International Journal of Multidisciplinary Approach and Studies

ISSN NO:: 2348 – 537X

# Inter District Disparity in Agricultural Development of Assam: An Application of Principal Component Analysis

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**ABSTRACT:**

*The concept of regional disparity was first examined in the book 'Geography of France' by Vidal de La Blache in 1903. This concept of regionalization was widely studied between the two world wars. However, India recognized this concept much after the Second World War, only after the Third Five Year Plan. The concept of regionalization represents the actual method of geographic perception of the entire special economic diversity of the country designed to uncover territorial production complexes that then becomes the areal units in planning and constructive transformation of the economy. Here, the state plays a leading role in the economic life of the country. In this study, the intra state level regional disparity of the economic scenario of Assam is investigated. Thus, the main objective is to understand the inter district disparity in the agricultural development of Assam and to identify the backward districts. For this purpose, the method of Principal Component Analysis is used, first devised by H. Hotelling in 1993. After careful study, the advanced districts in the agricultural sector of Assam were found to be Darrang & Dhemaji and backward districts were identified as Kamrup, Karimganj & NC Hills. All other districts fall in the developing category.*

The problem of inter regional disparity in the levels of development is not of recent origin and is almost universal. Its extent may differ in different economies but its existence can hardly be challenged. Like other developing countries, India also suffers from acute and more explosive problem of regional disparities.

Assam, the gateway of the North East, is a victim of regional disparity as evident on its standings on number of development indicators, inspite of its vast natural resources. But what is even more striking is the fact that there is widespread intra state level of disparity beset with the economy of Assam itself. The inter-district is considerable, especially in the level of agricultural development in the state.

Hence, the main objective of the study is to examine the inter-district disparity in the agricultural development of Assam and to identify the backward districts.

The method of Principle Component Analysis had been deemed suitable for the purpose of examining the inter-district disparity.

The study suffers a lot due to non availability of relevant data and hence development indicators which have been taken in the study are because of convenience rather than suitability. As for instance, data on irrigation was not available. So, the conclusion which have been drawn are subject to criticism.

## REGIONALISATION AND IDENTIFICATION OF LEVELS OF INTER-DISTRICT DISPARITY

The concept of regionalisation represents the actual method of geographic perception of the entire special economic diversity of the country designed to uncover territorial production complexes that will then become the areal units in planning and constructive transformation of the economy. It leads to spatial elaboration of national plans, models or measures. It has got an added importance today because the state plays a leading role in the country's economic life. More important than the exact adhoc decisions about the reach of planning measures in time and space are the processes of timing and regionalisation.

The modern regional consciousness and thinking in terms of areas and regions instead of places and points began only in the beginning of the present century with the monumental work in 1903 on the 'Geography of France' by Vidal de La Blache. Regionalisation dominated all geographical literature between the two world wars. India recognised regionalisation much after the Second World War and not before the Third Five Year Plan.

Regionalisation is of recent origin in the field of Economics. Economic phenomena used to be elaborated and developed in a "Wonder World with no spatial dimension" prior to the second decade of the twentieth century. The spatial dimension was recognised only by the second decade when a theory of inter-regional trade was attempted. The 'determinist understanding of the character of a region' formed the basis of the 'fortunator' concept of regional delimination and the same was further stressed by Kruber, Semener-Tyan-Shanskiy etc. in the pre-revolution period of economic regionalization. After Second World War, a phenomenal and dramatic rise emerged in the regional consciousness leading to conference on economic regionalization rational as the Prague in 1957, international as in Poland in 1959. This also led to application of more and more sophisticated techniques in regionalization. Among the galaxy of the scholars who dealt with methodological issues are Kendall, Gregory, Berry, Johnston, King, McGee, Stone, Henshall, Bassetts and Downs, Tylor, Hagood, Danilevsky and Beum etc.

## TECHNIQUES OF REGIONALISATION:

Delineation of regions involves grouping of spatial units with due regard to contiguity and homogeneity. The underlying principle is to ensure within a region that the units have the similar characteristics and that between the regions the distance among the units are large. Grouping is done on the basis of a number of indicators pertaining to socio-economic dimensions. Various techniques from simple one to sophisticated one have been developed in the field. In the literature of quantitative approach to regionalization, many techniques are available to construct composite index by fusing the individual sectoral indices of development levels.

The technique of Principal Component Analysis is briefly stated below

**The Method of Principal Component**:

In our study the method of principal components, first devised by H.Hotelling in 1993, has been adopted for constructing the indices for agricultural development of different regions (districts) of Assam.

In contrast to other methods the principal components analysis has got certain special advantages. These are:

1. The method yields mathematical weightage in purely objective manner.
2. This technique has the advantage to tackle the situation when the number of variable is larger than the number of observations.
3. This approach has been suggested as a solution to the problem of multicollinearity.

The method of principal components is a special case of the more general method of factor analysis. The aim of the method of principal components is the construction out of a set of variables, Xj's(j=1,2,……..,K) of new variables $p_1$'s is called " Principal Components" which are linear combinations of the X's.

$$P_1=a_{11}X_1+ a_{12}X_2 +\ldots\ldots\ldots\ldots\ldots\ldots+a_{1k} X_k$$

$$P_k= a_{k1}X_1 + a_{k2}X_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots+ a_{kk}X_k$$

The a's called loading, are chosen so that the constructed principal components satisfy two conditions:

(a) The principal components are uncorrelated (orthogonal) and (b) The first principal component $P_1$ absorbs and accounts for the maximum possible proportion of the variation in the set of all x's, the second principal component absorbs the maximum of the remaining variation in x's (after allowing for the variation accounted for by the first principal component) and so on.

**Regionalisation- Computational Procedure:**

As the whole approach to regionalization has been made with the principal components analysis, it is necessary to draw the steps needed for finding out the first principal component. The method used for finding factor loading has been devised by C. Burt. The method may be outlined as follows:

1. Simple correlation coefficient between K explanatory variables has been estimated and these correlation coefficients were then arranged in a table in a matrix form called correlation table or correlation matrix. The main diagonal elements in the matrix are unity since the elements of these diagonals are the self-correlations, i.e., the correlation of each Xi with itself ($r_{xixi}$=1 for all i's ). The correlation matrix is symmetrical, ie., the elements of each row are identical to the elements of the corresponding columns, since,

   $$r_{xixj}=r_{xjxi}$$

2. Next step is the summing up of the elements of each column ( or row) of the correlation matrix and obtain k sums of the simple correlation coefficient.

   $$\sum_{j}^{k} r_{xixj} = \sum_{i}^{k} r_{xixj}$$

3. Subsequently the square root of the sum total of the column (or row) has been computed, that is,

$$\sqrt{\sum_{i}^{k}\sum_{j}^{k} r_{xixj}}$$

4. Next, the loadings (aij's) for the first principal component $P_1$ has been found out by dividing each column ( or row) sum by the square root of the grand total

$$a_{ij} = \left(\sum_{j}^{k} r_{xixj}\right) / \sqrt{\sum_{I}^{k}\sum_{j}^{k} r_{xixj}}$$

where i refers to the ith variable X.

**REGIONALISATION IN ASSAM- METHODOLOGY AND DATA BASE:**

Coming to methodology of regionalization, first it is felt necessary to determine and select the indicators of agricultural development in order to identify the levels of development of different districts. In the present study six indicators of agricultural development have been worked out. These are : per capita agricultural production, per capita bank credit to agriculture, percentage share of labour force in agriculture sector, amount of fertiliser consumption per hectare, percentage share of cultivators and agricultural labours to the total population, and net sown area as a percentage of reporting area. Index of agricultural development for different districts of Assam have been worked out with the help of first principal component using the six indicators stated above. The study has considered all the twenty three districts of Assam. The source of data is the Centre for Monitoring of Indian Economy (CMIE) and the statistical data is the latest available, relating to the year 1994.

**APPLICATION OF THE PRINCIPAL COMPONENTS ANALYSIS MODEL FOR ASSAM:**

For finding out the level of agriculture development of each district of Assam and in order to identify the backwards districts, the following six indicators are chosen:

X1 = Per capita Agricultural Production (in '000 Rupees)

X2 = Per capita Bank Credit to Agriculture (in Rupees)

X3 = Percentage share of labour force in agriculture sector

X4 = Amount of fertiliser consumption per hectare (in kg)

X5 = Percentage share of cultivators and agriculture labours to the total population

X6 = Net sown area as percentage of reporting area.

Details of these indicators are given District wise in the following table 1

***TABLE-I District Wise Values of Different Indicators***

| Districts | X1 | X2 | X3 | X4 | X5 | X6 |
|---|---|---|---|---|---|---|
| Barpeta | 0.595 | 62 | 76.31 | 11 | 19.83 | 53.47 |
| Bongaigaon | 0.733 | 103 | 74.48 | 8 | 22.14 | 42.61 |
| Cachar | 0.959 | 105 | 69.04 | 11 | 16.35 | 29.16 |
| Darrang | 1.297 | 151 | 83.95 | 9 | 23.10 | 57.64 |
| Dhemaji | 1.938 | 112 | 85.65 | 6 | 28.44 | 29.28 |
| Dhubri | 0.457 | 30 | 75.85 | 9 | 19.88 | 52.00 |
| Dibrugarh | 2.406 | 248 | 68.64 | 9 | 13.13 | 30.33 |
| Goalpara | 0.733 | 112 | 75.16 | 8 | 21.48 | 42.61 |
| Golaghat | 0.878 | 89 | 80.92 | 21 | 22.42 | 34.18 |
| Hailakandi | 0.959 | 217 | 77.20 | 11 | 18.56 | 29.61 |
| Jorhat | 0.980 | 135 | 68.94 | 11 | 17.04 | 43.36 |
| Kamrup | 0.335 | 269 | 45.44 | 17 | 12.42 | 37.37 |
| Karbi- Anglong | 0.907 | 125 | 84.86 | 6 | 31.25 | 12.24 |
| Karimganj | 0.428 | 66 | 68.87 | 11 | 16.09 | 34.78 |
| Kokrajhar | 0.763 | 81 | 84.02 | 6 | 27.62 | 29.87 |
| Lakhimpur | 1.938 | 112 | 80.48 | 6 | 23.89 | 29.28 |
| Morigaon | 0.907 | 40 | 82.21 | 14 | 23.34 | 56.34 |
| Nagaon | 0.907 | 75 | 74.30 | 14 | 20.36 | 56.34 |
| Nalbari | 0.606 | 69 | 71.63 | 5 | 18.06 | 72.77 |
| NC Hills | 0.496 | 110 | 62.80 | 7 | 22.93 | 4.29 |
| Sibsagar | 1.954 | 135 | 75.39 | 8 | 18.55 | 53.46 |
| Sonitpur | 0.519 | 94 | 77.80 | 8 | 20.89 | 30.04 |
| Tinsukia | 2.406 | 29 | 71.95 | 9 | 15.05 | 30.33 |

***SOURCE: CMIE***

The variable in the table-I are found to be mutually correlated and the corresponding correlation given in the table-II

***TABLE-II***

| | X1 | X2 | X3 | X4 | X5 | X6 |
|---|---|---|---|---|---|---|
| X1 | 1.000 | 0.1583 | 0.2433 | -0.2390 | -0.0621 | -0.1301 |
| X2 | 0.1583 | 1.000 | -0.4383 | 0.1390 | -0.3074 | -0.2668 |
| X3 | 0.2433 | -0.4383 | 1.000 | -0.3045 | 0.7491 | 0.1313 |
| X4 | -0.2390 | 0.1390 | -0.3045 | 1.000 | -0.3604 | 0.0907 |
| X5 | -0.062 | -0.3074 | 0.7491 | -0.3604 | 1.000 | -0.17082 |
| X6 | -0.1301 | -0.2668 | 0.1313 | 0.0907 | -0.17082 | 1.000 |

Thus the first principal Component $P_{1i}$ is

$P_{1i} = 0.460\ Z_1 + 0.135\ Z_2 + 0.655\ Z_3 + 0.154\ Z_4 + 0.402 Z_5 + 0.310\ Z_6$ ……..(1)

Z's are the standardized values of X's and they are obtained by substracting the X's from their respective means and dividing them by the respective standard deviation.

The index of agriculture development has been estimated with equation (1). These are given district wise with their respective classes of occurrence (Table IV). The classification of indices has been done in the way as given in table III.

***TABLE : III Classification of indices***

| Class interval | Status | Symbols |
|---|---|---|
| Below (-2.198) | Very low | V.L. |
| -2.198 to -1.099 | Low | L |
| -1.098 to 1.102 | Moderate | M |
| 1.103 to 2.202 | High | H |
| Above 2.202 | Very high | V.H. |

***TABLE: IV Values of indices and classes of their occurrence***

| Districts | Values of index | Ranking | Symbols |
|---|---|---|---|
| Barpeta | -0.034 | 12 | M |
| Bongaigaon | -0.121 | 15 | M |
| Cachar | -1.013 | 20 | M |
| Darrang | 1.557 | 2 | H |
| Dhemaji | 1.848 | 1 | H |
| Dhubri | -0.619 | 19 | M |
| Dibrugarh | -0.108 | 11 | M |
| Goalpara | -0.108 | 14 | M |
| Golaghat | 0.833 | 7 | M |
| Hailakandi | 0.052 | 10 | M |

| | | | |
|---|---|---|---|
| Jorhat | -0.599 | 18 | M |
| Kamrup | -2.860 | 23 | VL |
| Karbi- Anglong | 0.951 | 6 | M |
| Karimganj | -1.427 | 21 | L |
| Kokrajhar | 1.079 | 4 | M |
| Lakhimpur | 1.053 | 5 | M |
| Morigaon | 1.089 | 3 | M |
| Nagaon | 0.302 | 9 | M |
| Nalbari | -0.378 | 16 | M |
| NC Hills | -1.923 | 22 | L |
| Sibsagar | 0.832 | 8 | M |
| Sonitpur | -0.412 | 17 | M |
| Tinsukia | -0.065 | 13 | M |

Ii should be noted that minus sign in the indices does not mean negative agriculturalisation. It shows the relative distances in the agricultural development.

**Identification of the levels of agriculture development of the districts: -**

Following the table IV, the levels of agricultural development of the districts of Assam can be identifies by arranging the districts in the following manner :

a) Advanced district : Darrand, Dhemaji

b) Developing district : Barpeta, Bongaigaon, Cachar, Hailakandi, Jorhat, Karbi Anlong, Kokrajhar Lakhimpur, Morigaon, Nagaon, Nalbari, Sibsagar, Sonitpur, Tinsukia.

c) Backward districts : Kamrup, Karimganj, NC Hills.

Although districts are divided into three broad categories as mentioned above, yet the present status of agriculture in Assam, compared to some other state of India, is quite backward.

Great care has been taken to avoid error bias in the study, but this study cannot be said to be totally free of errors as for some districts some exclusive indicators were not available and hence some approximation has been taken. The conclusions arrived at are subject to criticism. The main purpose of the study was to show the application of principal component analysis.

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