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Geographical Determinants of Population Distribution in Bankura District, West Bengal: A Geospatial and Statistical Analysis

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ABSTRACT

The spatial pattern of population distribution in Bankura district reflects a strong dependence on geographical conditions. The present study examines the influence of physiography, drainage, vegetation, climate, soil, and land use land cover on population density using geospatial datasets and statistical techniques. Elevation data derived from ASTER GDEM, vegetation indices from Sentinel imagery, and climatic variables have been integrated with census based population data. Linear regression analysis has been applied to evaluate the relationship between population density and selected environmental variables. The results reveal that low elevation, fertile soil, moderate vegetation cover, and favorable land use patterns are associated with higher population density, particularly in the eastern part of the district. In contrast, rugged terrain, lateritic soil, dense forest cover, and climatic variability contribute to lower population concentration in the western region. The study highlights the complex interaction between physical environment and human settlement and emphasizes the need for sustainable resource management strategies to achieve balanced regional development.

1. Introduction

Population distribution is inherently uneven and reflects the combined influence of physical, environmental, and socio economic factors. Among these, geographical determinants such as relief, drainage, soil, vegetation, climate, and land use patterns play a decisive role in shaping spatial variations in population density. In predominantly agrarian regions, the dependence on natural resources is particularly strong, making the physical environment a primary controlling factor in settlement distribution.

Relief or physiography exerts a fundamental influence on human habitation. Low lying plains with gentle slopes generally attract higher population densities due to their suitability for agriculture, infrastructure development, and accessibility. In contrast, elevated and rugged terrains tend to restrict settlement expansion because of poor soil conditions, limited water availability, and infrastructural constraints. Studies have demonstrated that a large proportion of the global population is concentrated in low elevation zones, highlighting the inverse relationship between altitude and population density (Cohen & Small, 1998).

Drainage characteristics also play a crucial role in determining population distribution. River systems provide essential water resources for agriculture, domestic consumption, and industrial activities. Regions with well developed drainage networks often support dense populations due to fertile alluvial soils and irrigation potential. However, excessive drainage density or flood proneness may negatively impact settlement stability, particularly in monsoon dominated regions.

Vegetation cover, as an indicator of ecological conditions, influences both agricultural productivity and habitability. Areas with moderate vegetation cover are generally associated with fertile land and favorable climatic conditions, supporting higher population densities. On the other hand, dense forest areas often exhibit lower population concentration due to restricted accessibility and conservation regulations. Remote sensing based indices such as the Normalized Difference Vegetation Index provide valuable insights into vegetation health and its relationship with human settlement patterns.

Climatic factors, particularly rainfall and temperature, further regulate population distribution by affecting agricultural productivity and water availability. Regions receiving adequate and reliable rainfall tend to support intensive agriculture and higher population densities. Conversely, areas prone to droughts or climatic variability often experience sparse population distribution and out migration. The variability of monsoonal rainfall in eastern India is especially significant in determining rural livelihood patterns and settlement stability.

Soil characteristics constitute another critical determinant of population distribution. Fertile soils with balanced texture and high nutrient content encourage agricultural activities and support dense rural populations. In contrast, lateritic or sandy soils with poor water retention capacity limit cultivation and consequently reduce population concentration. The relationship between soil quality and settlement pattern is particularly evident in rural landscapes where agriculture remains the dominant economic activity (Dhote, 2001).

Land use and land cover patterns reflect the dynamic interaction between human activities and the natural environment. Increasing population pressure leads to the transformation of natural landscapes into agricultural and built up areas. Urban and semi urban regions exhibit high population density due to diversified economic opportunities, whereas forested and barren lands remain sparsely populated. The study of land use patterns thus provides a comprehensive understanding of how human intervention modifies the geographical landscape over time.

In this context, Bankura district of West Bengal presents a unique setting characterized by a transitional physiographic structure between the Chotanagpur plateau and the Gangetic plain. The district exhibits significant spatial variation in relief, soil, vegetation, and climate, which in turn influence its population distribution pattern. Despite its predominantly rural character, the region shows marked intra district disparities in population density due to uneven resource distribution and environmental constraints.

The present study aims to examine the relationship between geographical factors and population distribution in Bankura district using geospatial techniques and statistical analysis. By integrating multiple environmental variables with population data, the study seeks to identify dominant controlling factors and their spatial influence on settlement patterns. Such an analysis is essential for informed regional planning and sustainable development, particularly in environmentally sensitive and resource constrained regions (Roy & Das, 2011).

2: Literature Review

The relationship between geographical factors and population distribution has been widely examined in geographical and demographic research. Early work by Cohen and Small (Cohen & Small, 1998) established that a significant proportion of the global population is concentrated in low elevation zones, emphasizing the inverse relationship between altitude and population density. This concept has been widely applied in regional studies to explain settlement concentration in plains and low lying areas.

Dhote (Dhote, 2001)analyzed the relationship between altitude and population density in the Purna River Basin and identified a clear negative correlation, where higher elevation areas exhibited lower population density due to physical constraints and limited agricultural potential. This finding is consistent with patterns observed in plateau fringe regions of eastern India.

In the context of West Bengal, Roy and Das (Roy & Das, 2011) examined population growth and socio economic conditions in Birbhum district and highlighted the role of environmental and infrastructural factors in shaping population distribution. Their study emphasized that regions with better agricultural productivity and resource availability tend to attract higher population concentration.

More recent studies have incorporated geospatial techniques and multivariate statistical methods to analyze population distribution. Ghosh et al. (Ghosh, Das, & Mondal, 2022) demonstrated the effectiveness of integrating spatial technology with statistical analysis in identifying key determinants of regional disparities. Their work highlighted the importance of combining environmental variables with socio economic indicators for comprehensive analysis.

Despite these contributions, limited studies have focused specifically on Bankura district using an integrated geospatial and statistical framework. The present study attempts to fill this gap by examining multiple geographical variables simultaneously and assessing their combined influence on population distribution.

3. Study Area

Bankura district is located in the western part of West Bengal between 22°38′N to 23°38′N latitude and 86°36′E to 87°46′E longitude, forming a transitional zone between the Chotanagpur Plateau in the west and the Gangetic Plain in the east.

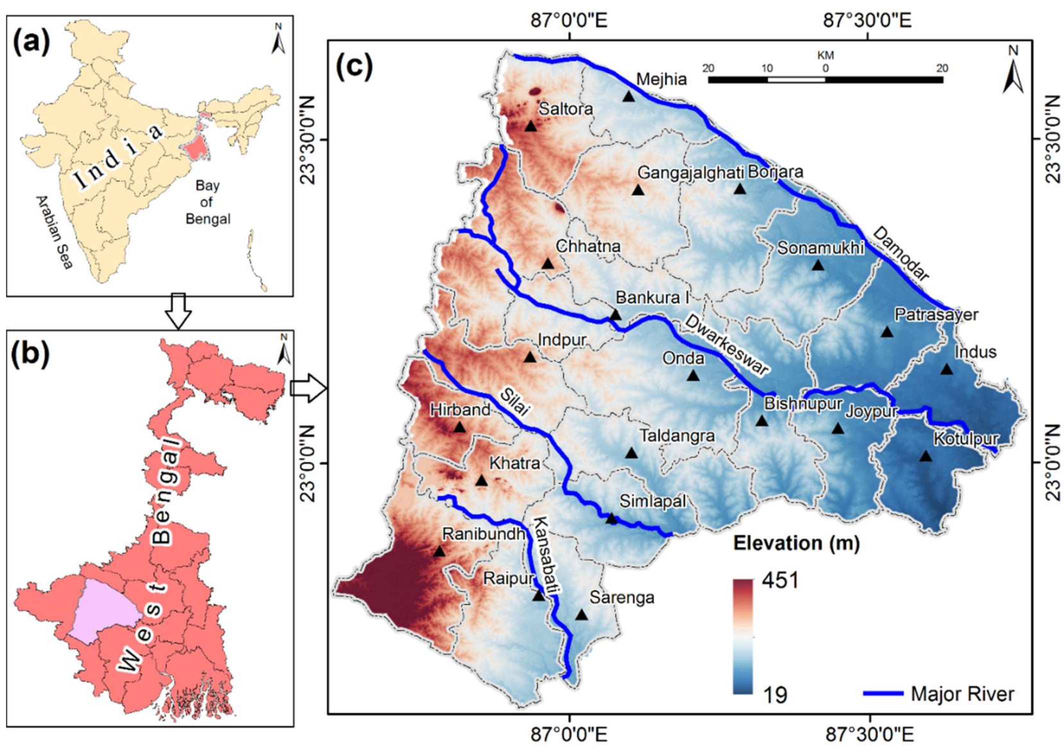


Figure 1 : Location Map of Bankura District

The western part is characterized by undulating lateritic uplands with residual hills and poor soil fertility, while the eastern part consists of flat alluvial plains with higher agricultural productivity and population concentration. Elevation shows a general west to east declining trend, influencing drainage and settlement patterns.

The drainage system is dominated by rivers such as Damodar, Dwarakeswar, Gandheswari, and Kangsabati, flowing west to east and supporting agriculture in the plains. The district experiences a tropical monsoon climate with annual rainfall ranging from 1000 mm to 1300 mm, with high seasonal variability and periodic drought conditions.

Soil varies from infertile lateritic types in the west to fertile alluvial soils in the east, directly affecting land use and population distribution. Land use is predominantly agricultural, with forest cover concentrated in western and southern parts, while urban development remains limited.

The study area thus exhibits strong spatial contrasts in physical and environmental conditions, providing a suitable framework to analyse the geographical determinants of population distribution.

4: Objectives of the Study

1. To examine the spatial pattern of population distribution in Bankura district.
2. To analyze the influence of physiography, drainage, vegetation, climate, soil, and land use land cover on population density.
3. To assess the relationship between population density and selected geographical variables using statistical techniques.
4. To identify the dominant factors controlling population distribution in different parts of the district.
5. To provide a geographical basis for sustainable regional planning and development.

5: Data Sources and Methodology

The present study is based on the integration of geospatial and statistical datasets to examine the relationship between geographical factors and population distribution in Bankura district. Both spatial and non spatial data have been utilized to ensure a comprehensive analytical framework.

The elevation and drainage data have been derived from ASTER GDEM, which provides high resolution digital elevation information suitable for terrain analysis. Vegetation characteristics have been assessed using Sentinel 2 multispectral satellite imagery, from which the Normalized Difference Vegetation Index has been computed to evaluate vegetation health and density. Land use land cover classification has also been carried out using Sentinel 2 data, categorizing the region into major classes such as water, vegetation, agricultural land, built up area, bare land, and rangeland. Climatic data, particularly rainfall and temperature, have been obtained from secondary meteorological records, while soil data have been collected from published soil maps and reports. Population data at the block level have been derived from census sources.

Table 1 : Data Sources and Resolution Used in the Study

Sl.No.	Data	Scale/ Resolution	Source
1	Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model (ASTER GDEM)	30m	National Aeronautics and Space Administration (NASA) and Japan's Ministry of Economy, Trade, and Industry (METI)
2	Sentinel-2 Multispectral Data	10m	Copernicus Data Space Environment
3	Rainfall Data	0.25° * 0.25°	India Meteorological Department
4	Soil Map	1:50,000	National Bureau of Soil Survey & Land Use Planning (NBSS&LUP)

To analyze the relationship between population density and geographical variables, linear regression technique has been applied. This statistical method establishes a functional relationship between a dependent variable and one or more independent variables. In the present context, population density has been considered as the dependent variable, while elevation, drainage density, vegetation index, rainfall, soil characteristics, and land use patterns have been treated as independent variables.

The general form of the linear regression model is: $Y= a+bXY = a + bXY=a+bX$

where Y represents population density, X represents the independent geographical variable, a is the intercept, and b is the regression coefficient indicating the degree and direction of influence.

The method aims to identify the best fitting line that minimizes the deviation between observed and predicted values. This approach is useful for quantifying the strength of relationships, identifying dominant controlling factors, and interpreting spatial patterns in a simplified statistical framework. Scatter plots have been used alongside regression analysis to visually examine the nature of relationships between variables.

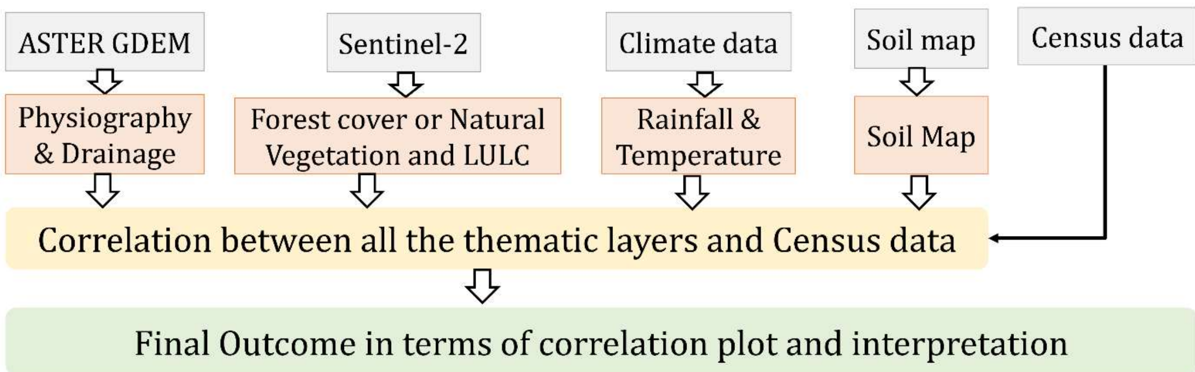


Figure 2: Methodological Framework of the Study

The overall methodology involves data collection, preprocessing of geospatial layers, thematic map preparation, extraction of block wise values, statistical analysis through regression, and interpretation of results. This integrated approach ensures a systematic understanding of how physical and environmental variables influence population distribution across the district.

6. Result and Discussion

6.1 Physiography and Population Distribution

Physiography is a fundamental determinant of population distribution, as variations in elevation and terrain directly influence agricultural suitability, accessibility, and settlement development. In Bankura district, elevation ranges from **19 m to 451 m**, exhibiting a clear west to east declining gradient which significantly shapes the spatial pattern of population density. (Fig B)

The western part of the district forms an extension of the plateau fringe, characterized by undulating uplands, residual hills, and dissected terrain. Prominent elevations such as Biharinath at about 448 m and Susunia at about 440 m represent the highest points in the region. These areas are marked by lateritic soil, low water retention capacity, and limited agricultural productivity, resulting in sparse population distribution. In contrast, the eastern region consists of low lying alluvial plains with gentle slopes, fertile soil, and better irrigation facilities, supporting relatively high population density.

Table 2. Comprehensive overview of population density and elevation across different administrative blocks

Administrative Blocks	Population Density (per km^2)	Elevation (m)
Bankura I	640	93
Bankura II	614	98
Bishnupur	446	80
Borjara	470	82
Chhatna	437	150
Gangajalghati	477	125
Hirband	434	168
Indpur	523	147
Indus	662	46
Joypur	596	62
Khatra	454	149
Kotulpur	760	38
Mejhia	522	82
Onda	501	79
Patrasayer	554	67
Raipur	452	79
Ranibundh	279	168
Saltora	421	174
Sarenga	476	91
Simlapal	440	66
Sonamukhi	423	58
Taldangra	426	82

The spatial pattern indicates that blocks located in the eastern and central parts of the district exhibit higher population density, while those in the western uplands show comparatively lower density. This reflects the strong control of terrain conditions on settlement concentration.

To quantify this relationship, a scatter plot has been constructed between elevation and population density.

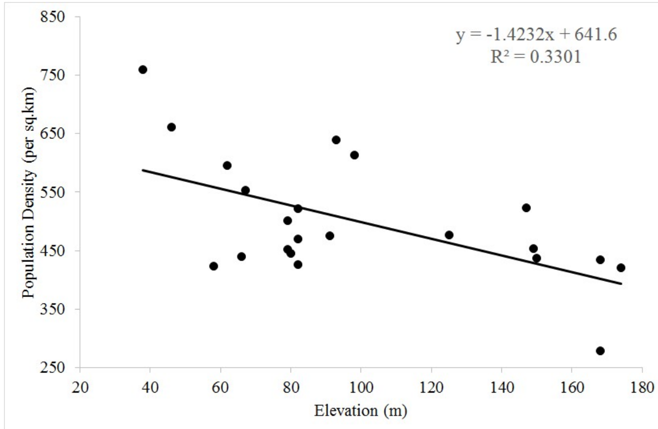


Figure 3. Scatter plot of population density and elevation.

The analysis reveals a negative correlation between elevation and population density, indicating that as elevation increases, population density tends to decrease. This inverse relationship highlights the constraints imposed by rugged terrain, poor soil conditions, and limited accessibility in higher elevation areas. Conversely, low elevation zones provide favorable conditions for agriculture, infrastructure development, and economic activities, thereby attracting higher population concentration.

Thus, physiography emerges as a primary controlling factor influencing the spatial distribution of population in Bankura district, with clear regional disparities between the plateau fringe and the alluvial plains.

6.2 Drainage and Population Distribution

Drainage plays a significant role in shaping population distribution by influencing water availability, soil fertility, and agricultural potential. In Bankura district, the drainage system follows the natural slope of the land from west to east, reflecting the overall physiographic structure of the region.(Fig C)

The major river systems include the Damodar, Dwarakeswar, Gandheswari, and Kangsabati, along with their tributaries. These rivers originate from the western uplands and flow eastward, forming a network of seasonal streams. The upper courses are characterized by narrow channels and stable banks, whereas the lower courses, particularly in the eastern plains, are prone to flooding due to weaker alluvial embankments.

Table 3. Comprehensive overview of population density and drainage density across different administrative blocks.

Administrative Block	Population Density (per km^2)	Drainage Density (km^2)
Bankura I	640	1.418
Bankura II	614	1.336
Bishnupur	446	1.200
Borjara	470	1.266
Chhatna	437	0.987
Gangajalghati	477	0.938
Hirband	434	1.142
Indpur	523	0.809
Indus	662	1.682
Joypur	596	1.592
Khatra	454	1.342
Kotulpur	760	1.582
Mejhia	522	1.339
Onda	501	1.472
Patrasayer	554	1.598
Raipur	452	1.310
Ranibundh	279	1.100
Saltora	421	1.132
Sarenga	476	1.445
Simlapal	440	1.354
Sonamukhi	423	1.598
Taldangra	426	1.580

Drainage density, defined as the total length of streams per unit area, varies across the district and has been classified into different ranges. Areas with moderate drainage density tend to support higher population concentrations due to better availability of water resources for agriculture and domestic use. River valleys, in particular, provide fertile land and favorable conditions for settlement development.

To examine the relationship between drainage density and population distribution, a scatter diagram has been constructed.

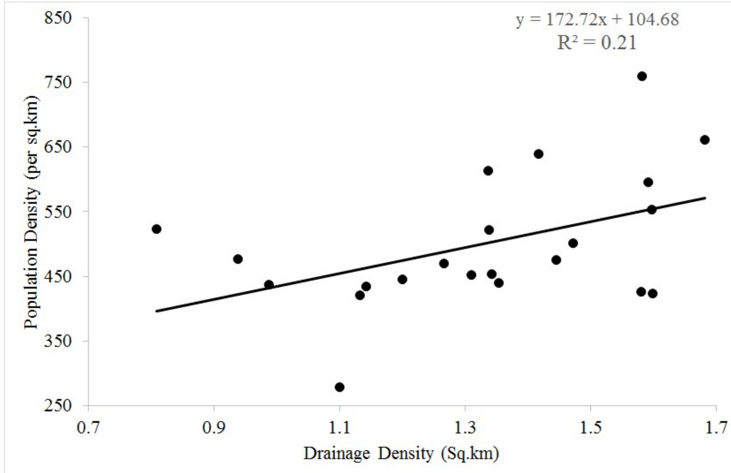


Figure 4. Scatter diagram of population density and drainage density.

The analysis indicates a moderate positive correlation between drainage density and population density. Regions with well developed drainage networks generally exhibit higher population density due to improved irrigation potential and agricultural productivity. However, extremely high drainage density or flood prone areas may impose constraints on settlement stability, particularly during periods of intense rainfall.

Thus, drainage emerges as an important geographical factor influencing population distribution in Bankura district, with its impact mediated through water availability, agricultural suitability, and flood dynamics.

6.3 Vegetation and Population Distribution

Vegetation cover reflects the ecological condition of a region and plays an important role in influencing population distribution through its impact on agriculture, resource availability, and land usability. In Bankura district, the distribution of natural vegetation shows considerable spatial variation, primarily controlled by climate, soil, and topography. (Fig D)

The district is characterized by the dominance of tropical deciduous forests, particularly sal forests, concentrated in the western and southern parts. These regions exhibit relatively dense forest cover due to rugged terrain, lateritic soil, and limited agricultural expansion. In contrast, the eastern and northeastern parts show sparse vegetation, where forests have largely been replaced by agricultural land and human settlements.

The Normalized Difference Vegetation Index has been used to quantify vegetation density and health. Higher index values indicate dense and healthy vegetation, while lower values represent sparse or degraded vegetation cover. Areas with moderate vegetation cover are generally associated with fertile land and active agricultural practices, thereby supporting higher population density.

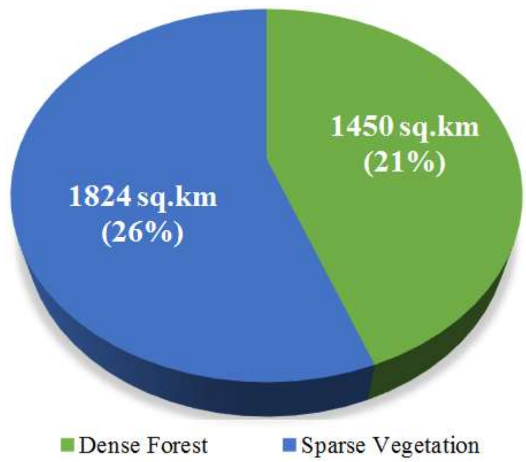


Figure 5. Pie chart showing the area percentage of forest cover and sparse vegetation.

The analysis reveals that regions with dense forest cover tend to have low population density due to limited accessibility, restricted land use, and conservation constraints. On the other hand, areas with moderate vegetation cover, particularly agricultural landscapes, support higher population concentration as they provide favorable conditions for cultivation and habitation.

Thus, vegetation acts as both a facilitating and limiting factor in population distribution. While moderate vegetation enhances agricultural productivity and settlement growth, dense forest cover restricts human habitation and results in lower population density in the western and southern parts of Bankura district.

6.4: Climate and Population Distribution

Climate is a critical determinant of population distribution as it directly influences agricultural productivity, water availability, and overall livability. In Bankura district, climatic conditions are characterized by pronounced seasonal variations, with rainfall and temperature acting as the principal controlling elements. (Fig E)

The district receives an average annual rainfall ranging from **1000 mm to 1300 mm**, of which nearly 78 percent is concentrated during the monsoon season from June to September. This seasonal concentration of rainfall plays a decisive role in shaping agricultural activities, particularly in a predominantly rainfed agrarian economy. Regions receiving relatively stable and adequate rainfall tend to support higher population density due to improved agricultural productivity and water availability.

However, the district is also marked by significant inter annual variability in rainfall and frequent dry spells, especially in the western uplands. Such climatic uncertainty adversely affects crop yield and livelihood security, thereby limiting population concentration in these areas. In contrast, the eastern plains, with relatively better moisture availability, support more stable agricultural practices and higher population density.

Temperature variation further influences settlement patterns.

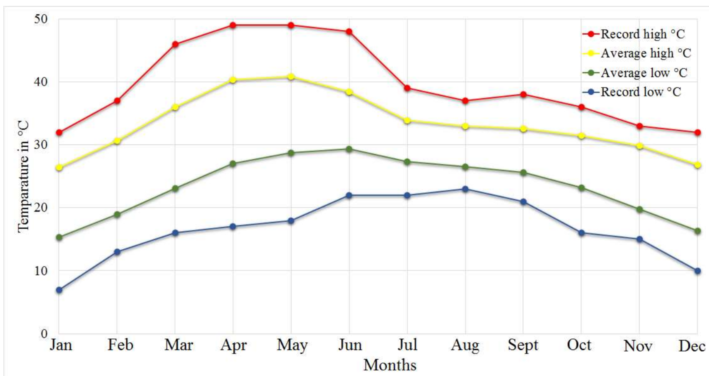


Figure 6: Temperature Graph showing Record High, Average High, Average Low, and Record Low (2023).

The temperature rises sharply from March onwards, with summer maxima reaching up to about 49°C, while winter temperatures range between 10°C and 13°C, occasionally dropping below 7°C. High summer temperatures combined with low soil moisture create stress conditions for agriculture in upland areas. The onset of the monsoon leads to a decline in temperature and provides relief for agricultural activities.

Climatic conditions also affect infrastructure development, economic opportunities, and migration patterns. Areas with favorable climatic conditions tend to attract population due to better living standards and economic prospects, whereas regions experiencing climatic stress, such as drought prone zones, often witness low population density and out migration.

Thus, climate, particularly rainfall variability and temperature extremes, plays a crucial role in influencing the spatial distribution of population in Bankura district by regulating agricultural productivity and environmental suitability.

6.5 Soil and Population Distribution

Soil is a fundamental determinant of population distribution, particularly in rural and agrarian regions where livelihood largely depends on agricultural productivity. The nature, texture, and fertility of soil directly influence crop cultivation, water retention capacity, and consequently the spatial concentration of population. (Fig F)

In Bankura district, soil types exhibit considerable variation and have been classified into categories such as fine, fine loamy, fine loamy coarse loamy, fine loamy sandy, very fine, fine fine loamy, and gravelly loam. The eastern part of the district is predominantly characterized by fertile alluvial and fine loamy soils, which provide favorable conditions for intensive agriculture. These areas support higher population density due to better crop yield, irrigation potential, and economic stability.

Table 4: Block wise Population Density and Soil Characteristics

Administrative Block	Population Density (per km^2)	Soil
Bankura I	640	Fine Loamy
Bankura II	614	Fine Loamy
Bishnupur	446	Fine Loamy
Borjara	470	Fine Loamy
Chhatna	437	Fine Loamy
Gangajalghati	477	Gravelly Loam Loam
Hirband	434	Fine
Indpur	523	Fine Loamy
Indus	662	Fine
Joypur	596	Fine Very Fine
Khatra	454	Gravelly Loam Loam
Kotulpur	760	Fine
Mejhia	522	Fine
Onda	501	Fine-Fine Loamy
Patrasayer	554	Fine-Fine Loamy
Raipur	452	Fine Loamy Sandy
Ranibundh	279	Fine Loamy

Saltora	421	Fine
Sarenga	476	Fine Loamy
Simlapal	440	Fine Loamy Sandy
Sonamukhi	423	Fine-Fine Loamy
Taldangra	426	Fine Loamy Sandy

In contrast, the western upland region is dominated by lateritic and coarse textured soils with low fertility and poor moisture retention capacity. These soils are often associated with undulating terrain and significant erosion, limiting agricultural productivity and thereby restricting population concentration. The prevalence of such marginal soils contributes to the dominance of subsistence agriculture and economic vulnerability in these areas.

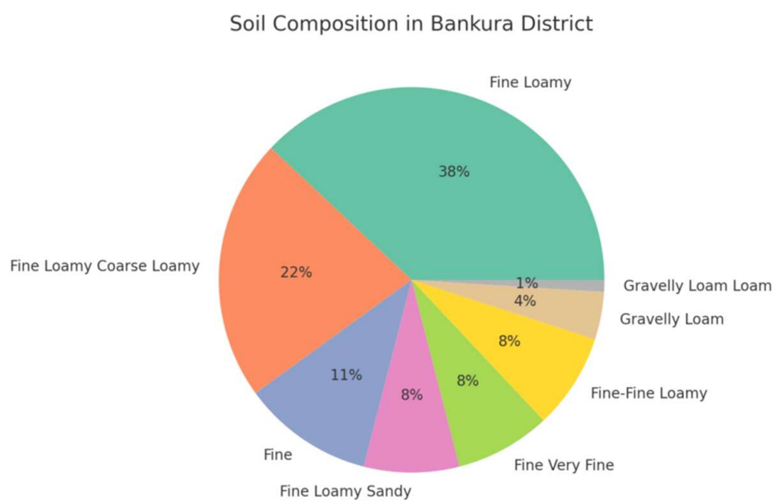


Figure 7: Pie Chart showing Area Percentage of Soil Texture

The analysis indicates a strong positive association between soil fertility and population density. Regions with fine and loamy soils exhibit higher population concentration, whereas areas with coarse and degraded soils show sparse settlement patterns. Furthermore, continuous exploitation of land resources without adequate soil conservation measures has led to declining soil fertility in several parts of the district, adversely affecting agricultural sustainability.

Thus, soil characteristics emerge as a key controlling factor in population distribution, influencing both the intensity of land use and the spatial pattern of human settlement in Bankura district.

6.6 Land Use Land Cover and Population Distribution

Land use land cover reflects the interaction between human activities and the natural environment and serves as a direct indicator of population pressure on land resources. The spatial pattern of land utilization in Bankura district is closely associated with its population distribution, economic structure, and environmental conditions. (fig:G)

The land use pattern of the district has been classified into major categories such as water bodies, tree cover, agricultural land, built up area, bare land, and rangeland. Agricultural land constitutes the dominant land use category, particularly in the eastern and central parts of the district, where favorable soil and climatic conditions support intensive cultivation. These regions correspond to areas of higher population density, reflecting the dependence of the rural population on agriculture.

In contrast, the western and southwestern parts of the district are characterized by forest cover, scrubland, and barren land, where physical constraints such as poor soil fertility, rugged terrain, and limited water availability restrict agricultural expansion and settlement growth. Consequently, these areas exhibit lower population density.

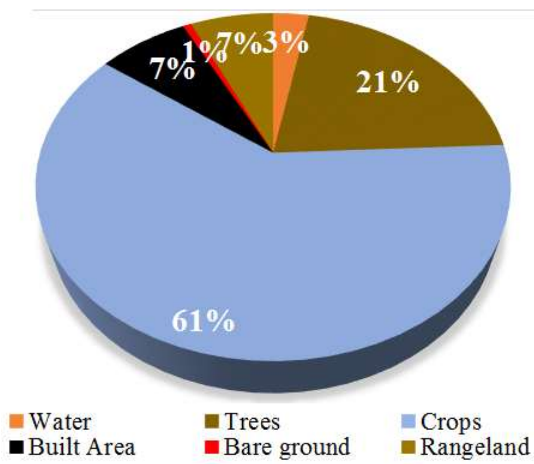
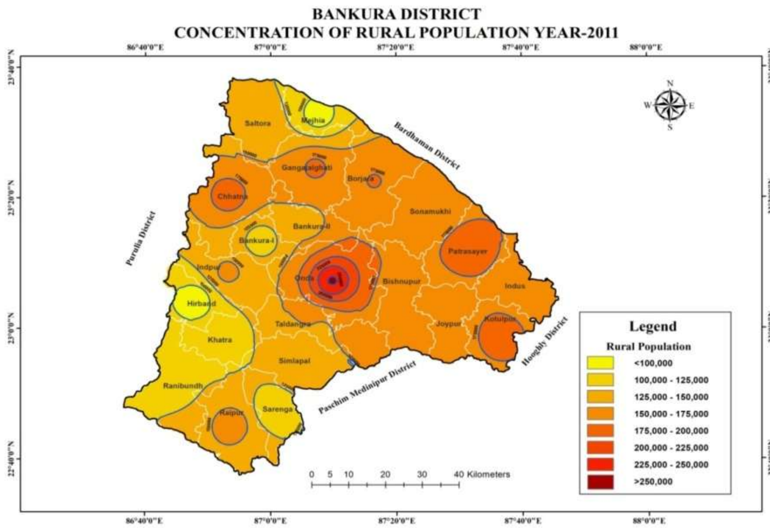


Figure 8: Pie Chart showing Area Percentage of Land Use Land Cover Classes

The built up area, although limited in extent, is concentrated around urban and semi urban centers, indicating localized zones of high population density and economic activity. The expansion of built up land reflects gradual urbanization and infrastructural development, though the district largely retains its rural character.

The analysis reveals a strong relationship between land use pattern and population distribution. Areas dominated by agricultural and built up land uses show higher population concentration, whereas forested and barren lands are associated with sparse population. This pattern highlights the role of economic opportunities and land productivity in shaping settlement distribution.

Thus, land use land cover emerges as an integrative factor that encapsulates the combined influence of physical environment and human intervention, providing a comprehensive understanding of population distribution in Bankura district.



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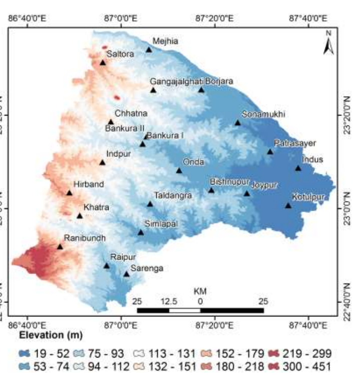

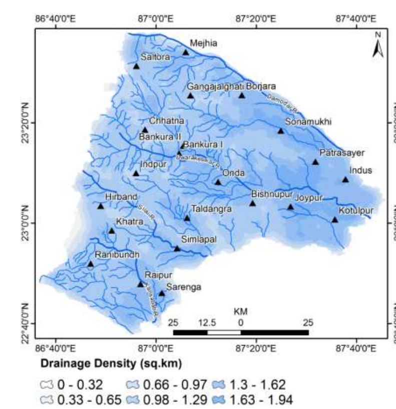

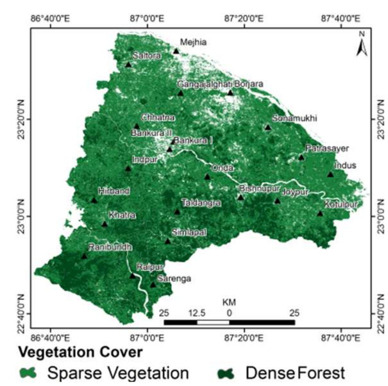

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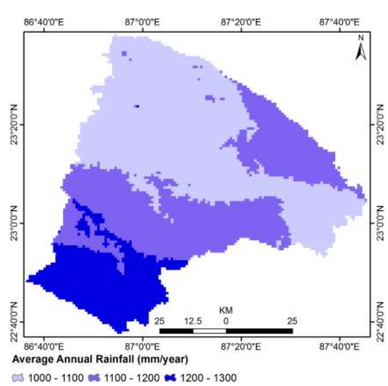

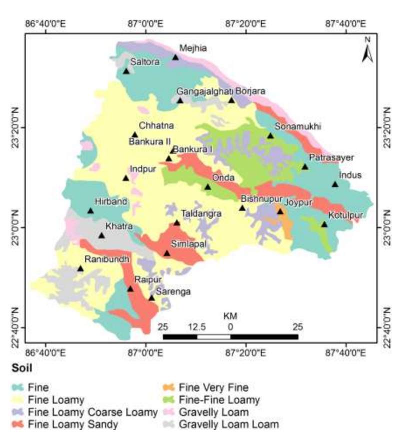

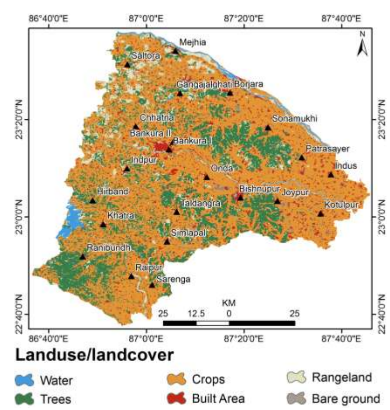

E F G

Figure. A: Population Concentration B. Elevation (m) C. Drainage Density (sq.km). D. Vegetation Cover E. Average Annual Rainfall (mm/y) F. Soil E. LULC

7. Implications for Sustainable Development

The findings of the study have significant implications for sustainable development, particularly in the context of resource constrained and environmentally sensitive regions like Bankura district. The observed spatial disparities in population distribution reflect unequal access to natural resources, agricultural productivity, and livelihood opportunities.

Regions characterized by fertile soil, adequate rainfall, and favorable land use patterns exhibit higher population density and relatively better economic conditions. In contrast, the western upland areas, marked by poor soil fertility, climatic variability, and limited water availability, face challenges related to low productivity and economic vulnerability. These disparities highlight the need for region specific development strategies.

Sustainable development in the district requires the integration of environmental management with socio economic planning. Soil conservation, water resource management, and afforestation in degraded upland areas can enhance agricultural productivity and support livelihood improvement. At the same time, controlled urban expansion and efficient land use planning are necessary to prevent environmental degradation in densely populated regions.

The study also underscores the importance of climate resilience, as rainfall variability and temperature extremes significantly influence agricultural stability. Adoption of drought resistant crops, improved irrigation practices, and watershed management can reduce vulnerability and promote sustainable livelihoods.

Thus, the geographical analysis of population distribution provides a critical foundation for achieving balanced and sustainable regional development.

8. Policy Recommendations

1. **Region Specific Land Management**
   Differential land use planning should be adopted, with emphasis on agricultural intensification in fertile eastern plains and resource conservation in western uplands.

2. **Soil and Water Conservation Measures**
   Implementation of watershed management, contour bunding, and soil conservation techniques is essential to improve productivity in lateritic regions.

3. **Irrigation Development**
   Expansion of irrigation infrastructure, particularly in drought prone areas, can reduce dependence on monsoon rainfall and enhance agricultural stability.

4. **Afforestation and Vegetation Restoration**
   Degraded forest areas should be restored through afforestation programs to improve ecological balance and support sustainable livelihoods.

5. **Climate Adaptive Strategies**
   Promotion of drought resistant crops, diversification of agriculture, and improved weather forecasting systems can help mitigate climatic risks.

6. **Balanced Urban Development**
   Planned development of small and medium towns can reduce excessive pressure on rural land and create alternative employment opportunities.

7. **Infrastructure Development**
   Improvement in transportation, connectivity, and rural infrastructure can enhance accessibility and reduce regional disparities.

These policy measures aim to address the underlying geographical constraints and promote equitable and sustainable development across different regions of Bankura district.

9: Conclusion

The present study reveals that the spatial distribution of population in Bankura district is strongly governed by an intricate interplay of geographical factors. Physiography emerges as a primary determinant, with low lying eastern plains supporting higher population density due to favorable terrain, while the rugged and elevated western uplands restrict settlement concentration. The inverse relationship between elevation and population density clearly reflects the constraints imposed by topography on human habitation.

Drainage conditions further influence population distribution through their role in water availability and agricultural development. Regions with moderate drainage density and proximity to river systems exhibit higher population concentration, whereas areas prone to flooding or with inadequate drainage show relatively lower settlement stability. Vegetation cover also demonstrates a dual influence, where dense forest areas limit habitation, while moderately vegetated agricultural landscapes support higher population density.

Climatic factors, particularly rainfall variability and temperature extremes, significantly affect agricultural productivity and livelihood sustainability. Areas receiving adequate and relatively stable rainfall tend to support denser populations, while drought prone regions of the western uplands experience lower population concentration and economic vulnerability. Soil characteristics reinforce this pattern, as fertile loamy and alluvial soils in the eastern region promote intensive cultivation and higher population density, whereas lateritic and degraded soils in the west constrain agricultural potential.

Land use land cover patterns provide an integrated perspective of these relationships, reflecting the cumulative impact of physical and human factors. Agricultural and built up areas correspond to zones of higher population density, while forested and barren lands are associated with sparse settlement. The observed spatial variations indicate that population distribution in the district is not random but closely aligned with environmental suitability and resource availability.

Overall, the study highlights that no single factor operates independently; rather, it is the combined effect of physiography, drainage, vegetation, climate, soil, and land use that shapes the population distribution pattern. The pronounced east west contrast within the district underscores the importance of region specific planning strategies. Sustainable management of natural resources, improvement of soil and water conservation practices, and balanced land use planning are essential to reduce regional disparities and promote equitable development.

10: References

1. Cohen J E and Small C. 1998. *Hypsographic demography: The distribution of human population by altitude*. Proceedings of the National Academy of Sciences, 95(24), 14009–14014.

2. Dhote A R. 2001 *Relationship between Population Density and Altitude: Tehsil wise analysis of Purna River Basin, Maharashtra*.

3. Roy P and Das S. 2011. *Population Growth, Socio economic conditions and Quality of Life in Birbhum District, West Bengal*. Current Research Journal of Social Sciences, 3(5), 412–418.

4. Ghosh R, Das N and Mondal P. 2022. *Explanation of major determinants of poverty using multivariate statistical approach and spatial technology: A case study of Birbhum District, West Bengal*. GeoJournal.