# Identification of Economic Zones in Bihar and Madhya Pradesh through a District-based Cluster Analysis

PRABHAT P GHOSH

**ADRI**

Asian Development Research Institute

**Disclaimer**
This monograph may not reflect the views held by the Asian Development Research Institute (ADRI) or any of its sister concerns. Usual disclaimers apply.

The development crisis in India has generally been characterized in terms of the low growth rate of its economy, with limited attention being paid to the regional inequalities that the growth process has consistently entailed. A recent comprehensive exercise analyzing the growth and inter-state disparities in India since the seventies clearly indicates a tendency for the Indian states to have 'diverged' vis-à-vis their per capita income status (Dasgupta, et al, 2000). The study further shows that the relative ranking of the states in terms of their per capita income has remained practically unchanged for the last 30 years; in other words, the states that were poor (rich) earlier are also the ones that continue to be poor (rich) today. Among the 15 major Indian states (each having a population of 20 million or more), Bihar has consistently been at the bottom, whereas Madhya Pradesh too has always been around the tenth position. Obviously, the intensity of the development crisis in these two states is much higher. But, just as the national indicators hide the inter-state disparities in development, the state-level indicators suffer from the same limitation vis-à-vis the inter-district disparities. The rationale for identifying the economic zones in each state with respect to their levels of development lies not merely in presenting a fuller description of the development process, but the exercise also often carries the potential of providing certain clues for analyzing the phenomenon. The present exercise of  identifying the main economic regions of Bihar and Madhya Pradesh, through a statistical cluster analysis, does indeed reveal some important dimensions of their respective development dynamics which could not have emerged from the state-level aggregates.

In the face of several dimensions of development, an empirical exercise like this must start with a delimitation exercise, resulting in a choice of development indicators which together adequately represent the development process and yet small in number so that meaningful interpretations of the empirical (statistical) result are possible. Such a choice of development indicators is also often constrained by the availability of empirical data on them. Our choice of development indicators for the present exercise was limited to only 9 variables and the rational for this choice is explained in the next section along with

the nature of database (Section II). Having chosen the indicators, the exercise then proceeds to divide the districts[1] of Bihar and Madhya Pradesh, through an exercise in cluster analysis, into a number of ranked groups and the results of this analysis is presented next (Section III). This cluster analysis has been done, for reasons explained later, for three years — 1990-91, 1995-96 and 1999-00. Apart from discussing the profile of these emerging clusters, an inter-temporal comparison is also made in this section between the clustering patterns of 1990-91 and 1999-00 (they are a decade apart). As mentioned before, the main purpose of this cluster analysis (and identification of economic zones) is to make comparisons within each state; for a comparison between the two states, however, one is still left with no choice than to use the state-level aggregate figures. In the present exercise, we have attempted an inter-state comparison of development levels using the district-level data, which puts together all the districts of Bihar and Madhya Pradesh in a single 'basket' and then subjects them to a cluster analysis. The interesting results of this atypical, if not innovative, exercise are presented and discussed next (Section IV). The final part (Section V) underlines the important implications of the results for the overall objective of research under Crisis State Programmes in India.

## II.  Development Indicators

Although the level of  urbanization in Madhya Pradesh is substantially higher than in Bihar (26.6 and 10.5 percent, respectively), both the states are so rural that indicators which pertain to the development levels of their rural economy are probably of the foremost importance in judging their real levels of development. We had, therefore, initially choosen as many as six variables relating to the rural economy —  first, the value of agricultural output per hectare (productivity of agricultural economy), another one indicating crop diversification (composition of output) and four others indicating the strength of technical base of agriculture (structure of inputs). Of these, the variable on crop diversification, (measured as 'percentage of area under crops other than rice and

2

wheat') was dropped because cultivation of pulses and oilseeds is much wider in Madhya Pradesh even by small farms, because of certain agro-climatic advantage. As such, unlike in Bihar, a higher acreage under non-cereal crops does not really indicate diversification of the agricultural production in Madhya Pradesh. The four input variables were — (i) Irrigation coverage, (ii) Use of improved seeds, (iii) Level of tractorization and (iv) Use of fertilizer. The two variables retained, out of these four, were 'Irrigation coverage' and 'Use of fertilizer', partly because of the better quality of the data and secondly because the correlation coefficients of these two variables with other indicators (listed later) were lower, a desirable condition for such an exercise.

Besides agricultural development, a second category of variables that obviously merit attention for scaling overall development levels are those indicating the infrastructural development of the districts. Prima facie, such infrastructural facilities are supposed to 'cause' economic development and not an outcome of development process. But public investment on infrastructure has a tendency to flow to those regions which are already comparatively more developed and hence in need of further infrastructural support. Unfortunately, the availability of district-level information on infrastructural facilities is limited and secondly, the reliability of some of the available information is rather low. Thus, to cover six major dimensions of infrastructure – roads, electricity, communications, banking, education and health, one could identify only one variable for each dimension, except for banking for which the data was available for three indicators— 'Number of branches', 'Per Capita Deposit' and 'Credit–Deposit Ratio'. In the final exercise, however, only three out of six dimensions of infrastructural development were retained – roads, banking and education. The indicator of power infrastructure (Percentage of villages electrified) was dropped because of low reliability; the indicator for communication facilities (Number of Post Offices) was again dropped because of its high correlation with the 'Number of bank branches per lakh of population' (the chosen variable for banking infrastructure); and finally, the indicator for health infrastructure (Number of Primary Health Centres per lakh of population) was found to

display erratic correlations with other variables and hence not worthy of inclusion in the analysis. One suspects that many of these PHCs are so non-functional that their existence is only official. The ultimate choice for variables for infrastructural development was thus the following three — (i) Road length (km/ 100 sq km), (ii) Number of bank branches per lakh of population, and (iii) Number of primary schools per lakh of population.

Three remaining variables to indicate the development levels of the districts were all demographic — (i) Decadal growth rate of population, (ii) Level of urbanization, and (iii) Literacy rate. Of these, the population growth and literacy rates are expected to reflect the social developments of the districts, whereas the size of the (generally more productive) non-agricultural economy in different districts was sought to be captured through 'Level of urbanization'. It would have been desirable to have a variable which captures this phenomenon more directly, preferably 'Percentage of workers engaged in secondary sector' as is normally available from the census reports, but the data on sectoral distribution of workforce for the 2001census is yet to be published. The list of 9 variables — 3 each on agricultural, infrastructural and demographic features — finally chosen for the cluster analysis is presented in Table 1. These variables, it might be noted, are indeed chosen to indicate 'economic' development, not the 'human' development levels of the districts which generally involve much larger number of variables. For example, a study on human development status in districts of Andhra Pradesh (Mohanty, 2000) uses as many as 30 variables. For the purpose of delineating economic zones, however, the set of 9 variables has proved to be adequate.

As regards the reference year for the exercise, it was planned to be done for two years, one in the beginning of nineties (1990-91) and the other at the end (1999-00). The rationale for repeating the exercise for two years, separated by about a decade, was to

4

**Table 1 : List of Variables (Bihar and Madhya Pradesh)**

| No. | Variable | Description |
|---|---|---|
| **1990-91** | | |
| 1 | AGP1 | Value of Agricultural Production (Rs./ha.) |
| 2 | IRR1 | Gross Irrigated Area/Gross Cropped Area (Percentage) |
| 3 | FRC1 | Fertiliser Consumption (kg./ha.) |
| 4 | DGP1 | Decadal Growth Rate of Population (Percentage) |
| 5 | URB1 | Urban Population (Percentage) |
| 6 | LIT1 | Literacy Rate (Percentage) |
| **1995-96** | | |
| 1 | AGP2 | Value of Agricultural Production (Rs./ha.) |
| 2 | IRR2 | Gross Irrigated Area/Gross Cropped Area (Percentage) |
| 3 | FRC2 | Fertiliser Consumption (kg./ha.) |
| 4 | RDL2 | Road Length (km/100 sq. km.) |
| 5 | BBR2 | Bank Branches (no./ lakh population ) |
| 6 | PRS2 | Primary Schools (no./ lakh population) |
| 7 | DGP2 | Decadal Growth Rate of Population (Percentage) |
| 8 | URB2 | Urban Population (Percentage) |
| 9 | LIT2 | Literacy Rate (Percentage) |
| **1999-00** | | |
| 1 | AGP3 | Value of Agricultural Production (Rs./ha.) |
| 2 | IRR3 | Gross Irrigated Area/Gross Cropped Area (Percentage) |
| 3 | FRC3 | Fertiliser Consumption (kg./ha.) |
| 4 | DGP3 | Decadal Growth Rate of Population (Percentage) |
| 5 | URB3 | Urban Population (Percentage) |
| 6 | LIT3 | Literacy Rate (Percentage) |

**Note :** (1) Values of DGP2, URB2 and LIT2 are estimated through interpolation of corresponding values for 1990-91 and 1999-00.

(2) For 1999-00, while the values for AGP3, IRR3 and FRC3 relate to the year itself, those for DGP3, URB3 and LIT3 are obtained from the census of 2001 which was conducted a year later.

(3) Decadal Growth Rates of Population (DGP1, DGP2 and DGP3) were actually defined as (100 – Growth Rate) to make it a 'positive' variable, as all others are. A positive value is one, a higher value on which denotes more development.

observe the changes, if any, in clustering patterns, reflecting the nature of development process in the two states during the intervening years. For this, while it was possible to obtain data on 3 agriculture-related and 3 demographic variables for both the years, the latest information on 3 infrastructural indicators related to as far back as 1995-96. Thus, the desired cluster analysis for 1999-00 with all the 9 variables was not feasible. This necessitated the exercise to be done only for one year (1995-96), with all the nine variables. For making inter-temporal comparisons, however, the exercise was also done for 1990-91 and 1990-00, but using only 6 variables— 3 on agricultural development and 3 others on demographic characteristics.

**Table 2 A :  Correlation Matrix (× 1000) (Bihar)**

|        | AGP2 | IRR2 | FRC2 | RDL2 | BBR2 | PRS2 | DGP2 | URB2 |
|--------|------|------|------|------|------|------|------|------|
| AGP2   |      |      |      |      |      |      |      |      |
| IRR2   | 654  |      |      |      |      |      |      |      |
| FRC2   | 115  | 346  |      |      |      |      |      |      |
| RDL2   | 382  | 76   | −101 |      |      |      |      |      |
| BBR2   | 404  | 295  | 233  | 332  |      |      |      |      |
| PRS2   | 415  | 602  | 104  | −124 | 117  |      |      |      |
| DGP2   | 433  | 350  | −42  | 315  | 395  | 502  |      |      |
| URB2   | 291  | 230  | 309  | 78   | 623  | 87   | 297  |      |
| LIT2   | 761  | 713  | 175  | 421  | 666  | 482  | 519  | 524  |

**Table 2 B :  Correlation Matrix ( ×1000) (Madhya Pradesh)**

|        | AGP2 | IRR2 | FRC2 | RDL2 | BBR2 | PRS2 | DGP2 | URB2 |
|--------|------|------|------|------|------|------|------|------|
| AGP2   |      |      |      |      |      |      |      |      |
| IRR2   | 455  |      |      |      |      |      |      |      |
| FRC2   | 674  | 541  |      |      |      |      |      |      |
| RDL2   | −114 | −222 | 9    |      |      |      |      |      |
| BBR2   | 220  | 107  | 291  | −78  |      |      |      |      |
| PRS2   | −218 | −181 | 483  | −43  | −190 |      |      |      |
| DGP2   | −27  | −18  | 148  | −13  | −301 | 469  |      |      |
| URB2   | 369  | 228  | 456  | −75  | 673  | −535 | −472 |      |
| LIT2   | 378  | 281  | 364  | −46  | 570  | −270 | 149  | 657  |

Before we present the results of the cluster analysis in the next section, it is interesting to analyse the inter-correlation matrix of the 9 variables (Table 2). This matrix, including as it does all the 9 variables, obviously relates to the data for 1995-96. Although 8 of the correlation coefficients in Bihar matrix and 6 in Madhya Pradesh matrix are rather high (above 0.5), the chosen indicators are seen to be reasonably uncorrelated. Indeed, even when a particular pair of variables is seen to have a high correlation in one state, the data for the other state indicates a much lower correlation. Only three variables — BBR2, URB2 and LIT2 – are seen to be highly correlated in both the states; but it is not difficult to realize that these variables relate to three distinctly different dimensions of development. Secondly, one can also note from the correlation matrices that the coefficients among the different indicators are generally lower in Madhya Pradesh than in Bihar and the unexpected negative correlations (since all variables are 'positive' ones) are also more prevalent in Madhya Pradesh. That the correlations among the development indicators are weaker in Madhya Pradesh is suggestive of the more regional diversity of the state's economy, not only in terms of regional endowments but possibly also with respect to the interplay of various development factors. Such intuitive perceptions like 'assured irrigation promotes more use of fertilizer' or ' larger number of primary school causes higher literacy rates' turn out to be far less valid in Madhya Pradesh than in Bihar.

## III. Economic Zones in Bihar and Madhya Pradesh
The most intuitive method of classifying a given number of districts into a smaller number of zones will be to choose one 'comprehensive' indicator of development and put districts having close values on that indicator into a single group. Sometimes, geographical contiguity will also be taken into account in choosing the members of a group, so that each group corresponds to a reasonably homogeneous 'zone' on the map. Unfortunately, this simple method of 'identifying homogeneous groups' breaks down when a single comprehensive indicator of development is not available and more than one indicator have to be used. In such a case, obviously, different indicators may cause different groupings, sometimes much irreconcilable. An appealing way of classification

in such a circumstance is to use the statistical method of 'cluster analysis' which, after computing the total variance in the system (taking all the indicators into account), so divides the number of entities (in our case, districts) into a given number of clusters (in the present case, 6 clusters) that the sum of the 'within group variances' is minimized. Smaller within group variance only ensures that the districts within a cluster are as similar as possible. Simultaneously, this also ensures that the different clusters are as dissimilar as possible. In other words, the method instead of putting together contiguous districts with broad similarities into a single cluster involves 'similarities alone' as the basis of clustering, irrespective of the contiguousness of the districts in a particular cluster or the number of districts in it. As mentioned before, this cluster analysis was done with all the 9 variables for 1995-96 data and the resulting cluster position of different districts are presented in the middle column of Table 3. In an alternative form, Table 4 presents the same result, listing districts under each cluster. The mean value of each of the indicators are presented in Table 5A (Bihar) and Table 5B (Madhya Pradesh).[2] The clusters have also been labelled as A (most developed) to F (least developed). It is not difficult to locate the geographical location of these clusters, as the districts in most of the clusters are contiguous or close by. However, for an easier comprehension, two maps at the end present the visual equivalent of Table 4.

**Bihar :** From Table 4 or the corresponding map, it is quite apparent that the six clusters in Bihar that were identified by the present exercise display a geographical pattern. For example, the districts in clusters A (Patna, Nalanda, Bhojpur–Buxar and Jehanabad) and B (Rohtas–Kaimur, Nawada and Aurangabad) are all in the south–west part of the state where the coverage of irrigation and agricultural productivity is the highest. The districts in cluster B are inferior to cluster A not in terms of state of their agriculture, but because of lower infrastructural endowment and social development. The districts in the two clusters C and D are quite scattered and spread over both north and south of the Ganges. Finally, the districts falling under clusters E and F are all in north, the least developed cluster F comprising the entire north-eastern region of the state and East Champaran.

8

**Table 3 : Cluster Position of Districts (Bihar and Madhya Pradesh) (1990-91, 1995-96 and 1999-00)**

| No. | District/Division | Cluster Positions | | | No. | District/Division | Cluster Positions | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 90-91 | 95-96 | 99-00 | | | 90-91 | 95-96 | 99-00 |
| **BIHAR** | | | | | | | | | |
| 1. | Patna | A | A | A | 16. | East Champaran | E | F | F |
| 2. | Nalanda | A | A | A | 17. | West Champaran | C | D | F |
| 3. | Rohtas/Kaimur | A | B | B | 18. | Muzaffarpur | D | D | D |
| 4. | Bhojpur/Buxar | A | A | B | 19. | Sitamarhi/Sheohar | F | F | F |
| 5. | Gaya | B | D | E | 20. | Vaishali | D | E | F |
| 6. | Jehanabad/Banka | B | A | B | 21. | Darbhanga | E | C | F |
| 7. | Nawada | B | B | B | 22. | Madhubani | E | E | D |
| 8. | Aurangabad | B | B | B | 23. | Samastipur | D | E | D |
| 9. | Bhagalpur | B | D | C | 24. | Saharsa/Supaul | E | F | F |
| 10. | Munger/Lak/Shek/Jam | B | D | E | 25. | Madhepura | E | F | F |
| 11. | Khagaria | F | F | C | 26. | Purnia | E | F | F |
| 12. | Begusarai | D | C | C | 27. | Araria | F | F | F |
| 13. | Saran | D | C | D | 28. | Kishanganj | E | F | F |
| 14. | Siwan | C | E | D | 29. | Katihar | F | F | F |
| 15. | Gopalganj | D | E | D | | | | | |
| **MADHYA PRADESH** | | | | | | | | | |
| 1. | Morena/Sheohar | A | D | B | 20. | Dewas | C | B | A |
| 2. | Bhind | C | D | D | 21. | Jhabua | F | F | F |
| 3. | Gwalior | A | B | A | 22. | Dhar | C | F | F |
| 4. | Datia | C | A | D | 23. | Indore | A | A | C |
| 5. | Shivpuri | E | F | F | 24. | West Nimar/Barwani | C | D | F |
| 6. | Guna | E | F | F | 25. | East Nimar | C | B | D |
| 7. | Tikamgarh | C | D | B | 26. | Rajgarh | E | F | F |
| 8. | Chhatarpur | E | F | F | 27. | Vidisha | D | E | F |
| 9. | Panna | E | E | F | 28. | Bhopal | B | A | C |
| 10. | Sagar | D | E | E | 29. | Sehore | E | E | F |
| 11. | Damoh | E | C | E | 30. | Raisen | D | E | D |
| 12. | Satna | E | C | F | 31. | Betul | E | E | E |
| 13. | Rewa | E | C | F | 32. | Hoshangabad/Harda | C | B | D |
| 14. | Shahdol/Umaria | E | E | E | 33. | Jabalpur/Katni | D | C | D |
| 15. | Sidhi | F | F | F | 34. | Narsimhapur | D | B | D |
| 16. | Mandsaur/Neemuch | C | B | A | 35. | Mandla/Dindori | E | E | E |
| 17. | Ratlam | C | B | A | 36. | Chhindwara | D | E | E |
| 18. | Ujjain | C | B | A | 37. | Seoni | E | E | E |
| 19. | Shajapur | C | B | A | 38. | Balaghat | D | E | D |

9

**Table 4 : Distribution of Districts by Clusters (Bihar and Madhya Pradesh) (1995-96)**

| Cluster | Districts | No. of districts |
|---------|-----------|:----------------:|
| **Bihar** | | |
| A | Patna / Nalanda / Bhojpur – Buxar / Jehanabad | 4 |
| B | Rohtas – Kaimur / Nawada / Aurangabad | 3 |
| C | Begusarai / Saran / Darbhanga | 3 |
| D | Gaya / Bhagalpur – Banka / Munger – Lakhisarai – Sheikhpura – Jamui / West Champaran / Muzaffarpur | 5 |
| E | Siwan / Gopalganj / Vaishali / Madhubani / Samastipur | 5 |
| F | Khagaria / East Champaran / Sitamarhi – Sheohar / Saharsa – Supaul / Madhepura / Purnea / Araria / Kishanganj / Katihar | 9 |
| **Madhya Pradesh** | | |
| A | Datia / Indore / Bhopal | 3 |
| B | Gwalior / Mandsaur-Neemuch / Ratlam / Ujjain / Shajapur / Dewas/ East Nimar/ Hoshangabad-Harda / Narsimhapur | 9 |
| C | Damoh /Satna / Rewa / Jabalpur – Katni | 4 |
| D | Morena –Sheohar / Bhind / Tikamgarh / West – Nimar – Barwani | 4 |
| E | Panna / Sagar / Shahdol-Umaria / Vidisha / Sehore /Raisen / Betul / Mandla-Dindori / Chhindwara / Seoni / Balaghat | 11 |
| F | Shivpuri /Guna / Chhatarpur /Sidhi / Jhabua / Dhar / Rajgarh | 7 |

It is easy to note from this cluster pattern that development gradient in Bihar runs from south to north as well as from west to east. This results in the south-western districts of Bihar being most developed, just as the north-eastern ones being most backward. A similar exercise done with 1970-71 data  (although with different set of variables) had indicated a similar clustering, except for Begusarai and West Champaran (Rodgers, 1987). Both these districts have lost their earlier advantage and are now members of much inferior clusters.

**Madhya Pradesh :**   In contrast to Bihar, the geographical dispersion of the districts within any particular cluster is higher in Madhya Pradesh and, by virtue of being a fairly

urbanized state, presence of large towns in a district influences its cluster position much. The best cluster A comprises Datia (close to Gwalior), Indore and Bhopal, while the next two clusters B and C contain Gwalior and Jabalpur–Katni, respectively. Leaving apart the urbanized districts of cluster A, the second most developed region of Madhya Pradesh (cluster B) comprises the districts of Malwa region on its west-central part. As the cluster means for indicator variables indicate (Table 5B), the districts in Malwa region are developed in all dimensions — agriculture, infrastructure and demographic characteristics. The next two clusters are smaller ones — cluster C comprising four districts of Sone Valley in north-eastern part of Madhya Pradesh (Damoh, Satna, Rewa and Jabalpur-Katni) and cluster D comprising four, scattered districts (Morena-Sheohar, Bhind, Tikamgarh and West Nimar-Barwani). Among others, cluster E covers the largest area of the state, spread over as many as 11 backward districts, nearly all in the south-western part of the state. However, the most backward districts, clubbed in cluster F, are the frontier districts of the state in north, east, and west.

**Inter-temporal comparison :** A general acquaintance with the economies of Bihar and Madhya Pradesh will obviously suggest that the major economic zones of the two states have remained unaltered during the recent decades. However, this does not preclude the possibility of a few backward districts surging ahead or some relatively more developed districts slipping down. The present exercise had, therefore, attempted an inter-temporal comparison of the clustering patterns in 1990-91 and 1999-00 which, in other words, tries to identify the changes in the boundaries of economic zones during the intervening period. As mentioned before, in the absence of the required data on all 9 variables, this exercise was carried out with only 6 variables. The resulting cluster positions of each of the districts in Bihar and Madhya Pradesh for both the years are presented in Table 3. Among the 29 districts of Bihar, it is noticed that as many as 4 districts (Gaya, Munger, West Champaran and Vaishali) have slipped more than one step down the development ranking. Khagaria, on the other hand, is the only district to have improved its ranking

during the decade of nineties. Quite expectedly, except in case of Gaya, these decadal changes in the cluster position of the districts are related to their agricultural growth.

In Madhya Pradesh again, as many as 9 districts have changed their cluster rankings more than one step, but 5 of them (Mandsaur–Neemuch, Ratlam, Ujjain, Shajapur and Dewas) have actually improved their position. Interestingly, all of them are from the Malwa region. The importance of agricultural growth in also apparent here as all these five districts have improved their relative positions principally through recording higher agricultural growth, the other  important contributor being their better performance in promoting literacy rates. Four districts which have experienced worsening of their relative positions are — Indore, Dhar, West Nimar-Barwani and Vidisha. From the primary data, it emerges that they all have fared poor on the two indicators of social development — decadal growth rate of population and literacy rates.

A second noteworthy feature of the development dynamics of the nineties in Bihar and Madhya Pradesh is the widening inter-cluster (and hence inter-district) disparities in development, a parallel of the widening inter-state disparities during the same decade.

Table 6 presents the distribution of districts among the 6 clusters in each of three years and one immediately notices there that the number of districts in cluster F (the most backward one) is increasing over the years in both the states. Interestingly, this process of widening disparity is stronger in Madhya Pradesh, where the two top clusters together (A and B) have a few more members, the two bottom clusters together (E and F) are swelling, leaving the middle clusters (C and D) thinner. It is quite possible that such crowding of the districts at the bottom cluster is the outcome of a market-led growth process that Madhya Pradesh has experienced during the last decade. If this process of widening inter-district disparity has been less visible in Bihar, it is possibly because development itself has been slower there.

**Table 5 A : Mean Values of Variables for Each Cluster (Bihar) (1990-91, 1995-96 and 1999-00)**

| Variable | A | B | C | D | E | F | Overall |
|---|---|---|---|---|---|---|---|
| | | | | **Clusters** | | | |
| | | | | **1990-91** | | | |
| AGP1 | 4513.5(2) | 3724.7(4) | 4836.0(1) | 4421.2(3) | 3392.4(5) | 2936.5(6) | 3865.3 |
| IRR1 | 76.8(1) | 61.5(2) | 41.2(3) | 40.1(4) | 29.7(6) | 35.7(5) | 46.6 |
| FRC1 | 127.9(1) | 75.6(4) | 72.7(5) | 111.6(2) | 57.7(6) | 87.8(3) | 87.4 |
| DGP1 | 79.0(2) | 77.7(3) | 79.8(1) | 74.0(5) | 76.5(4) | 73.3(6) | 76.4 |
| URB1 | 18.6(1) | 10.5(2) | 7.7(3) | 7.6(4) | 7.1(5) | 6.8(6) | 9.5 |
| LIT1 | 48.9(1) | 41.8(2) | 33.5(4) | 37.8(3) | 29.0(5) | 28.8(6) | 36.5 |
| | | | | **1995-96** | | | |
| AGP2 | 8205.2(1) | 7940.0(2) | 5933.0(4) | 5291.0(5) | 6589.6(3) | 4265.1(6) | 5938.9 |
| IRR2 | 75.8(2) | 80.4(1) | 43.9(3) | 41.3(5) | 42.9(4) | 39.5(6) | 50.1 |
| FRC2 | 91.6(3) | 91.8(2) | 100.3(1) | 83.0(4) | 44.7(6) | 73.6(5) | 77.4 |
| RDL2 | 44.5(3) | 31.4(4) | 51.5(1) | 29.1(6) | 44.7(2) | 30.5(5) | 36.9 |
| BBR2 | 5.8(1) | 4.8(4) | 5.1(3) | 5.4(2) | 4.7(5) | 4.3(6) | 4.9 |
| PRS2 | 50.5(2) | 55.6(1) | 38.2(6) | 48.9(3) | 41.4(4) | 39.8(5) | 44.6 |
| DGP2 | 76.9(1) | 72.8(5) | 73.4(4) | 75.2(2) | 74.5(3) | 71.8(6) | 73.8 |
| URB2 | 18.3(1) | 8.2(3) | 8.2(4) | 12.2(2) | 5.2(6) | 7.1(5) | 9.4 |
| LIT2 | 53.5(1) | 48.9(2) | 43.1(3) | 42.0(5) | 42.4(4) | 32.5(6) | 41.5 |
| | | | | **1999-00** | | | |
| AGP3 | 11985.5(1) | 10693.2(2) | 6572.3(5) | 9606.5(3) | 6876.0(4) | 6565.8(6) | 8313.1 |
| IRR3 | 73.3(2) | 81.3(1) | 52.3(3) | 45.9(5) | 47.8(4) | 42.2(6) | 53.5 |
| FRC3 | 133.5(1) | 94.6(3) | 125.7(2) | 73.0(6) | 74.2(5) | 76.3(4) | 87.6 |
| DGP3 | 75.6(1) | 70.4(5) | 71.9(4) | 74.0(2) | 72.7(3) | 68.5(6) | 71.2 |
| URB3 | 28.4(1) | 8.7(3) | 7.2(5) | 6.2(6) | 12.3(2) | 7.4(4) | 9.3 |
| LIT3 | 58.7(1) | 55.7(2) | 45.6(5) | 48.1(4) | 50.9(3) | 37.2(6) | 46.4 |

**Note :** Figure in brackets indicates the ranks of the clusters vis-à-vis the variable noted in left-most column

**Table 5 B :**   Mean Values of Variables for Each Cluster (Madhya Pradesh)   (1990-91, 1995-96, and 1999-00)

| Variable | A | B | C | D | E | F | Overall |
|---|---|---|---|---|---|---|---|
| | | | | Clusters | | | |
| | **A** | **B** | **C** | **D** | **E** | **F** | **Overall** |
| **1990-91** | | | | | | | |
| AGP1 | 4184.0(1) | 3236.0(2) | 2743.5(4) | 3199.7(3) | 1985.0(5) | 1533.0(6) | 2631.0 |
| IRR1 | 37.2(1) | 14.5(4) | 23.7(2) | 17.3(3) | 11.6(5) | 6.7(6) | 18.3 |
| FRC1 | 71.7(1) | 49.5(2) | 49.1(3) | 27.9(4) | 19.9(5) | 11.9(6) | 35.0 |
| DGP1 | 69.9(4) | 48.5(6) | 74.3(2) | 77.1(1) | 72.5(3) | 59.6(5) | 72.4 |
| URB1 | 49.6(2) | 80.0(1) | 23.1(3) | 22.6(4) | 16.3(5) | 7.6(6) | 23.4 |
| LIT1 | 55.1(2) | 64.3(1) | 43.4(4) | 50.2(3) | 38.9(5) | 24.0(6) | 43.6 |
| **1995-96** | | | | | | | |
| AGP2 | 7060.7(3) | 7361.3(1) | 5054.5(4) | 7259.2(2) | 4272.4(6) | 4712.3(5) | 5701.9 |
| IRR2 | 29.0(2) | 27.4(3) | 17.6(5) | 38.9(1) | 16.7(6) | 19.3(4) | 23.1 |
| FRC2 | 52.5(2) | 52.4(3) | 42.2(4) | 57.0(1) | 20.0(6) | 24.3(5) | 37.3 |
| RDL2 | 25.4(3) | 22.4(6) | 56.1(1) | 23.6(5) | 25.3(4) | 30.2(2) | 28.6 |
| BBR2 | 10.5(1) | 7.0(2) | 6.5(3) | 4.8(6) | 6.0(4) | 5.8(5) | 6.5 |
| PRS2 | 97.3(6) | 109.2(3) | 97.6(5) | 100.3(4) | 130.1(1) | 113.1(2) | 112.9 |
| DGP2 | 65.7(6) | 75.7(3) | 75.2(4) | 73.7(5) | 76.8(2) | 70.1(1) | 74.0 |
| URB2 | 57.6(1) | 29.7(2) | 24.2(3) | 18.5(4) | 17.3(5) | 15.4(6) | 23.9 |
| LIT2 | 66.3(1) | 58.6(2) | 56.8(3) | 49.6(5) | 53.9(4) | 41.7(6) | 53.6 |
| **1999-00** | | | | | | | |
| AGP3 | 15025.8(1) | 13305.5(2) | 9159.0(3) | 8442.4(5) | 7190.0(6) | 8577.0(4) | 9590.9 |
| IRR3 | 30.7(3) | 55.8(1) | 27.9(4) | 35.4(2) | 14.4(6) | 23.1(5) | 27.3 |
| FRC3 | 56.2(3) | 61.4(2) | 63.3(1) | 45.6(4) | 17.2(6) | 32.5(5) | 39.3 |
| DGP3 | 75.3(3) | 72.6(5) | 61.6(6) | 79.0(2) | 81.4(1) | 72.9(4) | 75.5 |
| URB3 | 33.1(2) | 18.2(5) | 76.0(1) | 23.2(3) | 18.5(4) | 17.0(6) | 24.3 |
| LIT3 | 68.2(3) | 55.9(6) | 74.9(1) | 70.7(2) | 63.6(5) | 66.6(4) | 63.6 |

**Table 6 : Number of Districts in Each Cluster (Bihar and Madhya Pradesh ) (1990-91, 1995-96 and 1999-00)**

| Cluster | No. and percentage of districts | | |
|---------|---------|---------|---------|
|         | 90-91   | 95-96   | 99-00   |
| **Bihar** | | | |
| A | 4 (13.8) | 4 (13.8) | 2 (6.9) |
| B | 2 (6.9) | 3 (10.3) | 5 (17.2) |
| C | 3 (10.3) | 3 (10.3) | 3 (10.3) |
| D | 6 (20.7) | 5 (17.2) | 6 (20.7) |
| E | 7 (24.1) | 5 (17.2) | 3 (10.3) |
| F | 6 (20.7) | 9 ( 31.0) | 10 (34.5) |
| **Total** | **29 (100.0)** | **29 (100.0)** | **29 (100.0)** |
| **Madhya Pradesh** | | | |
| A | 3 (7.9) | 3 (7.9) | 6 (15.8) |
| B | 1 (2.6) | 9 (23.7) | 2 (5.3) |
| C | 12 (31.6) | 4 (10.5) | 2 (5.3) |
| D | 7 (18.4) | 4 (10.5) | 8 (21.1) |
| E | 13 (34.2) | 11 (28.9) | 7 (18.4) |
| F | 2 (5.3) | 7 (18.4) | 13 (34.2) |
| **Total** | **38 (100.0)** | **38 (100.0)** | **38 (100.0)** |

## IV. Comparison between Bihar and Madhya Pradesh

A cluster analysis, as done above, is generally used as a statistical method for classification and not for comparing two entities. But we have attempted here to use the technique for such comparison through an atypical approach. The genesis of this exercise laid in the uncomfortable question that one could not avoid at the end of earlier analysis — are the clusters in Bihar and Madhya Pradesh (A to F) are comparable? Alternatively, one could also ask — is the cluster A of Bihar and that of Madhya Pradesh are nearly the same? A comparison of the means of same cluster (say, A) between Bihar and Madhya is bound to be inconclusive because comparison involves as many as 6 variables. One possible way of answering this query was to put all the 67 districts of Bihar and Madhya

Pradesh in a combined database (as if they are from the same state) and then subject them to a cluster analysis. In doing so, however, we had increased the number of clusters to be 10 to avoid too many districts thronging in a single cluster. The results of this exercise, as presented in Table 7, are indeed interesting.

The best cluster A comprises only one district Patna from Bihar. Cluster B then draws Gwalior and Indore from Madhya Pradesh. All these three districts, as is obvious, are highly urbanized ones. Because of an exceptionally high decennial growth rate of population, the capital district of Bhopal was placed alone in cluster G, far down the development ladder. It would be more meaningful to ignore this ranking and treat Bhopal as a member of cluster A or B. Surprisingly, the next two best clusters – C and D – are both occupied by the districts of Bihar. Thereafter the four clusters — E, F, G and H – are all occupied by the districts of Madhya Pradesh (except Munger falling in cluster F). The penultimate cluster I contains the largest number of districts which are all very backward ones (17 districts), and the only cluster to have mixed membership. Cluster J, the most backward, then contains two frontier districts of Madhya Pradesh – Sidhi and Jhabua. This classification of the 67 districts of Bihar and Madhya Pradesh obviously presents a paradox — while Madhya Pradesh as a whole is better off than Bihar on nearly all development indicators, most of the districts of Bihar are placed at a higher development level by the present exercise compared to those in Madhya Pradesh. At the source of this paradox is probably the choice of our development indicators which, except for one on urbanisation level, do not take adequate cognizance of developments in non-agricultural sector. With nearly one-fourth of the population living in urban areas in Madhya Pradesh, compared to barely one-tenth in Bihar, size of the non-agricultural economy is obviously larger in Madhya Pradesh. With an alternative indexing that adequately recognizes the contribution of non-agricultural economy towards the overall level of development, the districts of Malwa region of Madhya Pradesh would have occupied cluster C or D. However, if the comparison has to have a rural bias (since most people live in villages), it would be meaningful to conclude that, notwithstanding the lower overall development

levels in Bihar, the average development levels of its rural areas are probably a little better than in Madhya Pradesh.

**Table 7 :** **Distribution of Districts by Clusters in Combined Cluster Analysis of Bihar and Madhya Pradesh) (1995-96)**

| Cluster | Districts | No. of districts | | |
| :---: | :--- | :---: | :---: | :---: |
| | | Bihar | Madhya Pradesh | Total |
| A | Patna | 1 | 0 | 1 |
| B | Gwalior / Indore | 0 | 2 | 2 |
| C | Nalanda / Rohtas-Kaimur / Bhojpur-Buxar/Jehanabad/ Nawada/ Aurangabad | 6 | 0 | 6 |
| D | Gaya / Bhagalpur – Banka / Khagaria / Begusarai / Saran / Siwan / Gopalganj / East Champaran /West Champaran / Muzaffarpur / Sitamarhi – Sheohar /Vaishali / Samastipur / Purnea | 14 | 0 | 14 |
| E | Morena –Sheohar | 0 | 1 | 1 |
| F | Munger / Bhind / Datia / Raisen / Hoshangabad-Harda / Narsimhapur / Chhindwara / Balaghat | 1 | 7 | 8 |
| G | Bhopal | 0 | 1 | 1 |
| H | Sagar / Damoh / Satna / Rewa / Mandsaur – Neemuch / Ratlam / Ujjain / Shajapur / Dewas / East Nimar / Vidisha / Sehore / Betul/ Jabalpur-Katni / Seoni | 0 | 15 | 15 |
| I | Darbhanga / Madhubani / Saharsa-Supaul / Madhepura / Araria / Kishanganj / Katihar / Shivpuri / Guna / Tikamgarh / Chhatarpur/ Panna/ Shahdol-Umaria / Dhar / West Nimar-Barwani / Rajgarh / Mandla-Dindori | 7 | 10 | 17 |
| J | Sidhi / Jhabua | 0 | 2 | 2 |
| | **Total** | **29** | **38** | **62** |

## V. Conclusion

The most immediate objective of the present exercise was to identify the economic zones in Bihar and Madhya Pradesh and, towards that we now have clearly demarcated 6 zones in each state along with their development profiles. Among the developed zones in Bihar are those which are in the south-western part of the state where the extensive irrigation infrastructure provides a strong base for agriculture-led growth. In Madhya Pradesh, the developed zones are in the Malwa region which enjoys the advantage of both prosperous agriculture and sizeable non-agricultural sector. In both the states, the least developed

regions are in the east —in the north-east in Bihar and in the south-east in Madhya Pradesh. From the profile of the economic zones in the two states, it also emerges that the regional variations are much wider in Madhya Pradesh than in Bihar, which probably makes the task of development more challenging there, together with the fact that the state has a much larger area with relatively poorer road/rail network.

Through an inter-temporal comparison of the clustering pattern of the district in 1990-91 and 1999-00, the analysis has shown that the phenomenon of widening disparities is equally discernible during both inter-state and intra-state comparisons. That the intra-state disparities have widened more in Madhya Pradesh, where the economy has grown faster during the last decade, indicates what is often suspected to be an inseparable feature of a market-led growth process.

Nearly all development indicators would place Madhya Pradesh to be ahead of Bihar. But conclusions from such straight comparisons should be modified to take care of regional as well as rural-urban disparities. Through a comparison of the two states with the help of the district-level data, it emerged that Madhya Pradesh enjoys the gains of a larger secondary/tertiary sector and hence an overall advantage, but the level of rural development might indeed be higher in Bihar.

**Note :**

1. A number of districts in both Bihar and Madhya Pradesh have been divided in the recent past. In 1990-91, Bihar had only 29 districts, which after division stands at 38 districts now. The corresponding numbers for Madhya Pradesh are 38 and 45. The present analysis has been done for districts, as they existed in 1990-91. From the district names, presented in the tables, the division can be easily identified.

2. Since the variables are measured in different units, the cluster analysis has been done using the standardized variable. The presented means in Tables 5A and 5B refer, however, to original values of variables.

**Reference:**

1. Dasgupta, D et al (2000) : 'Growth and Inter-state Disparities in India : Statistical Analysis', 'Economic and Political Weekly', Vol. 35, No. 27.

2. Kenall, M (1975) : *Multivariate Analysis,* Grittin, London.

3. Mohanty, G (2000) : 'Human Development in Andhra Pradesh : A District Level Analysis', The Indian Journal of Labour Economics, Vol. 43, No. 2.

4. Rodgers, GB (1987) : 'A Cluster Analysis of Bihar Districts According to the Indicators of Agricultural Development and Demographic Characteristics', in *'Bihar : Stagnation or Growth'* (eds. Sharma A M and Gupta S), Spectrum, Patna / Delhi.

_____