_1 + a_{21} Z_2 + \ldots a_{n1} Z_n$$

The composite index of agriculture infrastructure at the sectoral level or at aggregate level is nothing but the first principal component of the variables. Then the equation of composite index for the i^{th} region is as follows:

$I_1 = a_j Z_{ji}$

Where

I1 = The composite index of infrastructure of i^{th} region (I = 1, 2 …N) =

(J = 1, 2, n) factor loading on the first principal component.

= (j=1, 2, ..n) jth standard normal variable of i^{th} region of (I = 1,2..N).

= 2….n are the Co-efficients or factor loadings of

= 1, 2, …m the jth variable relating to jth component.

Thus each component explains certain portion of variance of i^{th} variable. To put it in other word, each Principal component is a linear combination of weighted variables. This can also be written as:

Where a_j = factor loading of 'j' variables.

J =1, 2, ….n or

$P_i =$ $a_{ji} x$ ia2$_i$ x 2 + a3 x 3….an$_i$ x n….(2)

$P_{i =}$ 1, 2,…..m (components).

$a_{ji =}$ factor loading of jth variable of i^{th} component

$x_{j =}$ Variables

In the above model, each of 'n' normalized observed variables is described linearly in terms of 'n' new uncorrelated components P_1, $P_{2 \ldots .}$ P_n. Only one relationship of variables is derived from each separate component 'P_n' the coefficients of a_{jn} indicate to what extent and in which direction the normalized variables Z_j are related to the components of 'P_n'. For any individual observation (district). The same logic of the model applies and therefore, the mathematical sign 'i' (i = 1, 2, …N) is ignored.

Table 1:Composite Index of Agricultural Development in Proportion to Variance

S.No.	District	1990-91	Rank	2011-12	Rank
1.	Srikakulam	-0.031	9	-0.025	9
2.	Vishakapatnam	- 0.006	6	- 0.060	16
3.	East Godavari	0.056	3	0.038	3
4.	West Godavari	0.086	1	0.094	1
5.	Krishna	0.063	3	0.052	5
6.	Guntur	0.008	5	-0.048	13
7.	Prakasham	-0.063	15	-0.063	17
8.	Nellore	0.065	2	-0.012	6
9.	Kurnool	-0.079	17	-0.091	20
10.	Ananthapur	-0.100	21	-0.123	21
11.	Kadapa	-0.080	18	-0.068	18
12.	Chittoor	-0.024	7	-0.060	15
13.	Ranga Reddy	-0.031	8	-0.045	12
14	Nizamabad	-0.037	10	0.065	2
15.	Medak	- 0.077	16	-0.027	10
16.	Mahaboobnagar	-0.089	19	-0674	19
17.	Nalgonda	-0.061	14	0.016	8
18	Warangal	-0.060	13	-0.014	7
19.	Khammam	-0.052	12	-0.047	11
20.	Karimnagar	-0.051	11	0.037	4
21.	Adilabad	-0.090	20	-0.050	14
Coastal Andhra		0.196	1	0.138	1
Rayalaseema		-0.002	3	-0.043	3
Telanagana		0.080	2	0.102	2
Andhra Pradesh		0.391		0.324	

FINDINGS OF THE STUDY

By following the above mentioned the 21 districts of A.P. are ranked on the basis of the agriculture development. As pointed out earlier 12 variables are taken for analysis. The districts are ranked on the basis of their aggregate scores over 12 identified variables. The ranking of the districts are done at two different points of time i.e. 1990-91 and 2011-12

As it is evident from the table –1 that composite development index of the state as whole was 0.391, it is found that coastal Andhra occupied first place followed by Telangana and Rayalseema during the two bench mark years. One can infer from the above that there is no change in the relative positions of regions which implied that the regional disparities in the agricultural development did not come down over a period of time, implying that developed region remained developed and backward remains backward in terms of agriculture agricultural development in Andhra Pradesh, in spite of considerable development that has taken place.

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When we analyze intra-regional disparities, it is observed that West-Godavari stands first followed by Nellore, East Godavari and Krishna in the scale of agricultural development and least developed districts are Prakasham and Srikakulam in coastal Andhra region, Chittor stands first and Kurnool the least in Rayalseema region. In Telangana region Nizamabad stood first followed by Karimnagar, Khammam and Warangal in 1990-91 When we compared disparities in the benchmark year 2011-12 West Godavari remained in the same position i.e. it stands first in the scale of development followed by Nizamabad, East Godavari and Krishna.

Factor Analysis:

In order to identify the package of variables which affect inter-regional and intra-regional disparities in agricultural development Regression Analysis may be applied. Due to various problems encountered in regression analysis, Factor Analysis is often applied to isolate the group of variables in to factors Adelman and Morries and others have recommended factor analysis as an appropriate technique in isolating the determents. The procedure for the factor analysis, which attempts to estimate the value of coefficient of regression where variables are regressed upon factors. The coefficient of regression are referred in5 factor analysis literature is Factor Loadings. In the present study the "Principal Axis Method" is used to get these coefficients.

The factor loadings are rotated in order to have better explanation and interpretation of new factor loadings. While variety of criteria or methods are available in literature. The present paper applies "kisser's varimax criterion". The study also adopted Burt and Banks criteria to know the significance of factor loadings.

Table: 2
FACTORS IN AGRICULTURAL DEVELOPMENT ROTATED-MATRIX-1990-91

FACTORS					
Variables	F_1	F_2	F_3	F4	Communalities
X_{12} Agri. Production	0.998	0.20	0.007	0.025	0.99
X_{5}Agri. Workers	0.996	--031	0.057	0.017	0.99
X_{2} Fert. Consumption	0.989	0.050	-0.003	0.002	0.98
X_{3} Agri. Workers	0.987	0.080	0.030	0.041	0.98
X_{1} Tractors	0.981	0.097	-0.032	0.010	0.97
X_{5}Ari. workers	0.916	-0.064	0.025	0.012	0.84
X_{6} Pumpsets	0.384	0.899	0.621	0.182	0.84
X_{9} HYV	0.057	0.883	0.108	0.199	0.82
X_{10} Irrigation extent	.0.063	0.719	-0.415	-0.184	0.55
X_{11} Literacy	0.106	0.576	0.134	0.470	0.56
X_{4} Rainfall	0.044	0.395	0.1125	0.769	0.74
X_{8} Irrigation Intensity	-0.000	0.123	-0.909	-0.746	0.57
Latent Roots	5.67	2.63	1.44	1.47	
% Variance Explained	48.07	21.94	12.54	12.31	
% Cumulative variance explained	48.07	70.1	79.60	82.32	
Critical Value	0.714	0.732	0.751	0.751	

Note: Factor Analysis with Varimax Rotation was used

Table 2 presents the results of Rotated Matrix for 1990-91 the factors have been extracted on the basis of Kiser Varimax criterion, which is only factors with the latent roots greater than one are estimated. The table shows that the three factors with latent roots more than one could extract from the data together they could explain 82 per cent of variance of 12 indicators of agricultural development.

The first factor F1, explains nearly 48 per cent of total variance which consists of six significant factor loadings, that are well correlated these loadings include agricultural production , agricultural workers, and four indicators of capital used in agriculture Viz: agriculture credit, tractors, and fertilizer consumption. One can infer from the above analysis that agriculture output explains nearly about half of variance in agricultural development during 1990-91.

The Second factor F2 explains 22 percent of variance of indicators of agricultural development. This factor has only two significant factor loadings i.e. high yielding varieties and irrigation. I t is well known that the productivity of high yielding varieties depend on assured supply of water which is provided by irrigation. Thus we see that the new seed technology contributes about 22 percent.

The third factor F3 explains nearly 12 per cent of total variance. It is unique factor having only one significant factor loading i.e. rainfall. To summarize the results we could say that output, capital and labour contributed half of variations in the indicators of agricultural development. The new seed technology contributed about 22 per cent and rain fall 12 per cent.

Table: 3
FACTORS IN AGRICULTURAL DEVELOPMENT ROTATED-MATRIX-2011-12

FACTORS					
Variables	F_1	F_2	F_3	F4	Communalities
X_{3} Agri.Credit	0.998	-0.006	0.053	0.025	0.99
X_{1} Tractors	0.990	-0.045	0.057	0.041	0.98
X_{12} Agri. Production	0.982	-0.097	-0.003	0.043	0.97
X_{2} Ferti. Consumption	0.981	-0.073	0.030	0.037	0.97
X_{6} Pump sets	0.945	0.107	-0.032	0.054	0.91
X_{5}Ari. workers	0.932	-0.093	0.025	-0.189	0.91
X_{11} Literacy	0.087	-0.557	0.621	0.113	0.72
X_{8}Irriga. intensity	0.012	-0.140	0.108	0.936	0.91
X_{9} HYV	.0.025	-0.763	-0.415	0.435	0.91
X_{10} Irrigation Intensity	0.009	0.871	0.134	0.305	0.87
X_{7} Crop.Intensity	0.010	-0.833	0.1125	-0.217	0.76
X4 Rainfal	-0.003	-0.196	-0.909	-0.046	0.86
Latent Roots	5.67	2.43	1.44	1.264	
% Variance Explained	47.3	20.33	12.54	1054	
% Cumulative variance explained	47.3	67.60	79.60	90.13	
Critical Value	0.714	0.732	0.751	0.714	

Note: Factor Analysis with Varimax Rotation was used

Table 3 presents the results of the factor analysis of indicators of agricultural development during 2011-12 four factors together explain about 90 per cent total variance of the indicators. The first factor F1, explains about 47 per cent of

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total variance. The six significant factor loadings comprising agricultural output, workers, and capital namely agriculture credit, tractors, pump sets and fertilizer consumption, which implies that the four factors together explains about half of the variance in selected variables of agricultural development.

The second factor F2, accounts for about 20 per cent of variance in the variables. It has three significant factor loadings consists of high yielding varieties, irrigation extent and cropping intensity. Therefore, we see that high yielding varieties are well correlated with irrigation. However, in the year 2011-12 we found that these are combining with cropping intensity as well.

The third and fourth factors F3 and F4 have unique factor each which account for 12 and 10 per cent in that order. As stated above the third factor is rainfall and fourth factor is irrigation intensity. Irrigation intensity is the only significant loading and irrigation intensity and rainfall accounts for 10 and 12 per cent variations respectively.

To summarize the Rotated Factor Matrix results for the 2011-12, the major influencing factors are technological like tractors, fertilizer consumption, pump sets, irrigation extent. Institutional factors like agricultural credit and labour. These factors are continuously playing a predominant role in explaining disparities in agricultural development of Andhra Pradesh.

CONCLUSION:

Balanced regional development is going to be the major issue in future, because of the sharp increase in inter-regional and intra-regional disparities. The remedial measures for achieving the balanced regional development, the solution are in the near future lies in the development of agriculture.

Irrigation would play a critical role in the development process particularly public investment in surface irrigation; specifically canal irrigation should be increased. Priority should be given to backward regions and low rainfall regions. The most backward districts in respect of important and social variables have to identify and programmes should be implemented with close monitoring.

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