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Measuring micro spatial inequality of human development with the application of Principal Component Analysis (PCA) – a study in Purulia District, West Bengal, India

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Abstract

The investigation of unequal spatial distribution of human development is a dynamic research interest in the arena of social sciences. Gradual pluralistic trend of the measurement of human development leads to utilization of wider range of variables for the statistical analysis of the levels of human development over space. Principal Component Analysis (PCA) is a statistical device, popularly used for reducing the dimensions of contributing variables for reaching to a rational conclusion. The present study uses this technique for the block level analysis of inequality in human development in the district of Purulia, one of the most backward district in the western part of Indian state of West Bengal.

Keywords: Principal component, Development, Multivariate, Disparity.

Introduction

'Development' is presently being conceptualized as a process, which improves the quality of life of people; and, on the other hand, the relative differentiation of stock of resources, access to resources, physical quality of life, share of power in economics, social and political decision making etc between different individuals, groups or communities invades the ill-consequences of unequal development in the ambient society. The history of development plans in India, both centralized and decentralized, could hardly able to usher the optimum outcome from it, as most of the plans have been terminated through the partial fulfillment of the targeted objectives. In most of the cases the lack of flexibility in the planning becomes the tough challenge in gaining holistic success of the plans where the primary emphasis should have to be given in this sector, considering the reality that India is the abode of varieties of social, cultural, economic, lingual and religious groups. The failure of a plan in this respect would have every possibility to carry the benefits into a minor part of population by depriving the mass and the inequality tends to increase away. There are ample evidences favouring the fact that India is witnessing a gradual enhancement of the magnitude of regional disparities in India within last couple of decades[1-3]. Unchecked and uncontrolled process of growth leads to this regional disparities[4].

The Fourth Five Years Plan (1969-74) of India has been marked for the initiation of decentralization of national planning by introducing the district level plan. Further district level plan was decentralized at block level, during the Sixth Five Years Plan (1980-85). The Seventh Plan (1985-90) emphasized local area planning by stressing on demographic decentralization. The Eighth Plan (1992-97) brought forth the ideas of building, and strengthening people's institutions and making people actively participating within liberalization and privatization frame work. The main focus was on population control, environmental protection and infrastructural development. The ninth plan of India (1997-2002) focused on growth along with social justice and socio-economic equity. During the tenth plan (2002-2007) the Planning Commission of India advocated the concept of 'area approach' and targeted accelerating 'true' decentralization of planning. Gradually, the decentralized planning policy procedure was adopted to prepare village plans by collecting information of local requirements at block levels and finally they were assembled at district administrations for designing the district plans. But most of these initiatives were confined on papers and its proper execution has rarely been viewed. Removal of regional disparities in development has remained mostly untouched in the planning in India[5]. It is the fact that effort of decentralization in planning procedures in India is mostly limited to the allotment of financial support up to the micro level administrative units and their expenditure through the local governments. One of the most aspired goals of decentralized plans or local level plans is to mould the structure of plans necessarily as it would be best fitted with the local demand and be capable enough to satisfy the problems at local level. But these targeted goals are found getting unsatisfied for almost all the plans when they are judged through micro level studies or research works.

The above analysis bring to fore that the situation demands identifying the regions with a considerable degree of backwardness in terms of achieved level of development within the county, state and even at district level well as to measure

the level of disparities amongst different regions. Therefore, the present study initially attempts to investigate inter-block level disparities in terms of different socio-economic parameters in the study area, i.e. the district of Purulia and tries to realize the magnitude of unequal development existing therein.

Study area: Purulia, the western-most district of the state of West Bengal at present, making boundary with the neighbouring states of Jharkhand and Bihar, was the part of Manbhum district within the state of undivided Bihar during independence. The district of Purulia was formed and merged with West Bengal on 1st November 1956 by separating areas under 16 police stations of the then Bihar vide the Bihar and West Bengal (Transfer of Territories) Act 1956 as per the recommendation of the State Reorganization Commission[6]. Geographically the district extends between 22.70295^0 N to 23.71335^0 N latitude and 85.82007^0 E to 86.87508^0 E longitude, covering a total area of 6259 km^2. The district is ranked at the most rear position in the state in terms of the achieved level of human development and also exhibit a degree of inequality in terms of development among different social groups as well as sub-district level micro spatial units. Purulia district is selected as the study area for the present work (Figure-1).

Dataset and variables

The present investigation has utilized the secondary dataset. The block wise dataset on different parameters have been collected from the Primary Census Abstract of Census of India (2001 and 2011)[7,8] and the District Statistical Handbook of Purulia District (2001 and 2011)[9,10] , published by the Bureau of Applied Economics and Statistics, Government of West Bengal.

The present investigation has provided its effort to cover wider dimensions of human development at block level and a range of 25 (twenty five) important variables has been considered for this purpose. The list of variables and their working definitions are mentioned in Table-1.

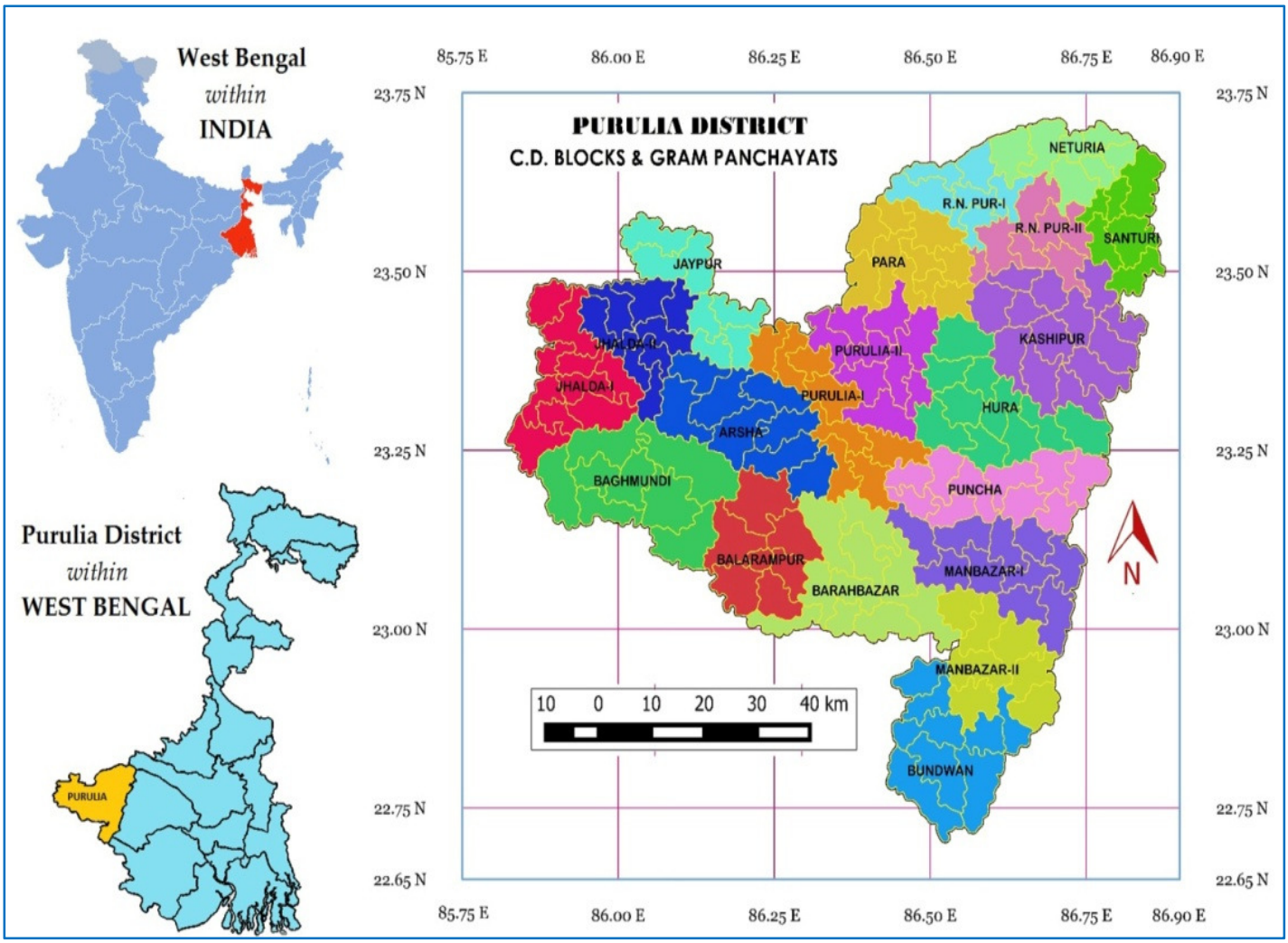

Figure-1: Location of the district of Purulia along with the blocks represented with different colour sheds.

Table-1: The variables used for examining the scenario of human development at block level in the district of Purulia

Variable expression	Variable name
GLR (x_1)	Gross Literacy Rate (% to total population)
FLR (x_2)	Literacy Among Female (% to total female population)
PSL (x_3)	No. of Primary School per 10,000 population
HSL (x_4)	No. of High and Higher Secondary School per 10,000 population
NSL (x_5)	No. of Special and Non-Formal School per 10,000 population
TPS (x_6)	No. of Teachers per 1000 of Students in Primary schools
THS (x_7)	No. of Teachers per 1000 of Students in High schools
PHC (x_8)	No. of Primary Health Centers per 100,000 population
BED (x_9)	No. of Beds in Public Hospitals & Health Cente per 100,000 population
DOC (x_{10})	No. of Doctors in Public Hospitals & Health Centers per 100,000 population
FWC (x_{11})	No. of Public Family Welfare Centers per 100,000 population
NSA (x_{12})	Net Sown Area as percentage to Total Geographical Area
IRG (x_{13})	Irrigated Area as percentage to Total Area under Cultivation
CRO (x_{14})	Area under more than one crop as % to Net Sown Area
AMN (x_{15})	Aman Rice production per Head (in Kg)
ADC (x_{16})	No. of ADAC per 100000 livestock creatures
BNK (x_{17})	No. of Banks per 100,000 population
POP (x_{18})	Population density (Population per sq. km)
SRT (x_{19})	Sex ratio (No. of female per thousand male)
WRK (x_{20})	Working population as % to total population
MWK (x_{21})	Main worker as % to total population
FMW (x_{22})	Female participation as main working population (%)
FRW (x_{23})	Female participation as marginal working population (%)
MNA (x_{24})	Main workers involved in non-agricultural occupations (%)
RNA (x_{25})	Marginal workers involved in non-agricultural occupations (%)

Principal Component Analysis (PCA)

The present investigation requires a suitable statistical analysis to describe the complex spatial structure of a large number of variables through some smaller number of underlying dimensions. The consideration of a larger number of variables may be described as in terms of the directly unobservable dimensions of human development and these underlying dimensions is possible to be extracted from the given set of structural variables on the basis of inter-correlations among them[11]. There are ample of quality research works in geography which have followed this particular methods[12-14] . The Principal Component Analysis (PCA) is a branch of factor analysis, popularly sued by in the research works in social sciences as an effective device to synthesize a large number of variables into a smaller number of general components retaining the maximum amount of descriptive ability for the entire dataset. It leads to a more 'economical' description of the given set of structural variables and suggest some underlying dimensions (i.e. components), accounting for the statistical relationship among them. It is, somehow, a method to discover those hidden factors which might have generated the dependence (or, covariance) among the contributing variables[15].

Theoretical concept of Principal Component Analysis (PCA): Hotelling[16] is credited for the propounding of mathematical formulation of the Principal Component Analysis (PCA) in 1933.

Let $X = (X_1\ X_2\ \ldots\ X_p)$ be a set of p vectors of standardized random variables having a considerable degree of inter-correlations among them. The principal components of these p structural variables are such linear combinations of them which ensure the maximum levels of variance.

So, if the required linear function is given as: $Y = a_1X_1 + a_2X_2 + \cdots + a_pX_p$ Then, the coefficient vector $\alpha = (a_1\ a_2 \ldots a_p)$ must satisfy: i. $s^2y = \alpha.s_a$ (i.e. the variance of y is maximum for all values of a; ii. $\alpha.\alpha = 1$ (which is a normalization condition for mathematical convenience).

Where, s is the variance-covariance matrix of X and s^2y is the variance of Y.

Hence, the objective of Principal Component Analysis (PCA) is to find out the values of coefficient vector α which satisfy both the conditions mentioned above. The mathematical solution of the problem shows that 'a' is one of the p eigen vectors (normalized to unity) of the matrix of inter correlations R among the original variables $(X_1\ X_2\ \ldots\ X_p)$. The number of components derived in this way are exactly equal to the number of original variables p , and the original total variance, associated with $(X_1\ X_2\ \ldots\ X_p)$ is truly preserved in the total variance of the components $(Y_1\ Y_2\ \ldots\ Y_p)$. The solution also suggests that the variance of a particular component is equal to the corresponding eigen value (λ_i) of the eigen vector used for the same. The component corresponds to the highest eigen value

is the first principal component and the similarly, the components correspond to next descending levels of eigen values are termed as second, third etc principal components. It is also fund that a few principal components posses higher variances which explain major portion of the total variance *p* keeping the rest of the components to explain negligible portion to explain.

Another important part of the PCA is the issues related to the factor loadings. Theoretically, if the p elements of an eigen vector, corresponding to the eigen value λ_i and normalized to unity, are multiplied by $\sqrt[2]{\lambda_i}$, they become the correlation coefficients of the i^{th} principal component with each of the *p* variables. These coefficients of correlation are termed as factor loadings. The variables having higher degree of correlation with particular component can be identified using the values of factor loadings. Thus a particular principal component can be linked with the underlying dimensions (and, may be given a name accordingly) by inspecting the factor loadings of the variables under that component.

Application of PCA to block level dataset: The inter correlation coefficient matrix (R_{2001}) comprising all the 25 variables mentioned above (Table-A2 in appendix) has been computed using the block level dataset for the census year 2001(which is given in details in the Table A1 in appendix). The eigen values of the matrix R_{2001} have been extracted accordingly (Table-A3 in appendix). Out of the twenty five eigen values extracted from the matrix R_{2001}, the eighth largest eigen value is almost unity (i.e. 1.060). Considering the first eight eigen values which are above unity the simple estimation of the portion of variance of the data matrix explained by them can be calculated as: [$^1/_{25}$ * (5.986 + 5.384 + 2.978 + 2.365 + 1.655 + 1.391 + 1.186 + 1.060)*100]= 88.015 which means, about 88 % of the total variance of the matrix is accounted for the largest eight eigen values. The eigen vectors, corresponding to the eight eigen values above unity, have been normalized to unity. For the computation of scores of first to eighth principal components, the 25 elements of each of the eight eigen vectors are used as weights of the standardized values of the given 25 variables in the data matrix (Table-A4 in appendix). The block wise variation of scores of first three principal components has been represented in Figure-2 below. Now, multiplication of each elements of these eigen vectors with the square root of their eigen values results into the factor loading of each variable (Table-2).

In a similar way the matrix of inter correlation (R_{2011}) has been computed (Table-A6 in appendix) for all the variables with the dataset of census year 2011 (detailed dataset given in Table-A5 in appendix) and all the eigen values have been extracted (Table-A7 in appendix) from the matrix accordingly. In this case of 2011 dataset, the sixth largest eigen value is almost unity (1.346). Considering the first six eigen values which are above unity, the estimation of proportion of variance explained by them can be calculated as: [$^1/_{25}$ * (6.756 + 5.583 + 3.002 + 2.062 + 1.624 + 1.346)*100]= 81.494 which means, about 81.5 % of the total variance of the matrix is accounted for the largest six eigen values. The scores of first six principal components have been computed similarly as discussed in the previous section (Table-A8 in appendix) and the block wise distribution of scores of first three principal components in Purulia district is presented through choropleth technique in Figure-2. The factor loadings of each variables for 2011 dataset has also been computed and summarized in Table-3.

Results and discussion

The application of Principal Component Analysis bring to fore some characteristics of the spatial pattern of human development in the district of Purulia. The variable wise factor loadings and the block wise score of components – these two are the essential elements to interpret the results of the Principal Component Analysis in the present study. The factor loadings on different variables for 2001 dataset (Table-2) provides the scope to identify the major components with their links with the contributing variables. The factor loadings of the first principal component of 2001 dataset exhibit that it has a significantly positive correlation with the variables PSL (x_3), HSL (x_4), TPS (x_6), PHC (x_8), FWC (x_{11}), AMN (x_{15}), BNK (x_{17}), SRT (x_{19}) and WRK (x_{20}) as well as significantly negative correlation with the variable POP (x_{18}) . The second principal component shows significant positive correlation with GLR (x_1), FLR (x_2), HSL (x_4) and NSL (x_5) as well as significant negative correlation with the variables IRG (x_{13}), MWK (x_{21}), FMW (x_{22}) and FRW (x_{23}). The third principal component shows significant positive correlation with the variables PHC (x_8), MNA (x_{24}) and RNA (x_{25}) . Similarly, the fourth principal component shows significant positive correlation with the variables THS (x_7) and BED (x_9) as well as this is in significantly negative correlation with the variable CRO (x_{14}). The remaining principal components (i.e. fifth to eighth) do not offer any meaningful relationship with the variables that can be useful to interpret the underlying dimensions of human development in the study area.

The block wise scores of first three principal components, represented in Figure-2, give a distinct view of spatial pattern of different factors in the study area which can be summarized as: (i) The component scores of first and third principal components (of 2001) make a clear dissection of the district with the concentration of higher scores at the eastern blocks and comparatively lower scores at the western blocks; (ii) The second principal component score offers no clear trend at the block level development pattern; (iii)The block level dataset of 2001 exhibit a quite 'seesaw' change of the position of the blocks in the order of component scores under different principal components. Figure-3 would reveal the fact that most of the blocks posses a wider range of component scores under different principal components; (iv) Most contrasting variation of the component scores under different principal components is found for the blocks of Bandwan, Jhalda-II and Purulia-I. These blocks come at the highest strata of the component score for a particular principal component and even come down to the lowest strata for another one component.

Table-2: Factor loadings of Principal Components for 2001 dataset

Variables		Components (2001)							
		1	2	3	4	5	6	7	8
GLR (x_1)	Gross Literacy Rate (% to total population)	.124	**.838**	-.230	-.137	-.307	.163	-.107	-.077
FLR (x_2)	Literacy Among Female (% to total female population)	.204	**.869**	-.120	-.174	-.300	.157	-.088	-.044
PSL (x_3)	No. of Primary School per 10,000 population	**.922**	.158	-.092	.018	.196	-.011	.014	.127
HSL (x_4)	No. of High and Higher Secondary School per 10,000 population	**.557**	**.609**	.067	.056	.119	.260	-.234	.152
NSL (x_5)	No. of Special and Non-Formal School per 10,000 population	.475	**.553**	.418	.073	.235	-.223	.007	.040
TPS (x_6)	No. of Teachers per 1000 of Students in Primary schools	**.574**	.431	-.111	.084	**-.572**	.106	.042	.006
THS (x_7)	No. of Teachers per 1000 of Students in High schools	-.098	.236	.058	**.549**	.228	.311	**-.560**	.132
PHC (x_8)	No. of Primary Health Centers per 100,000 population	**.602**	.124	**.619**	.158	.003	-.091	.105	-.328
BED (x_9)	No. of Beds in Public Hospitals & Health Centers per 100,000 population	-.362	.487	.399	**.567**	-.039	-.205	.113	.081
DOC (x_{10})	No. of Doctors in Public Hospitals & Health Centers per 100,000 population	-.182	**.566**	.487	.447	-.120	-.012	.292	.069
FWC (x_{11})	No. of Public Family Welfare Centers per 100,000 population	**.760**	.028	.491	.053	.040	-.186	.064	-.208
NSA (x_{12})	Net Sown Area as percentage to Total Geographical Area	-.426	.251	-.252	.478	.168	-.091	.445	.241
IRG (x_{13})	Irrigated Area as percentage to Total Area under Cultivation	-.293	**-.536**	.161	.393	.094	.479	.240	.203
CRO (x_{14})	Area under more than one crop as % to Net Sown Area	-.175	.025	.208	**-.678**	.136	-.153	.304	.123
AMN (x_{15})	Aman Rice production per Head (in Kg)	**.522**	.172	-.180	.333	.445	-.095	.078	-.337
ADC (x_{16})	No. of ADAC per 100000 livestock creatures	-.246	-.095	.131	-.097	.329	**.673**	.185	-.439
BNK (x_{17})	No. of Banks per 100,000 population	**.524**	.189	.133	-.090	-.301	.440	.408	.259
POP (x_{18})	Population density (Population per sq. km)	**-.834**	.333	.169	.106	-.055	-.050	-.170	-.079
SRT (x_{19})	Sex ratio (No. of female per thousand male)	**.627**	.003	-.405	.057	.418	-.059	-.046	.424
WRK (x_{20})	Working population as % to total population	**.745**	-.438	.233	-.151	.205	.181	.004	-.002
MWK (x_{21})	Main worker as % to total population	-.070	**-.669**	.457	.273	-.297	-.021	-.196	-.071
FMW (x_{22})	Female participation as main working population (%)	.486	**-.671**	-.003	.341	-.247	-.079	-.074	.093
FRW (x_{23})	Female participation as marginal working population (%)	.428	**-.768**	-.104	.214	-.322	.109	-.014	-.005
MNA (x_{24})	Main workers involved in non-agricultural occupations (%)	-.356	.296	**.664**	-.325	.195	.222	-.192	.192
RNA (x_{25})	Marginal workers involved in non-agricultural occupations (%)	.034	-.328	**.760**	-.313	-.054	-.074	-.127	.327

Table-3: Factor loadings of Principal Components for 2011 dataset

Variables		Components (2011)					
		1	2	3	4	5	6
GLR (x_1)	Gross Literacy Rate (% to total population)	.144	**.699**	.075	**-.616**	.069	-.188
FLR (x_2)	Literacy Among Female (% to total female population)	.234	**.725**	.104	**-.547**	.156	-.101
PSL (x_3)	No. of Primary School per 10,000 population	**.918**	.129	-.035	-.162	.137	.208
HSL (x_4)	No. of High and Higher Secondary School per 10,000 population	**.570**	**.565**	.062	-.216	.159	.297
NSL (x_5)	No. of Special and Non-Formal School per 10,000 population	**.679**	.363	-.187	.062	.039	-.340
TPS (x_6)	No. of Teachers per 1000 of Students in Primary schools	**.765**	.434	-.048	-.142	-.152	.253
THS (x_7)	No. of Teachers per 1000 of Students in High schools	.421	**.747**	.138	.092	-.124	-.042
PHC (x_8)	No. of Primary Health Centers per 100,000 population	**.678**	.253	-.108	.267	-.226	.038
BED (x_9)	No. of Beds in Public Hospitals & Health Centers per 100,000 population	.101	**.580**	.467	**.501**	.276	-.119
DOC (x_{10})	No. of Doctors in Public Hospitals & Health Centers per 100,000 population	.209	**.527**	.438	**.558**	.113	-.150
FWC (x_{11})	No. of Public Family Welfare Centers per 100,000 population	.483	.413	.265	.062	-.054	**-.567**
NSA (x_{12})	Net Sown Area as percentage to Total Geographical Area	-.117	-.271	**.646**	.195	.343	.284
IRG (x_{13})	Irrigated Area as percentage to Total Area under Cultivation	-.250	**.521**	.373	.358	-.041	.292
CRO (x_{14})	Area under more than one crop as % to Net Sown Area	-.415	.266	-.301	-.130	.484	.136
AMN (x_{15})	Aman Rice production per Head (in Kg)	.464	-.373	.389	-.044	.339	.164
ADC (x_{16})	No. of ADAC per 100000 livestock creatures	-.078	.147	**.606**	.069	**-.631**	.197
BNK (x_{17})	No. of Banks per 100,000 population	-.126	**.656**	-.197	-.145	-.340	.244
POP (x_{18})	Population density (Population per sq. km)	**-.845**	.236	.027	-.054	-.198	-.201
SRT (x_{19})	Sex ratio (No. of female per thousand male)	**.729**	-.248	-.037	-.014	.309	.266
WRK (x_{20})	Working population as % to total population	**.724**	-.275	-.355	.161	-.355	.171
MWK (x_{21})	Main worker as % to total population	**.659**	-.186	**-.519**	.345	-.152	.052
FMW (x_{22})	Female participation as main working population (%)	**.669**	-.490	.027	.019	.106	-.310
FRW (x_{23})	Female participation as marginal working population (%)	**.524**	**-.745**	.184	-.028	-.061	-.277
MNA (x_{24})	Main workers involved in non-agricultural occupations (%)	-.323	**.611**	**-.575**	.334	.138	.025
RNA (x_{25})	Marginal workers involved in non-agricultural occupations (%)	-.159	.321	**-.681**	.413	.259	-.050

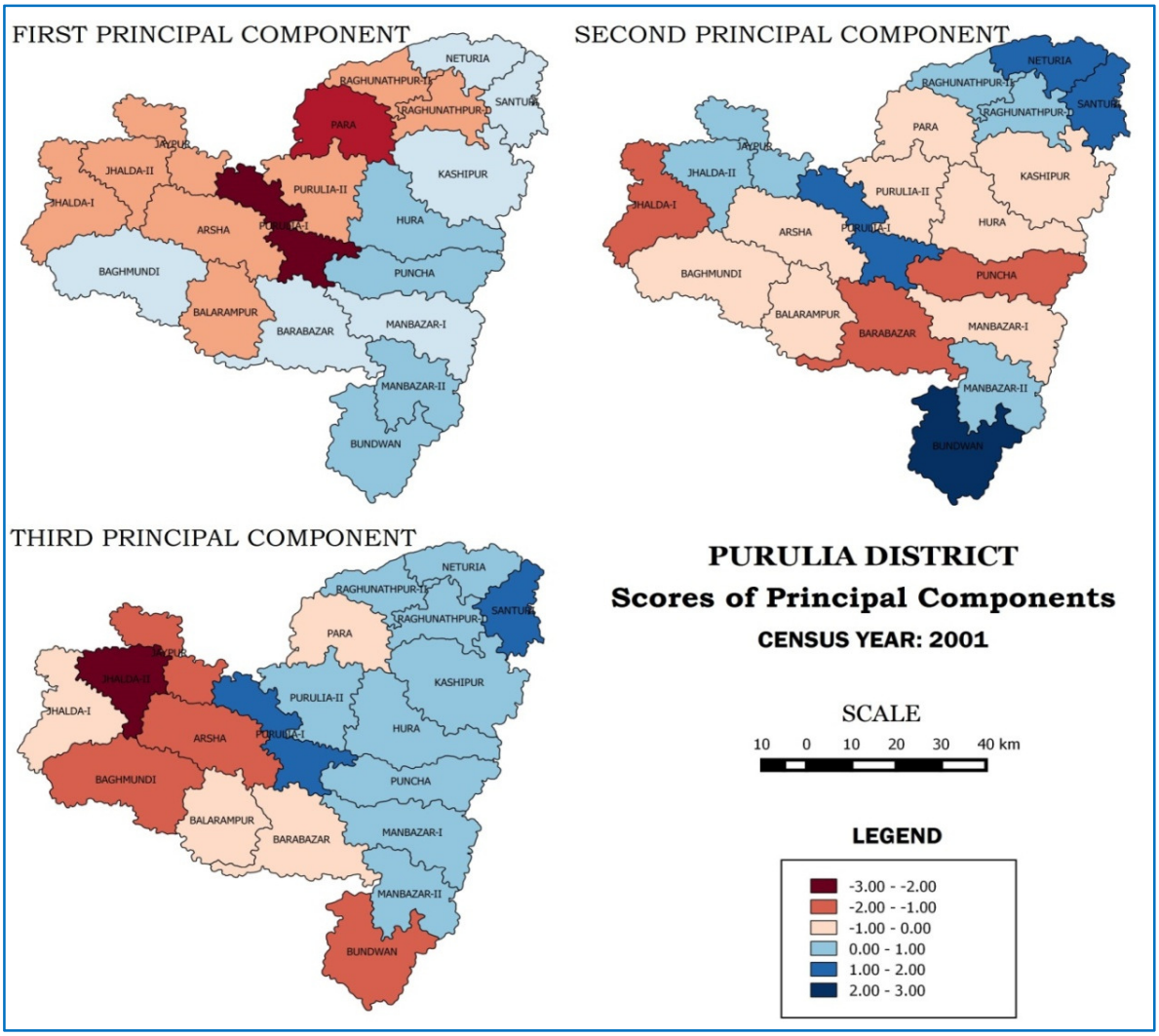

Figure-2: Block wise scores of first three principal components in the district of Purulia for census year 2001

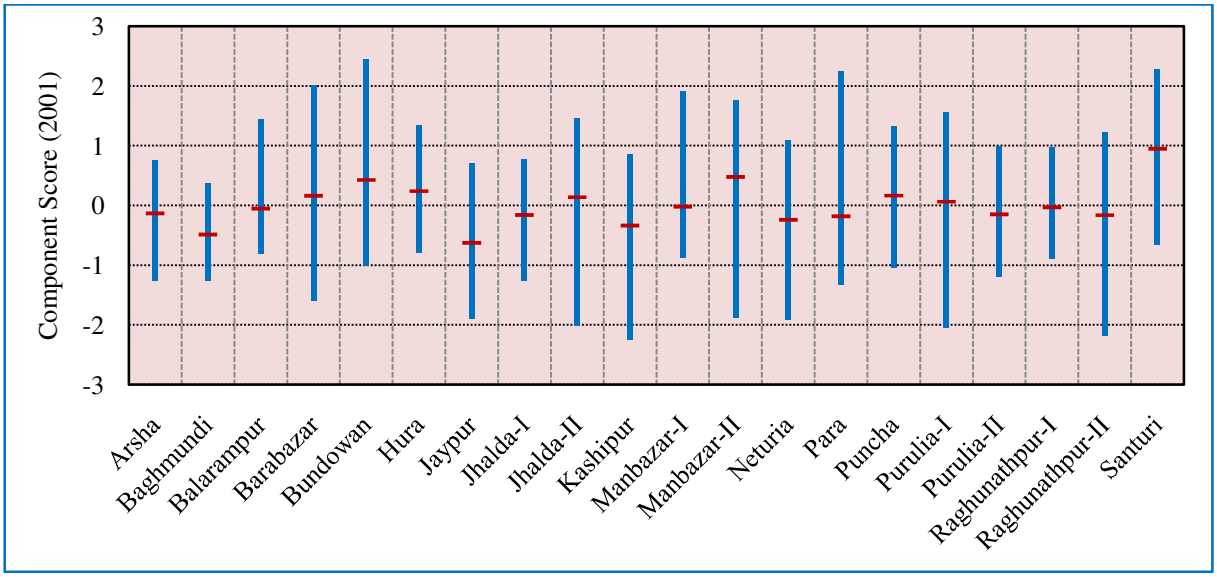

Figure-3: The block wise range of component scores (2001) with the red ticks indicating the average score possessed.

The factor loadings of the variables with 2011 dataset show, somehow, a slightly different scenario than the previous one. The first principal component (of 2011) shows that it possesses a significant positive correlation with the variables PSL (x_3), HSL (x_4), NSL (x_5), TPS (x_6), PHC (x_8), SRT (x_{19}), WRK (x_{20}), MWK (x_{21}), FMW (x_{22}) and FRW (x_{23}) as well as also significant negative correlation with the variable POP (x_{18}).

The second principal component exhibit significant positive correlation with GLR (x_1), FLR (x_2), HSL (x_4), THS (x_7), BED (x_9), DOC (x_{10}), IRG (x_{13}), BNK (x_{17}) and MNA (x_{24}). Similarly, the third principal component shows significance positive correlation with NSA (x_{12}) and ADC (x_{16}); and also shows negative correlation with the variables MWK (x_{21}), MNA (x_{24}) and RNA (x_{25}). The reaming principal components, i.e. fourth to sixth principal components exhibit no meaningful correlation with the variables to interpret the status of development in the study area.

The spatial distribution of scores of first three principal components (of 2011), as displayed in Figure-4, reveals that almost all the blocks have changed their relative positions in the district as per the score under first, second and third principal components. But, the ranges of score possessed by the blocks under different principal components (of 2011) are smaller than that of the scenario found in case of 2001 dataset (Figure-5 for details). The blocks of Bandowan, Kashipur, Neturia and Raghunathpur-II show comparatively wider ranges of component scores than that other blocks in the district. Though a time span of ten years is not sufficient enough for reaching to a conclusion regarding the trend of human development of a district level study area; however, the analysis on the recognized dataset of the census of India for the two consecutive census years (2001 and 2011) should lead to a casual remark that the development initiatives undertaken in the district, by the Central as well as State Government, is still found not enough for combating the spatial and non-spatial inequality of human development in the district.

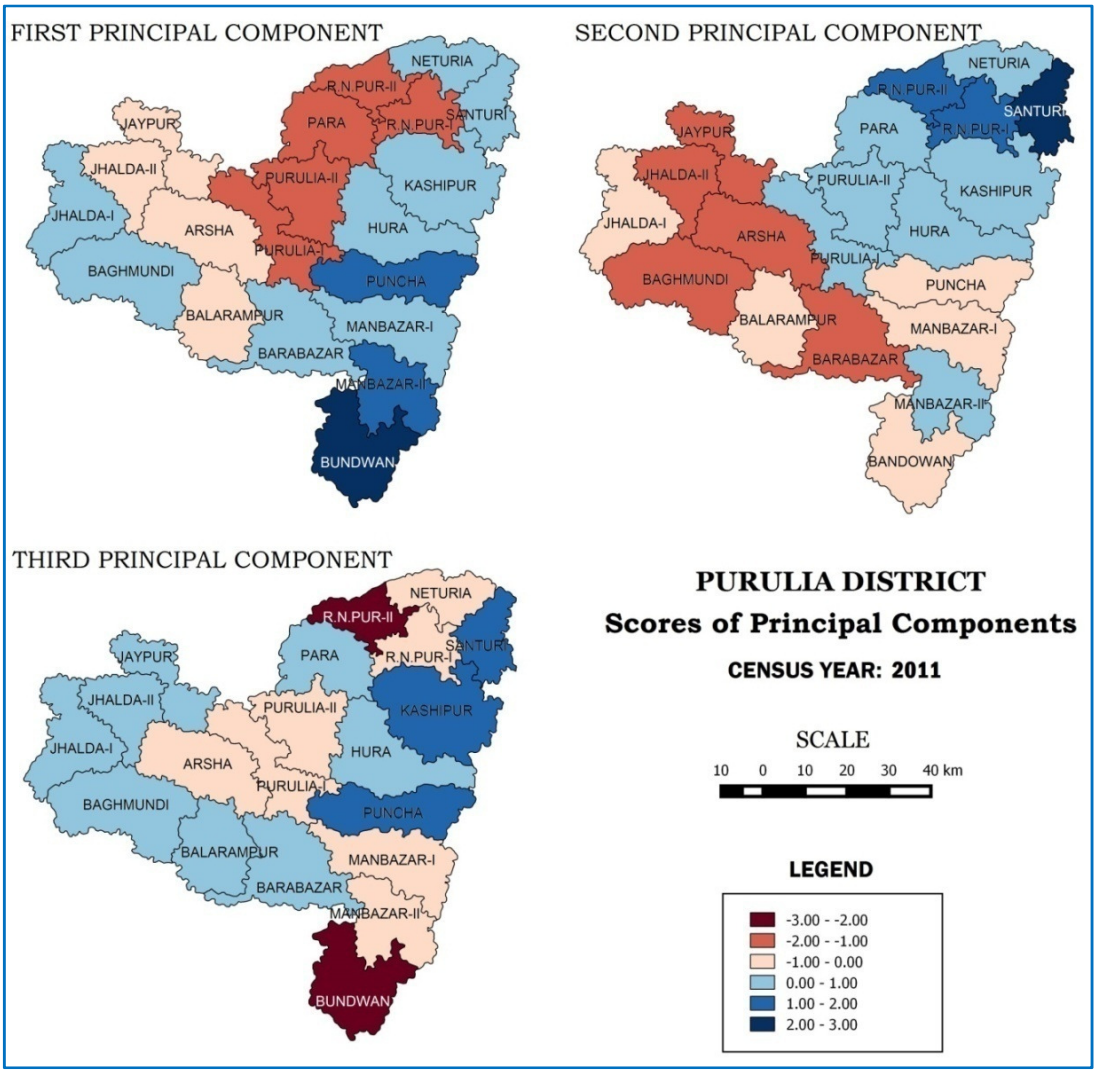

Figure-4: Block wise scores of first three Principal Components in the district of Purulia for Census Year 2011

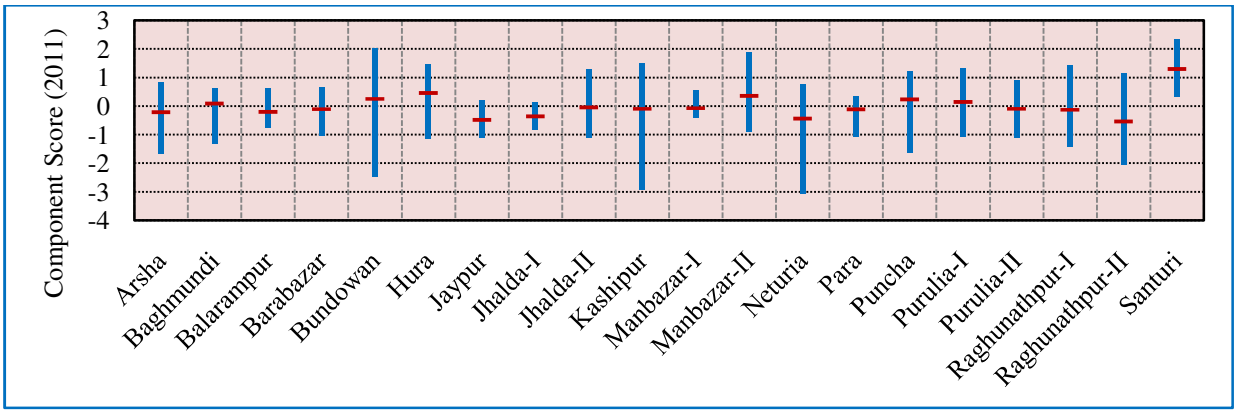

Figure-5: The block wise range of component scores (2011) with the red ticks indicating the average score possessed

Conclusion

The above analysis on block level dataset of the district of Purulia bring to fore some characteristic two important attributes of present pattern of human development, particularly the spatial pattern of development, in the study area which can be summarized under following heads: *(i) The inequality of development exists at the sub-district level*: The present analysis utilizes the block level recognized dataset so the result from the analysis do essentially highlight the pattern of development at sub-district level. The outcome of the Principal Component Analysis (PCA) from both of the census years' (i.e. 2001 and 2011) dataset confirms the fact that there is a block level inequality in human development in the district. The blocks are treated as very important sub-district level administrative units, not only in terms of maintaining the routinely hierarchical administrative linkage between the district administration and the local village level administrations, rather they possess vital roles in terms of executing, monitoring and evaluating the development plans and policies running within their administrative jurisdiction. In India, the blocks are popularly termed as Community Development Blocks (or C.D. Blocks) which clearly indicates the functioning of the blocks as important fundamental units of decision making and supervising the state aided community development initiatives. Hence, the prevalence of unequal pattern of human development at inter-block level is a key indication of the possible existence of spatial and non-spatial inequality of human development within the district. Under this circumstance, the present study needs to identify the variables influencing the development pattern, and requires a careful insight into the complex interaction between those contributing variable to address the causes of such inequality condition prevailing within the study area which is one of the primary objectives of the present study. *(ii) The trend of inequality in development is diverse*: The human development scenario in the district of Purulia is characterized by its diversified spatial pattern of inequality. The Principal Component Analysis (PCA) exhibits this diverse trend of human development clearly. There are quite a few blocks which are seen relatively advanced in terms of the scores of first principal component, found at the most rear position according to the scores of the second or third principal components.

The inconsistency of the ranks of sub-district level spatial units in different dimensions of development leads to conclude that the combination of all the dimensions of development to a single indicator to represent the intra district development pattern may mislead the interpretation. The actual scenario of the spatial pattern of the development can vividly be interpreted and the causes of unequal pattern of development may be addressed properly through the discussion of different dimensions of development parallel. There may be a degree of interrelationship between those dimensions and also, there may be some factors commonly contributes to different dimensions but there is hardly any generalized trend observed from the present analysis that confirms the mono-directive trend of all the factors over space resulting into determining the pattern of multi-dimensional human development.

Direction for future research: The block level investigation have confirmed the existence of inequality in human development in the study area and it also have given a casual indication of diverse trend of human development within the district; but, this is the fact that the above analysis does not provide any consistence result for making commentary on the trend of spatial pattern of development there. The blocks as the unit of spatial dataset may become too coarser to explore the spatial trend of unequal development within a district. The district of Purulia, as mentioned earlier, is itself a district of low level of human development in the state of West Bengal. Within such a backward district, the work of exploring the trend spatial inequality in terms of development becomes more challenging for the pluralistic measurement of development. The minor differences of different dimensions of human development between spatial units finer than the blocks (say Gram Panchyats) is not possible to be reflected through block level dataset. Hence, the effort of exploration of the pattern of intra district level of human development requires more detailed information from the spatial units of finer resolution and the present investigation requires further analysis to be carried out with utilizing the spatial dataset at least below the block level.

Table-A1: The block level dataset for Principal Component Analysis 2001

Block	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
Arsha	46.00	23.60	10.38	0.93	6.97	18.56	17.42	2.32	19.36	3.10	19.36	55.75	14.46
Baghmundi	46.90	25.10	12.36	0.98	9.07	18.86	19.48	3.56	32.90	3.56	21.34	36.40	4.44
Balarampur	45.80	25.10	10.58	0.85	11.94	18.02	22.27	3.39	235.39	9.31	19.47	63.35	11.58
Barabazar	51.20	30.20	13.61	1.29	11.23	19.00	17.29	2.04	13.61	4.08	17.02	67.30	13.75
Bundowan	47.70	28.50	15.77	1.67	16.85	21.30	19.57	4.78	29.87	8.36	23.90	40.33	11.72
Hura	59.00	41.20	14.83	2.12	13.10	25.02	21.78	3.14	34.53	6.28	19.62	54.53	6.92
Jaypur	50.10	26.90	10.38	0.81	8.77	19.75	12.39	3.58	25.95	6.26	18.79	57.09	11.34
Jhalda-I	53.80	33.20	12.27	1.42	7.26	20.90	24.29	2.59	18.71	2.99	17.28	54.37	11.45
Jhalda-II	43.80	18.40	9.30	0.89	9.30	15.18	24.84	2.42	29.10	6.47	18.59	59.14	35.93
Kashipur	61.80	44.40	12.14	1.23	12.51	29.55	17.19	2.67	136.34	16.04	20.85	55.58	5.07
Manbazar-I	55.10	35.90	15.13	1.33	14.58	16.33	18.82	2.35	29.78	7.05	21.16	48.89	2.62
Manbazar-II	53.50	33.40	15.72	1.88	17.59	22.50	17.41	5.86	25.81	10.56	24.63	59.44	7.82
Neturia	55.80	38.70	11.47	1.65	14.34	21.83	22.50	4.41	39.71	6.62	22.06	34.47	5.16
Para	55.60	35.20	9.45	1.20	8.59	18.12	17.94	2.29	16.03	4.58	16.61	53.96	18.01
Puncha	57.30	39.10	14.89	1.94	16.83	25.76	25.21	3.70	24.97	3.70	19.42	58.07	6.36
Purulia-I	54.40	33.50	8.87	1.55	15.16	15.89	26.69	3.19	469.63	31.36	17.56	71.45	7.10
Purulia-II	56.20	35.70	10.37	1.54	8.90	19.65	21.97	2.10	17.52	2.80	16.12	58.73	6.65
Raghunathpur-I	55.30	38.60	10.50	1.19	12.04	21.88	23.05	2.89	73.98	18.29	19.27	49.34	8.74
Raghunathpur-II	54.00	35.70	9.67	1.11	15.52	17.90	12.48	3.02	25.20	4.03	18.14	58.95	6.08
Santuri	56.50	40.00	12.79	1.58	14.66	24.26	21.43	4.31	388.00	43.11	21.56	62.33	17.38

Table-A1 continued…

Block	x14	x15	x16	x17	x18	x19	x20	x21	x22	x23	x24	x25
1	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*
Arsha	17.88	267.99	9.47	4.65	348	959	50.51	54.39	26.81	67.08	32.33	24.66
Baghmundi	23.63	256.92	12.06	3.56	265	952	52.07	57.70	25.02	70.74	24.04	14.41
Balarampur	8.54	271.97	11.22	3.39	394	954	37.01	57.56	22.07	66.35	36.72	11.97
Barabazar	14.12	115.09	8.99	5.44	351	980	49.68	49.51	26.50	66.81	20.40	6.53
Bundowan	21.14	202.05	11.30	4.78	238	979	78.98	62.41	33.74	69.38	58.49	56.85
Hura	17.72	325.32	5.69	5.49	321	977	42.24	49.80	21.53	65.87	40.18	14.16
Jaypur	16.83	207.93	9.39	3.58	485	921	43.09	63.32	33.88	73.11	22.72	25.88
Jhalda-I	13.69	316.46	14.23	3.46	421	969	45.01	54.71	27.17	63.54	29.65	7.78
Jhalda-II	15.58	276.36	14.67	3.23	482	956	48.08	65.40	30.00	71.57	38.80	21.00
Kashipur	14.41	235.35	5.92	3.74	422	964	26.78	55.85	25.76	63.51	28.26	8.92
Manbazar-I	13.86	372.49	11.17	3.13	342	985	54.20	48.33	19.51	53.82	39.91	8.65
Manbazar-II	16.03	431.19	16.00	4.69	293	966	70.85	50.71	23.31	62.17	28.64	8.37
Neturia	8.64	171.87	9.21	5.52	445	930	60.64	58.29	23.13	63.89	47.61	22.10
Para	16.43	170.71	25.85	3.44	567	934	34.94	55.37	19.33	62.32	52.73	17.62
Puncha	13.14	415.89	12.16	4.62	329	979	41.45	55.65	29.93	65.29	17.32	8.53
Purulia-I	16.29	208.99	9.05	1.60	851	934	11.68	54.44	15.62	45.54	54.35	20.36
Purulia-II	20.34	159.98	14.37	4.20	444	945	42.46	52.63	13.45	53.95	46.66	15.22
Raghunathpur-I	23.03	223.73	13.29	4.82	636	942	29.10	49.34	13.19	54.94	48.75	18.52
Raghunathpur-II	29.86	236.33	11.97	4.03	502	948	30.51	53.07	13.41	48.45	52.55	26.09
Santuri	16.35	286.98	15.47	7.19	387	943	43.43	54.61	19.83	57.24	46.51	16.43

Data Sources: (1) Census of India, 2001 and (2) District Statistical Handbook – Purulia, 2001

Table-A2: The correlation coefficient matrix 2001

Var.	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20	x21	x22	x23	x24	x25
x1	1	.974	.212	.599	.338	.647	.054	-.010	.125	.272	-.049	.064	-.516	-.053	.101	-.067	.226	.183	.026	-.351	-.536	-.419	-.488	.096	-.374
x2	.974	1	.275	.622	.440	.689	.062	.090	.155	.324	.072	-.027	-.562	-.025	.107	-.093	.343	.117	.053	-.285	-.553	-.442	-.499	.169	-.290
x3	.212	.275	1	.640	.532	.473	-.027	.469	-.253	-.087	.635	-.255	-.341	-.151	.530	-.203	.431	-.743	.765	.642	-.285	.348	.235	-.297	-.059
x4	.599	.622	.640	1	.617	.517	.360	.443	.051	.161	.308	-.039	-.357	-.127	.358	-.085	.406	-.196	.374	.234	-.379	-.092	-.215	.123	-.064
x5	.338	.440	.532	.617	1	.303	.072	.653	.275	.357	.589	.013	-.365	.002	.366	-.175	.230	-.092	.272	.175	-.195	-.118	-.355	.238	.153
x6	.647	.689	.473	.517	.303	1	.001	.329	-.009	.193	.363	-.134	-.339	-.128	.244	-.276	.533	-.326	.224	.029	-.144	.165	.153	-.265	-.166
x7	.054	.062	-.027	.360	.072	.001	1	-.022	.378	.275	-.110	.060	.162	-.379	.178	.034	-.100	.258	.088	-.170	.027	-.111	-.134	.154	-.165
x8	-.010	.090	.469	.443	.653	.329	-.022	1	.158	.279	.813	-.257	-.193	-.060	.366	-.001	.341	-.297	-.047	.511	.196	.227	.135	.047	.287
x9	.125	.155	-.253	.051	.275	-.009	.378	.158	1	.884	.005	.469	.010	-.180	-.047	-.105	-.096	.502	-.316	-.507	-.006	-.315	-.453	.307	-.039
x10	.272	.324	-.087	.161	.357	.193	.275	.279	.884	1	.194	.334	.063	-.046	.011	-.010	.199	.403	-.289	-.349	-.085	-.305	-.438	.336	.009
x11	-.049	.072	.635	.308	.589	.363	-.110	.813	.005	.194	1	-.491	-.217	-.075	.433	-.174	.349	-.534	.249	.653	.111	.299	.232	-.006	.269
x12	.064	-.027	-.255	-.039	.013	-.134	.060	-.257	.469	.334	-.491	1	.267	-.121	.044	.015	-.164	.392	-.007	-.530	-.217	-.198	-.321	-.122	-.356
x13	-.516	-.562	-.341	-.357	-.365	-.339	.162	-.193	.010	.063	-.217	.267	1	-.110	-.122	.394	.019	.097	-.109	.062	.508	.314	.373	.066	.165
x14	-.053	-.025	-.151	-.127	.002	-.128	-.379	-.060	-.180	-.046	-.075	-.121	-.110	1	-.152	.097	.001	.074	-.103	-.101	-.112	-.329	-.292	.309	.391
x15	.101	.107	.530	.358	.366	.244	.178	.366	-.047	.011	.433	.044	-.122	-.152	1	.012	.016	-.373	.480	.205	-.194	.139	.029	-.350	-.348
x16	-.067	-.093	-.203	-.085	-.175	-.276	.034	-.001	-.105	-.010	-.174	.015	.394	.097	.012	1	-.052	.136	-.254	.061	.041	-.202	-.092	.266	-.030
x17	.226	.343	.431	.406	.230	.533	-.100	.341	-.096	.199	.349	-.164	.019	.001	.016	-.052	1	-.480	.144	.401	-.210	.048	.169	-.026	.051
x18	.183	.117	-.743	-.196	-.092	-.326	.258	-.297	.502	.403	-.534	.392	.097	.074	-.373	.136	-.480	1	-.640	-.768	-.020	-.509	-.585	.441	-.011
x19	.026	.053	.765	.374	.272	.224	.088	-.047	-.316	-.289	.249	-.007	-.109	-.103	.480	-.254	.144	-.640	1	.396	-.330	.294	.179	-.324	-.164
x20	-.351	-.285	.642	.234	.175	.029	-.170	.511	-.507	-.349	.653	-.530	.062	-.101	.205	.061	.401	-.768	.396	1	.188	.517	.514	-.115	.331
x21	-.536	-.553	-.285	-.379	-.195	-.144	.027	.196	-.006	-.085	.111	-.217	.508	-.112	-.194	.041	-.210	-.020	-.330	.188	1	.638	.573	.003	.533
x22	-.419	-.442	.348	-.092	-.118	.165	-.111	.227	-.315	-.305	.299	-.198	.314	-.329	.139	-.202	.048	-.509	.294	.517	.638	1	.856	-.535	.256
x23	-.488	-.499	.235	-.215	-.355	.153	-.134	.135	-.453	-.438	.232	-.321	.373	-.292	.029	-.092	.169	-.585	.179	.514	.573	.856	1	-.549	.130
x24	.096	.169	-.297	.123	.238	-.265	.154	.047	.307	.336	-.006	-.122	.066	.309	-.350	.266	-.026	.441	-.324	-.115	.003	-.535	-.549	1	.566
x25	-.374	-.290	-.059	-.064	.153	-.166	-.165	.287	-.039	.009	.269	-.356	.165	.391	-.348	-.030	.051	-.011	-.164	.331	.533	.256	.130	.566	1

Table-A3: Total variance explained component wise 2001

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	5.986	23.943	23.943
2	5.384	21.535	45.478
3	2.978	11.912	57.390
4	2.365	9.459	66.849
5	1.655	6.620	73.469
6	1.391	5.564	79.033
7	1.186	4.743	83.776
8	1.060	4.239	88.015
9	.784	3.137	91.152
10	.628	2.514	93.666
11	.455	1.819	95.485
12	.315	1.260	96.745
13	.207	.827	97.571
14	.202	.808	98.380
15	.142	.570	98.950
16	.121	.484	99.434
17	.090	.362	99.795
18	.029	.115	99.910
19	.023	.090	100.000
20	.000	.000	100.000
21	.000	.000	100.000
22	.000	.000	100.000
23	.000	.000	100.000
24	.000	.000	100.000
25	.000	.000	100.000

Table-A4: Scores of Principal Components 2001

Block	Score of Principal Components							
	Component-1	Component-2	Component-3	Component-4	Component-5	Component-6	Component-7	Component-8
Arsha	-0.2163	-1.2644	-0.43548	-0.2503	0.03403	-0.39065	0.75262	0.69684
Baghmundi	0.37158	-1.16654	-0.05985	-0.71619	-0.00876	-0.93223	-0.14291	-1.26139
Balarampur	-0.51511	-0.59474	-0.03174	1.43794	0.43919	-0.80729	0.01087	-0.36958
Barabazar	0.10445	-0.43591	-1.59124	0.0686	-0.16808	0.11435	1.17714	2.01449
Bundowan	1.60711	-1.00651	2.4496	-0.82537	0.374	-0.10405	-0.84801	1.74886
Hura	1.06354	0.9582	-0.79384	-0.23163	-0.28334	0.30374	-0.47409	1.35194
Jaypur	-0.39393	-1.44496	0.15056	0.0581	-1.89723	-1.25077	0.71271	-0.96363
Jhalda-I	-0.04673	-0.28967	-1.26432	0.49722	0.29216	0.7781	-0.9711	-0.29893
Jhalda-II	-0.89336	-2.01868	0.36447	1.45258	0.86298	0.98369	-0.19259	0.5203
Kashipur	0.33318	0.86156	-0.85781	0.31521	-2.2404	-1.03254	-0.096	0.01584
Manbazar-I	0.57151	0.51466	-0.87438	-0.53831	1.90595	-0.85561	-0.55597	-0.34228
Manbazar-II	1.75813	0.48755	0.34529	0.35694	1.42827	-0.05951	1.38219	-1.88609
Neturia	0.63616	0.19808	1.09975	-0.35559	-1.44022	0.66258	-1.90809	-0.82756
Para	-1.32091	-0.23867	-0.07497	-0.84109	0.01579	2.25677	-0.00897	-1.26914
Puncha	1.32035	0.58012	-1.04325	1.11938	0.12405	0.24735	-0.7523	-0.29633
Purulia-I	-2.05254	1.55408	1.09468	1.41374	0.71965	-1.56679	-1.11112	0.43142
Purulia-II	-0.88542	0.45539	-0.62015	-1.19613	0.10109	0.98739	-0.4866	0.43157
Raghunathpur-I	-0.78948	0.96697	0.29342	-0.89016	-0.18635	0.46357	0.0084	-0.1253
Raghunathpur-II	-0.88073	0.5482	0.38282	-2.17652	0.58832	-1.12644	1.22752	0.12647
Santuri	0.22851	1.33529	1.46643	1.30158	-0.66109	1.32833	2.2763	0.30251

Table-A5: The block level dataset for Principal Component Analysis 2011

Block	x1	x2	x3	x4	x5	x6	X7	x8	x9	x10	x11	x12	x13
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
Arsha	54.78	38.75	8.66	0.58	14.61	19.99	14.07	1.29	28.44	3.88	0.65	60.13	11.58
Baghmundi	57.17	41.42	10.25	0.89	15.27	23.95	14.16	2.21	45.73	5.90	0.74	60.42	10.09
Balarampur	60.40	41.69	9.13	0.72	27.40	24.67	14.89	2.17	48.57	5.80	0.72	71.49	16.01
Barabazar	63.27	47.27	11.90	1.11	15.54	26.41	19.28	1.17	29.31	2.93	0.59	60.59	5.07
Bundowan	61.38	46.63	14.01	1.37	33.08	35.26	20.60	3.16	50.56	7.37	1.05	41.07	16.14
Hura	68.79	55.27	13.16	1.60	22.43	36.40	19.30	2.09	33.43	4.88	0.70	59.71	28.23
Jaypur	57.94	41.74	8.70	0.75	13.42	21.93	14.17	2.25	33.00	3.75	0.75	56.20	14.77
Jhalda-I	66.18	52.14	10.50	0.95	17.94	29.33	13.66	1.46	33.54	3.65	0.73	46.73	24.11
Jhalda-II	54.76	35.97	7.83	0.74	14.51	20.46	15.71	1.35	29.70	6.07	0.67	57.92	35.00
Kashipur	71.06	56.33	11.55	1.20	29.34	28.65	23.68	2.00	127.95	12.00	2.00	53.09	12.49
Manbazar-I	63.78	47.73	12.79	1.10	17.72	30.93	19.74	1.30	35.05	4.54	0.65	50.74	16.91
Manbazar-II	60.27	45.76	14.10	1.54	24.19	42.52	23.09	4.12	51.46	9.26	1.03	55.84	7.44
Neturia	65.14	49.38	10.55	1.38	21.89	31.93	25.41	2.96	47.32	7.89	0.99	32.00	16.54
Para	65.62	49.70	8.27	0.95	14.41	24.47	20.06	1.50	77.76	14.46	0.50	56.92	21.73
Puncha	68.14	54.82	13.08	1.70	22.93	36.06	20.07	2.42	41.98	4.84	0.81	57.17	19.64
Purulia-I	64.77	50.13	9.33	1.32	15.28	25.02	22.10	1.98	130.96	4.63	0.66	58.27	18.79
Purulia-II	63.39	49.51	8.85	1.42	13.28	17.66	16.33	1.18	23.60	2.36	0.59	58.85	20.37
Raghunathpur-I	67.36	51.03	8.92	0.93	19.19	32.07	20.93	1.70	26.32	3.40	0.85	54.88	39.74
Raghunathpur-II	67.29	52.31	8.70	1.05	22.94	26.18	17.08	1.76	38.67	4.39	0.88	27.30	10.88
Santuri	64.15	52.42	11.34	1.53	22.42	32.12	25.92	2.55	377.00	28.02	1.27	65.26	48.76

Table-A5 continued…

Block	x14	x15	x16	x17	x18	x19	x20	x21	x22	x23	x24	x25
1	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*	*25*	*26*
Arsha	9.97	273.37	2.75	3.88	413	974	47.50	22.43	23.00	59.97	35.46	28.13
Baghmundi	8.60	471.22	3.08	3.69	317	950	46.64	20.02	18.36	54.88	31.36	19.56
Balarampur	5.41	204.93	2.19	4.35	458	943	35.50	16.30	17.77	52.04	49.03	19.19
Barabazar	9.51	304.14	2.15	4.69	408	975	48.06	21.99	26.06	58.81	25.68	14.09
Bundowan	8.53	306.84	1.38	4.21	270	986	65.06	41.00	32.29	57.53	68.51	64.77
Hura	9.66	376.60	2.69	5.57	376	970	33.85	16.09	16.08	48.53	45.82	29.39
Jaypur	9.61	243.49	2.47	3.75	579	933	34.06	13.46	25.84	56.32	28.50	25.77
Jhalda-I	7.44	256.86	2.96	5.10	435	957	50.78	23.20	26.51	56.84	35.00	15.91
Jhalda-II	9.21	303.86	3.65	3.37	577	964	36.31	18.87	18.67	54.83	39.02	24.06
Kashipur	8.01	320.88	3.03	4.50	443	965	32.50	14.92	25.85	59.66	26.02	13.78
Manbazar-I	6.78	166.07	2.31	3.89	404	974	48.86	20.23	15.77	49.82	48.79	20.54
Manbazar-II	9.53	284.17	2.65	7.20	340	985	73.11	25.38	23.05	53.89	30.70	13.49
Neturia	2.98	150.05	3.94	5.92	498	939	58.80	25.92	16.17	49.61	51.62	27.89
Para	8.87	210.17	2.17	4.98	642	942	32.43	13.97	15.28	49.79	53.32	34.58
Puncha	7.63	379.41	3.10	4.04	375	976	41.57	16.80	26.67	57.71	17.66	6.13
Purulia-I	11.64	210.25	2.21	3.97	537	942	20.87	10.02	14.65	37.85	67.67	41.71
Purulia-II	11.95	187.20	2.76	5.31	547	960	37.19	17.49	12.27	41.81	50.55	32.23
Raghunathpur-I	11.36	185.98	3.68	11.04	583	934	28.89	15.44	11.52	37.41	60.93	35.76
Raghunathpur-II	17.60	171.43	1.77	7.91	576	943	34.56	16.29	10.94	37.34	72.12	38.85
Santuri	10.19	262.43	3.42	6.37	437	959	35.68	18.10	15.91	40.46	59.03	28.60

Data Sources: (1) Census of India, 2011 and (2) District Statistical Handbook – Purulia, 2011

Table-A6: The correlation coefficient matrix 2011

Var.	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20	x21	x22	x23	x24	x25
x1	1	.967	.297	.556	.371	.438	.519	-.011	.176	.135	.382	-.297	.156	.081	-.154	.013	.418	.093	-.093	-.275	-.251	-.170	-.335	.173	-.036
x2	.967	1	.387	.679	.358	.490	.552	.072	.295	.230	.403	-.272	.188	.134	-.068	.017	.394	-.017	.008	-.204	-.188	-.118	-.339	.157	-.016
x3	.297	.387	1	.699	.583	.834	.463	.564	.092	.134	.331	-.076	-.175	-.287	.390	-.169	-.036	-.816	.732	.597	.519	.483	.311	-.213	-.131
x4	.556	.679	.699	1	.397	.675	.683	.503	.324	.286	.288	-.129	.124	-.013	.150	.045	.167	-.365	.396	.207	.153	.023	-.218	.072	.018
x5	.371	.358	.583	.397	1	.629	.434	.601	.190	.267	.664	-.251	-.051	-.195	.104	-.203	.167	-.488	.318	.315	.453	.331	.125	.174	.167
x6	.438	.490	.834	.675	.629	1	.609	.708	.145	.237	.352	-.206	.081	-.214	.179	.040	.377	-.540	.420	.488	.373	.237	.030	-.013	-.072
x7	.519	.552	.463	.683	.434	.609	1	.491	.563	.589	.551	-.178	.238	-.149	-.167	.209	.344	-.085	.121	.107	.088	-.101	-.289	.249	.106
x8	-.011	.072	.564	.503	.601	.708	.491	1	.213	.322	.411	-.166	-.115	-.236	.179	.014	.164	-.457	.195	.557	.426	.286	.087	.011	.074
x9	.176	.295	.092	.324	.190	.145	.563	.213	1	.901	.471	.239	.522	.059	.000	.176	.068	-.020	-.045	-.228	-.153	-.119	-.315	.240	.065
x10	.135	.230	.134	.286	.267	.237	.589	.322	.901	1	.490	.169	.481	-.083	.030	.199	.094	-.022	.015	-.039	-.012	-.069	-.155	.169	.037
x11	.382	.403	.331	.288	.664	.352	.551	.411	.471	.490	1	-.179	.044	-.096	.141	.208	.149	-.225	.142	.071	.108	.267	.124	-.087	-.087
x12	-.297	-.272	-.076	-.129	-.251	-.206	-.178	-.166	.239	.169	-.179	1	.222	-.149	.343	.104	-.275	-.088	.097	-.317	-.380	.019	.141	-.361	-.358
x13	.156	.188	-.175	.124	-.051	.081	.238	-.115	.522	.481	.044	.222	1	.056	-.109	.513	.342	.296	-.208	-.405	-.207	-.364	-.466	.336	.176
x14	.081	.134	-.287	-.013	-.195	-.214	-.149	-.236	.059	-.083	-.096	-.149	.056	1	-.093	-.325	.391	.325	-.104	-.382	-.292	-.359	-.540	.379	.349
x15	-.154	-.068	.390	.150	.104	.179	-.167	.179	.000	.030	.141	.343	-.109	-.093	1	.087	-.368	-.621	.443	.138	.132	.480	.534	-.566	-.293
x16	.013	.017	-.169	.045	-.203	.040	.209	.014	.176	.199	.208	.104	.513	-.325	.087	1	.231	.159	-.207	-.073	-.192	-.216	-.051	-.286	-.414
x17	.418	.394	-.036	.167	.167	.377	.344	.164	.068	.094	.149	-.275	.342	.391	-.368	.231	1	.261	-.280	-.046	-.070	-.464	-.611	.401	.168
x18	.093	-.017	-.816	-.365	-.488	-.540	-.085	-.457	-.020	-.022	-.225	-.088	.296	.325	-.621	.159	.261	1	-.735	-.648	-.628	-.571	-.499	.303	.139
x19	-.093	.008	.732	.396	.318	.420	.121	.195	-.045	.015	.142	.097	-.208	-.104	.443	-.207	-.280	-.735	1	.585	.566	.547	.505	-.335	-.143
x20	-.275	-.204	.597	.207	.315	.488	.107	.557	-.228	-.039	.071	-.317	-.405	-.382	.138	-.073	-.046	-.648	.585	1	.852	.500	.485	-.219	-.067
x21	-.251	-.188	.519	.153	.453	.373	.088	.426	-.153	-.012	.108	-.380	-.207	-.292	.132	-.192	-.070	-.628	.566	.852	1	.538	.407	.077	.332
x22	-.170	-.118	.483	.023	.331	.237	-.101	.286	-.119	-.069	.267	.019	-.364	-.359	.480	-.216	-.464	-.571	.547	.500	.538	1	.848	-.558	-.164
x23	-.335	-.339	.311	-.218	.125	.030	-.289	.087	-.315	-.155	.124	.141	-.466	-.540	.534	-.051	-.611	-.499	.505	.485	.407	.848	1	-.765	-.419
x24	.173	.157	-.213	.072	.174	-.013	.249	.011	.240	.169	-.087	-.361	.336	.379	-.566	-.286	.401	.303	-.335	-.219	.077	-.558	-.765	1	.829
x25	-.036	-.016	-.131	.018	.167	-.072	.106	.074	.065	.037	-.087	-.358	.176	.349	-.293	-.414	.168	.139	-.143	-.067	.332	-.164	-.419	.829	1

Table-A7: Total variance explained component wise 2011

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	6.756	27.023	27.023
2	5.583	22.333	49.357
3	3.002	12.007	61.363
4	2.062	8.248	69.612
5	1.624	6.497	76.109
6	1.346	5.386	81.494
7	.937	3.747	85.242
8	.845	3.379	88.621
9	.719	2.875	91.496
10	.581	2.325	93.821
11	.431	1.726	95.546
12	.362	1.448	96.994
13	.244	.977	97.971
14	.205	.821	98.792
15	.169	.678	99.470
16	.070	.278	99.748
17	.041	.164	99.912
18	.020	.079	99.991
19	.002	.009	100.000
20	.000	.000	100.000
21	.000	.000	100.000
22	.000	.000	100.000
23	.000	.000	100.000
24	.000	.000	100.000
25	.000	.000	100.000

Table-A8: Scores of Principal Components 2011

Block	Score of Principal Components					
	Component-1	Component-2	Component-3	Component-4	Component-5	Component-6
Arsha	-0.41028	-1.69416	-0.17902	0.83111	0.17667	0.01542
Baghmundi	0.05863	-1.33219	0.59592	0.44155	0.16327	0.62606
Balarampur	-0.45255	-0.65218	0.16704	0.61979	-0.1098	-0.76936
Barabazar	0.37704	-1.05262	0.08898	-0.96195	0.66077	0.26276
Bundowan	2.02195	-0.03227	-2.47598	1.54643	1.04525	-0.59088
Hura	0.52639	0.59885	0.30178	-1.15542	1.03577	1.45537
Jaypur	-0.85691	-1.10849	0.21056	0.17205	-0.24327	-1.05368
Jhalda-I	0.15801	-0.56264	0.04366	-0.81608	-0.69698	-0.26413
Jhalda-II	-0.96513	-1.12496	0.68506	1.27746	-0.57118	0.44988
Kashipur	0.98673	0.58001	1.48278	-0.96912	0.29188	-2.92323
Manbazar-I	0.17078	-0.20603	-0.42814	-0.4309	-0.07574	0.5502
Manbazar-II	1.87986	0.05259	-0.29967	0.13494	-0.91379	1.31293
Neturia	0.47072	0.77371	-0.46928	0.24395	-3.07278	-0.56293
Para	-1.07835	0.33633	0.10629	0.22764	0.32269	-0.56227
Puncha	1.21816	-0.15131	1.18168	-1.63311	0.24602	0.55949
Purulia-I	-1.05411	0.82729	-0.2312	0.00646	1.3293	0.01714
Purulia-II	-1.11843	0.05254	-0.3692	-0.50883	0.48434	0.90561
Raghunathpur-I	-1.17122	1.43338	-0.17653	-0.41031	-1.41059	0.97883
Raghunathpur-II	-1.08654	1.14503	-2.05279	-0.95766	0.53206	-0.80274
Santuri	0.32527	2.11711	1.81808	2.342	0.80611	0.39551

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