



CHANGING LAND USE PATTERNS / RESOURCE AVAILABILITY DUE TO URBANIZATION AND TRANSPORTATION GROWTH IN SOUTH BENGAL

Srikrishna Paul

Research Scholar

Department of Geography, RKDF University, Ranchi, Jharkhand, India

Email – paulsrikrishna@gmail.com

Abstract: *The formation of settlements to support human activities is defined by studies of urban land use patterns. Reduced availability of public transit in high-density areas owing to rising prices is one example of how population, urban activity, and land use may impact transportation options. At the moment, research on the relationship between current urban patterns and shifting travel habits is taking a back seat to efforts to enhance public transit systems. This research aims to fill this gap in an ecologically vulnerable area of South 24 Parganas by conducting a primary survey and using the Structural Equation Model to restore the association in two pilot study locations of the region. We need to figure out what's really driving urbanization in India and other developing nations. Issues of culture, politics, economics, and demographics all play a part.*

Key Words: *Urbanization, India, Population, Economic and Transportation.*

1. INTRODUCTION:

The word that needs classifying; it's used synonymously with modernization, industrialization, and urbanization. These are the factors that may alter one's course of existence. Ashish Bose states that it is the gradual increase of the proportion of people living in urban areas (U) to the overall population (T). Increases in the U/T ratio guarantee that cities will continue to grow. One technique to measure urbanization is by looking at the percentage of the population that resides in cities. Another is to count how many cities there are. Over time, a country's urban population will surpass its entire population, a phenomenon known as urbanization. Urbanization would be meaningless without the accompanying growth of cities. This indicates that overall urban populations stay the same even as total areas as measured by the census continue to rise. Rural regions also see a steady increase in population.

An additional sign is a general increase in the number of cities; for example, between 1981 and 1991, India's total town population increased from 3,275 to 4,325. This is one another sign of how cities are growing. People and goods migrate from rural or underdeveloped areas to urban or developed ones as a result of urbanization. The Encyclopaedia of Social Science defines urbanization as "the process of transition from small towns predominantly or completely involved with agriculture to bigger places where activities are primarily concentrated upon government trade, manufacture, or associated industries." Undoubtedly, this urbanization research shows that Indian society is experiencing a massive urban transition. The number of people living in urban areas in India is second only to China's. India has become more urbanized due to both natural growth and migration from rural areas to urban centers. Between 1971 and 1981, natural growth contributed 41.7% to urban expansion, and between 1981 and 1991, it contributed 58.7%. A pattern that is almost similar has been found by. The significance of population increase is emphasized. From 1971 to 1981, net migration and changes in municipal boundaries made up 39.4% of the total; however, this percentage dropped to 22.1% from 1981 to 1991. Therefore, it's reasonable to assume that demographic variables are major determinants of India's urban population, and that urbanization is due to more than merely migration.

We need to figure out what's really driving urbanization in India and other developing nations. Issues of culture, politics, economics, and demographics all play a part. For a long time, people have believed that urbanization was an essential part of economic transformation, the force that brought down the feudal system and propelled civilizations to greater social levels. There is no way to separate the development process from urbanization, which is an essential



component of the current economic structure. However, there are those who contend that industrialization is only one of many factors that contribute to economic growth and social change, and that urbanization is an inevitable byproduct of all of these variables.

2. LITERATURE REVIEW:

Moadal, Pompa & Mistri, Tapas. (2018). Rapid urbanization is a hallmark of human civilization and an inevitable part of the natural world. This process has been going on continuously from the beginning of time in every corner of the globe. Because there is already too much population cramming into cities, more people want to reside in or near cities, which is causing urban sprawl, which is a byproduct of urban expansion. The transformation of a "formal" space into a "functional" one brings about several visible changes, which are the outward expressions of the complex socioeconomic forces at work inside. Therefore, researchers from many fields must pay close attention to changes in land use and land cover. The current research aims to evaluate the environmental impact of the current urbanization trend in the Rajpur-Sonarpur Municipality of South 24 Pgs, West Bengal. Among the world's cities, this one is expanding at a breakneck pace. The research makes use of geographic information system (GIS) and remote sensing methods to display the study region's built-up area and to identify the urban area's increase over time.

Rudra, Somnath & Shikary, Chumki. (2020). The rise of the population, aspirations for higher incomes, improvements to transportation, and rural-to-urban migration have all contributed to the acceleration and complexity of urbanization in the Purulia district of West Bengal, India. The structured and planned urban growth is impeded by this scenario, leading to a sprawl-like phenomena inside the metropolitan area. The majority of scholars have focused on the district's physical and socioeconomic issues, ignoring the urbanization scenario, since the district is located in a socioeconomically disadvantaged location. Given its population and importance to the district's urban operations, the Purulia Municipality is the focus of this study's efforts to evaluate urban growth modeling. The land use land cover (LULC) maps of 1998, 2008, and 2018 were prepared using images from the Landsat-5 Thematic mapper (TM) and the Landsat-8 Operational Land Imager (OLI). The maximum likelihood classifier was used for supervised classification.

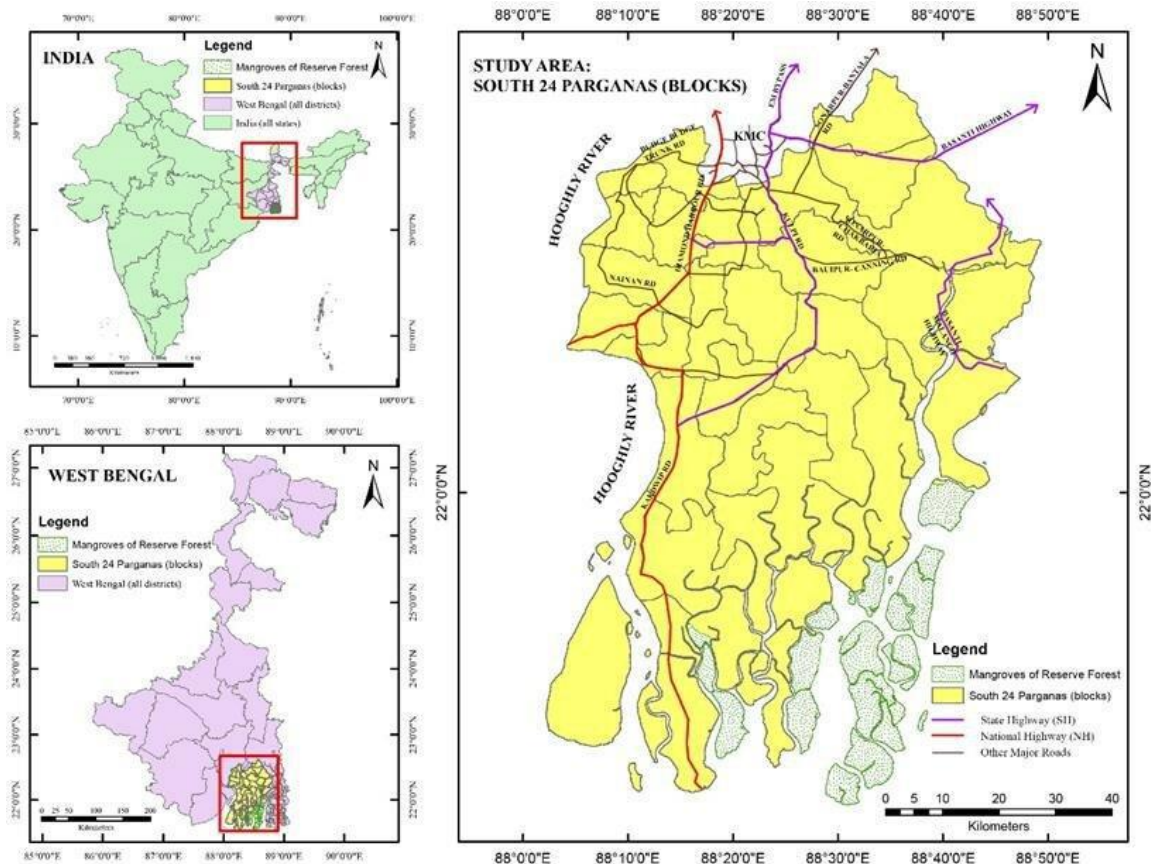
Saha, Jayanta & Paul, Suman. (2020). Tourism is often seen as a means of economic development in poor nations. Numerous potentials for the construction of tourist enterprises exist in the coastal pristine environment. There are a plethora of tourist hotspots dotting the shoreline of the Purba Medinipur district in West Bengal, India. Tourist numbers in the Mandarmani-Tajpur region have skyrocketed in the last ten to fifteen years. The environmental impacts of land use change surrounding these places from 2009 to 2019 as a result of tourism are examined in this research. The LULC categorization was done using Google Earth satellite pictures of the research region taken in 2009 and 2019 respectively. A land use change matrix has been created to determine the land use and land cover change that occurred between 2009 and 2019 using data obtained from LULC categorization. The findings verified a decline in arable land, vegetative cover, aquaculture in relation to bodies of water, and sand dunes. In contrast, there is a growing amount of natural fallow, habitation, and tourist-related activity areas.

Alam, Tazyeen & Banerjee, Ankhi. (2022). In the South Bengal Region, which is bordered by Kolkata Municipal Corporation (KMC), comparable dangers of unchecked growth exist, which may have devastating effects in places where the population is growing rapidly and where weather is unpredictable. In a nation like India, which is experiencing fast urbanization, it is crucial to track these changes in land use and land cover (LULC) in order to manage resources effectively and over the long term. In this research, the LULC dynamics in the South 24 Parganas district of the South Bengal Region during the last 30 years (1991–2021) were examined using Geographic Information Systems (GIS) and Remote Sensing (RS). In order to study the urban typologies, indices for monitoring urban sprawl were established statistically. These indices include patch size, density, and growth. Additionally, it has calculated expansion efficiency and decadal growth rate to evaluate the peri-urban settings along the South 24 Parganas area and how quickly they are changing. In the context of developing countries, this study provides valuable quantitative information for assessing the effects of urbanization on environmentally sensitive and cyclone-prone areas.

Alam, Tazyeen & Banerjee, Ankhi. (2024). The formation of settlements to support human activities is defined by studies of urban land use patterns. Reduced availability of public transit in high-density areas owing to rising prices is one example of how population, urban activity, and land use may impact transportation options. Problems in Indian cities stem from a lack of investigation into the ways in which people's transportation choices and urban land use patterns overlap. At the moment, research on the relationship between current urban patterns and shifting travel habits is taking a back seat to efforts to enhance public transit systems. This research aims to fill this gap in an ecologically vulnerable area of South 24 Parganas by conducting a primary survey and using the Structural Equation Model to restore the association in two pilot study locations of the region. Because of the proximity of different activities and infrastructures, this study's results imply that urban land use patterns impact people's transportation choices more than demographic and socioeconomic variables.

3. OBJECTIVES:

- To analyze spatiotemporal changes in Land Use and Land Cover (LULC)
- To evaluate the impact of transportation networks on urban sprawl.
- To examine the relationship between accessibility and land value.



Credit: Tazeen Alam

3. RESEARCH METHODOLOGY:

The associations in this research were modelled using quantitative data from the HH perception survey. Research was conducted in the BBM and DHM areas of the South 24 Parganas district from August to October 2022, twenty to fifty kilometers outside of the Kolkata Metropolitan Region. The results of the poll will show how the district's quickly expanding urban centers' transportation choices are affected by urban land use trends. Participants came from fifteen distinct communities (inner city, inner suburbs, and outer suburbs) and thirty-five distinct districts. No one under the age of 18 may participate, and each household was limited to sending in a single answer. Each ward's population determined the random number given to the HH. The sample group is middle-aged, has a low unemployment rate, earns a middle-range income, and has a low level of education. Some of these characteristics differ somewhat from the society at large, but in general, most people do not.

To fairly represent the effect of urban form on transportation choices impacted by SWB, the study's multiple regression analysis takes into consideration participants' age, unemployment, income, and education level, and the sample size is big enough to capture a cross-section of the population. The research used the conceptual technique, which is shown in Figure 1, and the indications that were taken into account for each variable are also identifiable.

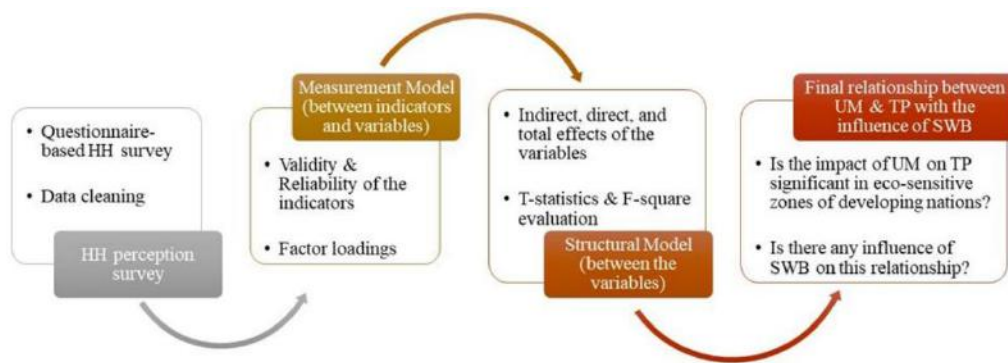


Figure 1. Conceptual Methodology

Data Sources

A home perception survey was used to gather primary data on the relationship between urban morphological features affected by residents' demographics, socioeconomic status, and preferred means of transportation. A total of 600 people were surveyed in the BBM and DHM pilot study regions in the South 24 Parganas district in West Bengal, India. For the purpose of analyzing the change in population, density, and socioeconomic parameters from 1991 onwards, secondary data was used from the Census Handbook of India. Although both municipalities have almost the same number of residents, DHM is smaller due to its distance from Kolkata proper. Compared to Diamond Harbour, BBM had a far greater population density. Males made up 53% of BBM respondents and females 62% of DHM respondents. With the majority working for themselves or in the private sector, HH sizes ranging from 3 to 5 pPHH were the norm in both of the examined towns. In the metropolitan region, men and females make up almost equal percentages (51% to 52%). Both instances had monthly incomes ranging from 60,000 to 90,000, with most of the participants having completed senior secondary school and a small number having graduated (Table 1).

Table 1. Population data (Census of India, 2011)

	BBM	DHM	District
Total population	76837	41802	8161961
Male population	39510	21050	4173778
Female population	37327	20752	3988183
Families surveyed	350	250	600
Surface area (sq.km.)	10.05	10.36	9960
Total HH	18055	10048	1781221
Population density (ppsq.km.)	7646	4035	820
Housing density (HHpsq.km.)	1797	970	179

Structural Equation

Approach to Modeling (SEM) Although SEM is a relatively new technique, its popularity has skyrocketed due to the availability of user-friendly tools like AMOS. Structural equation modeling (SEM) is a subset of regression analysis that aims to explain the relationships between system internal and external variables. It is capable of estimating a structural model, an external variable measurement model, and an endogenous variable measurement model all at once. SEM including latent variables elucidates the whole Model. Latent variables are defined in terms of other, more obvious variables (termed "indicators") due to their obscurity. While each latent variable is defined by the measurement model, the structural model depicts the interrelationships between endogenous and exogenous elements. Bollen (1989) states that the following equation (1) is crucial to the structural model:

$$\tau = \rho\tau + \rho\zeta + \gamma$$

in where τ (gamma) stands for the vector of random variables, τ (tau) for the vector of latent endogenous variables, and ζ (sigma variant) for the vector of latent exogenous variables. The elements of the ρ (rho) and q (rho variant) matrices indicate the structural coefficients of the Model. Equation (2) represents external variables in the measurement model, whereas equation (3) represents endogenous variables.

$$m_x = \Delta_x\zeta + \omega$$



$$m_n = \Delta_n \tau + \iota$$

the structural coefficient vector m_n represents the impact of the endogenous latent determinants on the estimated parameters, m_x and \ddot{v} (omega) are related to the observed exogenous variables and inaccuracies, respectively; m_n and ζ (iota) are related to the observed endogenous variables and inaccuracies, respectively. Selective effect modeling (SEM) differentiates between direct, indirect, and total effects. Understanding the complex dynamics of human travel patterns requires it.

5. DATA ANALYSIS:

Evaluation of the Measurement Model for Transport Preferences:

Eight indications were originally included for T_Dist (HH's distance from schools, hospitals, workplaces, transportation hubs, recreational areas, markets, outstation trips, and other destinations) and four for Modes (including modes of travel for daily and occasional purposes, expenses on the mode, and time travelled in the mode). However, since the model failed to achieve the minimum acceptable values of composite reliability and average variance extracted (AVE) after the first run of the PLS-SEM route model, a number of indicators were eliminated. As shown in Table 2, the indications were deleted from the construct until it reached the minimum suitable level of AVE and composite dependability. It gives the composite reliability for transportation preference and load-related constructions as well as the average trip time (AVE) value. Only by increasing the AVE and composite reliability values to minimum acceptable levels was the research able to exclude a few indications with outer loadings less than 0.708. In Table 2 you can see the indicators that were used to measure the commute preferences in this research.

Table 2. Indicators in the Constructs of Transportation Preferences

Latent Variables	Indicators	Outer Loadings	AVE > 0.5	Composite Reliability > 0.7
T Dist	TP ED	0.706	0.563	0.771
	TP HD	0.502		
	TP WD	0.800		
	TP ST	0.681		
T Modes	TP RS	0.773	0.688	0.815
TP T		0.883		

At first, there were a total of ten indicators for the ULUP, DP, and SE. These included HH developments, size, age, unit type, monthly income, earning members, occupation, marital status, and education level, as well as mobile phone ownership, two-wheelers, three-wheelers, four-wheelers, and expenses on food, electricity, healthcare, and education. Table 3 shows that the Model failed to achieve the required levels of average variance explained and composite reliability, thus several indicators were eliminated after the first run of the PLS-SEM route model, as was done in the previous occasion. In order to improve the AVE and composite dependability values, the indicators with outer loadings below 0.7 were excluded from the study. The variables that will be used to further assess the socioeconomic and urban morphological aspects of this study are shown in Table 3.

Table 3. Indicators in the Constructs of Urban land use patterns

Latent Variables	Indicators	Outer Loadings	AVE > 0.5	Composite Reliability > 0.7
ULUP	HC_DV	0.717	0.598	0.721
	HC_S	0.937		
	HC_YR	0.720		
DP	DP_E	0.736	0.623	0.758
	DP_EM	0.761		
	DP_RS	0.922		
SE	ASS_2W	0.758	0.536	0.814
	ASS_M	0.729		
	EX_E	0.699		
	EX_F	0.753		
	EX_H	0.777		

mobile assets; EX_E = Electricity expenses; EX_F = Food expenses; EX_H = Healthcare expenses



After these components are removed from this research, the factor model is reevaluated. The Model was reevaluated, and seventeen components were retained, as shown in Tables 2 and 3. Please be informed that the outside loadings of all retained items are more than 0.4. An acceptable limit of item dependability is provided by loadings more than 0.708. This is because loadings over this value show that the idea predicts more than 50% of the variance in the indicator. Composite reliability should be at least 0.7 and acceptable value of AVE should be at least 0.5, according to the study done by. Therefore, according to the AVE and composite reliability ratings, urban land use patterns are valid, and socioeconomic conceptions are reliable.

In Table 3, you can see the bootstrapping model's findings. In column one, you can see the model variables. In column two, you can see the original sample values (O). In column three, you can see the sample mean values (M). In column four, you can see the standard deviation of each coefficient and the T-statistic ($|O/STDEV|$), which shows that the estimated coefficient is significantly greater than 1.96. The standardized coefficients of the Model have p-values that are less than 0.005, as displayed in column five. With the exception of a handful of parameters shown as (*) in Table 4, all of the parameters have the right sign and take on a value that is statistically distinct from zero at an acceptable significance level. When the p-value is less than 0.05 and the t-statistic is more than 1.96, it means that the latent variables are significantly related to one another.

Table 4. PLS-SEM Bootstrapping results

PATH COEFFICIENT - DIRECT EFFECTS					
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ($ O/STDEV $)	P values [#]
DP -> SE	0.474	0.483	0.038	12.485	0
SE -> T_Modes	0.090	0.091	0.63	1.689	0.105*
T_Dist -> T_Modes	0.371	0.374	0.044	8.513	0
ULUP -> DP	0.551	0.551	0.03	18.34	0
ULUP -> T_Dist	0.359	0.364	0.041	8.677	0
ULUP -> T_Modes	0.215	0.213	0.047	4.563	0
TOTAL INDIRECT EFFECTS					
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ($ O/STDEV $)	P values [#]
DP -> T_Modes	0.046	0.042	0.04	1.505	0.116*
ULUP -> SE	0.261	0.266	0.026	9.911	0
ULUP -> T_Modes	0.146	0.15	0.027	5.45	0
SPECIFIC INDIRECT EFFECTS					
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ($ O/STDEV $)	P values [#]
ULUP -> DP -> SE	0.261	0.266	0.026	9.911	0
ULUP -> T_Dist -> T_Modes	0.133	0.136	0.023	5.73	0
DP -> SE -> T_Modes	0.047	0.045	0.03	1.502	0.116*
ULUP -> DP -> SE -> T_Modes	0.053	0.060	0.037	1.595	0.12*
TOTAL EFFECTS					
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ($ O/STDEV $)	P values [#]
DP -> SE	0.474	0.483	0.038	12.485	0
DP -> T_Modes	0.093	0.091	0.046	2	0.046
SE -> T_Modes	0.092	0.093	0.61	1.686	0.105*
T_Dist -> T_Modes	0.371	0.374	0.044	8.513	0
ULUP -> DP	0.551	0.551	0.03	18.34	0



ULUP -> SE	0.261	0.266	0.026	9.911	0
ULUP -> T Dist	0.359	0.364	0.041	8.677	0
ULUP -> T Modes	0.361	0.362	0.044	8.168	0

Significant at a level of 90%

Significant at a level of 95%

The concept of Model fit is far less important to PLS-SEM than it is to CB-SEM. Consequently, some researchers mistakenly believe that PLS-SEM is not useful for theory assessment and validation. Few authorities in the area have given their stamp of approval to PLS-SEM model fit measures. Researchers evaluating these measures for PLS-SEM should exercise great care, nevertheless. Since PLS-SEM methods do not aim to minimize the discrepancy between the actual and predicted covariances, the concept of Chi-square-based Model fit evaluations and its expansions, which are used in CB-SEM, are rendered moot.

Results from a comparable evaluation in this study show that both the saturated and estimated models have Standardized Root Mean Square Residual (SRMR) values below 0.080 and that the Normed Fit Index (NFI) values, also called the Bentler and Bonett Index (1980), are close to 0.90. Thus, according to Table 5, the Model is deemed fit.

Table 5. Model fit results

MODEL FIT	Saturated Model	Estimated Model
SRMR	0.064	0.079
d ULS	0.227	0.478
d G	0.057	0.081
Chi-square	136.151	189.69
NFI	0.894	0.85

6. CONCLUSION:

South 24 Parganas, home to the Sundarbans Reserve Forest, is an example of an eco-sensitive zone, and the fact that its growing urban centers have a greater impact on transportation choices lends credence to this claim. With p-values below 0.05 and a 95% confidence interval indicating statistical significance, one mediator that significantly impacts the link between the two variables is the planning viewpoint about the distances of amenities and facilities from the HHs. Urban form and transportation choice studies are crucial for future research possibilities, urban planning, and decision-making processes, according to this study's conclusions. Numerous factors are impacted by knowing how people travel throughout a city. These include community functioning, economic competitiveness, environmental well-being, and equality in mobility access among various population groups. Undoubtedly, this urbanization research shows that Indian society is experiencing a massive urban transition. The number of people living in urban areas in India is second only to China's.

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