

Generation of Spatial Database for the Study of Socio-economic Development in Bankura District, West Bengal: A Geospatial Approach

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Abstract

Maps are often used as a media of expression to portray details of spatial entities with locational specificity. While maps can clearly depict objects, the cartographical techniques are employed to represent the high-volume information content of datasets. But in modern GIS, the map is replaced by a database accessed through a software system; the software simply reproduces graphic products that look like traditional maps, but with added visual representations. In present paper an attempt has been made to generate a spatial database using geospatial tools and techniques, to understand the pattern of socio-economic development in Bankura district of West Bengal. For this purpose, thematic layers for each selected indicator have been generated with encoding numerical values for attribute information and analysis have been done by weighing z-score of each indicator and finally, an integrated composite index has been prepared under the domain of MapInfo Professional Software with version 8.5. Analysis of various attributes of socio-economic sector reveals that the spatial patterns of development are not uniform throughout the district. The study shows contrasting picture of development from one block to the other.

Keywords: Information, GIS, Spatial database, Geospatial tools, Socio-economic development

Introduction

Geographic Information System (GIS) is a broad term that is applicable to a system that uses computer facilities for handling data, referenced in the spatial domain, with the help of appropriate data sets, for carrying out spatial analysis, and for presenting the results in the most convenient mode of display (Krack, 1996). Database is a collection of information about things and their relationship with each other (Bhatta, 2011) and when the term spatial is added, it becomes very specific to a particular location on earth surface. The Spatial database (SDB) is an

important feature of GIS which comprises both spatial and graphical database (point, line and polygon) as well as attribute information. A number of scholars worked hard on the application of GIS in socio-economic analysis and spatial database generation. Many scholars from different countries and from different disciplines have undertaken a wide range of studies based on GIS, some are mentioned here Ali (2002), Banerjee et al. (2002), Thaker, and Shiyani, (2009), Neogi (2010), Sarkar (2015), Sarmin and Ismail (2016) etc. In present study, an attempt has been made to generate a spatial database under MapInfo

Professional 8.5 GIS software environment for the inspection of block wise spatial disparity in the level of socio-economic development based on ten selected socio-economic variables.

Study area

Bankura is the fourth largest district of West Bengal; located in the western part of West Bengal, which is popularly

known as ‘Rarh’. The district may be described as the ‘connecting link between the plains of Bengal on the east and Chota Nagpur plateau on the west’. The district is situated between 22°38’ and 23°38’ north Latitude and between 86°36’ and 87°47’ east Longitude. It is bounded by Paschim Medinipur in the south and Hooghly district in the north, Purulia district in the west, Bardhaman district in the north and east.

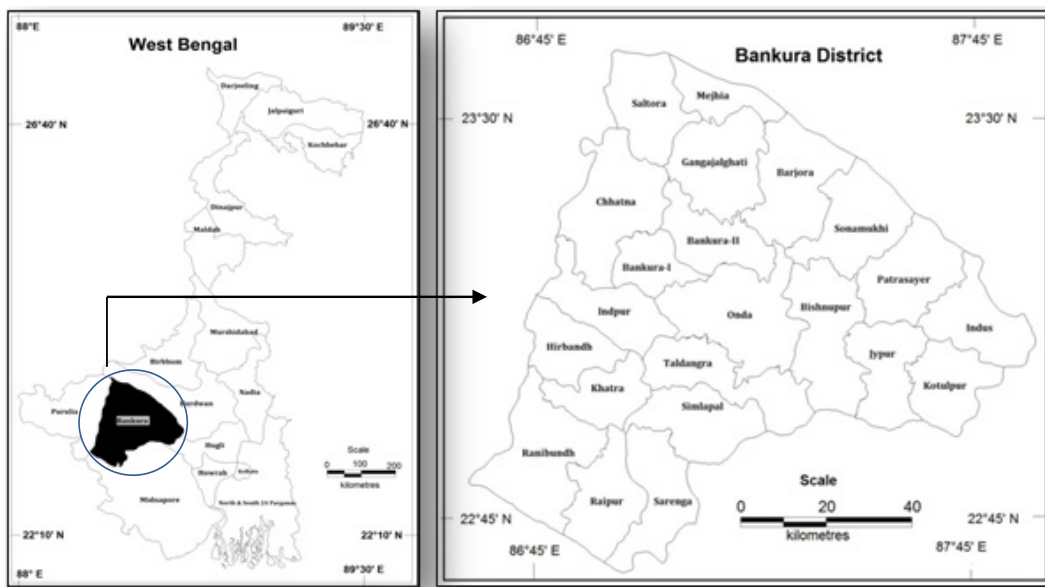


Figure 1: Location Map of Bankura District

Objectives of the study

The primary objective of present study is to generate a spatial database using GIS, to understand the pattern of socio-economic development in Bankura district of West Bengal. Within the frame of this prime objective, the detailed objectives put for the study are as follows.

i) To analyze intra-district variations in the levels of socio-economic development

with the help of indicators related to health, economy, education and gender parity and other demographic attributes.

ii) To identify the backward blocks in terms of socio-economic development, with regard to other regions of the district.

iii) To suggest major thrust areas for backward region of the district based on priority.

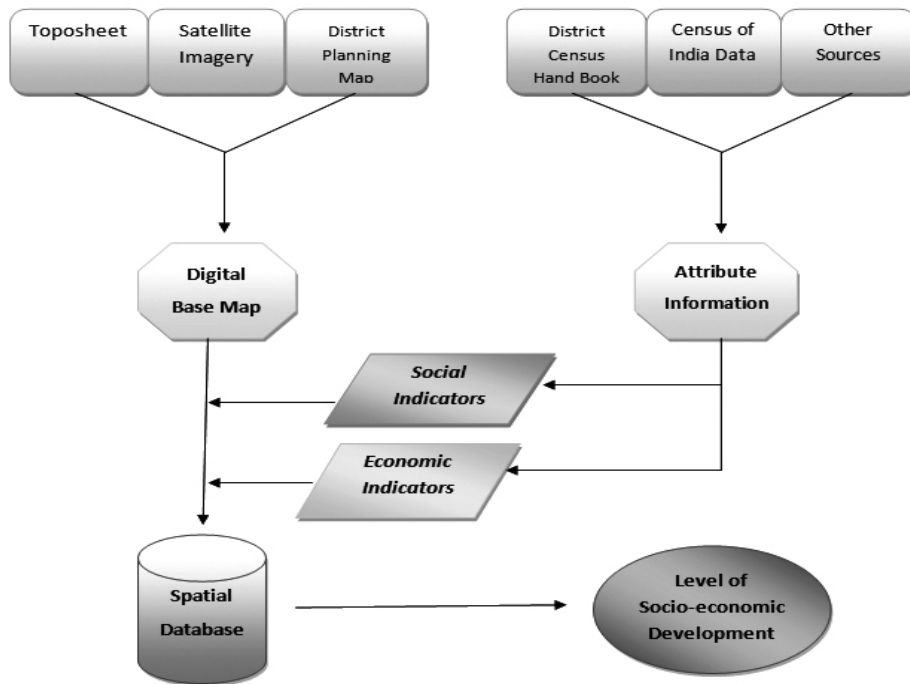


Figure 2: Methodology Adopted for Spatial Database Generation

Data Base and Methodology

The work is mainly based on available secondary data and other relevant information obtained from Census of India, District Statistical Handbook and various government publications such as reports from Office of the District Magistrate; District Programme Officer, ICDS; Natural Resource Data Management System (NRDMS); Office of the Divisional Engineer (Rural Electrification), West Bengal State Electricity Board; District Rural Development Cell, Bankura Zilla Parishad. For the present study, various important aspects such as education, health, economy, gender parity and other demographic variables have been considered and these are grouped into two broad categories, e.g. i) Social indicators

(A₁), ii) Economic indicators (B₁). Total 10 attributes that are best fitted to assess the level of socio-economic development in Bankura district have been chosen for the study. In present work, major emphasis has been given to assess the relative position of blocks in terms of level of socio-economic development by generating a database under GIS environment. To fulfil this objective, both types of data have been analyzed under different GIS layers, such as Level of Education (a₁), Gender Gap in Literacy Rate (a₂), Sex Ratio (a₃), Female Work Participation (a₄), Infant Mortality Rate (a₅); Level of Irrigation Facilities (b₁), Level of Electric Facilities (b₂), Families Living Below Poverty Line (b₃), Marginal Workers (b₄) and Child Labour (b₅).

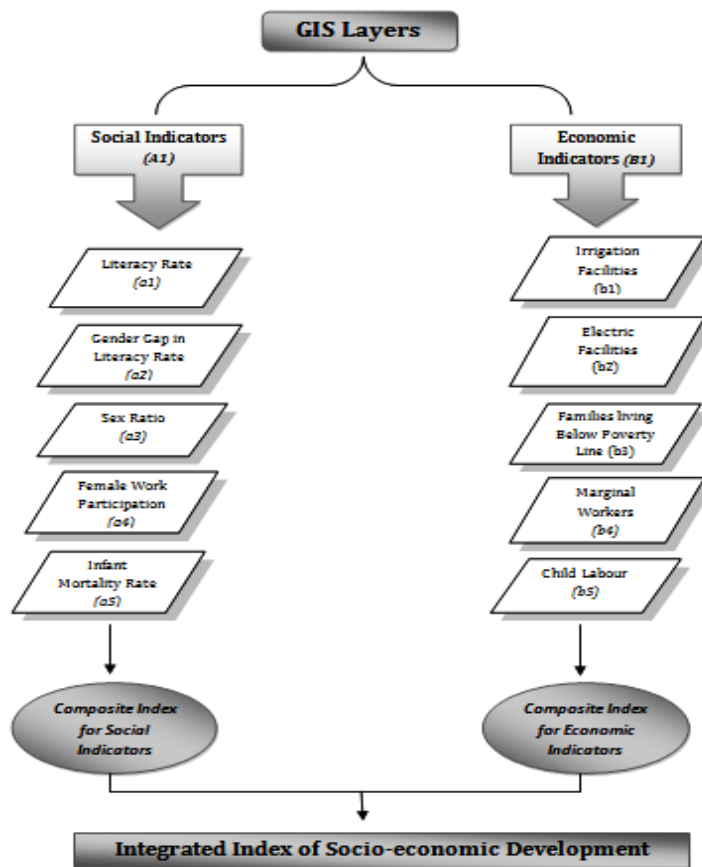


Figure 3: Different Layers of GIS for Integrated Index of Socio-economic Development

For this purpose, thematic layers for each indicator have been generated with encoding numerical values for attribute information and analysis have been done by weighing z-score of each indicator. An integrated composite index has been prepared to determine the level of socio-economic development in each block. Raw scores of each of these ten variables were standardized following the Z-score method. It is a linear transformation of the original data in such a way that its mean becomes zero and its standard deviation becomes unity.

Finally, Z- Scores of each attribute was summated and mapped to find out the levels of development in each block with regard to other blocks in Bankura district. With vertical integration of different thematic layers one upon another, a map of integrated composite index has been prepared to show the spatial pattern of socio-economic development. Spatial features were converted into digital format (such as line or polygon) by manual digitisation.

Results and discussion

Analysis of Social Indicators

Level of Education

Education transforms human being from ignorance to enlightenment, from the shape of social backwardness to light of social amelioration and a nation from under-development to faster social and economic development (Pattanaik, 2000). To assess socio-economic development of Bankura district, education has been considered as one of the important attributes of social indicators. Kotulpur ranks first with a literacy rate of 78.01% while Saltora is at the bottom with literacy rate of just 61.45%. Analysis of the spatial data reveals that the blocks of Jaypur, Kotulpur, Bankura-II and Sarenga have high literacy rate (1.02 to 2.27) within the district, while blocks of Raipur, Khatra, Taldangra, Indus and Bankura-II belongs to region of moderate literacy rate (0 to 1.02). A relatively large areas of central and western part of the district falls in the category of low level of literacy (-1.03 to 0) that covers the blocks of Ranibundh, Indpur, Chhatna, Bankura-I, Gangajalghati, Mejhia, Onda, Bishnupur, Sonamukhi and Simlapal. There is sporadic areas of very low level of literacy (-1.96 to -1.03) found in the blocks of Haribundh, Saltora and Patrasayer. Economic backwardness and low participation of females in education in these areas contributes in the low level of literacy.

Gender Gap in Literacy

This is an important social indicator to measure the level of gender parity of any area. Bankura district scores low on the female literacy side. Whereas the male

literacy rate is 80.05%, the female literacy rate is just 60.05% that results into a huge gender gap of 20 percent (Census of India, 2011). This gender gap is far more widening among S.Cs (23.82%) and S.Ts (26.98%). Analysis of spatial data shows that there is a high regional variation in gender gap throughout the study area. High degree (-1.97 to 1.02) of gender gap in literacy rate is found in blocks in the western part, viz. Ranibundh, Hirbandh, Indpur and Saltora; while Raipur, Khatra, Bankura-I, Chhatna, Gangajalghati and Mejhia registers a moderate degree (-1.02 to 0) of gender gap in literacy. Four blocks of eastern part of the district have very low (1.02 to 1.93) level of gender gap. These are Kotulpur, Jaypur, Patrasayer and Indus. Rest of the blocks have low gender gap (0 to 1.02). In general, it is found that gender gap increases as we move from eastern to western part of the district. Greater participation women in marginal agricultural labour force can be attributed as one of the reason behind low female literacy in western blocks.

Sex Ratio

'Sex Ratio' is another important parameter to track progress of a society or community. The Sex Ratio of Bankura District is 957 (per 1000 males) which is a little higher than the Sex Ratio of West Bengal (950) and it ranks 6th among 19 districts in the State. For rural area, it is 956, where as for urban area it is 968. Ranibundh block has highest sex ratio of 975 whereas Mejhia is at the bottom with 934 (Census of India, 2011). It has been observed that most of the blocks in the north-western part have low (-0.53 to 0.24) to very low (-2.07 to -0.53) sex ratio, while blocks in the southern and eastern part have moderate (0.24 to 0.62) to high (0.62 to 1.87) level of

sex ratio with regard to other regions of the district. It is worth mentioning that literacy rate in eastern and southern parts are higher than other parts of the district.

Female Work Participation

Apparently, participation of females in workforce is considered to be a positive social indicator but in case of Bankura district, it is opposite to this general notion as here females are often engaged in marginal agricultural labour force. About 47.49% of marginal workers are female (Census of India, 2011). Therefore, greater participation of females in workforce has been considered as negative social indicator. Raipur, Ranibundh and Haribandh have high (-2.23 to -0.99) participation of females in workforce; while Mejhia, Bankura-II and Indus have very low (1.06 to 2.1) female work participation rate. Rest of the blocks have moderate (-0.99 to 0.03) to low (0.03 to 1.06) level of female work participation. All these blocks are economically weaker than their eastern counterparts, which has been discussed later.

Infant Mortality Rate

Infant mortality rate (IMR) and socio-economic status are very much linked as high infant mortality rates are often associated with low socio-economic status. Therefore, IMR has been considered as one of the significant attribute for social indicator in present study. Infant mortality rate in Bankura represents a significant block wise variation. Bankura-I, Saltora, and Indpur have registered higher infant mortality rate (-2.17 to -1.02) with respect to district IMR. Bankura-I and Saltora are among the worst performing blocks with

IMR as high as 46.99 and 45 respectively (District HDR, 2007). Poor economy of these tribal blocks has a significant impact on IMR. Taldangra, Simlapal and Bankura-II are among the better performing blocks with very low (1.02 to 1.78) infant mortality rate. Mejhia, Barjora, Hirbandh, Ranibundh, Raipur, Patrasayer and Indus are in relatively better position with low (0 to 1.02) IMR. Rest of the blocks in the district comes under moderate (-1.02 to 0) category.

Spatial Patterns of Social Development

Overall pattern of social development in the study area is shown by the composite z-score, which is the aggregate of z-scores of all five social attributes, discussed earlier. The entire data of composite scores is again divided into 'high', 'medium', 'low' and 'very low' categories. A high level of societal development is represented by the index value of 2.8 to 4.9, moderate level ranges from 0 to 2.8, low level ranges from -2.8 to 0 and very low level of development is represented by z-scores of -5.6 to -2.8. A positive sign indicates better social progress with regard to other blocks, while negative sign indicates relative backwardness.

Kotulpur has the maximum index value of 4.86 as compared to Saltora at the bottom with an index value of 5.57. Kotulpur, Bankura-I, Taldangra, Jaypur and Indus are in better position with high composite score; while Raipur, Sarenga, Simlapal, Barjora and Patrasayer have moderate level of progress. Hirbandh, Indpur and Saltora are lagging behind others with very low index value. All other blocks have low index value ranges from -2.8 to 0.

Analysis of Economic Indicators

Level of Irrigation Facilities

As the economy of Bankura district is mainly dependent on agriculture, therefore irrigation is one important parameter determining economic development of the district. In order to assess the level of irrigation facilities, percentage of irrigated area to the total cultivable land in every individual block has been taken for consideration. It is evident from analysis, that Indus, Jaypur and Kotulpur has high percentage of land under irrigation as there is good surface irrigation network is available under the commands of Dwarkeswar and Damodar canal irrigation system. Chhatna, Bankura-I & II and Hirbandh have poor irrigation facilities with very low (-1.42 to -1.02) index value. In general it can be concluded that irrigation facilities in eastern part is much better than western part owing to its downstream location.

Level of Electric Facilities

Electricity plays a crucial role in triggering off economic development. An adequate power infrastructure is a natural corollary for industrialization and agriculture apart from rural social services. Percentages of electrified mouzas in each block have been taken to assess the level of electric facilities available in the district. Majority of the blocks in the district have moderate (0 to 1.02) to high (1.02 to 1.24) level of electrification rate. Indus and Mejhia have 94.7% and 92% of mouzas electrified respectively. The existence of thermal power plants in Mejhia, Durgapur and Kolaghat is one reason behind this better electricity there. Blocks in southern part of the district, particularly Raipur, Ranibundh and Indpur

are lagging behind others with very low (-3.35 to -1.02) electrification rate. Sarenga, Simlapal, Khatra, Hirbandh, Chhatna and Saltora have relatively low (-1.02 to 0) electrification rate compared to others.

Marginal Workers

Employment is one important parameter of economic development. But we have to consider the form and type of employment in order to understand the level of economic development in a region. 'Marginal workers' generally includes agricultural labours, vegetable sellers, contract labours in various sectors and others. Therefore more employment in the form of marginal workers in any region is considered to be a negative indicator rather than positive. Hirbandh, Ranibundh, Raipur and Sarenga have high (-2 to 1.02) percentages of workers in marginal category and thus have negative index value. On the other hand, Patrasayer, Bakura-I and Kotulpur have very low (1.02 to 1.35) percentages of workers engaged as marginal workers. Most of the blocks have moderate (-1.02 to 0) level of employment in marginal category of workers.

Families Living Below Poverty Line (BPL)

A possible solution to improve the quality of life is to reduce poverty first. Here an attempt has been made to understand poverty in the context of Bankura district. There is considerable difference from block to block in the percentage of people living below the poverty line. Chhatna, Haribandh, Ranibundh, Raipur, and Taldangra is at the bottom with high (-1.14 to -1.04) percentage of families living below poverty line. Indus, Jaypur, Kotulpur and Saltora is at top position with very low (1.03 to 1.23)

percentage of BPL families. Bankura-I & II, Gangajalghati, Sarenga, and Patrasayer is at relatively better position with low (-0.01 to 1.03) percentage of families under BPL. Rest of the blocks have moderate (-1.04 to -0.01) level of poverty.

Child Labour

Child labour is a menace to society and Bankura district is not free from it. Adult unemployment and large family size is mainly responsible behind this. It is a direct reflection of economic underdevelopment and social backwardness. On the basis of z-score analysis, Saltora, Gangajalghati, Barjora, Sonamukhi and Patrasayer are in worst condition with high (-2.79 to -1.02) number of child labour. Ranibundh, Chhatna and Indus are in moderate (-1.02 to 0) position. Rest of the blocks are in better condition with low (0 to 1.02) to very low (1.02 to 1.1) number of child labour.

Spatial Pattern of Economic Development

Spatial pattern of economic development in the study area is shown by the composite

z-score, which is the aggregate of z-scores of all five economic attributes, discussed earlier. The entire data of composite scores is again divided into 'high', 'medium', 'low' and 'very low' categories. A high level of economic development is represented by the index value of 3.2 to 6.7, moderate level ranges from 0 to 3.2, low level ranges from -3.2 to 0 and very low level of development is represented by z-scores of -5.4 to -3.2. A positive sign indicates better economic progress with regard to other blocks, while negative sign indicates relative backwardness. Kotulpur has the maximum index value of 6.63 as compared to Raipur at the bottom with an index value of -5.36. Kotulpur, Jaypur and Indus are in better position with high composite score; while Raipur, Ranibundh, Hirbandh, Indpur and Chhatna are least developed with very low index value of -5.4 to 5.32. Saltora, Gangajalghati, Barjora, Sonamukhi and Khatra are also lagging with low level of index value. All other blocks have moderate index value ranges from 0 to 3.2.

Spatial Patterns of Integrated Socio-economic Development

Table 3: Level of Integrated Socio-economic Development in Bankura District

Category	Range	No. of Blocks	Name of Blocks
High	5.6 to 11.5	3	Kotulpur, Indus and Jaypur
Moderate	0 to 5.6	9	Sarenga, Simlapal, Taldangra, Patrasayer, Barjora, Bishnupur, Onda, Bankura-II and Mejhia
Low	-5.6 to 0	5	Ranibundh, Hirbandh, Indpur, Chhatna and Saltora
Very Low	-8.5 to -5.6	5	Raipur, Khatra, Bankura-I, Gangajalghati and Sonamukhi

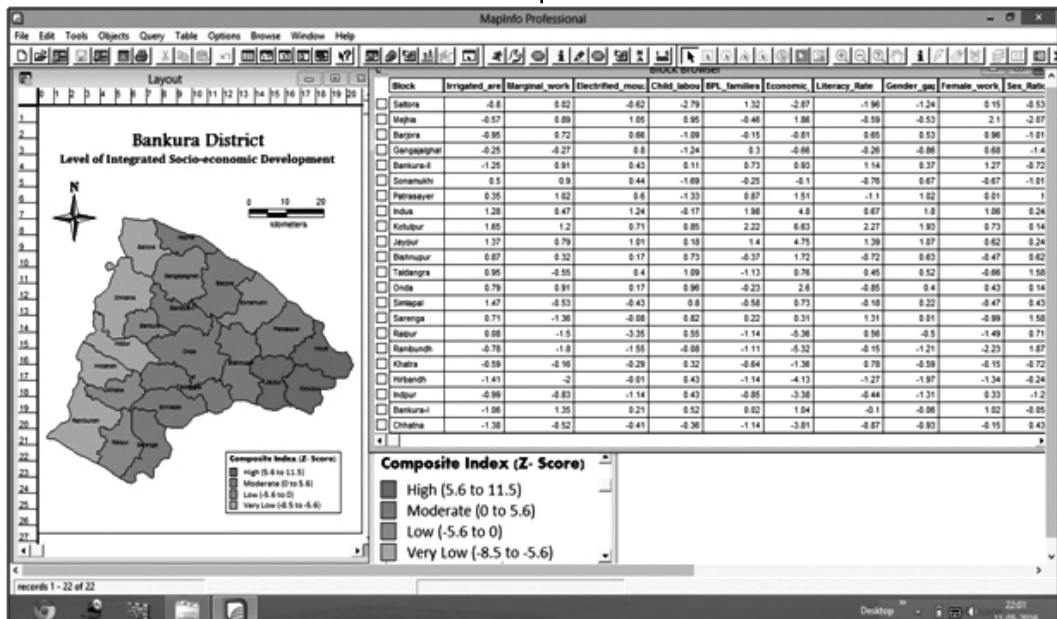
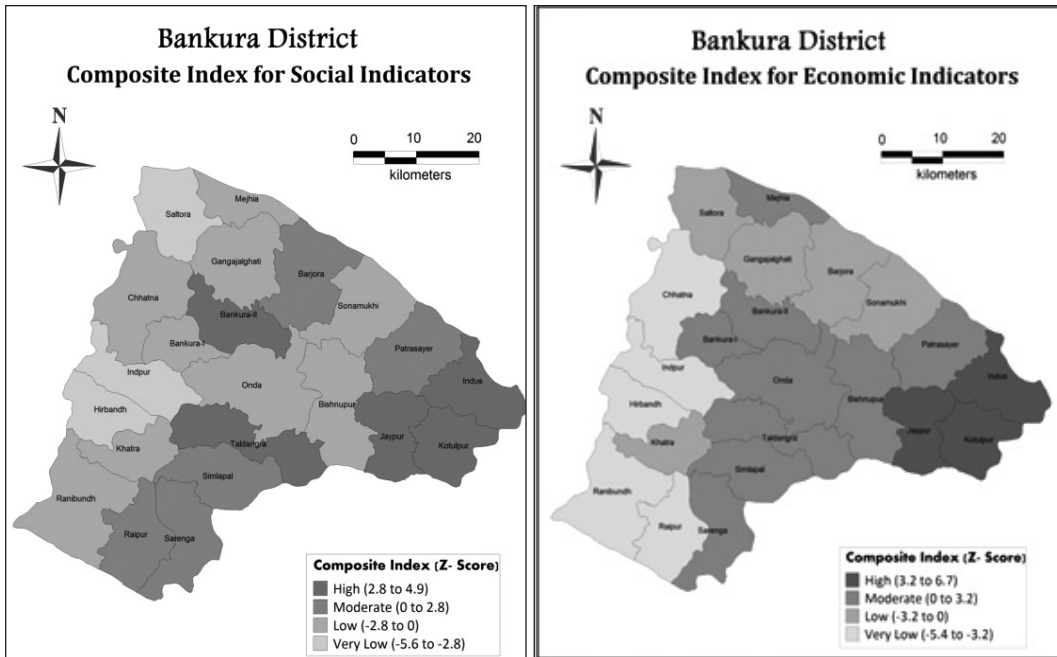


Figure 4: Spatial Database and Patterns of Integrated Socio-economic Development

Analysis of various attributes of socio-economic sector reveals that the spatial patterns of development are not uniform throughout the area under study. The study shows contrasting picture of development from one block to the other. Applying integrated overlay technique under GIS environment, five thematic layers were accounted as input files in each indicator and one final output has been generated for both social and economic indicators, separately. First, on the basis of z-scores, the categories were decided for all ten thematic layers and rankings have been done with 'high', 'moderate', 'low' and 'very low'. Then with composite index, database for the final level of development is generated. The blocks are grouped into four categories such as (i) High, (ii) Moderate and (iii) Low and (iv) Very Low.

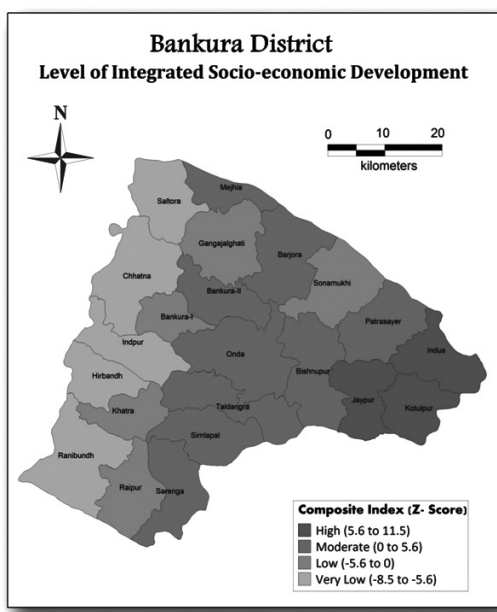


Fig. 5 : Level of Integrated Socio-economic Development of Bankura District

After the integration of both social and economic layers, it has been observed that western parts of the district have least development compare to other blocks. This outcome is largely due to rugged train, infertile soil and unavailability of irrigation water. These has led to poor economic structure which ultimately responsible for various social issues e.g. low level of literacy, high infant mortality rate and low standard of life which is reflected by large number of BPL families.

Conclusions

On the basis of geo-spatial analysis of spatial database (SDB), the entire district can be divided into three priority zones, viz., (i) first priority zone consists blocks in the western and south-western part which have poor socio-economic condition, (ii) second and (iii) third priority zones are to be decided after taking into consideration the blocks which have moderate to relatively better socio-economic development. Blocks situated in western part adjacent to Purulia district, such as Ranibundh, Hirbandh, Indpur, Chhatna and Saltora are lagging behind others. Here, Poor inaccessibility due to physiographic bottlenecks acts as a barrier against the development. Further this zone also acts as a buffer zone for Naxalite activities. Contrary to this, blocks in eastern part of the district have a sound socio-economic development, owing to better accessibility and agricultural prospect. In conclusion, it can be said that spatial database are very effective tool for planning purpose. It can enhance the capacity of local governing bodies to make strategies for the development and planning of a spatial unit.

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