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ASSESSMENT OF URBANIZATION IN CENSUS-UNITS THROUGH CONSTRUCTION OF A GENERALIZED URBANIZATION INDEX: A STUDY FOR ECONOMICALLY BACKWARD REGIONS OF WEST BENGAL DURING 1991 TO 2011

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Abstract

The Census Authority of India usually provides data regarding the nature of a few urbane characteristics for all the village units and thereby classifies a place as Census Town, which is considered as the lowest unit of urbanization. From the perspective of urbanization, regions of any state, consisting of blocks can be classified as economically advanced or economically backward on the basis of existence of Census Towns in it as urban places are likely to bring more prosperity in terms of standard of living. However, proper assessment of urbanization in a single measurement scale, of all village units of a particular block is not done so far. An attempt in that direction is made in this article through construction of a Generalized Urbanization Index (GUI) for all the village units of some blocks, selected through systematic-stratified sampling, from three major districts of Paschim Medinipur, Bankura and Purulia, which are known as 'so called' backward regions. The proposed GUI for a census-unit is constructed with two components - the town criteria index and the amenities index and the relative weights of both the component-indices and the underlying dimension indices are determined through the application of Iterative Average Correlation Method indicating some movement towards actuality in comparison to prevailing two other methods of weight determination - the Equal Weights Principle and the Principal Component Analysis.

***Keywords**: Urbanization, Census Town, Backward Region, Index, Equal Weights, Principal Component Analysis, Average Correlation*

***JEL Classification Codes**: C51, H54, O18*

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1. Introduction

The fundamental necessity for urban growth is found in rural areas. The extent of urbanization is limited by the food surplus available to the city. The world has been as urbanized as the level of agriculture made possible throughout the recorded history. The difference between current levels of urbanization and historical levels is due to the massive improvements in agricultural productivity and transportation technology arising from and contributing to the Industrial Revolution.

We have decided to pursue a research work about the ongoing urbanization process in the backward region of West Bengal and in this particular study we shall concentrate on three districts, namely the undivided district of Paschim Medinipur, Bankura and Purulia, which are specifically located in that region. As we have found, these three districts are having 71 community development blocks with thousands of villages therein with only a few municipalities. We are to enquire about the ongoing urbanization process in the rural areas of those districts (i.e., villages or mouzas or any such census-units likewise mentioned in the census) which are primarily classified under statutorily structured community development blocks. For the purpose of our study, we have designed a systematic stratified sampling method to choose two blocks from each of the chosen districts, which is based on certain arguments. The study is pursued covering a time period of three census decades (1991, 2001 and 2011) and we are to see whether there are adequate urbanization measures acting actively to keep pace with developmental aspirations of the people in that part of West Bengal.

This article intends to propose a new concept the ***Generalized Urbanization Index (GUI)*** to be applied for all the census-units (i.e., villages and census-towns lying within a block) which is obtained by adopting coherent methodologies (as discussed in the sections 5 and 6 of this article) on the basis of selected indicators for available amenities and other criteria which are very much likely to indicate the gravity and degree of urbanization in a particular area-unit. In constructing the above mentioned GUI we have tried to incorporate various factor indices which are specifically based on selected item-wise parameters of different types of amenities available, the underlying dimension indices of both the ***town criteria index (TCI)*** and ***the amenities index (AI)*** and finally to determine actual weights for those factor-indices and dimension indices by applying a new method, namely the ***Iterative Average Correlation Method (IACM)*** as proposed by Mondal, Mookherjee and Pattanayek (2017).

In Section 2 of this article, a brief review of literature and the research gap are presented. In Section 3 the major objectives of this article are mentioned and in Section 4 we would acknowledge the data sources and explain the specific methodologies which are applied. In Section 5, the concept of Average Correlation (AvCor) is discussed as a newly introduced method. The results of our findings are explained in Section 6 and the concluding remarks are made in Section 7.

1. A Brief Review of Literature and the Research Gap

There has been considerable volume of useful studies available for understanding the various facets of the process of urbanization. Among them, the most important studies are performed by the Census Authority of India over decades to analyze the degree and gravity of urbanization in India and more specifically in Indian states. Secondly, private research bodies like universities, research institutes and individual researchers contribute significantly at the field of literature about Urban Economics. Generally the small towns appear mostly in the semi-urban or rur-urban conditions, just as the gateway or focal point of the rural surplus enclave having network of communications all around. There are various potential factors for which these small towns develop here and there. Sometimes multiple factors are responsible for the growth of a small town, but initially, there must be at least one prominent factor, which facilitates the growth of a small town (Manna, 1994).

Now we are going to present some important studies on small towns conducted over last four decades. Corwin (1977) has worked on the elites of Mahishadal, as there were a significant number of rich businessmen, which was unbecoming of a small rural town. Acharya (1975) worked on a small town named Kendrapara in the district of Cuttack in Odisha to observe the tradition of modernity in the town. The 'Analysis of the Growth of Small and Medium Towns in West Bengal' (Giri, 1988) and 'A Case Study of Durgapur' (Basak, 1988) are very much important at the present context. Basak's paper contributed notably to understand the nature of growth process in steel town Durgapur and its spatial impact on the surrounding region. Further, her extensive study of the five Indian steel towns namely Jamshedpur, Durgapur, Bhilai, Rourkela and Bokaro covering the period 1961 – 1991 also examined the nature, direction and the degree of interaction of the steel towns with the surrounding region (Basak, 2000).

It is clear that the main impulse for urban growth in West Bengal continues to be derived from industrial and manufacturing activities (Dasgupta et al, 1988) — particularly in cases of the new towns. However, a good number of new towns – particularly in Howrah and North 24 Parganas, appear to be 'transformed agricultural settlements', which also account for a high proportion of promoted and high-growth towns. Generally speaking, the more urbanized districts are usually also the ones with better agricultural performance; but within each of these districts the agricultural and industrial areas tend to be clearly demarcated. This is particularly true for Burdwan, (where industrial mining activities are concentrated in Durgapur–Asansol region); North 24 Parganas, (where the western part is industrially developed while the eastern part is predominantly agricultural) and Hooghly, where industrial areas are located along the river Ganges.

The western part of the state, particularly Bankura and Purulia, continues to show low rates of urban growth, which are considerably below the state-average and indicate large-scale net outmigration. The North Bengal districts, in contrast, show very high rates of urbanization, far exceeding the state-average (excepting Cooch Behar). At the other end, the rates of urban growth for Kolkata, Howrah and Hooghly appear to be modest, while that for Kolkata isolated is disastrously low. This is a welcome development, though, as we have already noted, this are continues to account for a high proportion of new towns and promoted towns (Dasgupta et al, 1988).

Research Gap: As we have gone through the available literature on urbanization of area units (villages or census towns, as may be classified) in West Bengal, we have found that even if urbanization is defined as an index of transformation; however no indexing is done by anybody comprising the factors of urbanization with justifiable weights. In other words, no urbanization of any place, in no way is tried to be measured or evaluated till date.

Undoubtedly, amenities play a crucial role in determining urbanization of a place. The census authority collects and publishes data regarding amenities available in a place; however these data are not considered to determine the level of urbanization of a place. There are some factors of urbanization certainly and these are bound to affect urbanization in a place. However in discrete sense, the difference in the degree of urbanization in two separate places cannot be measured. In this study, we are to address the above mentioned problem and we shall try to construct a true urbanization index, based on certain well-accepted factors, on which urbanization of a place can be measured and compared with that of others. Basically a normal yard-stick for measurement of urbanization of all places is to be obtained from our adopted methodology.

2. Objectives of this Study

The major objectives of this article are as follows -

(a) **Selection of two sample blocks each** from the three backward districts following a method of systematic-stratified sampling,

(b) Computation of three criterion indices, namely the *Index for Total Population* (ITP), the *Index for Population Density* (IPD) and the *Index for Proportion of Male Main Workers engaged in Non-Agricultural Sector* (IPMMWNA) from the data available and thereby construction of a **Town Criteria Index (i.e., TCI)** for any census-unit of the area based on these three criterion-indices.

(c) Computation of different factor indices (such as FI1, FI2, FI3 etc.), guiding the availability of amenities in any census-unit and thereby computation of different dimensions belonging to amenities index (AI), which are *dimension index for health (DIH), dimension index for education (DIE)* and *dimension index for socio-economic infrastructure (DISEI*), leading finally to the computation of **Amenities Index (i.e., AI)** as a whole for a place.

(d) Construction of **Generalized Urbanization Index (GUI)** as a combination of the above-mentioned TCI and AI to assess the pattern of urbanization in the census-units.

(e) **Determination of appropriate weights** for the above mentioned criteria-indices in construction of TCI, for different factor-indices in constructing respective dimension indices, for the dimension indices in constructing the AI and finally, for the components of TCI and AI in determining the values of GUI on the basis of three methods - the **Equal Weights Principle (EWP)**, the **Principal Component Analysis (PCA)** and the **Iterative Average Correlation Method (IACM)**.

(f) To go through different values of GUI, as obtained by the application of IACM, to understand the pattern of urbanization in the census-units as a whole and with the help of these GUI values to obtain reasonable **block-level urbanization index (BUI)** values for the concerned blocks, to obtain reasonable **district-level urbanization index (DUI)** values for the three selected districts to experience the pattern of urbanization in the entire region for a period of three decades till 2011.

(g) To construct the values of **Backward Region Urbanization Index (BRUI)** with its components, in order to show the trend of urbanization in the area during the study period and the specific roles of two underlying components in determining the BRUI.

3. Data Sources and Methodologies Applied

We have extensively used secondary data provided by the Director General of Census Operations (DGCO), Ministry of Home Affairs, Government of India for this analysis and the areas for which data collected are regarding total population, population density, workers' profile, amenities available etc. The books which are consulted for this purpose are (i) Primary Census Abstract (PCA) of West Bengal for the census years 2011, 2001 and 1991, (ii) The Census Village Directory of West Bengal for the census years 2011, 2001 and 1991 and (iii) Different Issues of District Census Handbooks, published for the selected districts of West Bengal over the decades of 1991, 2001 and 2011. The websites which are extensively used to collect data of various types for this study are *www.censusindia.gov.in and www.censusindia.net*.

The newly proposed concept of Generalized Urbanization Index (GUI) for measurement of urbanization levels of the census-units is used in this article to understand the degree of urbanization through a measurement scale varying between zero and unity. The proposed GUI is constructed with two underlying components - the Town Criteria Index (TCI) and the Amenities Index (AI) and for the purpose of index construction; we have used the standard practice (following UNDP method of HDI computation). Moreover, the TCI is obtained by three criterion-indices with appropriate weights which are determined by the application of IACM. Actually the IACM for determination of actual weights to underlying components of an index was firstly introduced by Mondal, Mookherjee and Pattanayek in 2017 and following that method the actual weights for the concerned parameters are determined here. Similarly, the AI is constructed with its underlying dimension-indices and factor-indices with respective actual weights.

4.1 Selection of Sample CD Blocks from the Districts

We have adopted a special methodology to select two sample blocks from each of the three districts. For this purpose we have listed all the blocks of a district and consider two things - (i) increase in absolute number of census towns in the blocks from 2001 to 2011 and (ii) the percentage of urban population of all the blocks according to 2011 census, i.e., the number of people living in the census towns, if any, in a particular block. We are to construct two different kinds of indices from the above mentioned two criteria. For criterion (i) we have got the **index 1** which stands for absolute increase in number of census towns and for criterion (ii) we have got the **index 2** which stands for percentage of urban population. In both the cases the standard practice of index construction is followed with observed goalposts are taken as extreme points. Later, these two indices (obtained simultaneously from criterion (i) and criterion (ii)) are combined by using un-weighted arithmetic mean to obtain the *combined index for the blocks* (CIB).

At the next step, we have classified the blocks of a single district in three groups -

(a) the **first group** consists of those blocks where at least one census town is found in both the census years of 2001 and 2011, (b) the **second group** consists of those blocks where no census town was found in 2001 census but at least one such exists in 2011 and finally, (c) the **third group** consists of those blocks where no census town was found either in 2001 or in 2011.

To carry out our systematic stratified sampling in this context, we have left aside the third group as the blocks concerned are very much rural in nature and no sign of minimum level urbanization is seen there in a decade, as not a single census town has come up during that period. As our entire study is centered on to understand the degree of urbanization in a rural place and its measurement through indexing, we are here selecting those blocks of the sample districts which have at least a minimum tendency to move towards urbanization. We have observed that, there are approximately two hundred mouzas (or, villages) in average for a representative block. And among those census units, if even a single unit fails to qualify the criteria, that block can be termed as purely rural in nature and according to us problems and prospects of these census units are needed to be discussed elsewhere.

Therefore we are taking care of the other two groups in choosing sample blocks from the already selected three districts and for this purpose we shall rely mostly on the new concept, *combined index for the blocks (CIB)*. We have calculated CIB for all the counted blocks on the basis of available census data and made a ranking of the same in each group. Later, the ***topper blocks*** from each group are selected for detailed village-level study. In this way, the two sample blocks of diverse nature are chosen from three backward districts of West Bengal and it makes the number of sample blocks to six for our study purpose.

The tables in which the methodology is applied to obtain results favouring our selection are prepared and two of those tables (Table AT 1 and Table AT 2, for Paschim Medinipur) are presented in Appendix. We can put forward the names of all the selected blocks as: (a) Kharagpur 1 block from first group (CIB 0.75) and Garhbeta1 block (CIB 0.52) from second group in Paschim Medinipur district (as shown in Table AT 2), (b) Barjora block (CIB 0.50) from first group and Khatra block (CIB 0.89) from second group in Bankura district, and (c) Kashipur block (CIB 0.827) from first group and Jhalda 2 block (CIB 0.493) from second group in Purulia district. Thus, we are to deal with 1154 census-units distributed under 6 blocks of 3 districts as shown in Table 1.

Table 1: Complete Study Area covering 1154 Census-units located exhaustively in 6 C D Blocks of 3 Districts

SERIAL NO.	SAMPLE DISTRICTS	SAMPLE C D BLOCKS	NUMBER OF CENSUS UNITS
1	Paschim Medinipur	Kharagpur 1	222
2	Paschim Medinipur	Garhbeta 1	284
3	Bankura	Barjora	184
4	Bankura	Khatra	145
5	Purulia	Kashipur	200
6	Purulia	Jhalda 2	119
TOTAL	**3 Districts**	**6 Blocks**	**1154 Census-units**

Source: Arrangement by the Author using Census Information

4.2 Methodological Issues to reach out to our proposed GUI and Index Construction

We must follow certain steps in computing of GUI as it has some underlying components and dimensions. The dimensions are again dependent on various related factors and elementary parameters. Following the census principle, we have incorporated the same *three-point criteria* in constructing the town criteria index (TCI) of a census-unit and for *amenities index* (AI) we have selected some elementary parameters concerning the availability of amenities in the census-units for which data are available in three different census-years 1991, 2001 and 2011. Based on these parameters the corresponding factors of amenities (i.e., F1, F2, F3 etc.) are obtained. Therefore, the task before us is to carry out a multi-stage indexing covering the selected parameters, factors and dimensions respectively by following certain principles.

We have used the tabular form of census data to obtain information related to area, population and population density of all the mouzas (census-units) for the selected sample blocks. Next, we have computed the proportion of *male main workforce engaged in non-agricultural sector* (MMW in NAS) in each census-unit for the respective three periods. For this purpose, we have subtracted the number of persons engaged in agriculture and cultivation from the total main male workers (as given in Census publication) and obtain the requisite proportion as MMW in NAS.

Next, we have constructed criterion indices for the above three point criteria for all the census-units by applying the standard formula: **{(Xa – Xmin) / (Xmax – Xmin)}.** In fact, this is the ideal form of constructing an index and this method has vast applicability. The elements of ***Xmax*** and ***Xmin*** are selected on the basis of observed method of goalposts selection through rationalization of these observations by forward projection and backward projection of the data-set for all criteria, each by ten years and thereby extending the range of study area concerned (Mondal, 2005).

At the next step, when the criterion indices are found, we need to construct the ***Town Criteria Index (TCI)*** by taking a linear combination of all the three criterion-indices, in which three coefficients are to be associated with the indices, acting as their respective weights. Thus, the simple method of weighted arithmetic mean of the individual criterion (or, dimension) indices is used to determine the TCI (or, any final index value) at this study. However, the question regarding the choice of appropriate weights for the criteria might arise and in response to this query, initially we have responded by using two popular techniques to obtain the final weights for the respective criteria and afterwards a critical assessment of those two methods are discussed. Firstly, we have used the ***Equal Weights Principle*** (EWP), which is vehemently used by the UNDP in construction of its Human Development Index since 1990, and have obtained the TCI for all the census-units. Later, we have used the ***Principal Components Analysis*** (PCA) to obtain respective weights for the same criteria and found the required TCI. However, our main contribution through this article lies in introducing the concept of ***Iterative Average Correlation Method*** (IACM) to determine the actual weights of the concerned dimensions of an index as advancement over the other two methods as there exist some limitations in their applicability.

To construct the ***Amenities Index (AI)*** for all the census-units, under the purview of a block, we have identified 3 dimensions of different types of amenities which are likely to be available and these could be named as the Dimension of Health (DIH), the Dimension of Education (DIE) and the Dimension of Socio-economic Infrastructure (DISEI) respectively. Moreover, each dimension is comprised of some factors which are essentially related to different types of amenities and these factors are based on various elementary parameters, for which village level data are provided by the census authority. In this study we have selected 70 elementary parameters of different types of amenities and classified these parameters into 10 factors under the heads of 3 dimensions. In detail, the factors belonging to the ***Dimension of Health***

(DIH) can be listed as: (i) Availability of Basic Health Centers in numbers including Dispensaries and Medicine Shops (F1), (ii) Availability of recognized Medical Practitioners in numbers with formal and informal degrees (F2), (iii) Availability of government-run and privately run Hospitals and Nursing Homes in numbers (F3) and (iv) Available sources of Drinking Water to a village like Tap-water, Covered Well, Hand Pumps, Tube Wells etc (F4). Similarly, the factors belonging to the ***Dimension of Education (DIE)*** can be listed as: (i) Available Number of both Government-run and Privately-run Primary Schools (F5), (ii) Available Number of both Government-run and Privately-run Middle Schools, Secondary and Higher Secondary Schools (F6) and (iii) Available Number of all sorts of Higher Education Institutions like Degree Colleges, Medical and Engineering Colleges, Management Institutes, Polytechnics etc (F7). Thirdly, the factors belonging to the ***Dimension of Socio-economic Infrastructure (DISEI)*** can be listed as: (i) Available Coverage of Power Supply Areas, i.e., for domestic usage, for agricultural usage, for commercial usage and for usage by all others (F8), (ii) Available Types of Roadways and Transportation, i.e., National Highways, State Highways, All-weather Roads, District Roads, Bus and Taxi Services, Railway Station etc (F9) and (iii) Available Types of Other Miscellaneous Services like Commercial and Cooperative Banks, Post Office and Courier Services, Telephone and Mobile Services with Internet, Reading Room and News Paper etc (F10).

We have used the same formula of Index construction, mentioned above, to obtain the respective factor indices (i.e., FI1, FI2, FI3 etc.) with actual values, respective rationalized maximum and minimum values for each parameter. Next we have applied the method of arithmetic mean as usual to combine the factor indices and obtained the concurrent Dimension Index with relative weights. Later, we have constructed the Amenities Index (AI) with all three Dimension Indices, applying arithmetic mean, and here also, we have identified the weights by applying the above mentioned three methods - the EWP, the PCA and the IACM. Lastly, the ***Generalized Urbanization Index (GUI)*** is constructed from the linear combination of both ***Town Criteria Index (TCI)*** and ***Amenities Index (AI)*** with their respective shares as weights which have helped us in preparing the ranks of the listed census-units of a selected block in the scale of urbanization and a comparison amongst those area-units in terms of urbanization index can be made possible.

4.3 Choice of Weights for the Indicators – An Analysis

Weights to indicators can be assigned in a number of ways. One can simply judge the significance of an indicator on the basis of value-judgment and accordingly can assign a weight to it. In technical terms, one can assign equal weights to all indicators or assign different weights to different indicators according to their merit on the basis of acceptable reasoning. Side by side, there are a few available statistical methods like the Principal Component Analysis (PCA), which are not supposedly based on individual decision, rather coming-out from the data-base itself to determine actual weights for the concerned indicators.

Attaching equal weights (i.e., EWP) to all concerned parameters in explaining a particular final index can be done through subjective value judgement and there might be some sort of arbitrariness in it. The famous UNDP methodology for construction of HDI is based on such principle in which all the dimension indices are given same weight (i.e., 1/3 each), and this methodology of 'homogeneous weight principle' is accepted and applied by the majority of the researchers in the field of Social Sciences. But this phenomenon of attaching uniform weight cannot be possible in all cases, where the independent indicators are of different nature and are having different degrees of explanatory power in them and thereby, this weighting principle has been criticized as arbitrary. Hopkins (1991) mentioned that there might not be perfect substitutability among the DIs and that's why the concept of attaching equal weights is unjust. Desai (1991) and Ravallion (1997) also opined in favour of flexible weights as equal weights might not reflect the reality.

Thus we need to go beyond UNDP principle of attaching same weight to all variables and try another mechanism to obtain actual weights which may be different from one another and which are supposed to explain the relative different importance of each dimension index in explaining one particular final index. Noorbaksh (1998) and others claimed that the weights to individual indices should also be obtained from the data and this kind of data-driven weights should make the analysis more trustworthy. Many of them suggested that the coefficients of the first principal component of the individual indices could be used as their weights. Biswas and Caliendo (2002) have also suggested in favour of Principal Component Analysis (PCA). The theory of PCA, with all its modifications, is accepted by a large number of social scientists as a way out from the complex problem of actual weight determination. The principal components are constructed as a linear combination of the available variables in such a manner that the variance of the linear combination is maximized subject to the constraint that the sum of the squared coefficients must be equal to unity. The PCA suggests that if the variances of the dimension indices and the respective co-variances amongst themselves are found almost equal, the weights of those dimensions, obtained through the co-efficient of the first principal component will almost be equal. On the other hand, if the respective variances and pair-wise co-variances of the dimension indices are found unequal, the principal component analysis would supposedly provide unequal weights and the method would probably be considered as more relevant. However, the major difficulty of PCA is that it pays much attention to the variability of available data for a particular dimension (indicator) and does not take into account the actual explanatory power of that dimension (indicator). Thus for PCA, more the variability, more would be the assigned weight to a dimension.

The analysis of principal components is very much based upon variations of the individual dimensions. If variability of a particular DI is found to be very high, in PCA, this DI is supposed to have higher weight in contrast to others in determining the FI value. However, even if a particular DI has highest degree of variability amongst all, it does not ensure that it has highest explanatory power in explaining the dependent variable (e.g. the final index). As weights are meant to reveal degree of explanatory power, dealing with variability of a DI through PCA would not suffice to meet the requirement of explanatory power. Moreover, variability of a particular set of variables can be significantly different for different reasons.

This study is trying to offer an alternative measure in determining actual weights of an index and its comprising dimension indices which is based on correlation method. It proposes that the weights of individual dimensions (or indicators) are actually the proportion of their respective ‘average correlation’ values with that of the final index and this methodology of obtaining actual weights through ‘average correlation’ values might be named as the Iterative Average Correlation Method (IACM). In accordance with statistical texts, we may define ‘average correlation’ of a particular variable (or dimension) as the average value of its all sorts of correlations, i.e., its simple correlation, its ortho-partial correlation (Mondal, 2008) and its semi ortho-partial correlation(s), if any (Mondal, Mookherjee & Pattanayek, 2017).

The detailed methodology for understanding average correlation and its significance is given below. Let DI1, DI2 and DI3 are three underlying dimension indices of a composite final index. If it is assumed that the dimension-indices are mutually uncorrelated (i.e., there is no overlapping region among them), their exclusive correlation values with the final index will unambiguously be treated as their true explanatory power and therefore their respective weights. However, if those dimension-indices are mutually interrelated, then their variances [i.e., V(DI1), V(DI2) and V(DI3)] and their pair-wise co-variances [i.e., COV(DI1, DI2), COV(DI1,DI3) and COV(DI2,DI3)] must have some effective role in determining their respective weights. Among these three dimension indices DI1 will have higher weight than DI2, and DI2 will have higher weight than DI3 if the correlation between DI1 and DI2 is greater than that between DI1 and DI3, and the correlation between DI1 and DI3 is greater than that between DI2 and DI3. Larger the difference between these correlations, larger will be the difference of the weights of the dimensions. This weighting principle is based on the assumption that the correlation between any two indices is due to their interdependence and we may not have any specific (and prior) knowledge about the nature of this dependence. Thus, a high degree of correlation between DI1 and DI2 is supposed to lead towards higher weights for both of DI1 and DI2. To eliminate this problem, simple correlations between the respective dimension indices and the final index cannot be used and the average correlation of them with the final index, as mentioned earlier, can be used to determine their proper weights.

As the final index cannot be calculated unless the weights are determined and as the weights (or the average correlations) cannot be calculated unless the final index is determined, they are to be calculated simultaneously through an iterative process. The process starts with some arbitrarily fixed weights of the individual indices. On the basis of these weights a development index is determined. In the third step average correlations of the individual indices with the development index are obtained and these are used as weights to arrive at the new development index. In the next step we are to have new average correlations and new weights and thereby, another new development index is to be obtained. The process is to be repeated until the values of average correlations do converge to their earlier values and the final weights along with the final development index are to be calculated. All these calculations, in relation to this method proposed, can be obtained only through the application of specific computer programming. We have developed such a programming and on the basis of that, we have performed the empirical analysis given below.

5. Concept of Average Correlation

Let us suppose there are two interdependent explanatory variables X_1 and X_2 (depicted by two circles X_1 and X_2 respectively in Figure 5.1) explaining the variability of an explained variable Y (depicted by the rectangle in Figure 5.1) in a three-variable (one explained and two explanatory) regression model. The explanatory power of variable X_1 is decomposed into two areas denoted by (1) and (1.2). The proportion of the area (1+1.2) in the whole rectangle explains the squared simple correlation of X_1 with Y, denoted by r_1^2. Similarly, the explanatory power of variable X_2 is decomposed into two areas denoted by (2) and (1.2). The proportion of the area (2+1.2) in the whole rectangle explains the squared simple correlation of X_2 with Y, denoted by r_2^2.

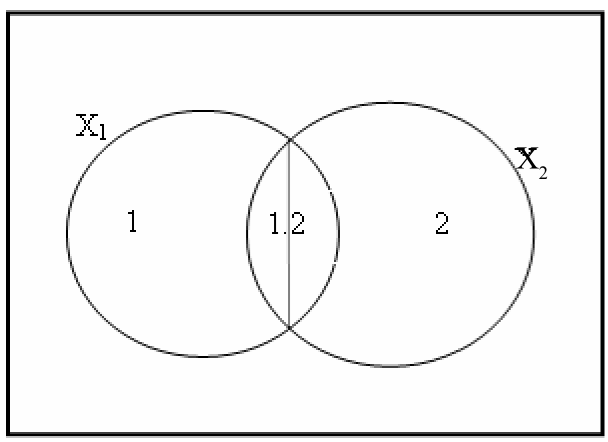


Fig. 5.1: Venn Diagram of Two Variables X_1 & X_2 (in Sets) - Showing the Corresponding Regions of Simple Correlation, Ortho-partial Correlation and the Average Correlation

The proportion of area (1) only in the whole rectangle explains the squared ortho-partial correlation (Mondal, 2008) of X_1 with Y, denoted by $r_{(OP)1}^2$. This part explains to what extent the variability of Y is explained by X1 alone independent of X_2. Thus, if we regress X_1 on X_2

and take the residue (denoted by $e_{1.2}$) that will give us that part of X1 which is not linearly explained by X_2. Now if Y is regressed on this $e_{1.2}$, we have this correlation $r_{(OP)1}^2$. Therefore, for variable X_1, we have squared ortho-partial correlation on the one hand, and squared simple correlation on the other explaining the variability of Y. The average explanatory power of this variable X_1 is just the average of these two squared correlations. Symbolically, average squared correlation (or, simply average correlation) values of variable X_1 is given by

$$\frac{(1)+(1+1.2)}{2} = (1) + \frac{(1.2)}{2}$$

And for variable X_2, in a similar manner, average explanatory power of it is just the average of its ortho-partial correlation and simple correlation, both in squared forms. Symbolically, average squared correlation (or, simply average correlation) values of variable X_2 is given by

$$\frac{(2)+(2+1.2)}{2} = (2) + \frac{(1.2)}{2}$$

Let us suppose there are three interdependent explanatory variables X_1, X_2 and X_3 (depicted by circles and oval-shapes in Figure 5.2) explaining the variability of an explained variable Y (depicted by the rectangle in Figure 5.2) in a four-variable (one explained and three explanatory) regression model.

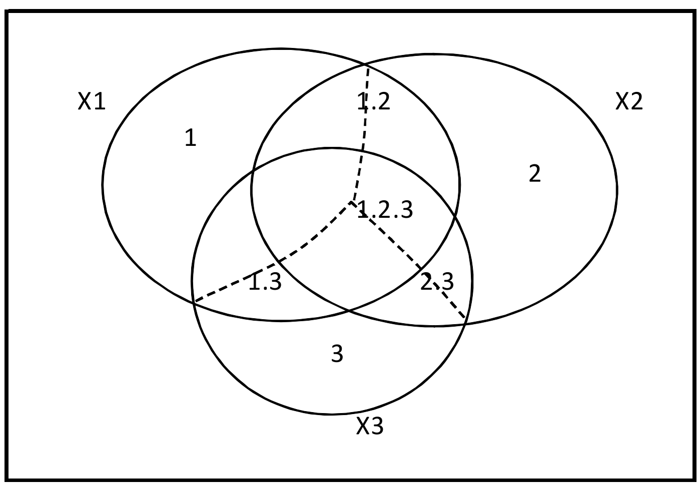


Fig. 5.2: Venn Diagram of Three Variables X_1, X_2 & X_3 (in Sets) - Showing the Corresponding Regions of Simple Correlation, Ortho-partial Correlation, Semi Ortho-partial Correlation and the Average Correlation

We can have the squared simple correlation values of these three variables of X_1, X_2 and X_3 in regions covered in the diagram as $r_1^2 = (1)+(1.2)+(1.3)+(1.2.3)$, $r_2^2 = (2)+(1.2)+(2.3)+(1.2.3)$ and $r_3^2 = (3)+(1.3)+(2.3)+(1.2.3)$.

Where, the region of (1) is purely the non-intersecting exclusive squared correlation part of X_1, which is the 'squared ortho-partial correlation' of X_1 with Y, denoted by $r_{(OP)1}^2$.

This part explains to what extent the variability of Y is explained by X_1 alone independent of both X_2 and X_3. Thus, if we regress X_1 on X_2 and X_3 and take the residue (denoted by $e_{1.23}$) that will give us that part of X_1 which is not linearly explained by either X_2 or X_3. Now if Y is regressed on this $e_{1.23}$, we can have this type of correlation $r_{(OP)1}{}^2$. Thus, for variable X_1, the 'squared ortho-partial correlation' is obtained.

On the other hand, if we regress X_1 on X_3 and obtain the residue (denoted by $e_{1.3}$), that will give us that part of X_1 which is not linearly explained by X_3. Now if Y is regressed on this $e_{1.3}$, we can have the correlation of Y with that part of X_1 which is not linearly explained by X_3, the squared of which can be called 'squared semi ortho-partial correlation' , identified by the region (1+1.2) and can be denoted by $r_{(SOP)1.2}{}^2$. Thus, for variable X_1, we may have one squared semi ortho-partial correlation.

Similarly, if we regress X_1 on X_2 and obtain the residue (denoted by $e_{1.2}$), that will give us that part of X_1 which is not linearly explained by X_2. Now if Y is regressed on this $e_{1.2}$, we can have the correlation of Y with that part of X_1 which is not linearly explained by X_2, the squared of which can be called 'squared semi ortho-partial correlation' , identified by the region (1+1.3) and can be denoted by $r_{(SOP)1.3}{}^2$. Thus, for variable X_1, we may have another squared semi ortho-partial correlation.

Therefore, for variable X_1, we are having two 'squared semi ortho-partial correlations' separately and these are identified by the regions (1+1.2) and (1+1.3) in Figure 5.2.

As argued earlier, the region of (1+1.2+1.3+1.2.3) is identified as the 'squared simple correlation' of X_1 and so for X_2 and X_3 respectively.

We are having three two-joint regions and one three-joint region for this three explanatory variable model and these areas can be accommodated to define semi ortho-partial correlation values. For instance, for the variable of X_1, there are two semi ortho-partial correlation regions, {1+(1.2)} and {1+(1.3)}; for X_2, the semi ortho-partial correlation regions are {2+(1.2)} and {2+(2.3)}, and for X3, the semi ortho-partial correlation regions are {3+(1.3)} and {3+(2.3)}.

To compute the value of Average Correlation (AvCor) for a particular variable, firstly, one has to take average of all its 'two-joint squared semi ortho-partial correlation' values and obtain the 'average two-joint squared semi ortho-partial correlation'. Next, the average of all three components i.e., the 'squared ortho-partial correlation', the 'average two-joint squared semi ortho-partial correlation' and the 'squared simple correlation' is to be computed and this value is to be considered as 'average squared correlation' value or simply the 'average correlation' value of the concerned variable.

For variable X_1, the 'squared ortho-partial correlation' of X_1 is: (1), The 'average two-joint squared semi ortho-partial correlation' of X1 is:

$$\frac{\{1+(1.2)+1+(1.3)\}}{2}=1+\frac{1.2}{2}+\frac{1.3}{2}$$

and The 'squared simple correlation' of X_1 is: [1+(1.2)+(1.3)+(1.2.3)]

Therefore, the '**Average Squared Correlation' of X1** can be determined as:

$$\text{AvCor}(X_1)=\frac{1+\{1+(1.2)/2+(1.3)/2\}+\{1+(1.2)+(1.3)+(1.2.3)\}}{3}$$

Or, AvCor(X_1) =1+(1.2)/2+(1.3)/2+(1.2.3)/3

Similarly, the '**Average Squared Correlation' of X_2** can be obtained as

AvCor(X_2) =2+(1.2)/2+(2.3)/2+(1.2.3)/3,

and **that of X_3** as

AvCor(X_3) =3+(1.3)/2+(2.3)/2+(1.2.3)/3

An extended analysis with five variables (i.e., four explanatory and one explained) and a generalized analysis with (k+1) variables (i.e., k explanatory and one explained) in understanding the definition of 'average squared correlation' (AvCor) can also be prepared.

1. Results: Study of Urbanization for the Census-units of the Region

We have computed the TCI, AI and GUI values for all the corresponding census-units of 6 selected blocks of the backward region and some of those values are presented in tables here and in appendices. We have shown the values of TCI for a representative selection of 25 census-units, belonging to the blocks of Kharagpur 1, Barjora and Kashipur for the period 1991 - 2011 which are obtained under the applications of EWP, PCA and IACM respectively in **Appendix Table AT 3**. Similarly, in **Table AT 4 there**, the obtained values of AI for the same census-units, calculated under three methods (for the same study-period) are shown. In **Table 6.1 here**, however, the **composite index values of GUI,** for those selected census-units, over the same period are presented. We have selected five census units each from three different blocks belonging to three different districts for the census year 2011 and five census-units from the Kharagpur 1 block of Paschim Medinipur district for the years 2001 and 1991.

Now to make a summary presentation of the entire study, we have selected **five top performer census-units** of the entire region on the basis of their GUI values attained in 2011 census and also have tried to make a trend analysis of the same units in accordance with their GUI values of 1991 and 2001. The results obtained are shown in **Table 6.2** and the trend analysis is presented in **Chart 6.1**, in which it is shown that **Adra of Purulia** district has topped the list in each census in terms of GUI but the movement along time is seemed to be convex (i.e., 0.733 in 1991, 0.589 in 2001 and 0.685 in 2011).

Table 6.1: Computation of GUI for the Census-units in EWP, PCA and IACM respectively, A Representative Picture with 25 Units under 3 Censuses

Serial No.	**DISTRICTS AND BLOCKS**	BLOCK-WISE SERIAL No.	**NAME of the VILLAGE UNITS / NON-MUNICIPAL TOWNS / CENSUS TOWNS**	**GUI (EWP)**	**GUI (PCA)**	**GUI (IACM)**
1	**Paschim Medinipur KGP 1**	**2011** 1	ABHOYANAGAR	0.140	0.319	0.222
2	**KGP 1**	2	AGARPARA	0.174	0.332	0.277
3	**KGP 1**	3	AJABGAR	0.127	0.231	0.198
4	**KGP 1**	4	AJABPUR	0.196	0.377	0.304
5	**KGP 1**	5	AJODHYAGAR	0.242	0.555	0.410
6	**Bankura BARJORA**	1	AMTHIA	0.067	0.122	0.100
7	**BARJORA**	2	ARJUNI	0.026	0.069	0.040
8	**BARJORA**	3	ASANSOLA	0.167	0.383	0.270
9	**BARJORA**	4	ASHURIA MADHABPUR	0.254	0.472	0.368
10	**BARJORA**	5	BAGULI	0.190	0.342	0.272
11	**Purulia KASHIPUR**	1	ADALI	0.068	0.112	0.094
12	**KASHIPUR**	2	ADRA (NM)	0.542	0.740	0.685
13	**KASHIPUR**	3	AGARDI	0.188	0.278	0.245
14	**KASHIPUR**	4	AGRABAD	0.083	0.143	0.122
15	**KASHIPUR**	5	AGUIBAD	0.135	0.252	0.206
16	**Paschim Medinipur KGP 1**	**2001** 1	ABHOYANAGAR	0.133	0.210	0.187
17	**KGP 1**	2	AGARPARA	0.101	0.168	0.132
18	**KGP 1**	3	AJABGAR	0.165	0.275	0.249
19	**KGP 1**	4	AJABPUR	0.081	0.087	0.094
20	**KGP 1**	5	AJODHYAGAR	0.188	0.345	0.285
21	**Paschim Medinipur KGP 1**	**1991** 1	ABHOYANAGAR	0.075	0.093	0.105
22	**KGP 1**	2	AGARPARA	0.058	0.086	0.088
23	**KGP 1**	3	AJABGAR	0.131	0.218	0.198
24	**KGP 1**	4	AJABPUR	0.128	0.181	0.183
25	**KGP 1**	5	AJODHYAGAR	0.061	0.078	0.087

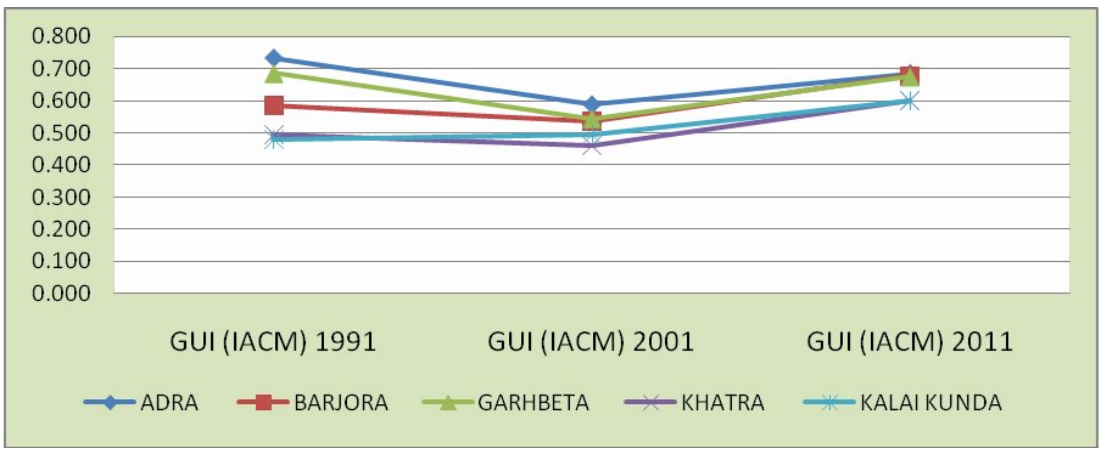
Source: Calculated by the Author on the basis of Selected Census Data

Table 6.2: Top Five Census-units of BR in 2011 Census, in terms of their GUI values (all IACM) and their Performances in 2001 and 1991 Censuses

SERIAL NO.	DISTRICTS AND BLOCKS	CENSUS-UNITS	GUI (1991)	GUI (2001)	GUI (2011)
1	KASHIPUR (PURU)	**ADRA**	0.733	0.589	0.685
2	BARJORA (BANK)	**BARJORA**	0.585	0.537	0.678
3	GARH 1 (PASCH MED)	**GARHBETA**	0.685	0.543	0.675
4	KHATRA (BANK)	**KHATRA**	0.495	0.460	0.601
5	KGP 1 (PASCH MED)	**KALAI KUNDA**	0.480	0.494	0.600

Source: Calculated by the Author on the basis of Selected Census Data

Chart 6.1: Trend of GUI for Top 5 Performers among the Census-units of the Backward Districts over three selected Census Years



Source: Calculated by the Author on the basis of Selected Census Data and Table 6.2

The other top performers in 2011 in GUI are Barjora, Garhbeta, Khatra and Kalai Kunda respectively, as obtained from the analysis and their urbanization trends are also presented. However, in **Table 6.3** we have enlisted the names of poor performing census-units belonging to different blocks at three different censuses and for this purpose we have identified five census-units each from the censuses. There are not too many common names in the list of census-units that secured the bottom most positions and their respective GUI values, as came out are negligible (varying between 0.005 and 0.046).

Table 6.3: Bottom Five Census-units of BR in 2011, 2001 & 1991 Censuses respectively in terms of their GUI values (all IACM)

Census Year	Block	Census-unit	GUI
2011	**BARJORA**	BANSOL	0.046
2011	**BARJORA**	ARJUNI	0.040
2011	**GARH 1**	CHANDRAPUR	0.037
2011	**GARH 1**	BARA RANGTIA	0.037
2011	**GARH 1**	DARKHOLA	0.036
2001	**KGP 1**	RATHBAR	0.029
2001	**GARH 1**	DARKHOLA	0.025
2001	**BARJORA**	BANSOL	0.018
2001	**KGP 1**	JAMJURI	0.015
2001	**GARH 1**	GARKI	0.008
1991	**JHALDA 2**	MAHUDA	0.017
1991	**GARH 1**	SIMLABADA	0.015
1991	**KASHIPUR**	BALARAMPUR	0.014
1991	**GARH 1**	DHANYARDIHA	0.010
1991	**KGP 1**	HAJICHAK	0.005

Source: Calculated by the Author on the basis of Selected Census Data

Results: Study of Urbanization for the Blocks of the Backward Region (BR) in terms of Block-level Urbanization Index (BUI)

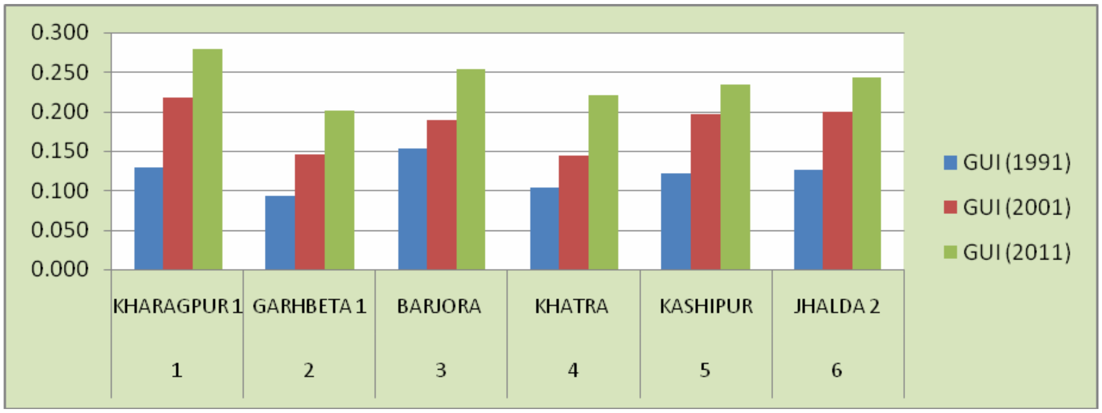
The detailed block level urbanization analysis for the entire backward region is presented in the **Table 6.4** and in the **Charts 6.2 and 6.3**. It is obtained from **Table 6.4** (Note: BUI is calculated as an average of all GUI values, obtained for the census-units belonging to a particular block) that the block of Kharagpur 1 has performed better than the other blocks in terms of Block-level Urbanization Index (BUI). In 2011, Kharagpur 1 obtained BUI as 0.280, followed by

Table 6.4: Pattern of Urbanization in 6 Selected Sample Blocks, belonging to 3 Districts of BR in terms of BUI for the Study Period

Serial No.	BLOCKS / YEARS	BUI (1991)	BUI (2001)	BUI (2011)
1	KHARAGPUR 1	0.130	0.217	0.280
2	GARHBETA 1	0.093	0.145	0.201
3	BARJORA	0.152	0.190	0.253
4	KHATRA	0.104	0.144	0.220
5	KASHIPUR	0.122	0.197	0.234
6	JHALDA 2	0.126	0.200	0.243

Source: Calculated by the Author on the basis of Selected Census Data

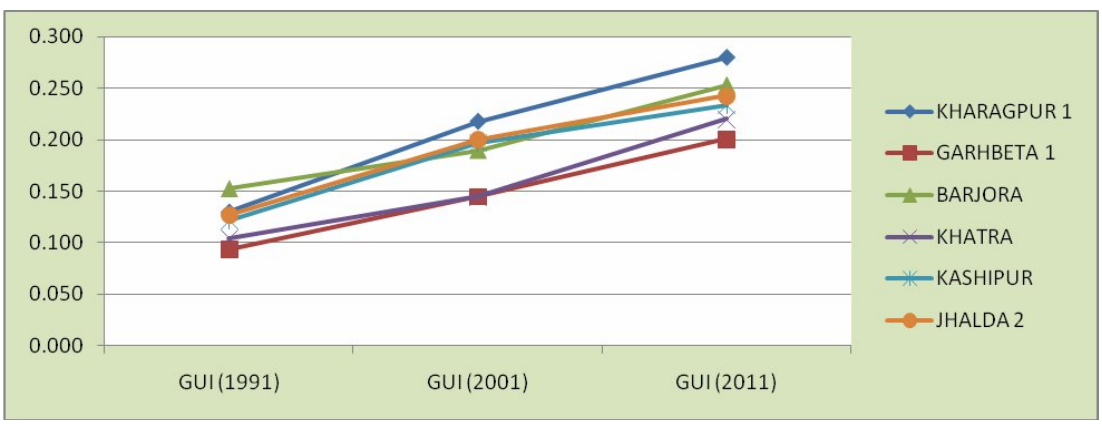
Chart 6.2: Pattern of BUI for 6 C D Blocks Selected from 3 Backward Districts of W B in Composite Bar Diagram over the selected three Census Years



Source: Calculated by the Author on the basis of Selected Census Data and Table 6.4

Barjora (BUI 0.253) and Jhalda 2 (BUI 0.243) and these three blocks have occupied the top three positions. In 2001 Kharagpur 1 (BUI 0.217) was followed by Jhalda 2 (BUI 0.200) and Kashipur (BUI 0.197) in top three. In 1991, however, the top three positions were captured by Barjora (BUI 0.152), Kharagpur 1 (BUI 0.130) and Jhalda 2 (BUI 0.126) respectively. In **Chart 6.2** the BUI values obtained by the blocks at different periods are shown in composite bar diagram ant it helps to understand the changes in BUI by each block in each census year. However, in **Chart 6.3** the urbanization trends of the six blocks concerned over the decades are presented and all are found rising with little variations in their respective slopes.

Chart 6.3: Trends of BUI for C D Blocks Selected from 3 Backward Districts of W B over the selected three Census Years



Source: Calculated by the Author on the basis of Selected Census Data and Table 7.4

Results: Study of Urbanization for the Districts of the Backward Region separately in terms of District-level Urbanization Index (DUI)

The district level urbanization study of the backward region is presented in **Table 6.5** from which it appears that the district of Bankura has occupied the top most position in 2011 in terms of District-level Urbanization Index (DUI) (Note: DUI is calculated as an average of obtained BUI values for the selected blocks belonging to a particular district). In 2011, Bankura has obtained DUI as 0.239, followed by Purulia (DUI 0.237) and Paschim Medinipur (DUI 0.235). These DUI values of 2011 are obtained in close proximities which imply that the districts of the backward region are showing homogeneous pattern of urbanization. In 2001, Purulia was a little bit ahead (DUI 0.198) than the other two, whereas, in 1991, Bankura again got the top position by securing DUI as 0.131. These values of DUI are seemed to be very low if we consider the greater perspective of urbanization features, though there is an increasing trend observed for all the three districts over the study period as shown in **Chart 6.4**.

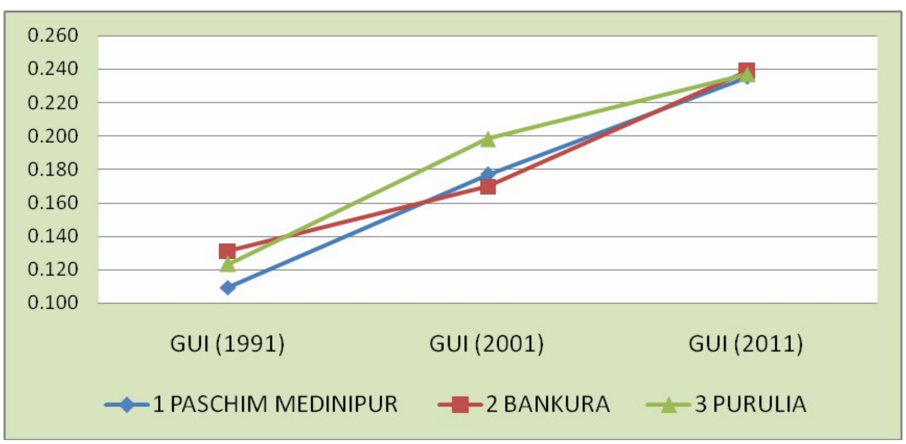
Table 6.5: Pattern of Urbanization in 3 Districts of BR in terms of their DUI Values over the Study Period of Three Decades

Serial No.	DISTRICTS / YEARS	**DUI (1991)**	**DUI (2001)**	**DUI (2011)**
1	PASCHIM MEDINIPUR	0.109	0.177 (62%)	0.235 (33%)
2	BANKURA	0.131	0.170 (30%)	0.239 (41%)
3	PURULIA	0.123	0.198 (61%)	0.237 (20%)

Source: Calculated by the Author on the basis of Selected Census Data

Note: Figures in the parentheses indicate per cent increase in the value over previous census year

Chart 6.4: Trend of DUI for 3 Backward Districts of West Bengal on the basis of Sample Blocks over the Selected Census Years



Source: Calculated by the Author on the basis of Selected Census Data and Table 7.5

In **Table 6.5**, it is observed that Bankura's rate of growth in DUI is observed as relatively higher during 2001-2011(i.e., 41 %) than what was during 1991-2001 (i.e., 30 %). On the contrary, Paschim Medinipur's rate of growth of its DUI was found much higher in 1991-2001 (i.e., 62%) than that achieved during 2001-2011 (33%), and in a similar trend, Purulia's rate of growth in its DUI was as high as 61% during 1991-2001 but fell drastically to 20% during 2001-2011.

Results: Study of Urbanization for the Districts taken together (of the Region) through Construction of Backward Region Urbanization Index (BRUI)

An analysis on urbanization is presented for the entire backward region through computation of BRUI in aggregation. It is obtained that the BRUI for the region stands at 0.237 at 2011, in which the component of TCI is 0.218 and that of AI is 0.264 and these two have their scheduled weights. As **Table 6.6** displays, BRUI was 0.181 in 2001 and 0.119 in 1991, indicating a gradual upward movement over the decades. However the contribution of AI in determination of BRUI has significantly changed from the period of 1991-2001 to 2001-2011 (an increase of 70% is observed). During the decade of 1991-2001, the importance of AI was much lower in comparison to TCI, whereas the situation just got reversed during 2001-2011 and AI has started to dominate the urbanization scenario (Ref: **Chart 7.5**).

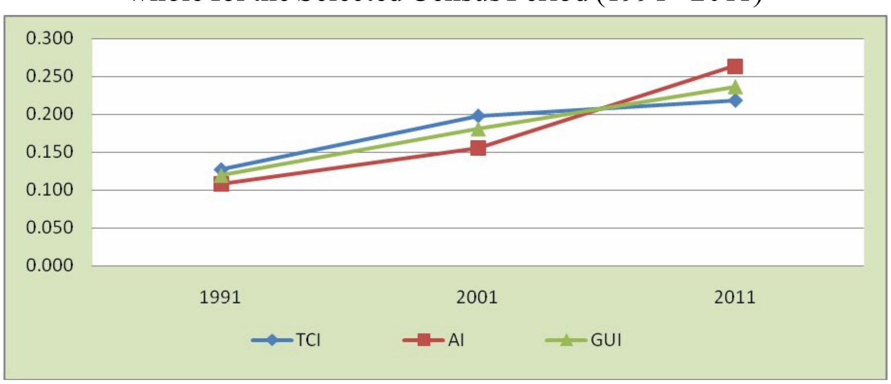
Table 6.6: Pattern of Backward Region Urbanization over Three Decades of Census in terms of TCI, AI and BRUI values (in aggregates)

ENTIRE COVERED REGION	1991	2001	2011
TCI	0.127	0.198 (56%)	0.218 (10%)
AI	0.107	0.155 (45%)	0.264(70%)
BRUI	0.119	0.181(52%)	0.237(31%)

Source: Calculated by the Author on the basis of Selected Census Data

Note: Figures in the parentheses indicate per cent increase in the value over previous census year

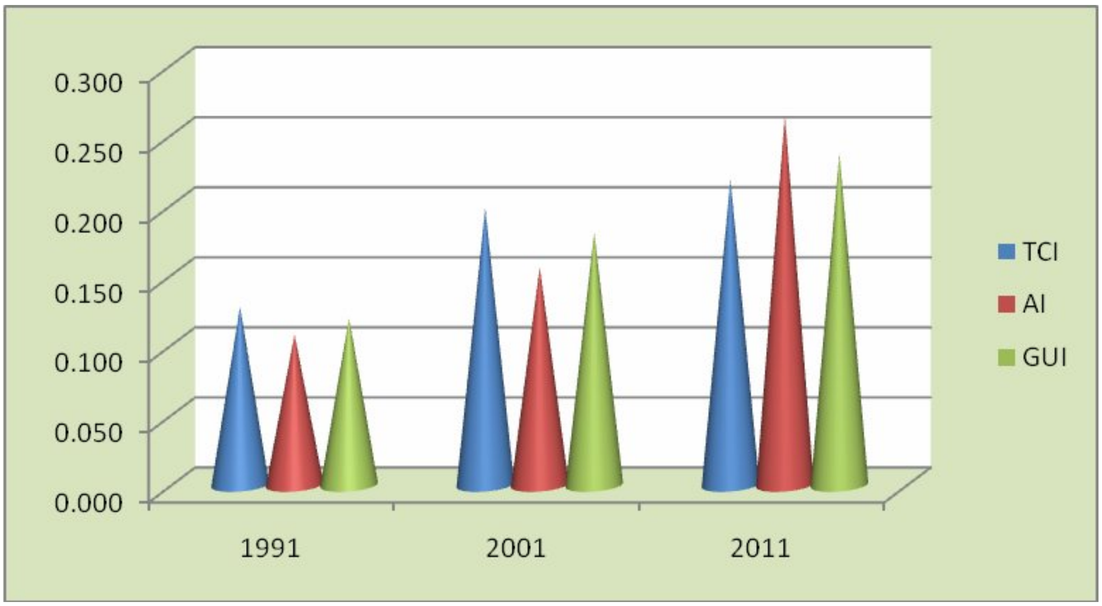
Chart 6.5: Trends of BRUI, TCI and AI for the Backward Region of West Bengal as a whole for the Selected Census Period (1991 - 2011)



Source: Calculated by the Author on the basis of Selected Census Data and Table 6.6

In **Chart 6.6** we have tried to show the pattern of urbanization for the entire backward region through diagram of composite cones. Actually the heights of the respective cones do matter and one can have a better understanding of the situation through looking at the height of the cones. It is observed that, in 1991 and in 2001, the cones representing TCI were higher than the rest two indices, though the average height of all three was much higher in 2001. In 2011, on the other hand, the cone representing AI was found longer than the other two signifying its growing importance over time.

Chart 6.6: Pattern of Urbanization in the BR of WB (in aggregates) in Terms of TCI, AI & BRUI, for last three Census Years in Composite Cones



Source: Calculated by the Author on the basis of Selected Census Data and Table 6.6

7. Conclusion: Findings and Interpretations

In this final section of the article, a summary of the entire study along with major findings are presented. We have shown the obtained GUI values of the respective census-units belonging to selected blocks within the three chosen districts. A 'block-wise urbanization' analysis through aggregation of GUI values of all the census-units therein and a 'district-wise' analysis through aggregation of the block level values therein is done sequentially and the results are presented here both in tabular forms and in diagrams. At the next step, a generalized picture of 'backward region urbanization' in terms of BRUI and its components TCI and AI are presented through the aggregation of the computed GUI values of the sample districts and it shows the movement of BRUI, TCI and AI over last three census decades.

The major findings of this analysis can be summarized as follows - (a) The three districts are identified as backward in terms of urbanization status as their overall DUI values are very low in comparison to other selected districts of West Bengal as obtained elsewhere. (b) There is a vast gap prevailing in GUI values between the limited number of census towns and the large number of village units found in a particular block of any backward region district. The census towns are relatively affluent and rich in having urban facilities to a larger extent in this region than other regions. This widespread gap between these two types of census-units is a matter of great concern and this high level disparity is seemed to be one of the major causes of low urbanization in this area. (c) As we have obtained, the backward region districts, particularly Bankura and Purulia, have continued to show low rates of urban growth over the decades which are considerably below the state-average and indicate large-scale net out-migration. Policy-makers have to take into account this point and necessary measures are to be enforced to curb down this sort of out-migration from these districts.

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Appendices

Table AT 1: CD Blocks of the district of **Paschim Medinipur** with number of Census Towns therein in 2011& 2001, Rate of Growth of Census Towns and per cent of Urban Population in the Respective Blocks in 2011 Census

BLOCKS OF PASCHIM MEDINIPUR (including JHARGRAM)	NUMBER OF CENSUS TOWNS (CT) IN 2011	NUMBER OF CENSUS TOWNS (CT) IN 2001	INC (IN CT) (2001 TO 2011)	RG (CT) (2001 - 2011)	TOT POP (BLOCK) (2011)	TOT URB POP (BLOCK) (2011)	% OF URB POP (BLOCK) (2011)
Garhbeta 1	2	0	2	-	228513	10274	4.50
Garhbeta 3	3	1	2	200.00	169528	20719	12.22
Kharagpur 1	2	1	1	100.00	258040	92079	35.68
Debra	1	1	0	0.00	288619	13784	4.78
Narayangarh	1	1	0	0.00	302620	9007	2.98
Dantan 1	1	0	1	-	172107	6186	3.59
Binpur 2	1	0	1	-	164522	5724	3.48
DISTRICT TOTAL	**11**	**4**	**7**				

Source: Census of India, 2001 and 2011; Own Calculation

Table AT 2: Calculation of Combined Index for the Blocks (CIB) of **Paschim Medinipur** District and Selection of Two Sample Blocks

BLOCKS	RG (CT) (2001 - 2011)	INC (IN CT) (2001 TO 2011)	Index 1 (for absolute increase in CTs)	% OF URB POP (BLOCK) (2011)	Index 2 (for % of Urban Population)	Combined Index for the Blocks (CIB)
Blocks with at least 1 CT in 2001						
Garhbeta 3	200	2	1	12.22	0.28	0.64
Kharagpur 1	100	1	0.5	35.68	1	0.75
Debra	0	0	0	4.78	0.05	0.03
Narayangarh	0	0	0	2.98	0	0
Blocks with no CT in 2001						
Garhbeta 1	-	2	1	4.5	0.05	0.52
Dantan 1	-	1	0.5	3.59	0.02	0.26
Binpur 2	-	1	0.5	3.48	0.02	0.26

Source: Census of India, 2001 and 2011; Own Calculation

Table AT 3: Computation of TCI for the Census-units in **EWP, PCA and IACM** respectively, A Representative Picture with 25 Units under 3 Censuses

Serial No.	**DISTRICTS AND BLOCKS**	Block-wise Serial No. in Census Years	**NAME of the VILLAGE UNITS / NON-MUNICIPAL TOWNS / CENSUS TOWNS**	**INDEX OF TOTAL POP (ITP)**	**INDEX OF POP DENSITY (IPD)**	**INDEX OF PROP OF MMW in NA (IPMMWNA)**	**TCI (EWP)**	**TCI (PCA)**	**TCI (IACM)**
1	**Paschim Medinipur KGP 1**	**2011** **1**	ABHOYANAGAR	0.0165	0.1690	0.1149	0.1001	0.1124	0.1099
2	**KGP 1**	2	AGARPARA	0.0043	0.1083	0.7496	0.2874	0.4712	0.3751
3	**KGP 1**	3	AJABGAR	0.0133	0.0922	0.3490	0.1515	0.2315	0.1906
4	**KGP 1**	4	AJABPUR	0.0384	0.1645	0.6546	0.2858	0.4343	0.3578
5	**KGP 1**	5	AJODHYAGAR	0.0326	0.0392	0.9226	0.3315	0.5611	0.4376
6	**Bankura BARJORA**	**2011** **1**	AMTHIA	0.0325	0.0675	0.1132	0.0710	0.0889	0.0802
7	**BARJORA**	2	ARJUNI	0.0028	0.0115	0.0000	0.0048	0.0033	0.0043
8	**BARJORA**	3	ASANSOLA	0.0449	0.0602	0.3281	0.1444	0.2163	0.1780
9	**BARJORA**	4	ASHURIA MADHABPUR	0.0207	0.0332	0.9536	0.3358	0.5760	0.4470
10	**BARJORA**	5	BAGULI	0.0589	0.0988	0.5156	0.2244	0.3391	0.2784
11	**Purulia KASHIPUR**	**2011** **1**	ADALI	0.0132	0.0115	0.0130	0.0126	0.0126	0.0125
12	**KASHIPUR**	2	ADRA (CT)	0.7478	0.1700	0.9969	0.6382	0.7528	0.6754
13	**KASHIPUR**	3	AGARDI	0.0531	0.0904	0.5176	0.2204	0.3373	0.2754
14	**KASHIPUR**	4	AGRABAD	0.0305	0.0329	0.1153	0.0596	0.0813	0.0697
15	**KASHIPUR**	5	AGUIBAD	0.0078	0.0475	0.4998	0.1850	0.3088	0.2432
16	**Paschim Medinipur KGP 1**	**2001** **1**	ABHOYANAGAR	0.0140	0.1434	0.2836	0.1470	0.2055	0.1775
17	**KGP 1**	2	AGARPARA	0.0045	0.1134	0.2142	0.1107	0.1555	0.1343
18	**KGP 1**	3	AJABGAR	0.0122	0.0846	0.7457	0.2808	0.4643	0.3674
19	**KGP 1**	4	AJABPUR	0.0257	0.1103	0.0702	0.0688	0.0729	0.0730
20	**KGP 1**	5	AJODHYAGAR	0.0275	0.0330	0.7853	0.2819	0.4775	0.3723
21	**Paschim Medinipur KGP 1**	**1991** **1**	ABHOYANAGAR	0.0114	0.1167	0.1571	0.0951	0.1236	0.1111
22	**KGP 1**	2	AGARPARA	0.0035	0.0894	0.1999	0.0976	0.1410	0.1200
23	**KGP 1**	3	AJABGAR	0.0087	0.0606	0.6058	0.2250	0.3750	0.2956
24	**KGP 1**	4	AJABPUR	0.0288	0.1234	0.4204	0.1909	0.2840	0.2364
25	**KGP 1**	5	AJODHYAGAR	0.0260	0.0312	0.1417	0.0663	0.0958	0.0801

Source: Calculated by the Author on the basis of Selected Census Data

Table AT 4: Computation of AI for the Census-units in **EWP, PCA and IACM** respectively, A Representative Picture with 25 Units under 3 Censuses

Serial No.	**DISTRICTS AND BLOCKS**	Block-wise Serial No. in Census Years	**NAME of the VILLAGE UNITS / NON-MUNICIPAL TOWNS / CENSUS TOWNS**	**AI (EWP)**	**AI (PCA)**	**AI (IACM)**
1	**Paschim Medinipur KGP 1**	**2011 1**	ABHOYANAGAR	0.179	0.560	0.386
2	**KGP 1**	2	AGARPARA	0.061	0.170	0.134
3	**KGP 1**	3	AJABGAR	0.102	0.229	0.210
4	**KGP 1**	4	AJABPUR	0.106	0.310	0.224
5	**KGP 1**	5	AJODHYAGAR	0.153	0.548	0.369
6	**Bankura BARJORA**	**2011 1**	AMTHIA	0.062	0.160	0.128
7	**BARJORA**	2	ARJUNI	0.048	0.145	0.092
8	**BARJORA**	3	ASANSOLA	0.189	0.576	0.405
9	**BARJORA**	4	ASHURIA MADHABPUR	0.171	0.352	0.253
10	**BARJORA**	5	BAGULI	0.156	0.345	0.262
11	**Purulia KASHIPUR**	**2011 1**	ADALI	0.123	0.228	0.214
12	**KASHIPUR**	2	ADRA (CT)	0.446	0.726	0.700
13	**KASHIPUR**	3	AGARDI	0.155	0.209	0.201
14	**KASHIPUR**	4	AGRABAD	0.107	0.215	0.200
15	**KASHIPUR**	5	AGUIBAD	0.084	0.186	0.151
16	**Paschim Medinipur KGP 1**	**2001 1**	ABHOYANAGAR	0.120	0.216	0.201
17	**KGP 1**	2	AGARPARA	0.092	0.182	0.129
18	**KGP 1**	3	AJABGAR	0.048	0.056	0.074
19	**KGP 1**	4	AJABPUR	0.093	0.102	0.125
20	**KGP 1**	5	AJODHYAGAR	0.093	0.192	0.158
21	**Paschim Medinipur KGP 1**	**1991 1**	ABHOYANAGAR	0.055	0.058	0.097
22	**KGP 1**	2	AGARPARA	0.019	0.023	0.042
23	**KGP 1**	3	AJABGAR	0.036	0.035	0.055
24	**KGP 1**	4	AJABPUR	0.065	0.061	0.104
25	**KGP 1**	5	AJODHYAGAR	0.055	0.058	0.097

Source: Calculated by the Author on the basis of Selected Census Data